Environmental Impact Assessment Report Summary

Extension of the Olkiluoto nuclear power plant by a fourth unit

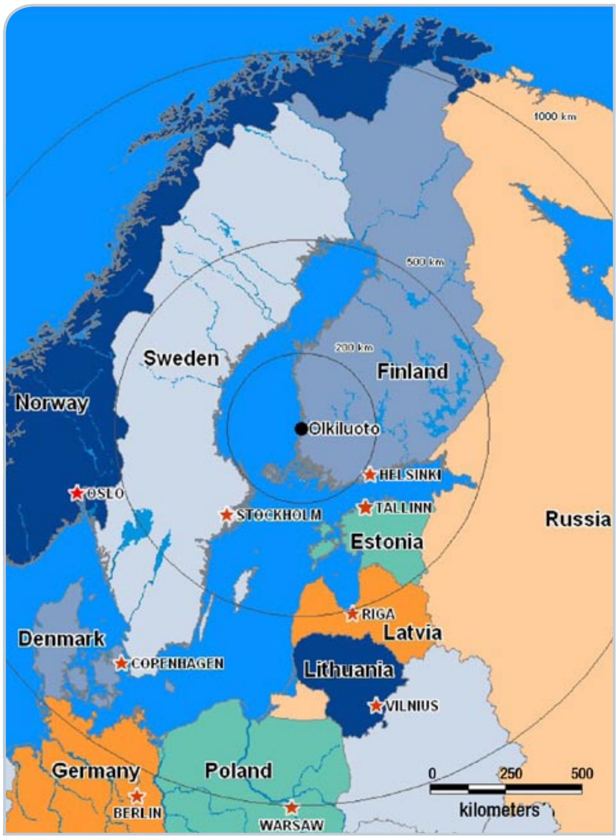
1 Project

In order to improve its readiness for constructing additional production capacity, Teollisuuden Voima Oyj (TVO) initiated in spring 2007 the environmental impact assessment procedure (EIA procedure) concerning a new nuclear power plant unit that would possibly be located at Olkiluoto. TVO is examining the construction of a nuclear power plant unit with approximate electric power of 1,000 to 1,800 MW and thermal power of 2,800 to 4,600 MW at Olkiluoto, which is the location of two existing nuclear power plant units (OL1 and OL2) and a third one Olkiluoto 3 (OL3) under construction. TVO is prepared to submit a possible application for a decision-in-principle concerning a new plant unit after the EIA report has been submitted to the coordinating authority. TVO has not made any decisions concerning action to be taken subsequent to the EIA procedure.

The electricity consumption in Finland continues to grow. Finland consumed approximately 90 TWh of electricity in 2006. The 80 TWh mark was exceeded in 2001, and 50 TWh in 1985. Electricity consumption has doubled in a quarter of a century. The annual consumption is estimated to exceed 100 TWh in 6 to 8 years.

Fortum Power and Heat Oy also have an EIA process in progress regarding a third plant unit to be built in conjunction with the Loviisa nuclear power plant.

Figure 1. Location of Olkiluoto on the west coast of Finland (Source: Pöyry Energy Oy).



1.1 Environmental impact assessment procedure

The directive (85/337/EEC) issued by the Council of European Communities (EC) has been enforced in Finland based on annex twenty (XX) of the Treaty establishing the European Economic Community by virtue of the EIA Act (468/1994) and Decree (713/2006) on environmental impact assessment. According to the list of projects in the EIA Decree, nuclear power plants are included in projects subject to the assessment procedure. Pursuant to the EIA Act, the coordinating authority for the EIA procedure is the Ministry of Trade and Industry, the duties of which were transferred on 1 January 2008 to the Ministry of Employment and the Economy.

The EIA programme of the project was completed in May 2007. The EIA programme was presented on different occasions, and it was available for public display in spring 2007. The statements received regarding the programme expressed the wish that particular attention be paid in the EIA procedure to nuclear safety, the impacts of cooling water and nuclear waste management. The coordinating authority issued its statement regarding the EIA programme in September 2007.

The results of the environmental impact assessment have been collected in the Environmental Impact Assessment Report (EIA Report). The EIA Report was submitted to the coordinating authority in February 2008, and it will be available for public display for the purpose of expressing opinions and issuing statements. After the public display, the coordinating authority issues its own statement, based on the opinions and other statements received, and the assessment procedure ends.

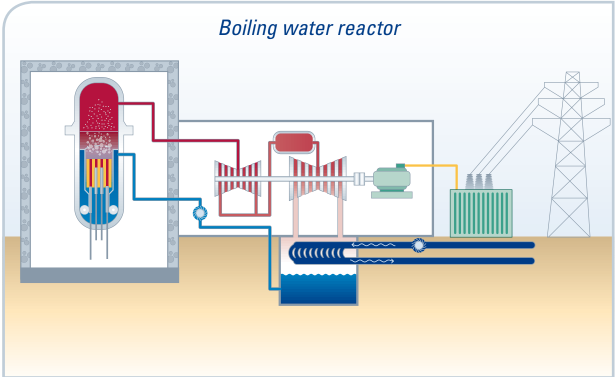
The UNECE Economic Commission for Europe Convention on Environmental Impact Assessment in a Transboundary Context (the so-called Espoo Convention, 67/1997) has been applied to the project. The nuclear power plant is included in the list of projects in the Convention. The point of contact for the Convention in Finland is the Ministry of the Environment. In the assessment procedure with respect to cross-border environmental impacts, the following countries were notified: Sweden, Denmark, Norway, Germany, Poland, Lithuania, Latvia, Estonia and Russia.

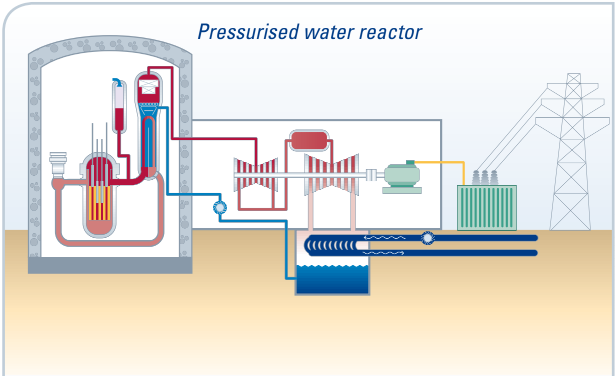
1.2 Permits required for the project

The construction of a nuclear power plant unit requires permits pursuant to many different acts, as well as a decision-in-principle issued by the Government and ratified by Parliament stating that the nuclear power plant unit is in line with the overall good of society. A positive decision-in-principle requires, among other things, that the municipality where the plant is to be located issues a positive statement. The investment decision for the project cannot be made prior to the decision-in-principle. The Government grants the construction licence and the operating licence if the prerequisites for granting a construction licence and an operating licence for a nuclear facility provided in the Nuclear Energy Act (990/1987) are met.

Other permits required include the building permit, environmental permit and permit pursuant to the Water Act. The permit authorities use the EIA Report, and the statement issued by the coordinating authority regarding it, as the basic material for their own decision-making. Permit applications are supplemented with more detailed reports on the project and its impacts, drawn up as the planning work advances.

Figure 2. The location of Eurajoki and Olkiluoto. Eurajoki is located along Highway 8 (E8). The distance from Highway 8 to the Olkiluoto power plant is approximately 14 kilometres.
(Base map © Affecto Finland Oy, licence number L7302/07)





1.3 Location

The planned location site for the nuclear power plant unit is on the west coast of Finland, on Olkiluoto island in the municipality of Eurajoki. The distance by road from Olkiluoto to the nearest town, Rauma, is approximately 25 kilometres.

1.4 Project options

The following project options were considered in the environmental impact assessment:

- Building a new nuclear power plant unit at Olkiluoto. The nuclear power plant unit may be a boiling or pressurised water reactor plant. The alternatives examined are:
  - two location sites at Olkiluoto
  - two cooling water intake and two discharge location alternatives.
- Non-implementation of the project (the zero-option). A situation in which the power plant unit will not be constructed at Olkiluoto was examined as the zero-option. It is assumed that in the zero option, TVO's shareholders will cover their electricity needs from the Nordic electricity market.

The project includes the on-site interim storage of spent nuclear fuel generated in the operation, as well as the processing and final disposal of low- and intermediate-level operating waste. The project also includes the required power transmission connection to the national grid.

The planned nuclear power plant unit will be a base-load power plant that will operate continuously with the exception of an annual outage. The technical service life of the plant unit is approximately 60 years. Table 1 presents some technical data on the prospective power plant unit. The figures are preliminary.

Table 1. Preliminary technical data on the nuclear power plant unit planned for Olkiluoto.

Description	Value and unit
Thermal power of reactor	approx. 2,800 to 4,600 MW_{th}
Electrical power	approx. 1,000 to 1,800 MW_e
Overall efficiency	approx. 35 to 40%
Fuel	Uranium dioxide UO_2
Consumption of uranium fuel	approx. 20 to 40 tonnes/year
Average degree of isotopic enrichment	approx. 2 to 5% U-235
Amount of uranium in the reactor	approx. 100 to 150 tonnes
Annual electricity production	approx. 8 to 14 TWh_e
Need for cooling water	approx. 40 to 60 m^3/s

MW = megawatt = one thousand kilowatts

TWh = terawatt-hour = one billion kilowatt-hours

Boiling Water Reactor (BWR)

The fuel in the reactor of a BWR plant is cooled by pure water. Within the pressure vessel, reactor coolant pumps circulate water through the fuel bundles. This heats the water to a temperature of approximately 300 °C, which makes it

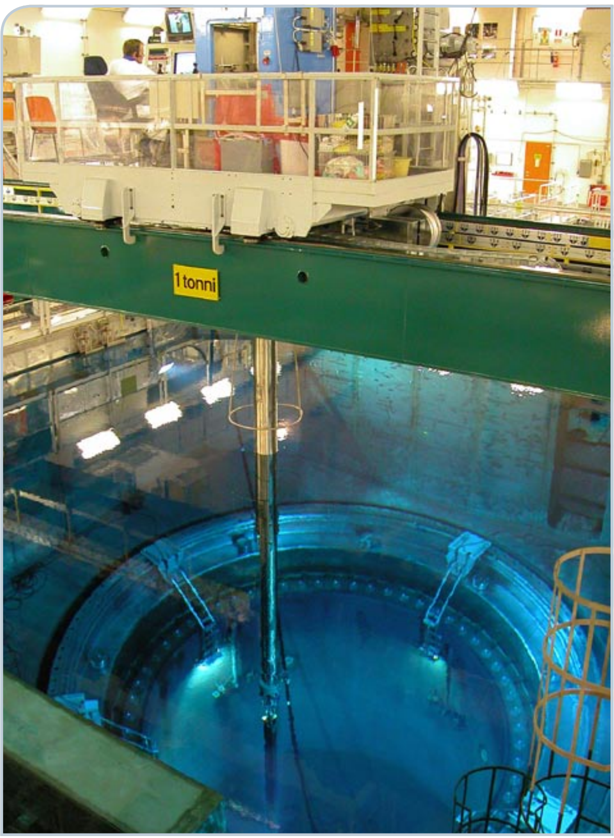


Figure 3. The Olkiluoto power plant site. Locations on the map include the existing nuclear power plant units OL1 and OL2 (1), the construction site for OL3 unit under construction (2), the interim storage for spent fuel (3), the final repository for operating waste (4), the construction site

boil and generate steam at a pressure of approximately 70 bar. The saturated steam is conducted through steam separators and the steam dryers located within the pressure vessel to a high-pressure turbine, the intermediate reheaters and the low-pressure turbines. The turbines are linked by a shaft to a generator that produces electricity. The amount of water present in the reactor is regulated by feedwater pumps. The safety valves attached to the steam tubes protect the reactor pressure vessel from overpressure, releasing steam into the large water pool inside the containment if necessary.

In addition to control rods, a boiling water reactor also employs reactor coolant pumps for regulation purposes. These pumps affect the reactivity through reactor coolant flow by changing the steam concentration in the reactor core. Rapid shutdown of the reactor is performed by inserting the control rods into the reactor core using a hydraulic reactor trip system.

The steam coming from the low-pressure turbines is conducted to a condenser, in which it is condensed into water using seawater. There is underpressure in the condenser, meaning that in the case of a leak, seawater will leak into the process, not vice versa. From the condenser, the water is pumped into pre-heaters. In the pre-heaters, steam extracted from the turbine heats the water before it is conducted back to the reactor.

The existing nuclear power plant units at Olkiluoto (OL1 and OL2) are of the BWR type.

Pressurised Water Reactor (PWR)

The fuel heats water in a PWR plant, but the reactor pressure vessel is maintained at such a high pressure that the water will not boil at any stage. The pressure is typically approximately 150 bar and the temperature in the reactor is approximately 300 °C. The safety valves attached to the pressurizer protect the primary circuit against too high a pressure. The pressurised water generates steam in separate steam generators, from where it is pumped into the reactor (primary circuit). The steam circulates in the secondary circuit, driving the turbine and generator.

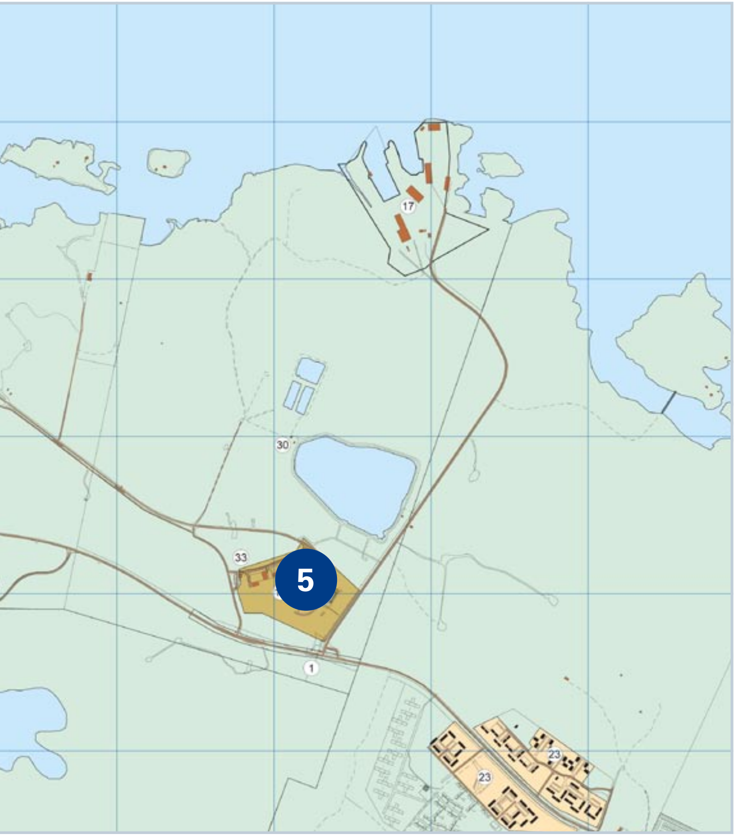
In a pressurised water reactor, power regulation is mainly performed through control rods and boron added to the coolant. Control rods are also used for rapid shutdown of the reactor in operating transients by dropping them into the reactor from above with the help of gravity.

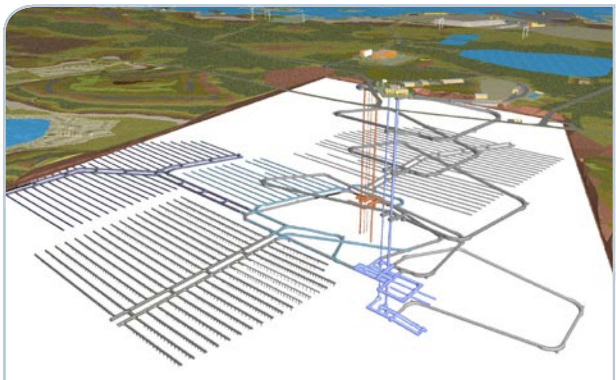
The OL3 unit under construction and the existing nuclear power plants at Loviisa are of the PWR type.

1.5 Nuclear safety

In Finland, the provisions for the use of nuclear energy are stipulated by the Nuclear Energy Act and Decree. The nuclear energy legislation lays down the requirements concerning, among other things, the general safety principles for the use of nuclear energy, the licensing procedure for nuclear facilities, the supervision of safety, and nuclear waste management.

In Finland, the Radiation and Nuclear Safety Authority (STUK) is the authority that supervises the safety of nuclear *for an underground rock characterisation facility for final repository of spent fuel (5), and Visitor Centre (6). The alternative locations for the new power plant unit are also indicated on the map.*





facilities and issues detailed regulations that apply to the safe use of nuclear energy and to physical protection, emergency preparedness and safeguards. STUK is also responsible for the supervision of the use of nuclear materials and the treatment and storage of nuclear waste. STUK is responsible for supervising all activities, ranging from the design of power plants to their decommissioning. The objective is to ensure nuclear power plant safety so that plant operation does not cause radiation hazards that could endanger the health of workers or the population in the vicinity or could otherwise harm the environment or property.

A nuclear power plant must be designed in accordance with nuclear energy legislation and Nuclear Power Plant Guides published by the Radiation and Nuclear Safety Authority in order to ensure the safety of its operation. The Nuclear Power Plant Guides apply to the safety of nuclear installations, nuclear materials and nuclear waste, as well as the physical protection and emergency preparedness required for the use of nuclear energy. The Nuclear Power Plant Guides are available on the Internet site of Radiation and Nuclear Safety Authority (www.stuk.fi).

The latest safety requirements will be taken into account in the potential new power plant unit, and preparations have been made for severe accidents and the mitigation of their consequences.

Reactor safety requires the functionality of three factors in all circumstances:

- managing the chain reaction and the power it produces;
- cooling the fuel after the chain reaction has ended, also known as decay heat removal; and
- isolation of radioactive substances from the environment.

The fundamentals of safety include several barriers for radioactive substances and the defence in depth principle of safety. The principle of several barriers means that there is a series of strong and tight physical barriers between radioactive substances and the environment, preventing the substances from entering the environment in all circumstances. The tightness of any single barrier is enough to ensure that no radioactive substances can enter the environment. The defence in depth principle refers to the prevention of the occurrence of transients and accidents, as well as to the control of transients and accidents and the mitigation of their consequences.

An explosive event arising from an uncontrolled increase in power is impossible in a light water reactor due to structural reasons. An accident leading to severe reactor core damage will require the simultaneous failure of multiple safety systems and several incorrect actions from the operating personnel.

2 Impacts of the project

Which environmental impacts were assessed?

When assessing the environmental impacts of the Olkiluoto nuclear power plant extension project, the present state of the environment was first examined, and after that, the changes caused by the projects as well as their significance were assessed, taking into account the combined impacts of the operations at Olkiluoto. The environmental impact assessment for the planned nuclear power plant unit covers the entire life cycle of the plant unit. The EIA Report describes and assesses, among others,

- **the impacts of construction on**
  - soil, bedrock and groundwater
  - vegetation, animals and objects of protection
  - employment and industries
  - residents' welfare
  - noise levels
  - traffic
- **the impacts during the operation of the new plant unit on**
  - air quality and climate
  - waters, water fauna and fishing
  - soil, bedrock and groundwater
  - vegetation, animals and objects of protection
  - land use, structures and landscape
  - people and society
  - the energy market.

The report further discusses

- the impacts of waste and by-products and their treatment
- the environmental impacts of traffic
- the impacts of exceptional and accident situations
- impacts of the decommissioning of the power plant unit
- impacts of nuclear fuel production and transportation
- impacts of associated projects.

Statements regarding the assessment programme

In all, 36 statements and 18 comments regarding the assessment programme were submitted to the coordinating authority. By the due date, Sweden, Norway, Estonia, Lithuania and Russia had announced their participation in the EIA procedure through international hearing. Sweden, Norway and Estonia issued their statements regarding the assessment programme.

The statements submitted consider the programme to be appropriate, in the main, and quite comprehensive. The statements and opinions took a standing on, among other things, the following: the justification and social significance of the project, the selection of the options under consideration, the observed area of the impact assessments, energy conservation matters, safety aspects and rescue operations relating to the new nuclear power plant unit, transboundary environmental impacts, traffic arrangements, management of spent fuel, combined effects of different projects, the thermal load arising from cooling water and its impacts, cooling water modelling, possibilities for utilising the thermal load arising from cooling water, the possible impacts of climate change, hazardous chemicals used at the power plant, the decommissioning of the plant unit and its impacts, employment impacts and availability of workforce, as well as the environmental impacts of the entire chain of nuclear fuel supply.

The statements received regarding the assessment programme in conjunction with the international hearing

According to the Swedish Environmental Protection Agency (Naturvårdsverket), the EIA programme was, in the main, sufficient. The Swedish Nuclear Power Inspectorate (Statens Kärnkraftinspektion) also considered the EIA programme sufficient. In particular, the assessment of impacts arising from normal plant operation was deemed comprehensive. Comments invited by the Swedish Environmental Protection Agency emphasise the assessment of radioactive emissions from multiple perspectives. Particular attention should be paid to the potential long-range dispersion of radioactive releases and the provisions made against it, technologies for reducing releases, and the mitigation of potential adverse impacts. The impact of releases on the nature and further to industries should be assessed, fish stocks and fishing being mentioned as examples. The comments also point out that it would be prudent to assess the combined impacts of the planned unit and the current units on the radioactivity of the Baltic Sea. The comments maintain that the assessment of impacts should be supplemented by taking the entire life cycle of the project into account and assessing the environmental impacts due to the production of nuclear fuel and spent nuclear fuel. The comments also draw attention to the omission or insufficient treatment of the zero option, with particular mention of the lack of alternative means of power production.

In Norway, the Ministry of the Environment acts as the environmental authority. It emphasises the assessment of reactor safety, accidents, unexpected events and radioactive emissions. It would be prudent to describe the plans and monitoring systems for emergencies and exceptional situations. Comments invited by the Norwegian environmental authority also emphasise the assessment of radioactive emissions from multiple perspectives. Particular attention should be paid to the potential long-range dispersion of radioactive releases and the provisions made against it, and mitigating potential adverse impacts. The impact of releases to the nature and further to industries should be assessed, vegetation, animals, reindeer husbandry and recreational use being mentioned as examples.

Acting as the environmental authority, the Estonian Ministry of the Environment emphasises the description of accidents with cross-border impact from multiple perspectives. The description should identify any impacts requiring protection from radiation, and the methods of informing neighbouring countries in emergencies. The authority notes that it would be prudent to assess the combined impacts of the planned unit and the current units.

Impacts of nuclear fuel production and transportation

The stages in the nuclear fuel production chain are quarrying of raw uranium, enrichment, conversion, isotopic enrichment, and manufacture into fuel bundles. In each country, the production, transportation and storage of nuclear fuel are carried out in accordance with the applicable environmental and other regulations. TVO procures uranium for fuel under long-term contracts from suppliers in countries such as Canada and Australia and from within the EU. TVO supervises and monitors the environmental impacts of fuel production in its different stages.

Figure 4. An example of ice conditions computed using the cooling water model in case of the zero option (three plant units in operation) and in case where four plant units are in operation.

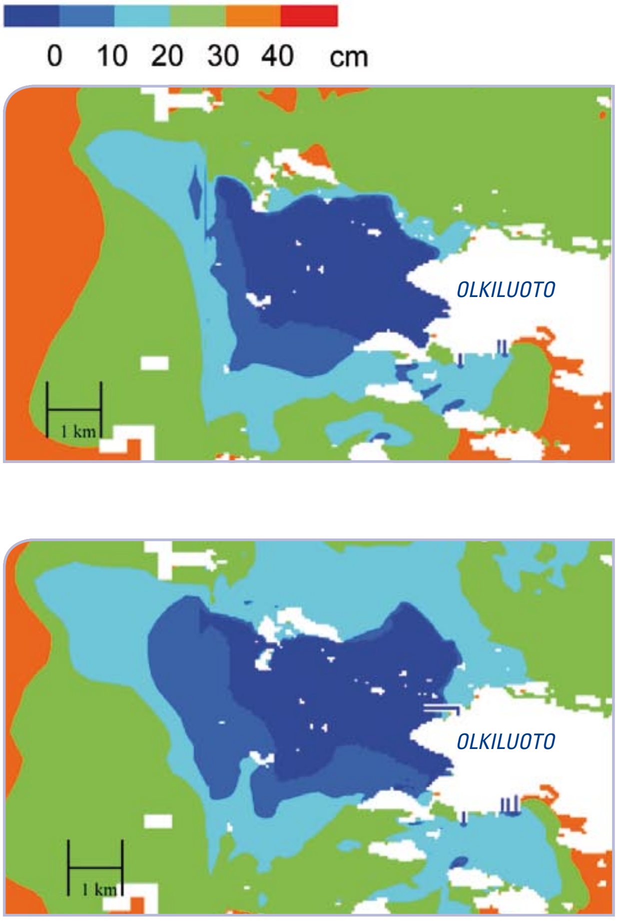
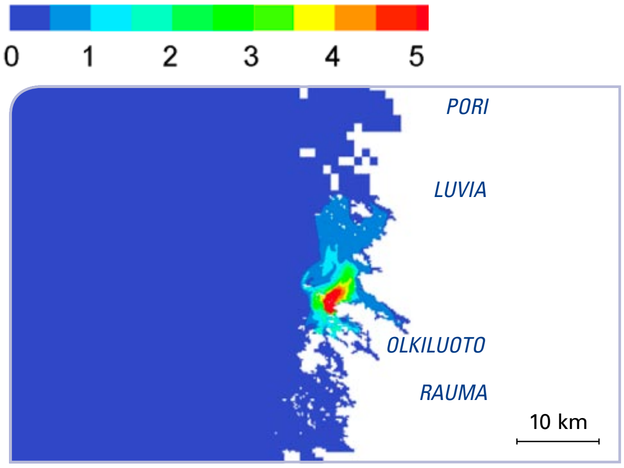


Figure 5. Figure illustrates an example of the impact of cooling water discharge on the temperatures of the surface layer of the sea area in a summertime situation with a southerly wind.



Waste and its impacts

During the service life of a plant unit, about 1,400–2,500 tonnes of spent fuel are produced, depending on the power of the unit, utilisation rate, service life and type of fuel used. Spent fuel is initially cooled down and stored for a few years in water pools at the power plant unit. After this, it is taken to intermediate storage in cooled water pools in the interim spent fuel storage facility at the Olkiluoto power plant. Intermediate storage will continue for decades until the final disposal of the spent fuel.

According to the Nuclear Energy Act, the export from and import to Finland of nuclear waste generated in nuclear power plants is prohibited. The party with the waste management obligation is responsible for the processing, storage and final disposal of nuclear waste in Finland, as well as for bearing the associated costs. The ultimate goal of nuclear waste management is the permanent disposal of waste in accordance with the Nuclear Energy Act and Decree, which refers to disposal in Finnish bedrock.

The low- and intermediate-level operating waste produced by the power plant unit, as well as the decommissioning waste and decommissioned components generated in connection with the decommissioning of the plant unit, will be placed in the operating waste repository. The implementation of the new power plant unit requires that the currently used intermediate storage for spent fuel and operating waste repository be expanded.

Established in 1995, Posiva Oy is an expert organisation responsible for the final disposal of the spent nuclear fuel originating from the nuclear power plant units of its owners, TVO and Fortum Power and Heat Oy, located in Finland, as well as for research associated with disposal, and expert tasks belonging to its scope of operations. The EIA procedure concerning the final disposal of spent nuclear fuel, assessing the final disposal of a maximum of 9,000 tU, was completed in 1999. The intention is to dispose of spent nuclear fuel in the bedrock of Olkiluoto at a depth of approximately 400 to 500 metres. The intention is to start the final disposal in 2020. Posiva Oy is also preparing for the final disposal of the spent nuclear fuel generated in the operation of the possible other new plant units of its owners to be possibly built in Finland, and has started, in early 2008, the preparation for the EIA procedure regarding an extension of the final disposal facility so that a maximum quantity of 12,000 tU could be finally disposed of to Olkiluoto.

The processing and final disposal of radioactive waste does not cause any harmful impacts on the environment or people.

Impacts of cooling water

The cooling water for the new unit will be taken either from a point located to the east of the cooling water intake points for the existing plant units or from the Eurajoensalmi inlet on the northern shore of Olkiluoto. The cooling waters are conducted back to the sea, either at the Iso Kaalonperä bay located at the western end of the island, or outside Tyrniemi. The process increases the temperature of the cooling water by approximately 11–13 °C. The impact of cooling waters on the temperatures and ice conditions at the discharge area

Figure 6. The nuclear power plant site of TVO as seen from the sea. The picture on top shows the existing plant units OL1 and OL2 and the OL3 construction site. The bottom picture is a photomontage that shows the existing plant units OL1 and OL2, the completed OL3 and OL4 on the left.

has been studied using a three-dimensional mathematical model for the aquatic environment. In addition to the areas outside Olkiluoto, the model covers the entire Botnian sea area. Figure 4 shows an example of the impact of cooling water discharge on the ice conditions in the sea area in case of the zero option situation where three plant units are in operation and in a situation where four plant units are in operation. The non-frozen sea area outside the discharge point will expand to about 1½ times the size it has when three plant units are in operation.

Figure 5 illustrates an example of the impact of cooling water discharge on the temperatures of the surface layer of the sea area in a summertime situation with a southerly wind. The increase in sea water temperature and weakening of ice in the winter is limited to the areas of sea outside Olkiluoto. The cooling waters have no impact outside Finnish territorial waters.

Besides the heat load, cooling water does not cause any nutrient load or oxygen-consuming load in the water system. Cooling water warmer than the environment may increase the natural temperature stratification of the sea area. The stratification of water can mainly affect the oxygen conditions in the hypolimnium and subsequently the other qualities of the hypolimnium. The oxygen conditions in the sea area off Olkiluoto have also been good close to the bottom and almost without exception, and the situation is not estimated to change substantially due to the increased thermal load. Any decline or dissolution of temperature stratification close to the cooling water discharge area may slightly increase the nutrient concentrations in the epilimnion and subsequently the basic production particularly in the beginning of the vegetation period.

The impact of cooling water on phytoplankton production near the cooling water discharge area will remain roughly at the present level. Impacts on phytoplankton production similar to the present ones will be observed in an area larger than previously. In this area, the vegetation period will be extended and total production will increase. However, the changes in phytoplankton production in high summer are estimated to be minor because the availability of nutrients will restrict the increase in production. No new changes in the organism population structure are expected to take place in the vicinity of the cooling water discharge area, but like the changes in plant plankton, the impacts will affect a larger area.

OL4 will increase the thermal load in the area and expand the area in which changes in aquatic vegetation will be observed. The extent to which changes in aquatic vegetation will be observed depends on the proportion of sea bed suitable for aquatic vegetation in the warmed-up area. The flora will become less diverse, and production will increase over a larger area.

The most substantial impact of the new plant unit's cooling water with regard to fishing takes place in the winter season when the increased area of unfrozen water and weak ice limits fishing from the ice. The cooling water has no impact on the suitability of fish for consumption.

Landscape and noise impacts

The new power plant unit will be located within the Olkiluoto power plant site and will utilise the existing infrastructure of the area. The construction of a new unit will add one large building to the nuclear power plant complex. Its impact on the landscape has been illustrated by photomontages.

The noise generated by the total impact of the new plant unit and the existing activities in Olkiluoto will not exceed the guide values set by the Government for the nearest affected location.

Employment impacts

The employment effect of building a new nuclear power plant unit is substantial. The effects on the economy and commercial life in the regions municipipalities will be positive. The project requires construction labour and construction site services, as well as special expertise and specialty manufacturing both in Finland and abroad. The labour requirement of the plant construction site will vary through the different stages of construction and installation work. During the first two years, the number of employees at the construction site will be from a few hundred to one thousand. After this, the number will vary between 1,000 and 3,500 people. The intensive period of construction and installation will last for approximately four years. The construction of the new nuclear power plant unit is expected to have a total employment effect of approximately 22,000 to 28,000 man-years in Finland. Foreign employees make a significant contribution to the planning and design of the nuclear power plant unit, manufacturing its components and building the plant.

The fourth nuclear power plant unit will require an operating staff of approximately 150, and the increased need for outsourced services will correspond to the work input of approximately 100 people. Annual outages of the fourth plant unit will require external staff of approximately 500 to 1,000 people. Because the same employees can be used for the maintenance of the three other plant units, the duration of employment during the maintenance period will be extended.

Traffic impacts

The construction of the new unit will take approximately 6 to 8 years. During construction, traffic on Olkiluodontie will increase threefold compared to the zero option in which the existing units, the OL3 unit and the spent fuel final disposal facility are in operation. Particularly at the initial stage of construction, also the proportion of heavy traffic on the road will increase. During the construction phase, large plant components will be transported to the Olkiluoto harbour by ship.

After completion, the new unit will increase the volume of traffic to Olkiluoto by approximately 25% compared with the zero option. After the completion of the OL4 plant unit, the Olkiluoto traffic volume would be 2,000 vehicles per day. During annual outages, the traffic volume would be about 4,500 vehicles.

Impacts of radioactive emissions

The releases of radioactive substances from the power plant are under constant monitoring. Releases may be emitted through the vent stack into the atmosphere or through the cooling water discharge opening into the sea. The releases are carefully measured to ensure that they remain clearly below the prescribed limits. Radioactive gases generated in a nuclear power plant are collected, delayed to reduce radioactivity, and filtered. After filtering, gases containing small amounts of radioactive substances may be released through the vent stack. The radioactive releases from the Olkiluoto nuclear power plant into the atmosphere are clearly within the limits set by the authorities. The releases are equal to a thousandth part of the set limits at most. Depending on weather conditions and the properties of each substance, the radioactive substances emitted to the atmosphere from the power plant will be carried to the surface of the earth or vegetation, aquatic environment and organisms. In samples taken from the objects listed above, radioactive substances originating from the power plant can occasionally be detected among other radioactive substances, when sensitive methods of analysis are used. No radioactive substances originating from the nuclear power plant have been detected in the measurements of the nearby population.

During the monitoring of the sea area around Olkiluoto, sensitive analysis methods are able to detect radioactive substances originating from the Olkiluoto power plant in algae and other aquatic vegetation, sea bed fauna, sinking matter and occasionally also in fishes. The amounts are substantially smaller than those of natural radioactive substances.

Since there will be only minor radioactive releases from the new nuclear power plant unit during operation, they will not have any harmful effects on the natural environment.

Impacts on human health

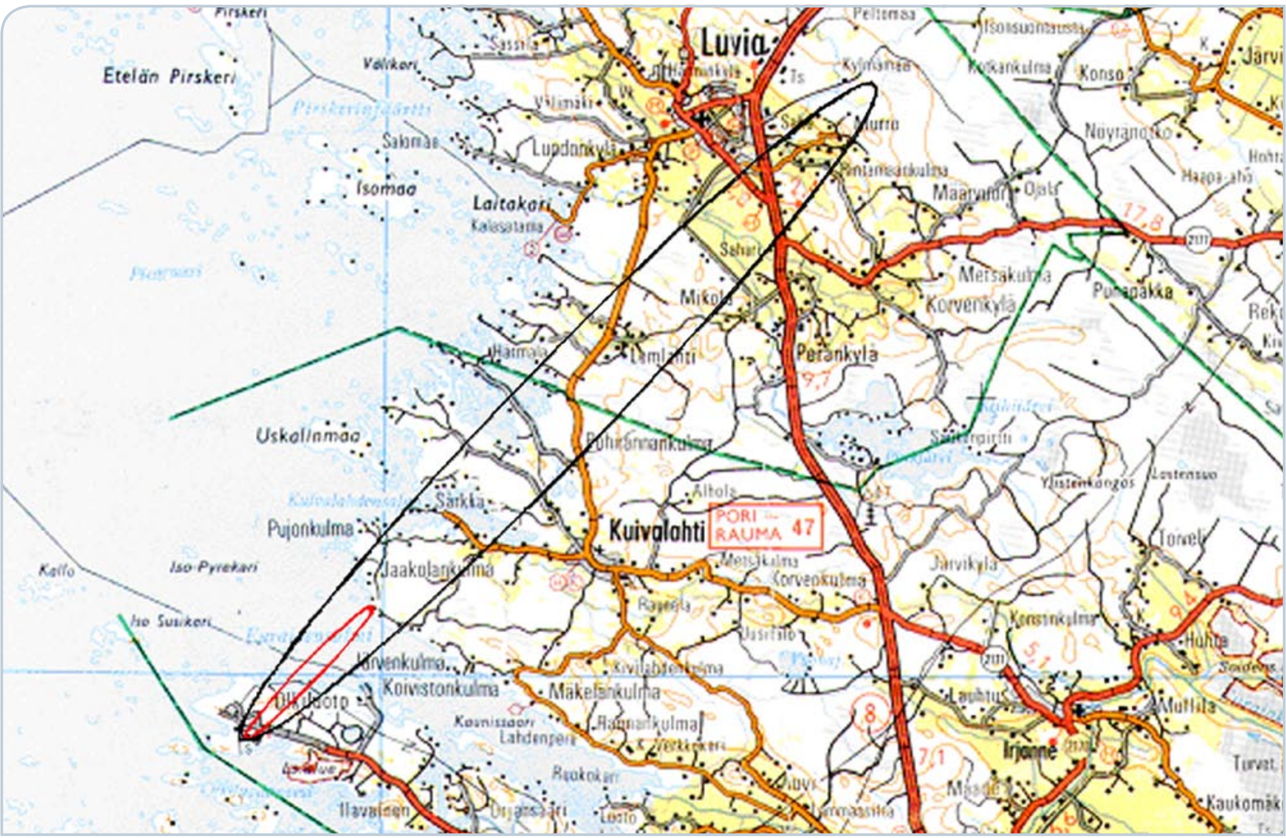
The radiation dose caused by releases from the operation of the four plant units of the Olkiluoto nuclear power plant to a member of the most exposed group of the population, as a result of their place of abode and living habits, will not exceed 0.001 mSv per year. The limit for radiation exposure arising from the operation of a nuclear power plant has been set at 0.1 mSv per year in Finland. It can be noted for comparison that the radiation dose received by each Finn from other radiation sources is approximately 3.7 mSv annually.

The dose imposed by the fourth nuclear power plant unit on nearby residents will be less than one hundredth of the radiation dose limit set for the operations of the nuclear power plant and less than one thousandth of the average radiation dose received by each Finn. The amounts of radioactive materials emitted or discharged from the fourth power plant unit at Olkiluoto into the environment are so minor that they do not have any significance to human health.

Impacts of accident situations

The EIA report examines the impacts of a radioactive release originating from a severe reactor accident on people and the environment. According to Government Decision (395/91) the release of long-lived radioactive substances from a severe reactor accident is assumed to be 100 TBq Cs-137 and a corresponding proportion of other isotopes of caesium. Furthermore, it is assumed that the release contains certain amount of radioactive isotopes of iodine and noble gases defined by accident analyses. The probability of the occurrence of the accident under review is less than once in 100,000 years.

Figure 7. Radiation doses caused by the accident under review during the first 24 hours without protective measures in the vicinity of Olkiluoto with a southwesterly wind. The red line represents the area within which the doses incurred exceed 50 mSv, and the black line represents the area within which the doses incurred exceed 10 mSv. (Base map © Affecto Finland Oy, licence number L7302/07)



Distance from the power plant (km)	Radiation dose during the first 24 hours (mSv)	Radiation dose accumulated over 50 years subsequent to the first 24 hours (mSv)
1	200	300
3	70	200
10	20	70
30	6	20
100	2	4
300	0.6	1
1000	0.2	0.3

Table 2. Radiation doses in the accident under consideration to the most exposed residents in the vicinity in case no population protection measures are taken.

The release would not cause an immediate health impact on even the nearest residents. The doses presented in Table 2 have been calculated with the assumption that the release will take place during such weather conditions and such a season that the doses would be lower than the specified value with a probability of 95 %. Computer programs, developed for the purpose and taking into account various factors including the direction and velocity of wind as well as the stability class on three different release heights, have been used for estimating the radiation doses incurred by nearby residents due to the releases. The input data required are the height of release, the time the release started and ended, as well as details of weather conditions and the amount of radioactive substances released.

In the absence of any protective measures, the radiation dose incurred during the first 24 hours by a person living ten kilometres from the power plant could be approximately five times the annual average dose of each Finn.

The radiation doses incurred in the vicinity during the first 24 hours have also been illustrated in Figure 7, which shows a map of areas in which the dose would exceed 50 mSv or 10 mSv. It can be stated that a computer tomography scan (CAT scan) of abdominal areas will cause an average radiation dose of 12 mSv, and that the annual dose incurred by people living in houses where the indoor air radon concentration exceeds 800 Bq/m^3 is about 14 mSv per annum (there are approximately 19,000 dwellings in Finland exceeding this value). The incurred doses can be substantially reduced by protective measures. Protective measures could include temporary evacuation up to an approximate distance of five kilometres, taking shelter indoors within 10 kilometres and the administration of iodine tablets to children within a few tens of kilometres.

To provide for the occurrence of accidents, the current Olkiluoto power plant has been allotted a protective zone extending some five kilometres from the power plant in the land use planning, as well as an emergency planning zone of rescue operations comprising the nearby municipalities of Eurajoki, Luvia and Rauma. There are several radiation measurement stations in the plant surrounds; they allow any changes in the radiation levels of the environment to be immediately detected. STUK will inform the neighbouring countries of any accident situation in compliance with international conventions.

Comparison between alternatives

The new unit will be either a boiling water reactor plant or a pressurised water reactor plant. The requirements concerning nuclear safety are practically the same for all plant types, which means that the chosen plant type is of no significance in that regard. Also, the plant types that come into question do not significantly differ from each other with regard to radioactive releases.

The size of the chosen plant type is of significance with regard to environmental impacts because the size affects the thermal load conducted to the sea. The impact of the size of the plant on radioactive releases is minor. The size of the plant will have some effect on the quantities of materials to be transported during construction and use, the quantities of waste generated, the number of employees and thus the volume of commuter traffic, as well as the economic impacts of the project. The size of the power plant may also affect the number of power transmission lines required.

With regard to environmental impacts, the differences between the alternative locations are minor, and the location can be chosen primarily on other grounds.

With regard to environmental impacts related to sea water warm-up, the differences between the alternative cooling water intake and discharge locations are small compared to the impact of variation in weather conditions. On average, the size of the warmed-up area and the area unfrozen in winter is directly proportional to the thermal power conducted into the sea. The size and shape of these areas vary greatly on the basis of weather conditions.

In summary, it can be stated that the environmental impact assessment did not find any adverse environmental impacts of such significance arising from the construction or operation of the nuclear power plant that they could not be accepted or mitigated to an acceptable level.

If the new nuclear power plant unit is not constructed, it is assumed that the electricity will be produced in accordance with the average Nordic electrical production structure, which will generate sulphur dioxide, nitrogen oxide, carbon dioxide and particle emissions.

3 Information about possible transboundary environmental impacts

The issues pointed out in the statements issued regarding the assessment programme in conjunction with the international hearing have been considered in the preparation of the EIA report and included in it, while the statements with respect to the most significant impacts have also been included in this summary document.

Safety will be the central design principle of the potential new nuclear power plant unit. If the decision is made to implement the new plant unit, the latest safety requirements will be taken into account in it. This plant unit will be one in which preparations have been made for severe accidents and the mitigation of their consequences. The potential hazardous situations will be analysed already during the plant design phase, and reliable technical protection will be designed for each.

Protection against external hazards will also be provided. The design of the plant unit includes preparations for, among other things, a large passenger aeroplane crash and exceptional weather conditions. Other contemporary threats, such as the effect of climate change, will also be considered in the design.

In the most unlikely severe reactor accident situation described in the EIA Report resulting in radioactive release would cause radiation doses in the order of magnitude shown in Table 2 outside Finnish borders. The nearest foreign state, Sweden, is some 200 km away from Olkiluoto. According to the international recommendations regarding population protection measures and restrictions on the use of foodstuffs, no protection measures or restrictions would be required outside Finnish borders. The project has not been identified as having any other impacts extending beyond Finnish territory.

4 Schedule

If the decision is taken to implement the project, the aim is to start the construction of the new nuclear power plant unit early in the 2010s. Construction is estimated to take approximately 6 to 8 years.

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EIA documents on the Internet
The EIA Programme, EIA Report and their respective summaries, as well as the statements and opinions submitted regarding the EIA Programme can be viewed on the Internet pages of the Ministry of Employment and the Economy (www.tem.fi).
The EIA Programme, EIA Report and their respective summaries can also be viewed on the Internet pages of TVO (www.tvo.fi).

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