Supplement to the Environmental Impact Assessment Report

Extension of the Olkiluoto nuclear power plant by a fourth unit

Quality and Environment

20.8.2008

Ministry of Employment and the Economy
P.O. Box 32
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Finland

Statement of the Ministry of Employment and the Economy 6811/815/2008, 19 June 2008

SUPPLEMENT TO THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT

INTRODUCTION

On 14 February 2008, Teollisuuden Voima Oyj (hereinafter 'TVO') submitted an environmental impact assessment report ('EIA report') to the Ministry of Employment and the Economy ('MEE') in accordance with the environmental assessment procedure ('EIA procedure'), pursuant to the Environmental Impact Assessment Act (468/1994, 'EIA Act'), on the project concerning the fourth unit of the Olkiluoto nuclear power plant.

MEE provided its statement regarding the EIA report concerning the fourth unit of the Olkiluoto nuclear power plant ('OL4') on 19 June 2008.

In its statement the MEE stated that the EIA report on the OL4 nuclear power plant unit meets the content requirements of EIA legislation and has been handled in the manner required by the EIA legislation. The ministry finds the EIA report essentially adequate, but certain topics require further clarification before the consideration of the application for a decision-in-principle, submitted by TVO on 25 April 2008, can commence regarding the application's essential parts.

In statements concerning the OL4 EIA report, the report was considered appropriate and extensive for the most part, although some instances, such as the Ministry of the Environment, Southwest Finland Regional Environment Centre and Radiation and Nuclear Safety Authority have stated that in some respects the EIA report is incomplete.

Therefore, the MEE considered the issues presented hereafter to need more precise examination in a supplementary report, due at the ministry by 31 August 2008. However, the schedule of the required Natura assessment may deviate from this schedule, and the assessment will be conducted separately in accordance with the Nature Conservation Act.

According to the statement given by the MEE, at least the following issues must be dealt with in the supplementary report:

1. Cooling water issues, with more specific assessment of the environmental impact of the embankment to be constructed. Furthermore, an assessment shall be provided of how the cooling water models would have presented the impact without the embankment. The licensing procedure for the embankment must also be presented.
2. A more detailed presentation of the various plant type alternatives, with a review of key technical information regarding the environmental impacts of the plant alternatives included in the application for a decision-in-principle on Olkiluoto 4, submitted on 25 April 2008.
3. The Natura site of the Rauma Archipelago (FI02000073) shall undergo a Natura assessment pursuant to Section 65 of the Nature Conservation Act, according to a separate schedule.
4. A more specific presentation of the methods used for accident analyses. The supplementary report must also include a brief assessment of the environmental impact of an accident less severe than the severe reactor accident presented in the EIA report – for example, an accident of category 4 or 5 on the INES Scale of the International Atomic Energy Agency (IAEA). Replies must be provided in writing to questions posed by Lithuania, Estonia and Norway, pertaining to the assessment of international impact, and the replies must be translated into English.
5. A more precise assessment of the employment effects of the project, including a review of the regional and broader employment effects on the basis of experience gained from the Olkiluoto 3 project.

Furthermore, TVO may, should it so wish, also handle other questions brought up in the statement.

At a meeting held on 26 June 2008, TVO presented the MEE with a plan concerning the issues to be dealt with in the supplementary report, as well as their presentation method and extent.

In this document, TVO presents the supplement to the environmental impact assessment report on the OL4 nuclear power plant unit as required by the MEE.

ISSUES DEALT WITH IN THE SUPPLEMENTARY REPORT

In the material that follows, TVO will refer to the statement made by the MEE on the issues to be covered in the supplementary report and answers the supplementing requirements, point by point.

1 ‘Cooling water issues; with more specific assessment of the environmental impact of the embankment to be constructed. Furthermore, an assessment shall be provided of how the cooling water models would have presented the impact without the embankment. The licensing procedure for the embankment must also be included.’

The embankment connecting the islands of Olkiluoto and Kuusisenmaa, presented in the EIA report, is associated with the energy-efficiency of the Olkiluoto power plant and the Olkiluoto 3 project.

The Olkiluoto nuclear power plant's cooling water intake and discharge locations are about one kilometre from each other, on the south and west sides of the Olkiluoto island. In certain wind conditions, the cooling waters recirculate from the discharge side to the water intake through the inlet between Olkiluoto and Kuusisenmaa. The significance of the impact of recirculation will increase with the OL3 plant unit, which, according to the information received from the plant supplier, will be completed in 2011.

The impacts of cooling waters of three plant units have been assessed in the environmental impact assessment report completed in 1999. In environmental permit decisions (11/2006/2 and 12/2006/2) granted for Olkiluoto nuclear power plant units OL1, OL2 and OL3, the Western Finland Environmental Permit Authority has required TVO to analyse any possible recirculation of heated cooling water into the intakes of cooling water, assess the significance thereof in terms of the power plant's energy-efficiency and present on the basis of the analysis potential measures to diminish or prevent circulation.

The impact of the recirculation of water through the inlet between Olkiluoto and Kuusisenmaa has been researched with flow modelling used for examining the dispersion of thermal load and the area with no ice or weak ice in a situation with three operating plant units, with and without an embankment. It has been noted that in a situation with three operating plant units, the embankment lowers the temperature of the cooling water intakes by 0–1 ºC in the summer, thus increasing the plant's energy-efficiency. In the winter, the embankment reduces the size of the iceless area by approximately one per cent. In a situation with four plant units, the embankment's positive effects are estimated to increase.

Figures 1 and 2 illustrate the temperature increase caused by the cooling waters of three plant units and the dispersion of warm water in the surface layer when wind is blowing from the north in the summer.

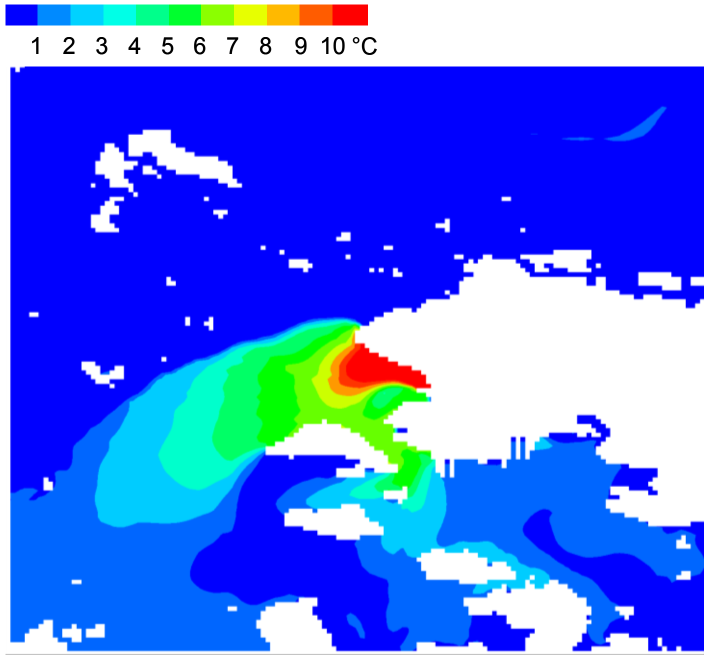

Figure 1. The impact of the thermal load of the cooling waters of three plant units on the sea surface temperatures without the embankment connecting Kuusisenmaa and Olkiluoto.

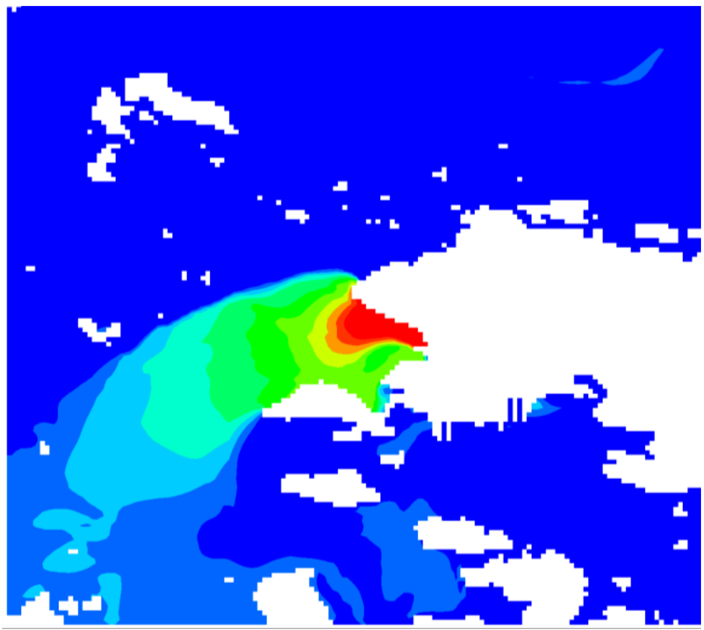

Figure 2. The impact of the thermal load of the cooling water of three plant units on the sea surface temperatures in a situation with an embankment connecting Kuusisenmaa and Olkiluoto.

The construction of the embankment is subject to a permit decision in accordance with the Water Act, including a permanent right to use the water area, which will be filled in. A permit application has been submitted to the Western Finland Environmental Permit Authority, and it has been brought up on 7 July 2008 with the record number LSY-2008-Y-180. Detailed grounds for the project, water system information and land use planning in the area, a project description and assessments of the project's environmental impacts, as well as the prevention of eventual adverse effects and their compensation, are described in the permit application. During the licensing process, the Environmental Permit Authority will examine whether the assessment of the environmental impacts is detailed enough. EIA procedure is not required for the construction of the embankment.

The embankment is closely associated with safety and energy-efficiency issues of the Olkiluoto power plant and the OL3 project, and TVO considers these to constitute the basis on which the requirements for granting of the permit are met. According to TVO's estimates, it is likely that, by the end of 2010 – that is, the time for which the environmental impacts of OL4 were assessed, when the OL3 plant unit is completed and in production use – the permit pursuant to the Water Act will have been granted and the embankment completed. This has been the starting point for the description of the embankment in the OL4 EIA report.

2 'A more detailed presentation of the various plant type alternatives, with a review of key technical information regarding the environmental impacts of the plant alternatives included in the application for a decision-in-principle on Olkiluoto 4, submitted on 25 April 2008.'

In Table 1, TVO describes the five plant type alternatives presented in the application for a decision-in-principle.

Table 1. Plant type alternatives investigated by TVO.

Type	Model	Electrical output	Supplier	Country of origin
Boiling water reactor	ABWR	Approximately 1,650 MW	Toshiba-Westinghouse	Japan, Sweden
	ESBWR	Approximately 1,650 MW	GE Hitachi	United States
Pressurised water reactor	APR1400	Approximately 1,450 MW	KHNP	South Korea
	APWR	Approximately 1,650 MW	Mitsubishi	Japan
	EPR	Approximately 1,650 MW	AREVA	France, Germany

2.1 General technical data and pictures of the plant type alternatives, based on information provided by the plant suppliers

General technical data and pictures of the plant type alternatives are presented on the following pages, on the basis of information provided by the plant suppliers. In connection with the pictures, besides type, model, electrical output, supplier and country of origin, also thermal power, the operating pressure of the reactor, the design pressure of the containment, the number of fuel elements and the number of control rods are presented.

The information on the plant type alternatives is also available on TVO's Web site at

http://www.tvo.fi/uploads/File/OL4_laitostyyppit_1.pdf.

ABWR

Supplier	Toshiba-Westinghouse
Country of origin	Japan, Sweden
Reactor type	BWR
Reactor's thermal power	4,300 MW
Electrical output	Approximately 1,650 MW
Reactor's operating pressure	71.7 bar
Fuel elements	872 pcs
Control rods	205 pcs
Design pressure of the containment	4.1 bar

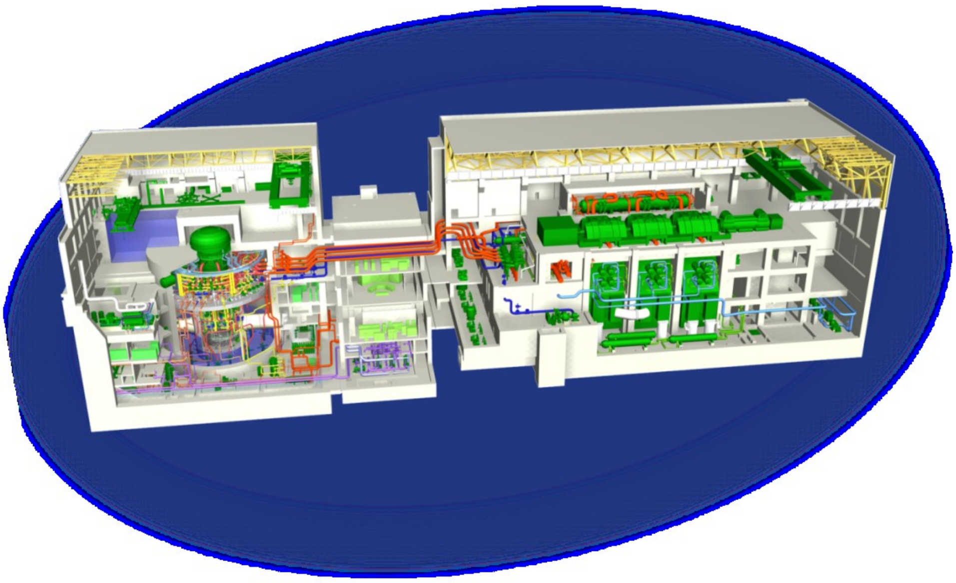

Figure 3. ABWR.

ESBWR

Supplier	GE-Hitachi
Country of origin	United States
Reactor type	BWR
Reactor's thermal power	4,500 MW
Electrical output	Approximately 1,650 MW
Reactor's operating pressure	71.7 bar
Fuel elements	1,132 pcs
Control rods	269 pcs
Design pressure of the containment	4.1 bar

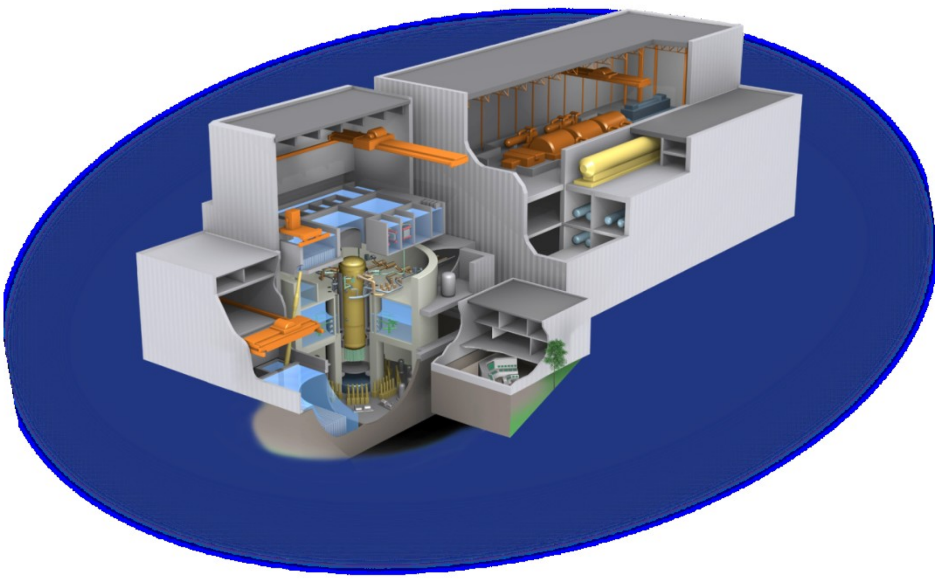

Figure 4. ESBWR.

APR1400

Supplier	KHNP
Country of origin	South Korea
Reactor type	PWR
Reactor's thermal power	4,000 MW
Electrical output	Approximately 1,450 MW
Reactor's operating pressure	155 bar
Fuel elements	241 pcs
Control rods	93 pcs
Design pressure of the containment	5.1 bar

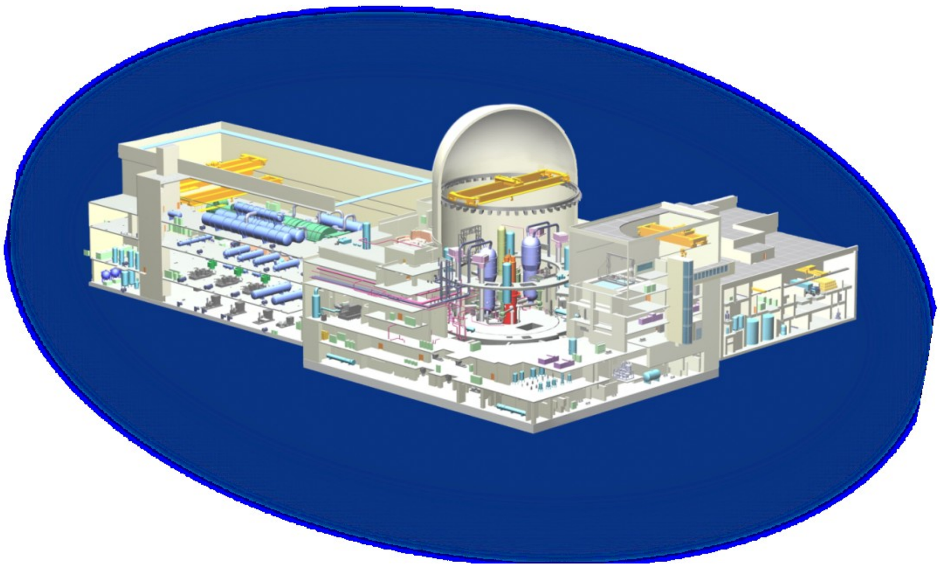

Figure 5. APR1400.

APWR

Supplier	Mitsubishi
Country of origin	Japan
Reactor type	PWR
Reactor's thermal power	4,451 MW
Electrical output	Approximately 1,650 MW
Reactor's operating pressure	155 bar
Fuel elements	257 pcs
Control rods	69 pcs
Design pressure of the containment	5.7 bar

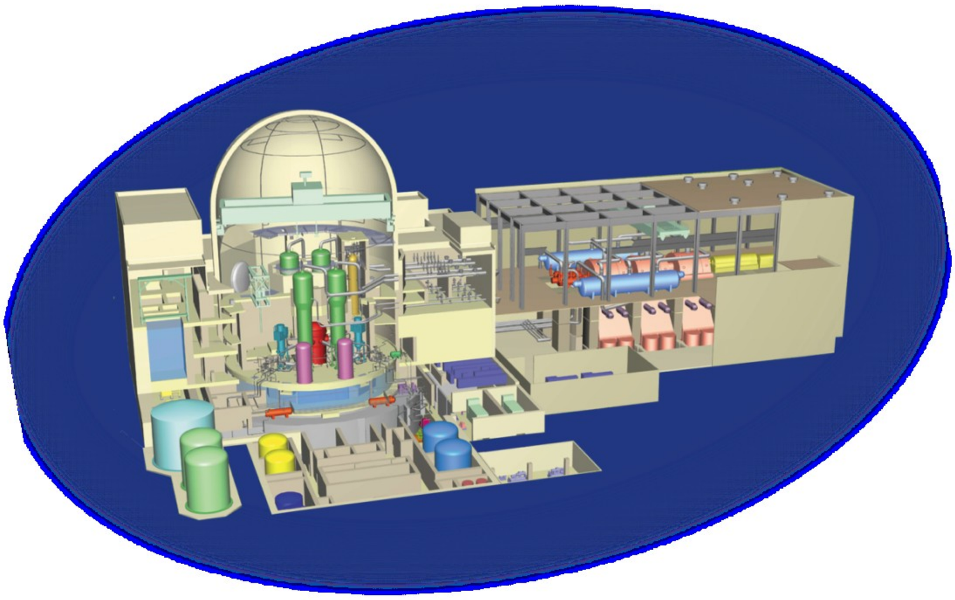

Figure 6. ABWR.

EPR

Supplier	AREVA
Country of origin	France, Germany
Reactor type	PWR
Reactor's thermal power	4,590 MW
Electrical output	Approximately 1,650 MW
Reactor's operating pressure	155 bar
Fuel elements	241 pcs
Control rods	89 pcs
Design pressure of the containment	5.3 bar

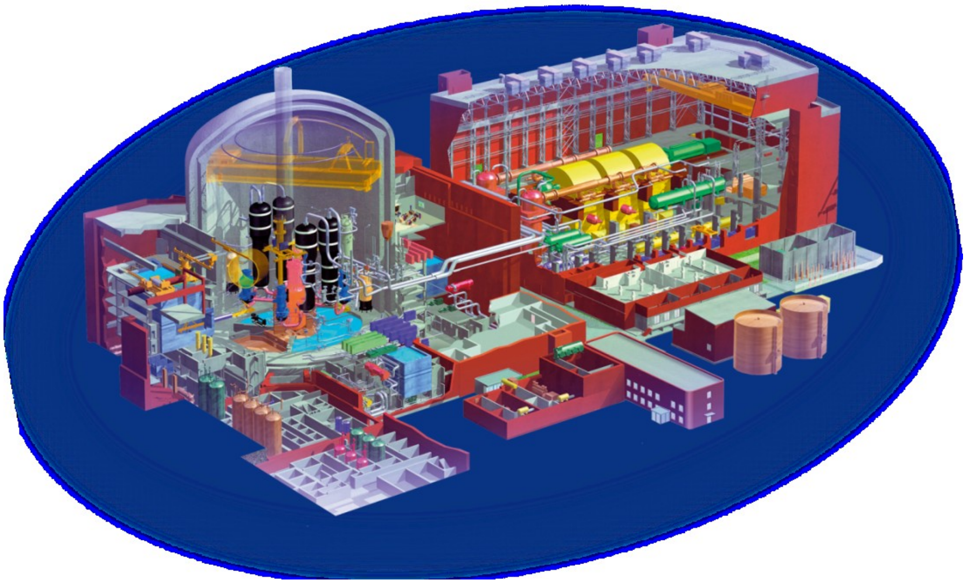

Figure 7. ABWR.

2.2 Safety functions of the plant alternatives

Basic information on all of the plant type alternatives (ABWR, ESBWR, APR1400, APWR and EPR) and the method of implementation of safety functions in them are presented in Appendix 7 to the application for a decision-in-principle submitted by TVO to the government. The technical implementation of the following safety functions are presented in that appendix: reactor shutdown, decay heat removal from the reactor, emergency cooling of the reactor core, decay heat removal from the containment and severe accident management.

Principal requirements for nuclear safety in Finland are generally presented in Appendix 8 to the decision-in-principle. All plant type alternatives must comply with these principles.

The plant type alternatives ABWR, APR-1400, APWR and EPR are so-called evolutionary plants, and the implementation of their safety functions is primarily based on active safety systems, which require an external power supply. In the ESBWR design, safety functions and coolant circulation are implemented as passive; i.e. their operation does not require external power, apart from certain actuation signals. The ABWR, APR-1400, APWR and EPR alternatives also include safety systems that can be considered passive.

The containment building has a key role in the limitation of releases caused by highly unlikely accidents, dealt with in Chapter 10.4 of the EIA report. In the boiling water reactor alternatives (ABWR and ESBWR), a compact pressure suppression containment building based on the condensation of steam, with separate wet-well and dry-well sections, is located in the reactor building. The pressurised water reactors (APR-1400, APWR and EPR) are equipped with a dry, large-volume containment building. The containment buildings of APR-1400 and EPR suggested for Finland are double-walled, whereas the APWR containment represents a one-wall solution with penetrations located inside the reactor building.

Design pressures of the containment buildings are presented above in connection with the figures illustrating the plant type alternatives. Properties required of the containment buildings for Finland are presented in sections 4.2.2 and 4.2.5 of Appendix 8 to the application for a decision-in-principle submitted by TVO to the government.

2.3 Thermal load to the environment during normal use

The OL4 EIA report, sections 9.7.6–9.7.8, deals with cooling water intake, discharge and impacts on the environment. As regards plant type alternatives, the technical features associated with this issue include the required cooling water flow, thermal efficiency and temperature increase of the cooling water.

Thermal power and electrical output as declared by the plant suppliers are presented above in connection with figures 3–7. However, the final electric power, thermal efficiency and seawater flow depend on the turbine plant selected and its optimisation for the seawater conditions prevailing in the Olkiluoto area. This selection is not made in the EIA or decision-in-principle phase. The starting point for the temperature increase of the cooling water in the turbine condenser is approximately 12 °C, as it is for the OL3 plant unit.

The estimated efficiency of the plant unit will be approximately 37–40%, depending on the turbine plant selected and the seawater temperature. In plant alternatives ABWR, ESBWR, APWR and EPR, the total cooling water flows will be approximately 60 m^3/s. With APR1400, the corresponding cooling water flow will be approximately 50–55 m^3/s. It can be noted for comparison that in the OL3 plant unit the total flow of seawater is 57 m^3/s.

3 'The Natura site of the Rauma Archipelago (FI02000073) shall undergo a Natura assessment pursuant to Section 65 of the Nature Conservation Act, according to a separate schedule.'

TVO has started to plan the implementation of the Natura assessment concerning the impacts of the OL4 project on the Rauma Archipelago Natura 2000 area.

3.1 The Natura 2000 area of the Rauma Archipelago

The Natura 2000 site in the Rauma Archipelago (FI02000073) covers 5350 ha. It is a Sites of Community Importance (SCI) area, protected on the basis of the following habitat types listed in the Habitats Directive, Annex 1 (* denotes priority habitat type) and species from Annex II:

Habitat type	**Estimate of the existence of the habitat type in the Natura 2000 area**
Coastal lagoons* (1150)	1%
Reefs (1170)	1%
Annual vegetation of drift lines (1210)	<1%
Perennial vegetation of stony banks (1220)	1%
Vegetated sea cliffs of the Atlantic and Baltic coasts (1230)	<1%
Boreal Baltic islets and islands in outer-archipelago and open-sea zones (1620)	2%
Boreal Baltic coastal meadows* (1630)	<1%
Boreal Baltic sand beaches with perennial vegetation (1640)	<1%
Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)	<1%
Fennoscandian lowland species-rich dry to mesic grasslands* (6270)	<1%
Western taiga* (9010)	1%
Natural forests of primary succession stages of land-upheaval coast* (9030)	1%
Fennoscandian herb-rich forests with *Picea abies* (9050)	<1%
Fennoscandian wooded pastures (9070)	<1%

Species
Halichoerus grupus, grey seal

3.2 The purpose of the Natura assessment

The purpose of the Natura assessment is to investigate whether the cooling water load of the OL4 nuclear power plant unit, together with the cooling waters of the other plant units operating in the area, will cause harmful impacts on the Natura site in the Rauma Archipelago and its basis for protection, as well as of what kind and how widely spread and significant the eventual harmful impacts may be. The thermal load of the cooling waters is concentrated on underwater and coastal habitat types.

3.3 Assessment methods

The area affected by the cooling waters will be determined on the basis of the results received from the simulation of the dispersion of cooling waters of the Olkiluoto nuclear power plant.

Other source materials include Natura Standard Data Form information, previous Natura investigation reports, information on the current status of the sea, maps and results of follow-up studies.

Missing information is supplemented by field studies examining the present status of the impact area and the existence of nature values that are the basis for protection.

The harmfulness and significance of the impacts are assessed on the basis of the environmental criteria concerning the organisms present in the habitat type as well as water temperature increase, which may be temporary or permanent, depending on the prevailing currents and wind conditions. The impacts on biological populations essentially depend on the magnitude, duration and repetitiveness of the change. In the assessment, the impacts of alternative implementation options are compared.

The results obtained will be compared with the entire Natura site's natural features. This aids in gaining an estimate of the area of the impact area for the habitat types in comparison to the entire Natura 2000 site, and an assessment can be made of the significance of the changes that have been assessed as harmful in the area affected by cooling waters, from the standpoint of the protection of the habitat found in the entire protection area.

However, the location or real acreages of the habitat types that are the basis for protection have not previously been examined for this particular Natura 2000 site. The percentages presented for the existence of habitat types presented on the Natura Standard Data Form are estimates.

On the basis of the Natura assessment, a follow-up programme tracking eventual effects on the impact area will be drawn up.

A steering group comprising experts from various fields will be formed to monitor the assessment. The group will also be reserved the opportunity to comment on, for example, the work programme and the results of the assessment.

3.4 Schedule

The drawing up of the research plan for the Natura assessment was started in the summer of 2008.

According to a preliminary schedule, the Natura assessment will be completed during 2009.

4 'A more specific presentation of the methods used for accident reviews. The supplementary report must also include a brief assessment of the environmental impact of an accident less severe than the severe reactor accident presented in the EIA report – for example, an accident of category 4 or 5 on the INES Scale of the International Atomic Energy Agency (IAEA). Replies must be provided in writing to questions posed by Lithuania, Estonia and Norway, pertaining to the assessment of international impact, and the replies must be translated into English.'

4.1 A more specific presentation of the methods used for accident reviews

4.1.1 Dispersion modelling

A Gaussian plume model has been used as the dispersion model for airborne releases. The Gaussian dispersion model based on statistical dispersion theory can be presented as follows (1):

$$\chi(x,y,z,t) = q_0(t - x/u_H)\,\frac{1}{2\pi\sigma_y\sigma_z u_H}\exp\left(-\frac{y^2}{2\sigma_y^2}\right)\cdot \left(\exp\left(-\frac{(z-H)^2}{2\sigma_z^2}\right) + \left(\exp\left(-\frac{(z+H)^2}{2\sigma_z^2}\right)\right)\right) \quad (1)$$

where

χ	is radioactivity concentration in the air (Bq/m^3),
x, y, z	are location co-ordinates,
t	is the time co-ordinate,
q_0	is release rate (Bq/s),
σ_y	is a dispersion parameter depending on weather type,
σ_z	is a dispersion parameter depending on weather type,
u_H	represents wind velocity at altitude H and
H	is release altitude.

The equation (1) does not take into account the reduction of radioactivity q_0 during dispersion; this will be done separately at a later stage (see equations 3, 4 and 5). The origin of the location co-ordinates is ground level, x is the dispersion direction, y is horizontal and perpendicular to the dispersion direction and z is vertical direction. Release altitude H refers to the altitude where the release remains, its temperature and release rate being considered. The term $\exp[-(z+H)^2/2\sigma_z^2]$ describes the part of the release that is 'reflected' upward as a result of the lower part of the radioactive cloud reaching ground level.

When radioactivity concentration at ground level, z = 0, is examined, the terms $\exp[-(z+H)^2/2\sigma_z^2]$ and $\exp[-(z-H)^2/2\sigma_z^2]$ describing the vertical distribution can be summed. Dispersing radioactivity will reduce because of radioactive decay and fallout. Therefore, the radioactivity of the release is assumed to be a function of distance x (or dispersion time x/u_H). In order to facilitate dose calculations, a time integral of radioactivity concentration is formed from Equation 1, when z = 0, and the dimension will be $Bq \cdot s/m^3$.

Wind velocity is expected to increase as a function of altitude as follows:

$$u_H = u_{z_0} (\frac{H}{z_0})^m \tag{2}$$

where

z_0	is reference altitude,
u_{z0}	is wind velocity at reference altitude and
m	is Frost index.

In calculation of the time integral of concentration, radioactive decay during dispersion is taken into account with the factor $f_r(x)$,

$$f_r(x) = \exp(-\lambda x/u) \tag{3}$$

where λ is the radioactive decay constant of a nuclide.

Removal of radioactivity from the cloud caused by dry fallout is taken into account with the factor $f_d(x)$ calculating the portion remaining in the cloud:

$$f_d(x) = \exp\left[-\frac{v_d}{u_H} \sqrt{\frac{2}{\pi}} \int_0^x \frac{1}{\sigma_z} \exp(-\frac{H^2}{2\sigma_z^2}) dx \right] \tag{4}$$

where v_d is deposition rate.

Removal of radioactivity from the cloud caused by wet fallout is taken into account with the factor $f_w(x)$:

$$f_w(x) = \exp(-\Lambda \frac{x}{u}) \tag{5}$$

where Λ is wash-out coefficient, depending on rain rate and the stability of the air.

At distance x, the radioactivity of the release is

$$Q(x) = f_r(x)\, f_d(x)\, f_w(x) Q_0 \qquad (6)$$

where Q_0 is radioactivity when x = 0.

Radioactive fallout C_A (Bq/m^2) is derived from the expression of χ:

$$C_A(x,y) = v_d \chi(x,y), \text{ (no rain)} \qquad (7)$$

$$C_A(x,y) = \left[v_d + \Lambda \cdot \sqrt{\frac{\pi}{2}} \frac{\sigma_z}{\exp(-\frac{H^2}{2\sigma_z^2})} \right] \cdot \chi(x,y) \text{, (rain)} \qquad (8)$$

The values of the dispersion parameters σ_y and σ_z are presented in the literature.

4.1.2 Description of fallout with the K_z theory

The reduction of material in a cloud caused by dry fallout is calculated in Equation (4), assuming that the removal has no impact on the cloud's vertical concentration distribution. Mostly, this is true only in labile and neutral dispersion conditions. In stabile conditions, the dispersion of material is slow as a result of minor turbulence, and using Equation (4) results in overestimation of the removal. A more realistic description in this respect can be obtained by using an approach based on the K_z dispersion theory (analogous to the molecule diffusion theory), where the vertical concentration distribution in the air $C_z(z,t)$ is obtained from the equation

$$\frac{\partial C_z(z,t)}{\partial t} = \frac{\partial}{\partial z}\left(K_z(z) \frac{\partial C_z(z,t)}{\partial z}\right) \qquad (9)$$

where $K_z(z)$ is a diffusion factor depending on altitude z and stability. The boundary condition of earth surface is presented as

$$\left(\frac{\partial C_z(z,t)}{\partial t}\right)_m = \frac{\partial}{\partial z}\left[K_z(z) \frac{\partial C_z(z,t)}{\partial z} - v_d C_{zm}(z,t) \right] \qquad (10)$$

where the index m refers to the ground surface and the term $K_z(z)\frac{\partial C_z}{\partial z}$ describes a turbulent flux from above to the ground surface level (computationally slightly above the ground surface) and the term V_dC_{zm} describes a flux to the ground surface. This method of describing fallout has been used in the ARANO near-field model developed by VTT and the Finnish Meteorological Institute and in the TRADOS long-range transport model. The TRADOS model has already been abandoned and replaced by the VALMA model, specifically designed for the handling of emergency situations, and with the even further developed SILAM model, which is a 3D particle model. Its initial meteorological data are obtained from HIRLAM, an operative numerical weather prognosis model of the Finnish Meteorological Institute.

4.1.3 Dose calculation

Methods that meet the requirements of Finnish legislation and instructions provided by the Radiation and Nuclear Safety Authority have been developed for the assessment of the radiation dose of an individual of a critical group in the environment. The instructions to be applied are YVL 7.2, ‘Assessment of radiation doses to the population in the environment of a nuclear power plant’, and YVL 7.3, ‘Calculation of the dispersion of radioactive releases from a nuclear power plant’.

The dose-effect factors for different nuclides used in the calculation of radiation caused by a release comply with the Radiation and Nuclear Safety Authority's Guide 7.3, ‘Calculation of the Dose Caused by Internal Radiation’, and Council Directive 96/29 EURATOM.

The following dose routes have been taken into account in the calculation programs used by TVO:

- Direct gamma radiation from the cloud
- Beta radiation on ground surface
- Direct radiation from the fallout
- Inhalation dose from the cloud
- Radiation dose received from food through eating vegetables, meat or milk produced in the vicinity of the plant, or berries, mushrooms, game or freshwater fish

4.1.4 Gamma radiation from a radioactive cloud

The following integration over the area surrounding the observation point (ρ_d,θ_d,0) must be performed in order to calculate the gamma dose (Γ_0) received directly from a radioactive cloud:

$$\Gamma_0(\rho_d,\theta_d,0) = K \int_{\rho=0}^{\infty} \int_{z=0}^{\infty} \int_{\theta=-\pi/2}^{\pi/2} \frac{B(\mu r)e^{-\mu r}}{4\pi r^2} \dot{\chi}(\rho,\theta,z)\cdot\rho\cdot d\theta\cdot dz\cdot d\rho, \quad (11)$$

where

$K = 0{,}0005928\sigma_{en}E_{\gamma}$,
σ_{en} = energy absorption factor (cm^2/g),
E_{γ} = total gamma energy release (MeV/scattering),
B = increase factor,
μ = linear attenuation coefficient for air (1/m) and
$r2 = \rho^2 + \rho^2_d - 2\rho\rho_d\cos(\theta-\theta_d) + z^2$.

In calculation of radiation doses, besides radioactive decay, eventual daughter nuclides must be taken into account.

4.1.5 Radiation from the fallout

In calculation of the dose from the fallout, the dose can be assumed to be directly proportional to the fallout at the point in question. In practice, the height and topography of the ground surface and structures limit the effective area of the dose, keeping it relatively small. When calculating a long-term fallout dose, removal processes lowering the radiation level, such as migration of radioactive substances from the ground surface under the ground, must be taken into consideration. Migration taking place in the soil can be described with migration models or empirical equations describing removal processes.

4.1.6 Dose received through inhalation

Radiation dose D accumulated through inhalation can be calculated from Equation 12:

$$D = \chi \cdot J \cdot DF, \qquad (12)$$

where J is breathing rate (m^3/s) and DF is the dose factor (Sv/Bq) of the inspected nuclide expressing the size of the dose per radioactivity unit breathed in. In calculation of the dose factor, the behaviour of a nuclide in respiratory organs (e.g., the size distribution of carrying particles), absorption in bodily liquids and migration to the various organs and elimination through metabolism are taken into consideration. Furthermore, the radiation types and energies emitted by decaying nuclides and the behaviour of eventual daughter nuclides must be taken into account in order to calculate the dose received by different organs.

4.1.7 Dose from food ingestion

The most important possible dose routes through food are milk, beef, corn, vegetables, root vegetables, berries, mushrooms and fish. The migration of iodine to the thyroid through the route fallout pasture – cow – milk – human can be particularly significant. In estimation of the radiation doses received through food, the migration of radionuclides to the edible parts of the plant through direct fallout on the plant as well as through roots from fallout to the earth must be considered. Some of the radioactivity that has fallen to the earth may be dispersed as dust on plants, and cattle also eat some earth along with grass. Tilling and the migration of radionuclides deeper into the ground with rainwater also have an impact on the distribution of radioactive substances in the soil. The migration of radionuclides to a plant through roots is usually described with an enrichment factor based on experiments or experiential knowledge, describing the ratio of concentrations in the earth to concentrations in the plant. Furthermore, when one is considering the milk and beef dose routes, the cow's metabolism should be taken into account. Usually models are utilised where parameters are adjusted to correspond to experimental or experiential knowledge.

Inhalation and ingestion dose factors are described in, for example, ICRP publications.

Direct radiation from the plant itself has been assessed as environmentally insignificant on the basis of the thickness of the containment building's walls and distance from human settlements.

4.1.8 Calculation software used

The doses presented in Table 10.1 in the OL4 EIA report have been calculated for near-field (max. 100 km) with version 4 of the TUULET software introduced in TVO in 2006. The software was developed in 1991 for the assessment of radiation doses released in accident situations in nuclear power plants /1/. The software has since been developed to suit other applications also, such as the assessment of environmental impacts caused by normal releases /2/. In computing, the TUULET software uses the above-described principles, except that it does not include the description of fallout with the K_z theory. The TUULET software takes weather conditions into account statistically; thus, in 95% of the cases, actual doses remain below the presented result.

Long-range transport has been assessed by extrapolation, on the basis of the results calculated in the report of Nordlund et al. /3/, so that the report's results have been adjusted from the results of the TUULET software. In the reference, the above-described K_z method, which better takes into account the behaviour of a vertical component on the ground surface level than the Gaussian model does, has been used.

4.1.9 References

/1/ Saikkonen T. Radioaktiivisista päästöistä ihmisille aiheutuvan säteilyannoksen arviointi. Diploma thesis, TKK, 20.3.1992.

/2/ Lamminmäki H. TUULETVL-ohjelmiston kehittäminen (TUULETV2003). Report NUCL 2078, Fortum, 3.11.2003.

/3/ Nordlund G., Rossi J., Savolainen I., Valkama I.. Ilmaan joutuvien radioaktiivisten päästöjen vaikutus väestön säteilyannoksiin laajoilla alueilla. VTT Publications 525, Espoo, 1985.

4.2 Assessment of the environmental impact of an accident less severe than the severe reactor accident presented in the EIA report (INES 4–5)

The results of a simulation of a severe accident in a pressurised-water plant equipped with modern safety systems are presented as an INES-4–5-category accident, which is less severe than a severe reactor accident as presented in the EIA report. Furthermore, the example case has been compared to the 1979 TMI-2 accident at the Three Mile Island nuclear power plant in Harrisburg, Pennsylvania (USA). On the INES scale, the TMI-2 accident is a category-5 event.

4.2.1 Accident description

A severe accident of an EPR-type reactor caused by the break of the pressurizer surge line connected to a hot leg is used as an example scenario. In the accident scenario, it is assumed that several systems fail and the reactor core melts, making this a severe accident beyond plant design basis conditions. The modelling and results presented are based on a release analysis provided by the plant supplier and dispersion simulation performed with the TUULET software used by TVO. The dispersion calculation in the TUULET software is based on the Gaussian plume model described above. Melting of the reactor core, failure of the pressure vessel and relocation of the core melt within the spreading area inside the containment are assumed events of the accident. It is assumed that radioactive fission products are released from the core to the containment building, both when the core melt is in the pressure vessel and when it has spread to the spreading compartment. Noble gases and volatile chemical elements iodine and caesium are typical substances released from a damage fuel assembly and core melt.

In the case of the EPR-type reactor, key activities in the management strategy for a serious reactor accident are

1. Depressurisation of the primary circuit before the pressure vessel fails
2. Transport of the molten core material to a special spreading compartment inside the containment building, followed by solidification and long-term cooling
3. Removal of hydrogen by means of passive catalytic recombiners
4. Removal of residual heat from the containment building by means of a separate cooling system

The final state foreseen in the management strategy is that the core melt is solidified and is coolable for the long term. In this case, the majority of the radioactive substances in the reactor will not be released from the core melt. The sooner the core melt is solidified, the smaller the amount of radioactive substances that will be released to the containment atmosphere.

The containment enables all of the mentioned operations by isolating the damaged reactor and molten core from the environment. The containment is cooled with a system especially designed for severe accidents, which controls the pressure and temperature inside the containment building. One of the design basis requirements for the containment is that cooling will not have to be initiated until 12 hours after the onset of a severe accident.

4.2.2 Release

Table 2 illustrates a simulated release of the most significant nuclides causing environmental doses during a severe accident in an EPR, the initiating event being a large break loss of coolant accident (LB-LOCA). In this accident, it is assumed that the ventilation of the containment building is not in operation. Neither is filtered containment venting required.

Of the noble gases, xenon (Xe-133) is significant because its half-life is approximately five days and its amount in the core inventory is relatively large compared to those of other isotopes of noble gases. Caesium, on the other hand, may be enriched in the food chain and replace natural potassium. The isotopes Cs-137 (half-life: about 30 years) and Cs-134 (half-life: roughly two years) are relatively long-lived. Iodine is enriched through food in the thyroid. The amount and half-life of the isotope I-131 (half-life: about eight days) are significant in comparison to other iodine isotopes.

As for the EPR alternative, the release presented below is based on final safety analysis report (FSAR) analyses currently under preparation. For comparison, the release of nuclides from a severe accident described in the OL4 EIA report and from TMI-2 are presented also. Release from TMI-2 has previously been described in several sources, such as in Reference 1.

Table 2. Release from a category-4–5 accident on INES scale and comparison to the numeric values presented in the OL4 EIA report and the TMI accident.

	Severe reactor accident in an EPR	**Severe accident presented in OL4 EIA report**	**TMI-2 data from Reference 1**
	TBq		
Noble gas (Xe-133)	400	10,000,000	70,000–370,000 (all gas isotopes)
Cs-137	0.0002	100	-
Cs-134	0.0003	in relation to the inventory	-
Iodine (I-131)	0.003	1,500	0.55 (all noble iodine isotopes)

Olkiluoto weather mast hourly averages for 2007 have been used as weather information. In the year in question, the representativeness of measurement data was approximately 98%. The variables measured are wind direction, wind speed, stability class and rainfall. With these variables it is possible to simulate the dispersion of a radioactive cloud, as well as dry and wet fallout on the ground and plants.

4.2.3 Doses to the population in the environment without protection measures

Table 3 presents estimated doses resulting from releases caused by an accident in accordance with Table 2. On the basis of the calculation results, it can be stated that a severe reactor accident in a nuclear power plant equipped with a modern containment building would lead to only a fraction of the environmental doses caused by the accident at TMI-2.

Table 3. Environmental doses caused by a category-4–5 accident on INES scale and comparison to the numeric values presented in the OL4 EIA report and the TMI accident.

	Severe reactor accident in an EPR	**Severe accident presented in OL4 EIA report**	**TMI-2, data from Reference 1**
1 km	5.2 µSv	500 mSv	< 1 mSv (estimated maximum personal dose)
3 km	2.0 µSv	270 mSv	
10 km	0.8 µSv	90 mSv	0.08 mSv (within 16 km radius)
30 km	0.3 µSv	26 mSv	
100 km	< 0.1 µSv	6 mSv	-
300 km	< 0.1 µSv	1.6 mSv	-
1,000 km	< 0.1 µSv	0.5 mSv	-

The doses include a dose caused by a radioactive cloud as well as that accumulated through fallout and food over a period of 50 years. It should be noted that these figures also overestimate the doses, as it is assumed that the person resides in the same area all this time.

4.2.4 References

/1/ Sandberg J. (ed.). Säteily ja ydinturvallisuus 5 - Ydinturvallisuus. Säteilyturvakeskus, 2004.

4.3 REPLY TO THE QUESTION POSED BY LITHUANIA: 'The questions concern, for instance, the release limits of the currently used nuclear power plant units of Olkiluoto 1 and 2, and the intended tritium release limitsof plant units Olkiluoto 3 and Olkiluoto 4.'

Release limits complied with in TVO's current plant units are presented in the Technical Specifications materials for the plant units (TTKE). The limits are applicable to the combined emissions from OL1 and OL2. Limits have been defined for liquid and airborne emissions for the following nuclides or nuclide groups:

- Limits for airborne radioactive releases per calendar year
  - Noble gases 17700 Kr-87 ekv. TBq
  - Iodine 114 I-131 ekv. GBq

- The following emission standards apply to radioactive substances released through the cooling water channels of OL1 and OL2 per calendar year:
  - Tritium 18,300 GBq
  - Other beta active nuclides 296 GBq

Standards concerning shorter-term releases have been determined on the basis of annual limits, and they are also presented in the Technical Specifications.

The limits have been justified in the explanatory section of the Technical Specifications as follows:

In Government Resolution 395/91, the limit value of a committed dose to an individual in the general public caused by normal year-long usage of a nuclear power plant is set at 0.1 mSv. This applies to the total dose caused by all airborne and liquid radioactive releases from the plant facility. Therefore, annual release limits are applied to the combined releases of OL1 and OL2. The release limits have been so defined that the requirement concerning radiation dose caused by releases is met with an ample margin.

The release limits of the future OL3 and OL4 plant units will differ to some extent from the release limits of OL1 and OL2. The reason for the differences is that the properties of different plant types differ from each other, also as regards releases. For example, tritium release from the OL3 plant, currently under construction, will be approximately 10 times the combined tritium release of OL1 and OL2. This is because in a pressurised-water plant, criticality is controlled by means of boron dissolved in the cooland. As a result of the activation of boron, tritium is produced. Because of its long half-life (approximately 12 years), it is virtually impossible to prevent it from entering the sea. As tritium has low radiation energy and is only mildly radiation toxicity, the dose effect is minor. Carbon-14, the result of the activation of oxygen atoms in the primary coolant, is the most significant nuclide as regards environmental dose. Carbon-14 release is more or less directly related to the plant's thermal power, so the radiation dose from the OL3 and OL4 plant units will be roughly the same as the combined dose from the current plant units.

The above-mentioned 0.1 mSv limit value for environmental dose will be applied as a unit-specific release limit criterion (combined effect of all plant units) also after the introduction of the OL3 and OL4 plant units.

4.4 REPLY TO THE QUESTION POSED BY ESTONIA: 'Furthermore, Estonia states that in accident situations, STUK would inform the neighbouring countries in accordance with international conventions, but the EIA report should include a more specific description of this (e.g., which laws will be applied and how the operations will proceed).'

Responsibility for the communication to neighbouring countries, and international communication in general in emergency situations, is based on the following international general conventions:

Ratified general conventions of the IAEA:
- Convention on Early Notification of a Nuclear Accident
- Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency

European Council decision:
- Community arrangements for the early exchange of information in the event of a radiological emergency

It should be noted that the European Commission has signed on to both of the IAEA general conventions.

According to the responsibilities stated in the Notification Convention, STUK has been named the competent party in Finland. Additionally, a 24-hour contact point is required. In Finland, it is maintained by STUK.

Other agreements concerning Finland include ratified bilateral agreements with Sweden, Norway, Denmark, Russia, Germany and the Ukraine. As regards Iceland and Estonia, the procedures followed are similar to those applied with the agreement countries.

4.5 REPLY TO THE QUESTION POSED BY NORWAY: ‘Norway would like to obtain a report presenting the accident scenarios, methods and risk assessments used in establishing the maximum radioactive emissions that would drift to Norway, and the extent of radiation doses that would follow.’

The maximum radioactive doses described are not the result of a specific accident scenario; the release term, release caused by a severe accident, is defined in Finnish legislation and official regulations, and it was selected as such. A prerequisite for the new plant unit is that the probability of this kind of release clearly fall below the $5 \cdot 10^{-7}$ per year limit, given in the official regulations.

Calculation methods are presented above, in section 4.1.

The radiation doses caused correspond roughly to the size of the release. Weather conditions during an actual release situation would have a considerable impact on dispersion and doses. Weather conditions are statistically taken into account such that in 95% of the cases, actual doses remain below the result presented.

Radiation doses estimated as described above at different distances from the plant unit are presented in Table 10-1 in the OL4 EIA report. The shortest distance to the territory of Norway is approximately 500 km.

5 'A more precise assessment of the employment effects of the project, including a review of the regional and broader employment effects on the basis of experience gained from the Olkiluoto 3 project.'

5.1 General

An assessment of the impact of OL4 on the regional economy and employment was presented in the EIA report on the OL4 plant unit, in section 9.11.4. In this supplementary report, the research method and initial information, with more detailed estimates, are presented. Furthermore, the results of the research examining the effects of the construction of the OL3 plant unit on the regional economy and employment are presented.

The author of the assessment of the impacts on the regional economy and employment that is presented in the EIA report is identified in the introduction to the report.

5.2 The method used in the assessment of the employment effect presented in the OL4 EIA report

The employment effects have been calculated by using the Statistics Finland work contribution coefficient, based on input–output research carried out by Statistics Finland.

The method description for the input–output research of Statistics Finland has been used as a source as such (http://www.stat.fi/meta/til/pt.html).

5.2.1 Description of the method

Supply and use tables and the input–output tables based on them describe in detail product flows in the national economy. They are suitable for analysing production activity structures and interdependencies among industries. The tables add detail to national accounts and form a coherent framework for describing product flows in the accounts. As the tables are compiled as an integral part of national accounts, they also improve the quality of other national accounts data.

Supply and use tables describe the supply of products formed by domestic production and imports, and the use of these products as intermediate products in the production of other products and as final products for consumption, capital formation and exports.

The actual, symmetrical input–output tables provide a picture of interdependencies among industries, while analysis tables derived from them indicate the importance of the production and final outputs of different industries to production and employment in the economy as a whole.

5.2.2 Data content

The supply tables describe, by commodity group, production and imports of the goods and services that are produced by different industries and used in the national economy. The use tables describe, by commodity group again, the use of these products as intermediate products in different industries and for domestic final use and exports. The description also shows the distribution of expenditure by industry into purchasing of domestic and foreign products, and wages, operating surplus and other value-added items.

The input–output tables formed from the supply and use tables examine the use of the outputs of industries as intermediate product inputs and for final use in other industries. Thus, the input–output tables provide a picture of the structure of production activity and the interdependencies of industries. On the basis of these interdependencies, input–output models are compiled for studying structural changes in the national economy and evaluating the impact of the changes on, for example, production, imports, inflation and employment.

The concepts and definitions used in the compilation of the supply and use tables and also the input–output tables are based on the European System of Accounts (ESA 1995) and the UN's congruent System of National Accounts 1993 (Handbook of Input–Output Table Compilation and Analysis 1999).

5.2.3 Classifications used

The industrial classification used in the supply and use tables and in the input–output tables is a classification scheme based on the Standard Industrial Classification TOL 2002, used in national accounts, while the product classification used is one based on the EU's classification by activity (CPA). The published tables cover 60 industry and product groups.

5.2.4 Data collection methods and data sources

Input–output is a derived statistic for which only some data are separately collected. The most important data sources are national accounts, structural statistics on manufacturing and products, structural statistics for service industries, statistics on foreign trade, Register of Enterprises and Establishments data, corporate taxation records, source data for statistics on central and local government and agriculture and forestry and the Household Budget Survey. Various other data sources are utilised in addition to these.

5.3 Data sources and statistics used in the assessment of the impact on the regional economy and employment presented in the OL4 EIA report

5.3.1 Data provided by TVO

Project data provided by TVO were used as initial data in the assessment of the employment impacts in the OL4 EIA report. These include

- affected and observed area
- OL4 plant unit's construction cost estimate and an estimate of its breakdown between different locations
- estimate concerning the degree of domestic origin of the construction phase and operational phase
- estimate of the duration of the project
- estimate of the need for employees in the construction phase
- estimate of the availability and sufficiency of professional domestic employees
- number of employees in the operational phase of the OL1 and OL2 plant units and estimates of the number of employees in the operation phase of OL3 and OL4
- the scope of the travel-to-work area and personnel groups of TVO's current personnel
- estimate of the value of outsourced services in the operation phase
- estimates concerning annual plant outages (duration, costs, number of people involved)
- estimate of taxes and payments to general government paid by TVO

As for the range of variation in the data provided by TVO, the company's experience and expertise in the operation and construction of a nuclear power plant were utilised. In the initial information on the construction of the OL4 plant unit, the effects of different implementation methods were considered.

5.3.2 Data acquired from Statistics Finland

In addition to data provided by TVO, information was acquired from Statistics Finland (municipal facts database). These data, presented by municipality and region, include:

- demographic data

- employment data
- commuting and other such data

Labour multipliers received from the input–output research covering the entire country were utilised in the calculation of employment effects.

5.4 Utilisation of experiences gained during the construction phase of the plant unit OL3

TVO has commissioned research (‘Olkiluoto 3 ydinvoimalaitosyksikön rakentamisen taloudelliset vaikutukset’, by Ari Karppinen and Elias Oikarinen, TuKKK 3) to be published in 2008. The purpose of the research was to assess the central economic and employment effects of the OL3 project in Satakunta, and also nationwide. The research was a continuation of previously published research on the economic and employment effects of the OL3 project (J. Heinonen, A. Miettilä, E. Oikarinen and P. Sinervo’s *Ydinvoimalaitoshankkeen taloudelliset vaikutukset - aluetalouden näkökulma*, published by Turku School of Economics, Yritystoiminnan tutkimus- ja koulutuskeskus PK-instituutti, publication series B, B1/2001).

The research fills a worldwide gap in this field; regional economic effects of investments in nuclear power have not been assessed recently with a regional input–output model.

The research will complement and update information on the regional effects of the construction of the OL3 plant unit in Satakunta and provide information on total production, employment and local tax revenue effects of the OL3 project, and it will also clarify the economic and social dimensions of the project's social responsibility (cf. GRI indicators).

Research information on the construction phase of the OL3 project also is suitable for assessment of the economic and employment effects of the eventual construction of OL4 in Satakunta, with current economic structure and similar economic trends. The assessment of economic and employment effects of the OL4 project is more reliable if the project is implemented in a manner similar to that used for OL3.

5.4.1 Research method and initial information

TVO delivered information on the OL3 project for the researchers.
The regional economy of Satakunta was described mainly via Statistics Finland's statistics on regional economy (regional economic trends, structure and employment by industry), regional input–output tables and indices of regional specialisation (Herfindahl-Hirschman) as well as

previous research studying the competitiveness of Satakunta. The most recent regional input–output tables provided by Statistics Finland concerning the statistics year 2002 and published in 2006, and an input–output analysis based on the tables, were utilised in the analysis of regional production and employment effects. Accordingly, the newest (2007 and 2005) national input–output tables provided by Statistics Finland were used in analysis of national effects. Local tax revenue effects were assessed by utilising the results of a regional input–output model and with calculation methods that took into account tax revenue specifically from the OL3 region (income tax of Satakunta and Eurajoki municipality, real estate tax, corporate tax, state subsidies).

The direct and multiplier effects based on demand from foreign employees have been assessed via a regional-project-specific (Satakunta-OL3) Keynesian multiplier model.

5.4.2 Suitability of Satakunta as the location of a nuclear power plant from the regional economy standpoint

One result of the study conducted by the Turku School of Economics is that regional effects also depend on the features of the location of the major project.

According to the research, Satakunta is, from the standpoint of implementation of the OL3 project and especially because of the spreading of the effects on the regional economy, an especially suitable municipality. It is a successful exporter and, within Finland, regionally accessible and heavily industrialised (especially the wood and paper, metal and chemicals industry). Its population is centralised, but the economic structure is versatile. It can be assumed that these competitiveness features will support local income formation, improve conditions for economic growth and increase ‘feedback effects’ extending beyond the region, and all of these can be expected to have a positive effect from the standpoint of the impact of OL3. Satakunta is very ‘self-sufficient’ as regards the construction industry – of key import in the OL3 project: almost two thirds of the intermediate products for the construction are bought from Satakunta, and the end products are sold almost completely to Satakunta (96%). Furthermore, the ‘self-sufficiency degree’ of machines and equipment manufactured in Satakunta is 50%, and a high ‘sales degree’ is characteristic of its network-like operations: 42% of this industry's products are used as intermediate products in Satakunta. The high regional degree of self-sufficiency supposedly decreases ‘leaks’ from the regional economy and enhances the regional multiplicative effects of OL3.

On the basis of research data concerning the construction phase of the OL3 project, Satakunta can be considered a viable location for OL4 from the regional economy standpoint, provided that no major changes in the economic structure of Satakunta occur.

5.4.3 Regional economic development of Satakunta during the OL3 project

After the OL3 project was launched, the regional economic development of Satakunta has been, according to the most recent (2005-2007) regional and industry-specific economic statistics provided by Statistics Finland, exceptionally positive in terms of the development of turnover and wages when compared with earlier development in Satakunta and overall development in Finland in the same time frame. Especially in 2007, when the construction project expanded considerably in terms of employees, and especially in industries central to the OL3 project (i.e., construction, machine and equipment manufacture and business services – including OL3 project planning services), development in Satakunta has been exceptionally positive. In construction, the growth of turnover was a record-high 35% for the last six months of the year, compared with 17% in the country overall, and total growth in Satakunta in 2007 was 29%, whereas in other provinces it was approximately 16%. In the 2000s, before the launching of the OL3 project, the growth of turnover in the construction industry in Satakunta was only around 5.5%. Positive development in recent years probably has the most significant consequences specifically in Satakunta; already in 2005, the employment effect of refining (excavation of minerals, industry, the energy sector and construction) was by far the biggest (33%) among all Finnish provinces.

Figure 8 illustrates the development of turnover in the construction industry in Satakunta and the entire country (year 2000 = 100).

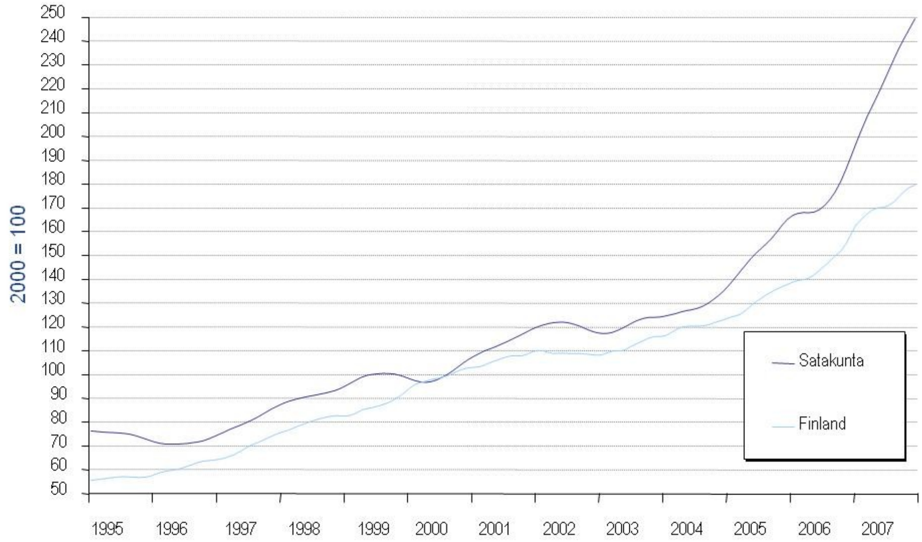

Figure 8. The development of turnover in the construction industry in Satakunta and Finland. Source: Satakunnan talous 2008.

Figure 9 illustrates the development of turnover in Satakunta and Finland (year 2000 = 100).

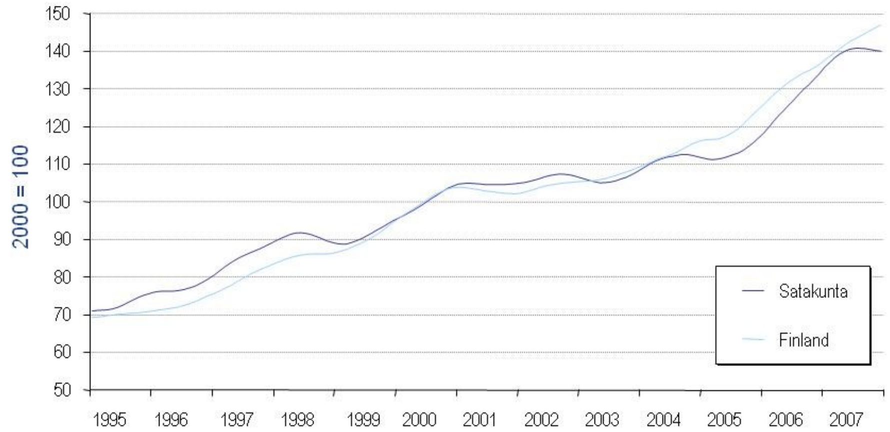

Figure 9. The development of turnover in Satakunta and the entire country. Source: Satakunnan talous 2008.

However, the regional economic significance of the OL3 project cannot be assessed solely on the basis of this simultaneous positive regional economic development. A region- and project-specific model review was carried out in order to meet the basic goals of the research. The results are presented in sections 5.4.3–5.4.6.

5.4.4 The impact of the OL3 project on total production

5.4.4.1 The impact of the OL3 project on total production in Satakunta

On the basis of the research, it can be estimated that, as a result of the OL3 project, total production in Satakunta will experience growth (incl. direct, multiplier and induced effects) of 530–840 million euros (on average, 685 million euros), which, on average, is more than 12% of the value added according to basic prices in Satakunta in 2006.

Figure 10 illustrates the estimated impact of the OL3 project on production in Satakunta.

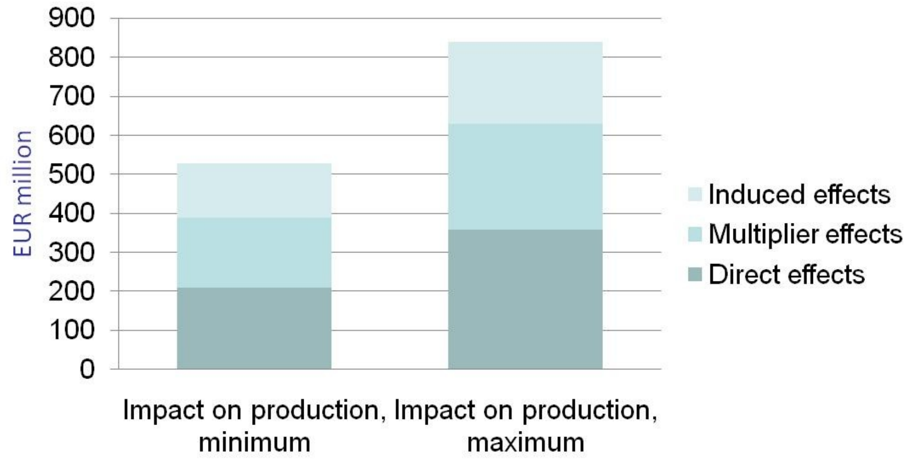

Figure 10. Estimated impact of the OL3 project on production in Satakunta.

5.4.4.2 The impact of the OL3 project on gross domestic production

On the basis of the research, it can be estimated that, as a result of the OL3 project, total production (direct, multiplier and induced effects) in Finland will grow by 1,700–3,200 million euros during the project.

Figure 11 illustrates the estimated impact of the OL3 project on production in Finland as a whole.

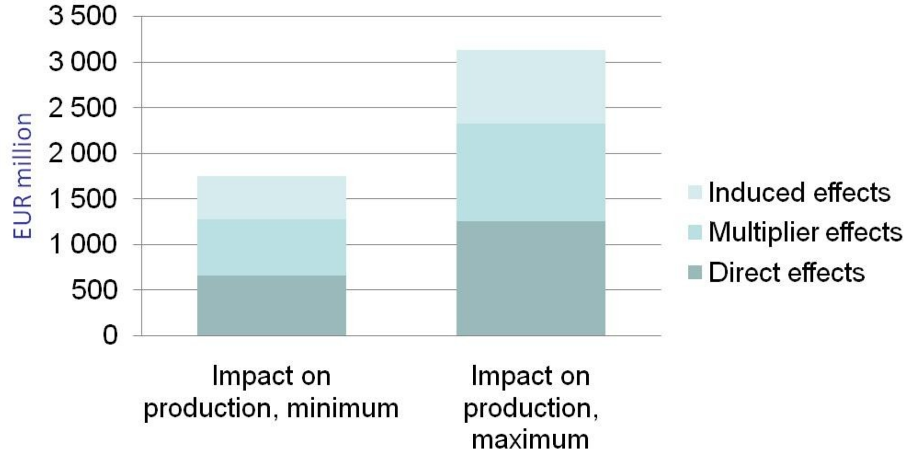

Figure 11. Estimated impact of the OL3 project on production in Finland.

5.4.5 The impact of the OL3 project on employment

5.4.5.1 Employment effect in Satakunta

As a result of the OL3 project, total employment in Satakunta will increase by 6,980–10,310 man-years (average: 8,645 man-years), the average of which corresponds to five per cent of the total work input of Satakunta in man-years. The impact of multiplier and induced effects is a mere 60% of the total production effects, and approximately 45% of total employment effects. The most significant multiplier effects occur in construction and in machine and equipment manufacture.

Figure 12 illustrates the employment effect of the OL3 project during the construction phase in Satakunta.

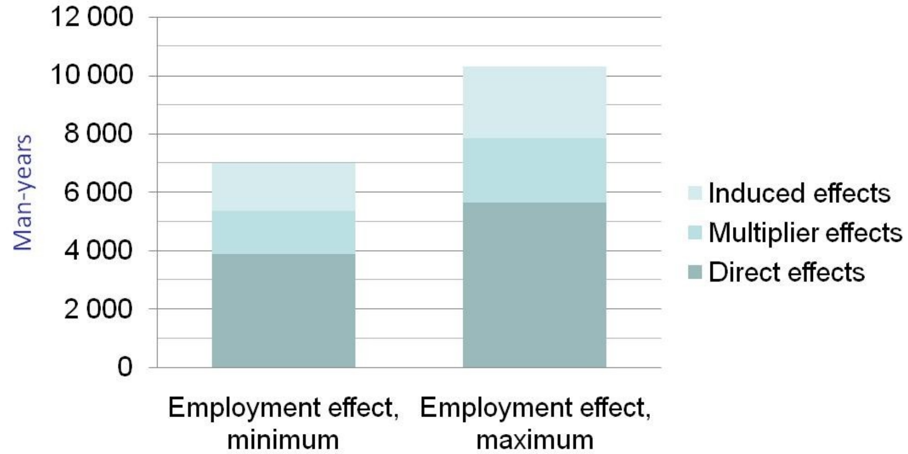

Figure 12. Estimated employment effect of the OL3 project in Satakunta.

5.4.5.2 Employment effect in Finland as a whole

As a result of the OL3 project, total employment in Finland will grow by almost 30,000 man-years (17,600–29,160 man-years) at maximum. The impact of multiplier and induced effects is approximately 60% of the employment effects (58%).

Figure 13 shows the employment effect of the OL3 project for Finland in the construction phase.

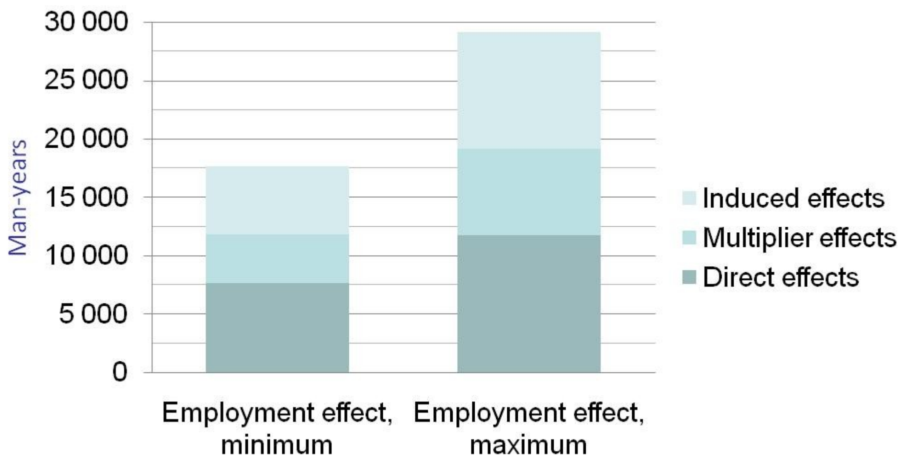

Figure 13. Estimated employment effect of the OL3 project in Finland.

5.4.6 The impact of the OL3 project on local tax revenue

In the operational phase, the permanent annual net impact of the OL3 plant unit in Eurajoki on local tax revenue is 2.8–8.9 million euros (average: 5.8 million euros) – approximately a third of the municipal tax revenue in 2006. During the construction phase, local tax revenue effects of the OL3 project in Satakunta total 25–34 million euros (average: 30 million euros) – almost six per cent of the average local tax revenue in Satakunta in 2002–2006.

Figure 14 illustrates the local tax revenue effects of the OL3 project during the construction phase in Satakunta.

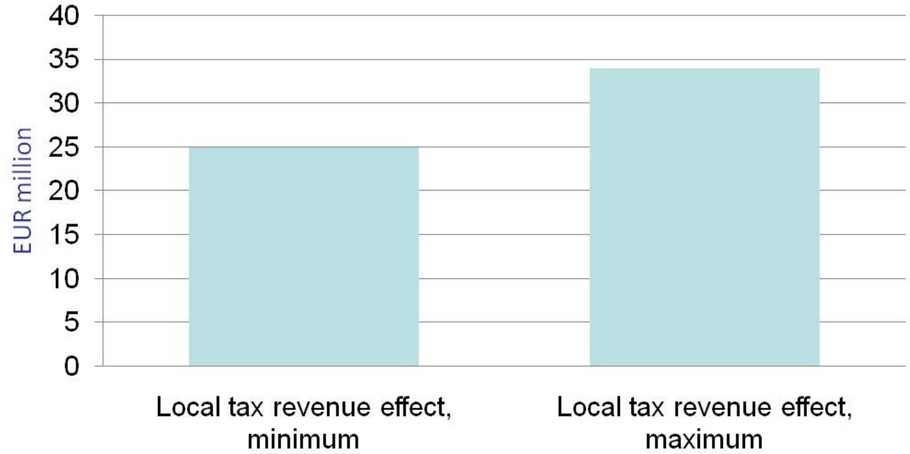

Figure 14. Estimated local tax revenue effects of the OL3 project during the construction phase in Satakunta.

5.4.7 The impact of foreign employees on total demand

The total production effects, including multiplier effects arising from the increased total demand from the OL3 project's foreign employees in 2005–2011 in Satakunta, come to approximately 160 million euros, with the maximum estimate being almost 210 million euros (110–210 million euros). The average estimate is a scant three per cent of the value added at basic prices of Satakunta in 2006.

5.5 Terms used

DIRECT EFFECTS (i.e., immediate effects) arise from earthwork and the construction of the power plant building, acquisition and installation of equipment. These effects include the hiring of project leaders.

MULTIPLIER EFFECTS refer to the need of companies (subcontractors) satisfying the original direct increase in demand (in this case, the construction of a nuclear power plant) for intermediate products (that is, products and services produced by other companies) in order to enable their own additional production. These subcontractors need to increase their production, and they also need intermediate products from other companies from the same industry or others, and so on, as the chain continues. This multiplier chain in the input–output model is typically 'only' generated by the productive sector (private companies and services provided by the public sector). The latter division is a feature dictated by the input–output model.

With INDUCED EFFECTS, as a result of the increased original direct effects, new workplaces are created and the new salary income, for its part, increases demand (to the extent that products and services produced locally are demanded). This additional demand must be satisfied, and companies must hire more employees, who further create additional income and demand. Not all additional income is spent, so the additional demand chain, created by consumption, subsides.

OTHER RECOMMENDATIONS PRESENTED IN THE STATEMENT

In its statement, the contact authority notes that TVO may, should it so wish, also address other questions brought up in the statement.

In the statements of the contact authority and other parties, attention has been paid to the impact of participation. TVO wants to deal with the issue in more detail in a supplementary report and states the following:

TVO established an auditing group comprising representatives of different interest groups. The purpose of the group was to promote the flow and exchange of information. From among the environmental authorities, representatives of the Ministry of the Environment, the Western Finland Environmental Permit Authority and the Southwest Finland Regional Environment Centre were invited to join the auditing group. The Western Finland Environmental Permit Authority and Southwest Finland Regional Environment Centre participated in the auditing group. In the auditinggroup, the representatives of environmental authorities had the opportunity to comment on issues related to their respective fields and discuss deficiencies and amendments of the EIA programme and the report, prior to the publication of the documents.

During the environmental impact assessment for the OL4 project, several presentation and discussion forums for other interest groups were organised. The three events arranged for the nearby and holiday residents of the area around Olkiluoto attracted the largest audience, approximately 100 people. One of the important discussion topics was the embankment connecting the Olkiluoto and Kuusisenmaa islands, depicted in the conceptual images in the EIA report. The participants brought up the importance of the inlet as a passage for small boats and presented a wish that an opening for passing through be left in the inlet. Although the embankment construction project is not included in the EIA procedure as such, it was important for TVO and the local residents that an opportunity was opened for discussing it at events that are not otherwise included in the licensing procedure required in the construction of the embankment. On the basis of the events, TVO decided to change the construction plans for the embankment such that passing through the inlet will be possible also in the future.

SUMMARY

In this supplementary report, TVO has presented the complement required by the contact authority in the statement concerning the OL4 EIA report.

TVO considers the supplementary report provided to cover all issues as required by the MEE and to be sufficient.