Government Decision-in-Principle of 6 May 2010 on the Application of Teollisuuden Voima Oyj Regarding Construction of a Nuclear Power Plant Unit

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Government decision-in-principle of 6 May 2010 on the application of Teollisuuden Voima Oyj regarding construction of a nuclear power plant unit and expansion or construction of nuclear facilities required on the same plant site for the operation of the unit

Application

Teollisuuden Voima Oyj has by an application dated 25.4.2008 requested the Government's decision-in-principle referred to in Section 11 of the Nuclear Energy Act (990/1987) on that the construction of the new nuclear power plant unit and the expansion or construction of nuclear facilities required on the same plant site for the operation of the unit is in line with the overall good of society.

The plant unit would incorporate a light water reactor with a thermal output of at most 4 600 Megawatts and the net electric output of the unit would be 1 000 - 1 800 Megawatts. The plant unit would be located on the Olkiluoto power plant site owned by Teollisuuden Voima Oyj and would be the fourth unit of the nuclear power plant. The planned technical service life of the new unit is sixty years.

The project referred to in the application also incorporates the expansion or construction on the same plant site of nuclear facilities related to the operation of the new nuclear power plant unit. These facilities are required for the storage of fresh nuclear fuel, interim storage of spent nuclear fuel and handling, storage and final disposal of low and intermediate level operating waste. According to the application, the final disposal of spent fuel is to be implemented in the final disposal repository planned by Posiva Oy.

The applicant company has presented the following justification for the construction of the power plant unit:

- *According to the applicant, the need for new electricity production capacity is estimated to be ca. 5 500 MW in 2020, based on an annual growth rate of 1.2%. New production capacity is used to cover the deficit caused by the increasing demand for electricity, the decommissioning of old power plants as well as import.*
- *The proportion of fuel costs, and particularly raw uranium, is low in the price of electricity produced by nuclear power, which for its part ensures the stability of the price of nuclear electricity and a higher domestic content of the electricity than for electricity produced with fossil fuels. Stable electricity price enable long-term investment decisions in Finland.*
- *The reports prepared show that the planned nuclear power plant unit is the most economical alternative for the production of base-load power.*
- *The utilisation of the infrastructure available on the Olkiluoto nuclear power plant site for the existing plant units significantly improves the economical viability of the project.*

- *The preliminary cost estimate for the power plant unit amounts to EUR 3 - 4 billion depending on e.g. the size of the plant unit. The share of Finnish work, materials and equipment is estimated to account for about 35 - 45 per cent of all investment costs.*
- *The Olkiluoto nuclear power plant site is suited as the site for the new plant unit. The fuel and nuclear waste management of the new unit can be organised on the basis of the arrangements in place for the existing units.*
- *According to calculations, the project is economically viable. Teollisuuden Voima Oyj's financial key figures and ability to meet interest payments and repayments of loans will remain at a level satisfactory to financiers throughout the construction period. According to analyses, financing can be arranged for the project.*
- The applicant company also concludes the following in the application:
- *Fuel management of the new nuclear power plant unit can be implemented reliably in a diversified manner from several sources using similar arrangements as for the existing power plant units.*
- *The intention is to use the same plans, methods and waste management facilities that are used for the existing power plant units. There are final disposal facilities for low and intermediate level operating waste on the plant site, and these can be expanded to accommodate the needs of the new unit as well.*
- *Spent nuclear fuel is to be disposed of in the final disposal facility in Olkiluoto, currently under planning by Posiva Oy, which is a company jointly owned by Teollisuuden Voima Oyj and Fortum Power and Heat Oy. The spent fuel from the new nuclear power plant unit referred to in this application has been taken into account in Posiva's plans regarding the final disposal facility. Posiva Oy has submitted a separate application for the Government's decision-in-principle concerning the construction of the final disposal facility for spent fuel expanded so that spent fuel from Olkiluoto 4 can be disposed of in the facility. The total capacity of the final disposal facility to be constructed would then be 9 000 tons of uranium.*
- *Construction work for the power plant unit could be started in about 2012 after the competitive tendering and construction licence processes following the decision-in-principle have been carried out. The construction period for the plant unit is about 6 - 8 years. This means that the unit's production could be started at the end of the decade. The scheduling of the final investment decision will take into account the outlook for the shareholders' electricity demand and the development of the electricity market.*
- *Studies conducted by Teollisuuden Voima Oyj show that there are several nuclear power plant alternatives available on the market that are feasible, with no modifications or with modifications that can be implemented, to be built in Finland. The new unit could be either a boiling water reactor or pressurised water reactor in type.*
- *In accordance with the Nuclear Energy Act, the starting point for the design, construction and operation of a nuclear power plant is to obtain a nuclear power plant unit of high standards which is safe and does not cause injury to people, or damage to the environment or property. The new nuclear power plant unit is designed to meet the internationally advanced safety requirements valid in Finland. Finnish nuclear power plants have had only a small number of incidents that have had safety implications or disturbed the operation of the plants. None of these incidents have caused the allowed radiation doses for employees to be exceeded or any radiation hazard to the environment.*

- *The direct and indirect impact of the planned nuclear power plant unit on people, nature and the built environment has been assessed in accordance with the Act on Environmental Impact Assessment Procedure. The Environmental Impact Assessment Report was submitted to the contact authority in February 2008. Appropriate attention will be paid to the aspects presented in the statements issued on the assessment report when developing the project further.*

The application has been supplemented with the following documents required by Section 24 of the Nuclear Energy Decree:

1) an extract from the trade register
2) a copy of Articles of Association, partnership agreement and shareholders' register
3) a description of the expertise available to the applicant
4) a description of the general significance of the nuclear facility project and its necessity, particularly as concerns Finland's energy supply, and of its significance from the standpoint of e.g. nuclear waste management
5) a description of the applicant's financial resources and the economic viability of the nuclear facility project
6) an overall financing plan for the nuclear facility project and a) an outline of the technical principles of the planned nuclear facility, b) a description of the safety principles that will be observed, c) an outline of the ownership and occupation of the site planned for the nuclear facility, d) a description of settlement and other activities and town planning arrangements at the planned nuclear facility site and in its immediate vicinity, e) a description of the suitability of the planned location for its purpose, taking account of the impact of local conditions on safety, security and emergency response arrangements, and the impacts of the nuclear facility on its immediate surroundings, f) an assessment report drawn up according to the Act on the environmental impact assessment procedure (468/94) as well as a description on the design criteria that will be observed by the applicant to avoid environmental damage and to restrict the burden on the environment, g) an outline plan on nuclear fuel management, h) an outline of the applicant's plans and the available methods for nuclear waste management.

Processing of the application and actions preceding decision-making

Hearing

Public hearing referred to in Section 13 of the Nuclear Energy Act

The applicant has distributed the overall description of the nuclear power plant venture, reviewed by the Ministry of Employment and the Economy, to every household in the municipality of Eurajoki and in the neighbouring municipalities. The overall description has been available to the public in locations indicated in the public announcements of the Ministry of Employment and the Economy regarding the venture.

The Ministry of Employment and the Economy has on 12 September 2008 given public notice of the pendency of the project on the notice boards of the municipalities of Eurajoki, Eura, Kiukainen and Lappi and the town of Rauma. The Ministry has also announced the pendency of the project in the following newspapers: Helsingin Sanomat, Hufvudstadsbladet, Turun Sanomat, Länsi-Suomi, Satakunnan Kansa and Uusi-Rauma.

A summary of the written opinions sent to the Ministry is included as an Appendix to this decision. Summaries of the statements and opinions presented in connection with the environmental impact assessment procedure have been annexed to the statement issued by the Ministry of Employment and the Economy as the contact authority on the environmental impact assessment report.

The public hearing required by the Nuclear Energy Act was arranged in Eurajoki on 13 October 2008. Summaries of the opinions presented on this occasion are included as an Appendix to this decision.

Statements requested on decision-in-principle

The Ministry of Employment and the Economy has, pursuant to Section 12 of the Nuclear Energy Act, obtained statements on the original application from the Ministry of the Environment, the Municipal Council of Eurajoki and the neighbouring municipalities of Eurajoki. Pursuant to Section 25 of the Nuclear Energy Decree, the Ministry has requested a statement on the application from the following bodies: Ministry of the Interior, Ministry of Defence, Western Finland Provincial Government, Regional Council of Satakunta, Satakunta Employment and Economic Development Centre, South-West Finland Employment and Economic Development Centre and South-West Finland Environment Centre.

The Ministry of Employment and the Economy has further requested a statement from the following organisations: Ministry of Social Affairs and Health, Ministry of Finance, Ministry of Transport and Communications, Finnish Environment Institute, Safety Technology Authority, OSH District of Turku and Pori, Satakunta Rescue Service, Finnish Energy Industries ET, Fingrid Oyj, WWF Finland, Greenpeace Finland, Finnish Association for Nature Conservation FANC, Western Finland Environmental Permit Office, Confederation of Finnish Industries EK, Federation of Finnish Enterprises, Central Union of Agricultural Producers and Forest Owners MTK, Central Organisation of Finnish Trade Unions SAK, Confederation of Unions for Professional and Managerial Staff in Finland AKAVA, Finnish Confederation of Professionals STTK, Svenska Lantsbruksproducenternas Centralförbund, Natur och Miljö, Government of Åland, National Emergency Supply Agency, Fortum Power and Heat Oy, Fennovoima Oy and Posiva Oy.

Summaries have been prepared of all the received statements. The summaries are included as an Appendix to this decision.

Notice to Swedish authorities

Pursuant to the Guidelines for Communication Between Finland, Norway, Sweden and Denmark on Security Issues Related To the Nuclear Installations Constructed Near the Border (SopS 19/1977), the Swedish authorities have been informed about

the project. The statement was submitted, on behalf of the Swedish authorities, by the Swedish Radiation Safety Authority (Strålsäkerhetsmyndigheten SSM). The statement of SSM has been described in the summary of statements provided as an Appendix to this decision.

Preliminary safety assessment

The Ministry of Employment and the Economy has, pursuant to Section 12 of the Nuclear Energy Act, requested the Radiation and Nuclear Safety Authority to prepare for the project the preliminary safety assessment referred to in Subsection 2 of Section 25 of the Nuclear Energy Decree. The Radiation and Nuclear Safety Authority has enclosed to its safety assessment the statement of the advisory committee (Advisory Committee on Nuclear Safety) referred to in Subsection 2 of Section 56 of the Nuclear Energy Act. The preliminary safety assessment is presented as an Appendix to this decision.

The Radiation and Nuclear Safety Authority has also issued a statement on the project. A summary of this statement as well as a summary of the statement of the Advisory Committee on Nuclear Safety are presented in the summary of statements provided as an Appendix to this decision.

Other clarifications

Teollisuuden Voima Oyj has as an Appendix to the application for the decision-in-principle submitted to the Ministry of Employment and the Economy the environmental impact assessment report prepared in compliance with the Act on the environmental impact assessment procedure (468/1994) for the site of the unit to which the project pertains. Pöyry Energy Oyj has acted as the main consultant for Teollisuuden Voima Oyj in the assessment of the environmental impact of the expansion of the Olkiluoto nuclear power plant.

As the contact authority referred to in the Act the Ministry of Employment and the Economy has issued a statement of the report and its adequacy and annexed it to the documentation used in the preparation of the decision-in-principle. The statement of the Ministry of Employment and the Economy concludes that the environmental impact assessment report prepared for the project is adequately wide in scope and detailed, taking into account the current phase of the project, and meets the requirements laid down in the Act and the Decree on the environmental impact assessment procedure as well as the targets specified in the environmental impact assessment programme prepared for the project. The Ministry further concluded that some of the subject matters addressed in the environmental impact assessment procedure require further clarifications. Teollisuuden Voima Oyj submitted the required clarifications to the Ministry of Employment and the Economy.

Pursuant to Section 34 of the Administrative Procedure Act, the Ministry of Employment and the Economy has requested the applicant company to submit a reply to the statements and opinions issued and to the preliminary safety assessment. A summary of this reply is presented in the summary of statements provided as an Appendix to this decision.

The Ministry of Employment and the Economy has prepared for the resolving of the decision-in-principle to the Government the review of nuclear waste management

referred to in Subsection 1 of Section 26 of the Nuclear Energy Decree and the review of the importance of the nuclear facility for Finland's energy supply referred to in Subsection 2 of Section 26 of the Nuclear Energy Decree. The reviews are presented as Appendices to this decision.

Regulatory provisions applicable to decision-making

Pursuant to Subsection 1 of Section 14 of the Nuclear Energy Act (990/1987), the Government shall before making the decision-in-principle referred to in section 11 of the Act ascertain that

- the municipality where the nuclear facility is planned to be located in its statement referred to in section 12, is in favour of the facility and that
- no facts indicating a lack of sufficient prerequisites for constructing a nuclear facility, as required in section 6, have arisen.
- Pursuant to Section 6 of the Nuclear Energy Act, the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property.
- Pursuant to Subsection 2 of Section 14 of the Nuclear Energy Act, should the Government find that the prerequisites laid down in subsection 1 have been met, it shall, in reaching its decision-in-principle, consider the issue from the perspective of the overall good of society, and take into account the benefits and drawbacks arising from the nuclear facility, paying particular attention to:
  1) the need for the nuclear facility project with respect to the country's energy supply;
  2) the suitability of the intended site of the nuclear facility and its effects on the environment; and
  3) arrangements for the nuclear fuel and waste management.

Fulfilment of preconditions for decision-in-principle

Statement from the Municipality of Eurajoki

The Municipal Council of Eurajoki has on 15 December 2008 issued a statement on the project, expressing a favourable opinion on the construction of the nuclear power plant unit referred to in the Application. No appeals were made against the decision of the Municipal Council and the decision is legally valid.

Fulfilment of requirements of Section 6 of Nuclear Energy Act

The preliminary safety assessment prepared by the Radiation and Nuclear Safety Authority has not revealed any factors suggesting that adequate prerequisites do not exist for ensuring that the plant alternatives presented in the application for the decision-in-principle are consistent with Finnish safety requirements. However, none of the plant alternatives presented in the application meet all the safety requirements as such. The nature and extent of the required modifications vary considerably between the plant alternatives. Some plant alternatives would only require only fairly minor modifications related to system technology; some would require more extensive structural modifications.

According to the environmental impact assessment report, the environmental impact of the nuclear power plant unit is minor and the plant would cause no adverse effects to human health.

The Government concludes, based on the preliminary safety assessment of the Radiation and Nuclear Safety Authority, the statements issued, the environmental impact assessment and the clarifications enclosed to the application by the applicant as required by Section 24 of the Nuclear Energy Act, that no factors have been revealed which would suggest a lack of adequate prerequisites for the construction of the new nuclear power plant unit or for the expansion or construction of nuclear facilities required on the same plant site for the operation of the unit in compliance with the requirements set forth in Section 6 of the Nuclear Energy Act.

Deliberation of decision-in-principle

The Government has concluded that the Municipality of Eurajoki, which is indicated in the application as the locality for the project, has expressed a favourable opinion on the implementation of the project in the area of the Municipality and that no factors have been revealed which would suggest that the project could not be implemented in compliance with the requirements set forth in Section 6 of the Nuclear Energy Act. Pursuant to Section 14 of the Nuclear Energy Act, the Government has deliberated the decision-in-principle in terms of the overall interest of the society and has taken into consideration the benefits and drawbacks of the nuclear facility.

According to the presentation of the application, the spent fuel generated at the new nuclear power plant unit is to be placed in the final disposal repository under planning by Posiva Oy for final disposal. A separate decision will be issued on Posiva Oy's application for the decision-in-principle regarding this matter.

Decision-in-principle

The construction of the new nuclear power plant unit Olkiluoto 4 and the construction or expansion of nuclear facilities required on the Olkiluoto power plant site for the operation of the unit, as presented in the description provided in the application of the key operating principles of the plant and solutions related to securing safety, is in line with the overall good of society.

The nuclear facilities covered by the decision, which are required on the same plant site for the operation of the new nuclear power plant unit, are used for the storage of fresh nuclear fuel, interim storage of spent nuclear fuel as well as handling, storage and final disposal of low and intermediate level operating waste.

Validity of decision-in-principle

This decision-in-principle will be revoked if the licence referred to in Section 18 of the Nuclear Energy Act, which is required to start the construction of the new nuclear

power plant unit, has not been applied for within five years after the Parliament has decided on the ratification of the decision-in-principle.

Justification for decision-in-principle

Effect of project on energy supply

The goals defined in Finland for the performance of the open electricity market include securing the electricity supply, maintaining electricity prices at reasonable levels, securing adequate self-sufficiency in electricity production and keeping the environmental impacts of electricity production at an acceptable level. These goals are based on the Government's long-term climate and energy strategy set forth in November 2008, on the updating of the demand and supply estimates included in the climate and energy strategy in 2009 as well as on studies that have been conducted and statements and opinions presented on the application.

Due to structural and cyclical changes in the Finnish forest industry, in particular, the consumption of electricity decreased in 2009 to ca. 81 Terawatt-hours. However, the demand for electricity is estimated to increase during 2010s and 2020s. According to the most recent updated estimates, the consumption of electricity is estimated to increase so as to allow the supply capacity of electricity to be dimensioned to 98 TWh by the year 2020. For Finland to be self-sufficient in electricity supply, new electricity production would be needed in 2020 in an extent corresponding to at most two large nuclear power plant units, in addition to wind power, bio-based electricity supply and combined heat and power production, which have been defined as promotion targets in the climate and energy policy.

The construction of at most two large nuclear power plant units in Finland increases the supply reliability of electricity over the long term, as domestic production capacity can reduce dependence on the import of electricity. The construction of additional nuclear power would for its part help maintaining the price of electricity at a reasonable level.

The connection of more than one new nuclear power plant unit to the grid results in considerable extra investment needs in the national grid and foreign connections in comparison with the current investment plans regarding the national grid. The construction of more than one new nuclear power plant unit makes it necessary to reinforce the national grid between Northern Finland and Southern Finland to ensure that the performance of the electricity market is not impaired in comparison with the present situation. Congested foreign transmission connections will in the alternative of two new units call for an increase in the transmission connection capacity from Southern Finland to Sweden.

Apart from the border connections included in the current plans, Baltic and Scandinavian transmission grids do not make allowance for any significant new transmission connections between Finland and the grids of the neighbouring countries. Additional investments will increase the costs of national grid transmission for all electricity consumers. An alternative for grid investment would be an essential impairment of the performance of the electricity market. Foreign connections would become congested and there would probably be a shortage of regulating capacity.

Congestion in the national grid would result in the risk of Finland being divided into separate price regions.

The Government concludes that the construction of at most two new nuclear power plant units would contribute favourably to the reduction of greenhouse gas emissions and promote the performance of the electricity market.

Suitability of plant site and environmental impact of project

The suitability of the Island of Olkiluoto in the Municipality of Eurajoki as the site of nuclear power plants was assessed and approved already in connection with the decision made on the construction of the existing two plant units and again when the decision on the construction of the third unit was made. The suitability of the site for the construction of the new nuclear power plant unit has been assessed in the environmental impact assessment procedure. The construction of the new nuclear power plant unit has been taken into account in the municipal land use planning.

According to the Radiation and Nuclear Safety Authority, the clarifications regarding settlement, land use, planning and conditions on the planned site of the new plant unit in Olkiluoto and in the environment of the plant as well as the effects of these on the safety of the planned plant unit and on the implementation of physical protection and emergency response arrangements are adequate for the review of the application for a decision-in-principle.

In the opinion of the Radiation and Nuclear Safety Authority, the conditions on the site do not display any unfavourable features that would constitute an obstacle to the new plant unit or the other nuclear facilities referred to in the application and related to the operation of the new unit being constructed in conformity with safety requirements or to the implementation of physical protection and emergency response arrangements.

It has been concluded in the environmental impact assessment procedure that the local environmental impact caused by the project will be minor. The most visible impact of the project would be the changes resulting from the increased temperature of the sea area of the plant site.

The Ministry of Employment and the Economy concluded in the statement it issued on the environmental impact assessment report in its capacity as the contact authority that the environmental impact assessment report for the Olkiluoto 4 nuclear power plant unit meets the requirements laid down for the content of the report in the Act and the Decree on the environmental impact assessment procedure and the report has been reviewed in the manner stipulated by law. The Ministry concluded in the statement, however, that although the report is adequate in main parts, certain subject areas require additional studies. Teollisuuden Voima Oyj submitted the required clarifications to the Ministry of Employment and the Economy on 20 August 2008. The Ministry of Employment and the Economy concludes that the studies that have been conducted are adequate.

One of the most important additional studies that were required was to conduct the Natura assessment referred to in Section 65 of the Nature Conservation Act (1096/1996) on Natura 2000 network area FI0200073 in the archipelago of Rauma. The Natura assessment that has been conducted concludes that the operation of the

new unit together with the existing units of the power plant will probably not cause any significant changes in the Natura area located near the power plant site as far as the natural values on the basis of which the area has been included in the Natura network are concerned. The statements of the Southwest Finland Centre for Economic Development, Transport and the Environment (formerly Southwest Finland Environment Centre) and Metsähallitus (Forest Administration) confirmed this assessment.

The Government concludes on the basis of what is presented above that the proposed Olkiluoto plant site is suitable for the implementation of the project.

The Government also concludes that an advantage offered by the planned plant site to the implementation of the project is the existing nuclear plants' infrastructure in place on the plant site, which supports the construction and operation as well as the physical protection arrangements of the new plant. The emergency response arrangements required by the new plant unit can also be implemented by supplementing and expanding the existing arrangements.

Organising nuclear fuel and nuclear waste management

The Government finds that the procurement of nuclear fuel can be realised with good reliability using the decentralised system based on several suppliers presented in the application. Nuclear fuel management and the associated nuclear proliferation safeguards can be organised in compliance with the Nuclear Energy Act and the obligations Finland is committed to pursuant to international treaties.

The licence referred to in the Nuclear Energy Act is required for the use of nuclear energy and, pursuant to the Act, the licensee is responsible for the safety of the use of nuclear energy. The licensee is also responsible for all the activities associated with the nuclear waste management of nuclear waste generated as a result of the use of nuclear energy, and for appropriate preparations of these activities and for the costs of the activities.

The Government made in 2000 a decision-in-principle on the final disposal of spent nuclear fuel project. According to the decision-in-principle, the spent nuclear fuel generated in the operation of the Olkiluoto 1, Olkiluoto 2, Loviisa 1 and Loviisa 2 plant units could be treated and placed in the facility for final disposal. The Government made in 2002 a decision-in-principle on the construction of an expanded final disposal facility for spent nuclear fuel so as to allow also spent nuclear fuel from Teollisuuden Voima Oyj's third power plant unit (Olkiluoto 3 unit currently under construction) to be treated and placed in the facility for final disposal.

According to the Radiation and Nuclear Safety Authority, no obstacles have been found on the plant site to the safe processing of low and intermediate level operating waste and spent nuclear fuel to be generated at the new nuclear power plant unit. The same applies to the processing of spent nuclear fuel from the new nuclear power plant following the same procedure as with the existing plant. The new plant unit can also to a great extent rely on the infrastructure already in place on the plant site.

The new nuclear power plant unit will increase the amount of nuclear waste accumulating in Finland. The Government finds, however, that nuclear waste can be safely treated, stored and emplaced for final disposal using the methods already in use.

A separate decision will be issued on Posiva Oy's application for the decision-in-principle regarding the final disposal of spent nuclear fuel.

Other effects of the project on society

The Government concludes that the construction of the new nuclear power plant unit does not have any direct effects on the national economy, since no government funding or subsidies are required for the implementation of the project.

The construction of a nuclear power plant unit is an extensive project in terms of requirements, scope and duration. At the construction stage, the employment effects of the project amount to tens of thousands of person-years, which is significant to the regional economy of Satakunta, in particular. The financial and employment effects of the project during the unit's operating stage are also significant to the site locality and the surrounding regions.

Nuclear proliferation safeguards and expertise

The construction of the new nuclear power plant unit requires an increase in the resources of the control authorities, in particular the Radiation and Nuclear Safety Authority, and the strengthening of research activities that support the operation of the unit. The costs of regulatory control will be borne by the party responsible for the project. The Government finds that the current status of legislation and safety requirements as well as the adequacy of expertise make Finland prepared for increasing the use of nuclear energy and ensuring efficient control of the use.

Applicant's ability to implement the project

The Radiation and Nuclear Safety Authority concludes in its statement that the construction of the new nuclear power plant unit is an extremely demanding project and requires long-term and extensive preparations. Teollisuuden Voima Oyj has successfully implemented the operation, modernisation and power increases of the first two Olkiluoto units. The construction project of the third Olkiluoto units has for its part also increased this experience. The Company focuses efforts determinedly on maintaining and developing the competence of the personnel.

The Radiation and Nuclear Safety Authority has analysed critically the expertise available to the applicant and the applicant's ability to manage the construction stage of the Olkiluoto 4 unit. The extent and the level of expertise required of the applicant's own organisation depends greatly on the delivery method selected for the new plant.

The Government finds that Teollisuuden Voima Oyj has gained through the construction, development, operation and already implemented modernisation projects of the existing Olkiluoto power plant units extensive expertise in the nuclear industry and this expertise is available also in the new power plant project.

According to the Articles of Association of Teollisuuden Voima Oyj, the shareholders are responsible for the fixed annual costs of the company in proportion to the number of shares they own. The shareholders are further responsible for the variable annual costs of the Company in proportion to the amount of the produced electricity they use. Taking into consideration the ownership structure of the Company, the Government finds that the financing of the nuclear power plant unit can be arranged as presented

by Teollisuuden Voima Oyj with the Company maintaining a satisfactory gearing ratio and creditworthiness.

The Government finds on the basis of the statements obtained, analyses conducted and the Government's own assessment that Teollisuuden Voima Oyj has the prerequisites for the construction of the nuclear power plant unit referred to in the application.

Overall good of society

The Government concludes that the operation of the applicant's existing nuclear power plant has been safe and the units have operated reliably and that the application has the prerequisites for the construction of the nuclear power plant unit referred to in the application.

On the basis of the following facts:
- no factors have been found which would show that the new nuclear power plant unit referred to in the application of Teollisuuden Voima Oyj could not be implemented safely;
- no factors have been found which would show that the site of the new nuclear power plant unit is unsuitable for the implementation of the project or that environmental impact on the plant site could not be limited to a reasonable level;
- the construction of the new nuclear power plant unit would help achieve the objectives defined in the climate and energy strategy; to ensure electricity supply, to keep the price of electricity reasonable, to secure adequate self-sufficiency in electricity supply and to keep the environmental impact of electricity production reasonable;
- Teollisuuden Voima Oyj produces electricity at cost-price for e.g. the needs of Finnish industries;
- the nuclear waste generated by the new nuclear power plant unit can be safely treated, processed and placed for final disposal utilizing methods that are already in place or under planning;
- the adverse environmental impact resulting from the normal operation of the new nuclear power plant unit are acceptable in comparison with the benefits to be gained and low in comparison with the impact caused by alternative production methods,

the Government finds that it is in line with the overall good of society to construct on the Olkiluoto power plant site the new nuclear power plant unit referred to in the application of Teollisuuden Voima Oyj for the decision-in-principle and to construct or expand the nuclear facilities required on the same site for the operation of the unit.

Justification for validity period

The Nuclear Energy Act stipulates no provisions regarding the validity period of the decision-in-principle. However, the Government finds that the existence of a decision-in-principle has a significant effect on the electricity market. This makes it expedient to limit the validity period of the decision. On the other hand, the validity period should not be so short that it would unreasonably restrict the applicant's possibilities to schedule the decisions related to the construction of the plant, the actual construction and the commissioning of the plant to the economically most favourable point in time in terms of the production capacity.

Fee

A fee of EUR 84 100 has been charged for this decision pursuant to the Decree on Fees Charged for Government. Decisions Regarding Supervision of Nuclear Energy Use (1474/2001).

Parliamentary deliberation

This decision is pursuant to Section 15 of the Nuclear Energy Act forwarded to the Parliament for perusal.

In Helsinki on 6 May 2010

Minister of the Economy Mauri Pekkarinen

Senior Engineer Jorma Aurela

APPENDICES

1 Summary of statements and opinions
2 Review of nuclear waste management
3 Analysis of additional nuclear power in terms of energy economy
4 Preliminary safety assessment of the Radiation and Nuclear Safety Authority

APPENDIX 1

Compilation of statements on the application for decision-in-principle regarding the Olkiluoto 4 nuclear power plant unit

Content

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1 Consultation, communication and public hearing regarding the application for decision-in-principle

The Ministry of Employment and the Economy has pursuant to Section 12 of the Nuclear Energy Act invited statements on the application for the decision-in-principle from the Ministry of the Environment, the Municipality of Eurajoki and the neighbouring municipalities of Eurajoki (municipalities of Eura, Kiukainen, Lappi, Luvia and Nakkila and the Town of Rauma). The Municipality of Kiukainen did not submit a statement.

The Ministry of Employment and the Economy has pursuant to Section 12 of the Nuclear Energy Act invited a preliminary safety assessment on the project from the Radiation and Nuclear Safety Authority. The Radiation and Nuclear Safety Authority has submitted the invited safety assessment and a statement and, as an enclosure to the statement, the statement of the Advisory Committee on Nuclear Safety which is referred to in Section 25 of the Nuclear Energy Decree.

Pursuant to Section 25 of the Nuclear Energy Decree, the Ministry has also invited statements on the application from the following bodies: Ministry of the Interior, Ministry of Defence, Western Finland Provincial Government, Regional Council of Satakunta, Satakunta Employment and Economic Development Centre, South-West Finland Employment and Economic Development Centre and South-West Finland Environment Centre.

The Ministry of Employment and the Economy has further invited a statement from the following organisations: Ministry of Social Affairs and Health, Ministry of Finance, Ministry of Transport and Communications, Ministry of Agriculture and Forestry, Ministry of Foreign Affairs, Western Finland Environmental Permit Office, Finnish Environment Institute, Safety Technology Authority, OSH District of Turku and Pori, Satakunta Rescue Service, Confederation of Unions for Professional and Managerial Staff in Finland AKAVA, Confederation of Finnish Industries EK, Finnish Energy Industries ET, Greenpeace, Central Union of Agricultural Producers and Forest Owners MTK, Central Organisation of Finnish Trade Unions SAK, Finnish Association for Nature Conservation FANC, Federation of Finnish Enterprises, Finnish Confederation of Professionals STTK, Svenska Lantsbruksproducenternas Centralförbund, Natur och Miljö rf, WWF, Fingrid Oyj, Fortum Power and Heat Oy, Fennovoima Oy and Posiva Oy. After the Åland Government made questions regarding the project, a statement was separately invited from them by the Ministry. Further, a statement was invited from the National Emergency Supply Agency in the spring of 2009. The content of the statements is presented in a summarised form in Section 3.

The following organisations did not submit a statement: Finnish Environment Institute, Western Finland Environmental Permit Office, Fortum Power and Heat Oy, Finnish Confederation of Professionals STTK ry and Natur och Miljö rf.

The notice of the application for the decision-in-principle was published on 12 September 2008 in the following newspapers: Helsingin Sanomat, Hufvudstadsbladet,

Turun Sanomat, Satakunnan Kansa as well as Uusi Rauma and Länsi-Suomi. The notice and the application for the decision-in-principle are posted on the web site of the Ministry of Employment and the Economy at www.tem.fi.

The notice of the application for the decision-in-principle was posted for public display in the Council Offices of Eurajoki, Eura, Kiukainen, Lappi, Luvia and Nakkila as well as in the Environmental Office of Rauma on 12 September – 12 November 2008.

The applicant has distributed the overall description of the nuclear power plant project, reviewed by the Ministry of Employment and the Economy, to every household in the municipality of Eurajoki and in the neighbouring municipalities. The overall description has been available to the public in locations indicated in the public announcements of the Ministry of Employment and the Economy regarding the project.

The Ministry conducted a public hearing in Eurajoki on 13 October 2008. The four statements presented on this occasion are presented in Section 5.

An assessment procedure between nations was also applied to the project in connection with the environmental impact assessment procedure. In this procedure the other countries included in the scope of the so-called Espoo Convention (67/1997) are given an opportunity to participate in the environmental impact assessment procedure. After the completion of the EIA procedure stage, the Federal Ministry of Agriculture, Forestry, Environment and Water Management (Austria) also entered the procedure and on Austria's request the consultation referred to in Section 15 of the Espoo Convention was organised later. Austria announced in this context its intention to also participate in the licensing of the project and submitted a statement to the deliberation process of the application for the decision-in-principle.

The Ministry further sent a letter to the Swedish Radiation Safety Authority SSM (Strålsäkerhetsmyndigheten) announcing, pursuant to the so-called border reactor guidelines, the five decision-in-principle processes pending in Finland. These projects include the power plant projects of Fennovoima Oy, Teollisuuden Voima Oyj (TVO) and Fortum and the two projects of Posiva for the expansion of the final disposal of spent fuel.

In October 2009, TVO submitted to the Ministry of Employment and the Economy for information the Natura assessment of the Natura area in the archipelago of Rauma. The assessment assessed the impact that the operation of the OL1-OL4 power plant units may have on the Natura area in the archipelago of Rauma due to the increase in the temperature of the seawater caused by the units. The assessment primarily focused on the impact on underwater Natura nature types as well as on the Natura nature types in the shore zones of islands and islets.

The conclusion presented in the Natura assessment was that the thermal load migrating to the sea area in the condensate water of the OL1-OL4 plant units does not endanger the level of favourable protection of the protected nature types or species in the Natura area in the archipelago of Rauma. Thus, the project together with the existing units in the area does not endanger the consistency of the Natura 2000 network on the coast of the Bothnian Sea, either.

Pursuant to Section 65 of the Act on Nature Conservation, on 15 December 2009 the Ministry invited statements on the assessment conducted from the Southwest Finland Environment Centre (at present part of the Southwest Finland Centre for Economic Development, Transport and the Environment), Metsähallitus (Forest Administration) and two private landowners in the nature conservation area. The Southwest Finland Centre for Economic Development, Transport and the Environment submitted a statement in March 2010 stating that the cooling waters from the OL1-OL4 power plant units will probably not significantly impair the natural values for which the area has been included in the Natura 2000 network and the project is not considered to affect the consistency of the Natura 2000 network.

2 Regulatory statements

According to the Radiation and Nuclear Safety Authority (STUK), the plant alternatives presented in the application for the decision-in-principle are not as such consistent with Finnish safety requirements. However, the Radiation and Nuclear Safety Authority estimates that the plant alternatives can through design modifications be made consistent with Finnish safety requirements. The nature and extent of the required modifications vary between the plant alternatives. Some plant alternatives would only require fairly minor modifications while some would require more extensive structural modifications. For some plant alternatives the technical solutions are still open.

TVO has the required pre-conditions to create a management system for the management of safety and quality and establishment of good safety culture for the construction and operating stages of the Olkiluoto 4 plant unit. TVO has also presented that an adequate number of competent personnel will be recruited for the different stages of the Olkiluoto 4 project.

The Radiation and Nuclear Safety Authority has assessed the suitability of the planned site for the Olkiluoto 4 nuclear power plant unit as well as the fulfilment of pre-conditions for the implementation of physical protection and emergency preparedness arrangements, nuclear waste management and nuclear proliferation safeguards. No factors have been found in the assessment of the plant site which would constitute an obstacle to the construction of the new nuclear power plant unit or the other nuclear facilities related to its operation as referred to in the application.

Pursuant to Section 6 of the Nuclear Energy Act, the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property. No facts indicating a lack of sufficient prerequisites for constructing the Olkiluoto 4 nuclear power plant unit as required in section 6 of the Nuclear Energy Act have arisen in the preliminary safety assessment.

The statement of the Advisory Committee on Nuclear Safety concludes that required amendments have been made in recent years in nuclear energy legislation and the legislation is at present well up-to-date and comprehensive.

Further in the opinion of the Advisory Committee, the safety assessment conducted by STUK, addresses well the plant alternatives referred to in the application. The key safety features of the plant alternatives have been assessed. The safety assessment also analyses physical protection, emergency response and rescue arrangements, nuclear waste management as well as the suitability of the plant site. The Advisory Committee is of the opinion that STUK's safety assessment has been prepared in a comprehensive and competent manner.

No facts indicating a lack of sufficient prerequisites for the nuclear power plant unit referred to in the application as well as the facilities required for the nuclear fuel management of the plant, for increasing the interim storage capacity for spent fuel and for the processing, storage and final disposal of operating waste being constructed as required in section 6 of the Nuclear Energy Act have arisen in the review conducted by the Advisory Committee.

The statement of the Ministry of the Environment concludes that the construction of new nuclear power plant capacity is justified from the point of view of achieving the objectives defined for reduction of greenhouse emissions in report "Long-term climate and energy strategy" issued by the Government in November 2008. However, when assessing the significance of the project to the overall good of society, also the other objective of the climate and energy strategy have to be taken into consideration. These pertain to more efficient use of energy, halting the growth of total energy consumption and increasing the share of renewable energy sources. These objectives lay down certain boundary conditions to both the action implemented by the project developer to obtain savings in energy consumption and to the total amount of nuclear power plant capacity in the Finnish energy production system.

The Ministry of the Environment concludes that TVO has presented five plant alternatives in the application and, in the understanding of the Ministry, TVO cannot select a plant alternative that was not known when the application for the decision-in-principle was reviewed.

The Ministry of the Environment has, in the statement issued by the Ministry on the Environmental Impact Assessment Report, brought up the need to analyse any significant impact possibly caused to the natural values of the Natura 2000 area in the archipelago of Rauma located near the plant site. Such an analysis is needed for the authorities that grant permits and ratify plans to be able to verify, as referred to in Article 6 of the Nature Directive and in Section 66 of the nature Conservation Act, that the project will not impair these natural values considerably. With respect to the multi-phase licensing process of the project, the Ministry of the Environment is of the opinion that it is advisable to have these issues clarified at an as early stage as possible. (The Natura assessment was completed in the autumn of 2009 and the authorities issued statements on it in the spring of 2010).

The Ministry of the Environment further reminds that a monitoring system, which can later be used to validate the correctness of the conclusions made in the impact assessment to be conducted, shall be targeted at the nature types on the basis of which the aforementioned area has been selected as a Natura 2000 area.

According to the Ministry of the Environment, Olkiluoto is well suited as the site for the potential new nuclear power plant, since all required nuclear waste management activities are available in the future on the Island of Olkiluoto. This will essentially reduce the risks associated with e.g. transport of spent nuclear fuel. Also, the Ministry is not aware of any factors, which would render the planned plant site unsuitable from the point of view of the use of the areas.

Taking into consideration the viewpoints presented in this statement, the Ministry of the Environment sees no obstacle to forwarding the application for the decision-in-principle to the Government for deliberation.

The Ministry of the Interior's Department for Rescue Services has announced having no comments on the application for the decision-in-principle from the point of view of the Department's own field of competence, as situations requiring rescue activities are only addressed in the application from the internal viewpoint of the plant and the plant site. The Department for Rescue Services has previously issued a statement on the topic, advising that attention should be paid to the effects of the project on rescue arrangements and to the multiplicative effects of a potential accident in the area of a significant conglomeration of nuclear power plants.

The Municipality of Eurajoki supports, pursuant to Section 14 of the Nuclear Energy Act, the construction of the new nuclear power plant unit in Olkiluoto in Eurajoki. TVO's application is justifiable on the ground of securing national electricity production and emissions caused by fossil fuels, particularly carbon dioxide emissions. According to the Municipality of Eurajoki, nuclear power is as an electricity production method in harmony with the Finnish climate and energy strategy. The production of nuclear electricity produces no carbon dioxide emissions and the use of nuclear electricity helps to reduce dependence on the import of electricity.

Eurajoki further refers to net emigration and unemployment figures in the Rauma region and concludes that the impact of TVO's project on regional economy is substantial, for example according to the recently completed analysis of the Turku School of Economics. The direct and indirect employment effect, for example, is estimated to be almost 30 000 person-years during the construction stage. Eurajoki also concludes that no changes are needed in the plan of the island of Olkiluoto due to this project.

The Municipal Board of Eurajoki arranged on 15 December 2008 a joint seminar with the Radiation and Nuclear Safety Authority for the members of the Board and the Council about the safety of the project, and Eurajoki concludes in its statement that no factors related to nuclear safety were brought up in this seminar on the basis of which the Municipality would not be able to support the project.

According to the Municipality of Eura, the emergency response arrangements to be implemented in foresight of abnormal incidents and accidents require that the regional rescue services should also be prepared for exceptional conditions. The Government shall see to it that the responsibility for the costs resulting from the preparedness of the regional rescue services is assigned to the owner of the power plant. Eura also pays attention to TVO announcing in the application for the decision-in-principle that TVO will ensure the consideration of the viewpoints presented in the statements issued in the Environmental Impact Assessment procedure. The Government should verify that the parties that have issued statements really are taken into consideration in the further development of the project.

According to the Municipality of Lappi, before the decision-in-principle is made, the documents related to the project shall be further reviewed to assess if they analyse adequately the matters brought up by the Municipality in the statement it issued on the EIA Report. These matters included the extension of the EIA area, the environmental impact of electricity transmission connections and the consideration of the experience gained from the ongoing construction project of the third plant in the assessment of environmental impact.

According to the statement of the Municipality of Luvia, it is of particular importance to both the permanent and the summer residents of the Municipality that the condition of the sea in the area of the Municipality remains on at least the present level; the increase in the temperature of seawater as well as increases and changes in currents may cause unexpected effects also in the sea areas off the Municipality of Luvia. In the opinion of the Municipality, TVO should select alternative A presented in the EIA report as the discharge point for cooling water. This will minimise the warming effect of the surface water in the sea area of Luvia.

The statement of the Municipality of Nakkila pays attention to the global effects of nuclear power. According to the statement, additional construction has a significant boosting effect on the economy, particularly in regional terms, but unfortunately the severe accident risks involved in the production of nuclear power weigh on the opposite side of the scale. For this reason, an absolute prerequisite for a favourable decision-in-principle taken by the Finnish Parliament is that a statement be also issued regarding global nuclear safety.

The Town of Rauma supports in its statement the making of the decision-in-principle on the Olkiluoto 4 project. The project is necessary to ensure the energy supply of the country and to reduce the emissions of fossil fuels. In the opinion of the Town, the existing infrastructure in Olkiluoto supports the project and TVO's organisation and networks have gained competence and experience in the construction of a nuclear power plant.

However, Rauma points out that the connection of the new unit to the grid, for example, will have significant effects on the environment and that the associated EIA procedure will not start until after the decision-in-principle is possibly made. Rauma further concludes that for more than 20 years demands have been made to utilise in the Town of Rauma the waste heat deposited from the nuclear power plant to the sea, and such utilisation should still be an objective.

The Town of Rauma also concludes that the effect of the thermal load caused by the Olkiluoto plant units has been taken into account in the planning of the National Park of the Bothnian Sea. In this area, the natural values of the National Park are found on islands, not in the underwater nature. The delimitation of the area pursuant to the Natura 2000 programme does not include the nearest water areas off Olkiluoto. The preparatory procedure of the National Park also includes a proposal according to which the special effect of the production of nuclear power is mentioned in the preamble to the act on the establishment of the park, to be later taken into consideration in proceedings related to Water Law.

3 Other invited statements

The statement of the Ministry of Social Affairs and Health concludes that issues related to nuclear and radiation safety are not reviewed in the statement, because nuclear safety aspects are reviewed in the statement of the Radiation and Nuclear Safety Authority, which is an authority under the Ministry.

The statement of the Ministry of Social Affairs and Health focuses particularly on reviewing matters related to the sufficiency of electricity and general security of energy supply. At present, the capacity of Finnish electricity production is 13 300 MW. The maintenance of an inexpensive price level requires adequate supply of electricity in our own country. The price of electricity usually rises on markets based on demand and this does not support the promotion of equality and social wellbeing. The rising price of electricity impairs the competitiveness of industry operating in Finland, and thus has an adverse effect on employment.

The Government's Strategy for Securing Functions Vital to Society (2006) considers the securing of environmental health care significant. Many of the basic functions that guarantee the performance of environmental health care are completely dependent on uninterrupted supply of electricity.

In the opinion of the Ministry of Social Affairs and Health, the construction of adequate base-load capacity is necessary, as it increases domestic electricity production capacity and reduces the risk of power shortage. The construction of Olkiluoto 4 would promote favourably the supply security of the energy sector, which is difficult in many aspects, as uranium fuel can be stored for a long period of time without any significant effects to the cost-efficiency of nuclear power.

The Ministry of Social Affairs and Health finds the construction of the Olkiluoto 4 nuclear power plant to be necessary for environmental health care and in line with the overall good of society, taking also into account the deteriorating economic situation and the resulting growth of unemployment and social inequality. The decision to construct Olkiluoto 4 would create stability and promote a socially and economically balanced development in Finland.

According to the statement of the Ministry of Finance, the Olkiluoto 4 project is extensive and of wide significance both regionally and nationally. In the opinion of the Ministry, the application provides quite a comprehensive assessment of the key issues of the project, and the Ministry has no comments on the content of the application as such.

In the opinion of the Ministry of Finance, as far as issues related to the competence of the Ministry are concerned, the application at disposal does not provide adequate information about TVO's financial prerequisites for operation and about the business

profitability of the nuclear facility project and the overview financing plan for the nuclear facility project. Thus, the Ministry requests the Ministry of Employment and the Economy to see to it that more detailed estimates of the aforementioned issues are obtained should the matter proceed to further preparation. When issuing the statement, the Ministry of Finance was aware of two other possible nuclear power plant projects. The statement of the Ministry concluded that a more detailed opinion on TVO's application for the decision-in-principle cannot be expressed until at a later stage.

The Ministry of Finance issued a new statement in March 2010, stating that the starting point for the further preparation of the matter should be that a decision-in-principle for the construction of nuclear power production could be granted to all three applicants of the decision-in-principle on a nuclear power plant project, provided the preconditions stipulated in the Nuclear Energy Act are met. The decision-making regarding decisions-in-principle on the final disposal facilities for nuclear power waste will be adapted to the decision-making regarding decisions-in-principle on the construction of nuclear power plants.

The Ministry of Agriculture and Forestry addresses in its statement the effects that the rising seawater level caused by climate change will have on the safety of the new nuclear power plant unit. The Ministry commented on this matter in the statement it issued on the EIA Report. If the Parliament issues a positive decision-in-principle, the most recent perceptions and research data produced by the scientific community on the development of climate change and on the associated increased fluctuation and rising of the seawater level shall be taken into consideration in the planning of the implementation of the venture.

The statement of the Ministry emphasises that should the decision-in-principle be made, the starting points for the decision-making shall be the following: production capacity based on renewable energy is promoted strongly and the progress made in terms of the efficiency of energy use is at least consistent with what is presented in the National Energy Strategy.

The Ministry further brings up in its statement some issues related to fishing. The considerably large cooling water intake of the Olkiluoto plants may for its part cause adverse effects to fish economy as fish are carried into the plant in the cooling water. In order to prevent these adverse effects, the required screening equipment shall be constructed in the structures of the plant. The Ministry further points out that TVO has provided no information in EIA documentation or decision-in-principle documentation on whether fish farming is carried out in the area of influence of the cooling water, and if fish farming is carried out, what is the effect estimated to be. All in all the Ministry of Agriculture and Forestry sees no obstacle to making the decision-in-principle on the construction of the new nuclear power plant unit.

The Department for External Economic Relations in the Ministry for Foreign Affairs concludes in its statement that the construction of the new nuclear power plant unit would increase the energy security of Finland by reducing dependency on import. From the point of view of Finnish energy-intensive export industry, it is important that the electric energy is available to the industry at a reasonable and stable price to enable continuation of the operation and implementation of new investments in Finland. As nuclear power replaces obsolete power plants that use coal and oil as fuel, it supports Finland's national objectives as well as the objectives laid down within the scope of EU to reduce carbon dioxide emissions.

The Department for External Economic Relations further concludes that the high capacity factor and safe operation of the four existing Finnish nuclear power plant units have contributed favourably to the image of Finland as a high technology country.

The statement of the Ministry of Defence concludes that if implemented, the Olkiluoto 4 power plant unit will support the climate objectives of the defence administration. It also increases supply security in terms of energy production, provided the availability of fuel is on an adequate level.

The Ministry of Transport and Communication concludes in its statement that there are at present congestion problems in the intersection of highway No. 8 and local road No. 2176. The Turku Road District of the Road Administration has imposed a variable speed limit in the intersection to facilitate access to highway No. 8 during rush hours. The possible improvement action for the intersection would be to replace it with a grade-separated intersection; the rough cost estimate of this improvement is EUR 8 million and special financing would be required for the project.

In the opinion of the Ministry, the road should also be repaved before the construction of the fourth unit to ensure the load-bearing capacity of the road. The Ministry further emphasises that national and international regulations are to be complied with in transports of nuclear fuel, including the regulations for carriage of dangerous goods stipulated in Part D in Section VII of the SOLAS Convention of the International Maritime Organisation IMO.

The statement of the West Finland Provincial Government concludes that the Regional Council of Satakunta is preparing a provincial plan, which is designed to replace regional plan 5 currently valid in the area. The planning action required due to the Olkiluoto 4 nuclear power plant unit can be handled through this plan and other planning action in progress.

As far as arrangements for rescue services are concerned, the Provincial Government considers it justified and rational to place the new nuclear power plant unit on the same site with the existing plants. This makes it possible to utilise the existing safety structures, rescue plans and the knowledge gained in exercises when the operation is expanded. However, an adequate amount of personnel resources must be reserved for the review of safety arrangements and rescue plans. The Provincial Government also concludes that the construction of the new unit and its potential commissioning will not result in any essential additional requirements in terms of police activities.

According to the statement of the Southwest Finland Environment Centre, Olkiluoto is excellently suited as the site for the nuclear power plants possibly constructed in Finland, as the existing units and the unit under construction on the site require many solutions, which it would not be rational to implement on several sites.

According to the Finnish Environment Institute, the most obvious impact of the nuclear power plant on the environment is caused by the increase in the temperature of water in the discharge area of cooling water. The model analyses presented in the EIA Report show considerable differences between the different discharge point alternatives in terms of the temperature of the water in the surface layer. The Southwest Finland Environment Centre is of the opinion that the discharge of cooling

water shall be implemented so that the increase in temperature is limited to an as small area as possible.

The Finnish Environment Institute requires that the construction licence decision to be possibly made orders the applicant to present an environmental protection plan for the construction stage to the control authority responsible for environmental protection before construction is started.

The duties of the Southwest Finland Environment Centre were on 1 January 2010 transferred to the Southwest Finland Centre for Economic Development, Transport and the Environment. The Southwest Finland Centre for Economic Development, Transport and the Environment submitted a statement on 16 March 2010 stating that the cooling waters from the OL1-OL4 power plant units will probably not significantly impair the natural values for which the area has been included in the Natura 2000 network and the project is not considered to affect the consistency of the Natura 2000 network.

Metsähallitus (Forest Administration) stated in its statement in the spring of 2010 that it appears clear on the basis of the Natura assessment that the condensate water from the Olkiluoto power plant reduces the representativeness of the nature type "reefs" in the northern parts of the Natura area in the archipelago of Rauma. According to the Forest Administration, the spread of kelp does not sufficiently describe the condition of the nature type "reefs and as such, kelp should not be considered as the only species for monitoring purposes. The Forest Administration also presented various actions for ensuring that the effects are monitored also in the future.

The OSH District of Turku and Pori made no comments on the application for the decision-in-principle.

The statement of the Satakunta Rescue Services refers to the 30 years of experience in nuclear power operation with the associated problems investigated together with the power plant company. However, the Rescue Services expects the power plant company to further focus efforts on the preparedness of rescue activities, practical arrangements and good cooperation with the Rescue Services.

The Rescue Services is of the opinion that the conditions for the enforcement of the special safety requirements referred to in Section 30 of the Rescue Act (468/2003) are fulfilled for the Olkiluoto power plant and is considering exercising the power stipulated in the Act to order the power plant company to implement the aforementioned activities.

According to its statement, the Safety Technology Authority Tukes has estimated the amounts of chemicals to be used at the future plant to be of the same magnitude as at the existing Olkiluoto 1 and Olkiluoto 2 plant units and the Olkiluoto 3 plant unit under construction, although the application for the decision-in-principle does not provide detailed information of any dangerous chemicals under the control of Tukes. Accordingly, Tukes assesses that the provisions stipulated in the Chemical Safety Act (390/2005) do not constitute an obstacle to the construction of the new unit in Olkiluoto.

According to the Satakunta Employment and Economic Development Centre, the economical analysis of the planned nuclear power plant unit shows that the advantage

it offers over other corresponding projects is that the infrastructure already in place in Olkiluoto for the purposes of the existing plant units can be utilised in the implementation of the project.

On the other hand, the Employment and Economic Development Centre considers the construction of the new plant unit in Olkiluoto in Eurajoki to have significant positive effects on the development of economy and employment in the entire Satakunta area. In the opinion of the Employment and Economic Development Centre, the matters presented in TVO's application for the decision-in-principle prove that the implementation of the project is in line with the overall good of society.

According to the statement of the Regional Council of Satakunta, Olkiluoto in Eurajoki is also from the point of view of regional planning suitable as the site for the fourth nuclear power plant unit Olkiluoto 4 and that the construction of the unit would in this sense implement the land use objectives of the regional plan.

The Regional Council of Satakunta has no other comments on the decision-in-principle on the basis of regional plan No. 5 and other regional overview plans. The Council points out that the land use plans shall also take account of the protective zones required for the nuclear power plants and allow for the final disposal of nuclear waste.

The Åland Government concludes in its statement that it has not received enough information about the application for the decision-in-principle. The Åland Government particularly pays attention to the long-term and responsible management of nuclear fuel and is especially interested in the sea transports of fresh fuel and possibly also spent fuel.

The statement of Greenpeace demands that TVO's application for the decision-in-principle be rejected. Greenpeace justifies this stance with the significant and long-term environmental impact caused by the project as a result of uranium mining and ore enrichment. Also, Greenpeace is of the opinion that TVO is not in possession of means to deal with spent fuel in compliance with the Nuclear Energy Act. The ability to use nuclear power in the production of nuclear weapons is also an argument for rejecting the application.

According to Greenpeace, the project cannot be justified on the basis of reduced emissions into the atmosphere, either, since according to the Environmental Impact Assessment, the reductions in emissions produced by the project are minor. The plant unit would also decrease the self-sufficiency of Finland in energy and would make it difficult to increase domestic renewable energy sources, which is not in line with the overall good of society. Further, the low cost estimate of TVO might result in attempts to compromise nuclear safety and also, TVO is not prepared for the insurance or security required under the new Nuclear Liability Act.

WWF Finland concludes in its statement that the construction of the new nuclear power plant unit is not in line with the overall good of society and thus, the application for the decision-in-principle shall be rejected. In the opinion of WWF, Finland must not make a decision on the construction of the new nuclear power plant unit, as this will cause significant difficulties to bringing the structure of energy production to a sustainable level as outlined by the objectives of EU.

WWF concludes that the demand for electricity can be met with renewable energy and increased energy efficiency. Renewable energy forms are also employment-intensive, particularly in the countryside and in areas that suffer from the structural change of the society. Electricity produced with renewable energy is decentralised also in crisis conditions and as a domestic form of energy, more securely available. The raw material of nuclear power plants must be imported and the production is vulnerable in crisis conditions as it is centralized in nuclear power plants. WWF is of the opinion that the entire production chain of nuclear power production involves, due to the dangerous nature of the raw material and the waste, risks that affect our own society, the future generations and people living far beyond the borders of our country.

The conclusion drawn in the statement of the Finnish Association for Nature Conservation FANC is that the construction of the fourth reactor in Olkiluoto is not in line with the overall good of society.

The electricity production capacity need not be increased in Finland to the extent suggested by the application and additional nuclear power will make it difficult to make the use of energy more efficient and will essentially rob resources from the development of renewable energy.

FANC further concludes that the supplementary report submitted by TVO to the contact authority on 20 August 2008 has shortcomings. Cooling water issues and the embankment to be possibly constructed, in particular, are addressed in a deficient manner. The impact of the embankment can be considerable on the replacement of water and eutrophication which is why thorough clarification is needed.

Ålands Natur och Miljö concludes in its statement that the construction of the new nuclear power plant unit is not in line with the overall good of society. Nuclear power involves risks and uncertainty factors. The Association is concerned about the increase in the production of nuclear power within the scope of the Baltic Sea, as the associated transports, nuclear facilities and processing of nuclear waste endanger the future of the Baltic Sea, which is already in a poor state. The association particularly wishes to bring up the releases of tritium and other radioactive substances, taking place routinely. The Association further points out that the final disposal of nuclear waste has not been resolved in a functioning and safe manner.

Fingrid Oyj concludes in its statement that it has regulatory obligations pursuant to the Electricity Market Act for system responsibility and development of the grid. The Company analyses the needs for the reinforcement of the Finnish national grid as a whole. The predicted changes in the needs for electricity transmission and the consequential needs for the reinforcement of the transmission grid are based on long-term predictions of electricity consumption, development of the electricity production capacity and development of the import and export of electricity.

Fingrid Oyj's current investment strategy allows for the reinforcement of the national grid and reserve power with ca. EUR 1.6 billion in the next ten years. These investments will make it possible to connect one large nuclear power unit as well as 2000 MW of geographically decentralised wind power production to the national grid, and ensure the operating reliability of the electric power system. These investments will also contribute to the development of pre-conditions for the operation of the

expanding electricity market and cover the needs for renovation resulting from the ageing of the national grid.

The connection point of the new power plant unit to the national grid is at the Rauma power station in the Town of Rauma, near the existing nuclear power plant locality Eurajoki. The connection of the power plant unit to the national grid requires the construction of new 400 kilovolt (kV) power lines to the national grid between Olkiluoto in Eurajoki and the Rauma power station, and further in the direction of the power stations of Ulvila, Forssa and Lieto. The connection solution can be designed in detail after the technical values for the power plant unit have been defined, taking into account the requirements of the power system.

The effect of the new power plant unit on the required electricity transmission capacity is not a single, separate issue, but the transmission need of the national grid depends to a great extent on the development of the Nordic electricity market and the production capacity in other countries in the entire Nordic power system. The transmission need is also influenced by the development of connections from the Nordic system to other power systems.

The development of the national grid is taken into consideration in Fingrid Oyj's investment plan for the next ten years. The Company assesses the development of electricity transmission needs in a continuous process. From the point of view of transmission capacity, the increasing size of the power plant units makes it necessary to reinforce the transmission capability of the national grid. The growth in the production of wind power and the fluctuations of production also increase electricity transmission needs in the national grid and in the transmission connections between different countries. In practice, these translate into the construction of new power lines. In Finland, the national grid has to be reinforced with new 400 kV connections in the areas of Kanta-Häme, Eastern Finland and Ostrobothnia. Also, a third alternating current line is needed between Finland and Sweden to equalise variations in production and to utilise regulating and reserve capacity in the entire market area.

At present, the largest production unit in the Finnish power system is the Olkiluoto unit with an electric output of 860 MW; as of the year 2012 the largest unit will be the third 1 600 MW unit to be completed in Olkiluoto. The effects of this unit on the power system will be reduced to 1300 MW by means of fast disconnection of loads. Teollisuuden Voima Oyj's application for the decision-in-principle refers to a nuclear power plant unit with an electric output of 1 000 - 1 800 MW. When the size of the largest power plant unit connected to the grid increases, it has both technical and financial effects on the power system.

The disturbance reserves of the Nordic power system are dimensioned on the basis of the largest production unit or the most severe grid fault. The grid must withstand the consequences of the fault and after the fault, the use of the grid is adapted within 15 minutes to the new situation. The system responsibility that Fingrid Oyj bears means that the Company is responsible for the adequacy of the frequency-controlled normal operation and disturbance reserves and the fast active disturbance reserve. Frequency-controlled normal operation and disturbance reserves are necessary to maintain the operability of the power system if a power plant is suddenly disconnected from the grid.

Fast active disturbance reserve, on the other hand, is needed to replace the production of the disconnected power plant immediately after the transient. The power plant unit referred to in the application for the decision-in-principle can increase the amount of the disturbance reserve needed in Finland considerably, depending on the size of the unit. In addition, an adequate amount of slow regulating capacity with a reasonable activation time is needed from the electricity market to release the fast active disturbance reserve in order to maintain the reliability of operation.

Fingrid Oyj's long-term investment plan allows for a plant unit of ca. 1 600 MW as far as the dimensioning of the fast active disturbance reserve is concerned. The final need for the construction of new fast active disturbance reserve capacity, however, will depend on the size of the new plant unit, existing reserve capacity and possibilities of utilizing the disconnected loads.

The power plant unit to be constructed will make it necessary to reinforce the national grid to enable the connection of the plant and to develop transmission capacity. Reserve capacity also needs to be increased; the amount of the increase depends on the size of the power plant unit, taking other resources applicable for reserve purposes into account.

Posiva Oy concludes in its statement that the Company has applied for a decision-in-principle on that it is in line with the overall good of society that the final disposal facility for spent nuclear fuel in Olkiluoto in Eurajoki as planned by Posiva be expanded to accommodate for spent nuclear fuel from Olkiluoto 4.

Fennovoima Oy concludes in its statement that the Company has launched a venture for the construction of a new nuclear power plant in Finland. Fennovoima considers that it is expedient with respect to the overall good of society that TVO's and Fennovoima's applications for the decision-in-principle be prepared and reviewed together.

According to the Federation of Finnish Enterprises, the construction of TVO's fourth nuclear power plant unit is in line with the overall good of society. The direct employment effect of the construction of the plant unit is ca. 12 000 – 15 000 person years and the indirect effect ca. 10 000 – 13 000 person years. Moreover, nuclear power is an economically competitive form of base load production and causes no emissions of greenhouse gases into the atmosphere. The Federation of Finnish Enterprises further emphasises the effect of reasonably priced electricity on general competitiveness and economic growth in Finland. As the share of nuclear fuel is small in the price of nuclear electricity, the price of nuclear power is low and stable.

The Confederation of Finnish Industries EK considers in its statement the adding of nuclear power to be in line with the overall good of society and supports the decision-in-principle. Imported electricity can be replaced, the growing demand met and obsolete electricity production capacity replaced with domestic, emission-free production by increasing nuclear power production. The Confederation emphasises the good experience gained in Finnish nuclear power and its safety. The Confederation also brings up the high degree of dependency on import in Finland. Already at present, a deficit of 2 000 MW of production output is experienced in Finland during times of peak electricity consumption. Finland relies then primarily on electricity imported from Russia and Sweden.

The Confederation also concludes that nuclear power and renewable energy are not alternatives or mutually exclusive, but the different energy sources play their own role in different purposes of use. The production forms of renewable energy cannot satisfy the need for base load; only about one tenth of the nominal output of the wind power capacity, for example, is available during the peak consumption times in the winter.

Finnish Energy Industries (ET) concludes in its statement that Teollisuuden Voima Oyj's project for the construction of a fourth nuclear power plant unit in Olkiluoto supports in a significant manner the objectives of the Finnish Energy and Climate Strategy and is therefore in line with the overall good of society. Finnish Energy Industries also concludes that the objective outlined in the strategy for self-sufficiency in both electric energy and electric output is a good one. In order to achieve this objective, Finnish Energy Industries estimates that 4 000 – 5 500 MW of new electricity production capacity is required in addition to the power plants under construction at present. Finnish Energy Industries emphasises that our current production capacity is more than 2 000 MW less than the peak consumption in Finland.

The Central Union of Agricultural Producers and Forest Owners (MTK) concludes in its statement that Finland has to construct an amount of electricity production capacity corresponding to the market demand. Renewable energy production and production utilising bioenergy shall be constructed primarily, but nuclear power can additionally be constructed in an adequate amount to make Finland theoretically independent of imported electricity in the electricity market.

MTK is aware of there being three simultaneous applications for the decision-in-principle on new nuclear power in Finland and expects these decisions to be made at once. In the opinion of MTK, it is important that new nuclear power capacity is for safety reasons constructed in different locations from the existing nuclear power conglomerations. In addition, the owners of the new capacity should be different from the owners of the existing nuclear power plants.

The statement of the Central Organisation of Finnish Trade Unions (SAK) concludes that nuclear power offers an alternative that replaces fossil fuels and is emission-free in the production of base load power. As a country greatly dependent on import, Finland must ensure supply of energy to the industry at a reasonable price. SAK further points out that the experience gained in the use of nuclear power is in most parts positive in Finland. SAK does not take a stance on the order of priority of the different power plant projects pending in Finland.

The Confederation of Unions for Professional and Managerial Staff in Finland Akava concludes in its statement that nuclear power is still a disputable issue within the research community and in international debate. The attitude toward additional construction of nuclear power is also divided in almost all communities. However, the cutting of greenhouse emissions has emphasised the significance of the energy sector, where production based on coal and other fossil fuels can be replaced with low-emission production forms. However, Akava expects that no government funding is used on nuclear power plant projects, but public funding should be focused on the development of renewable energy forms as well as on research and development. The Government and the Parliament shall take the wishes and opinions of the residents of the nearby areas into consideration when making decisions on the three applications for the decision-in-principle.

The statement of Svenska Lantbruksproducenternas Centralförbund concludes that the Association has taken a negative stance on the use of nuclear power since 1998. According to the Association, the use of bioenergy should be particularly promoted in energy policy. However, if adequate production cannot be achieved in this manner, the construction of any additional nuclear power should be concentrated on the existing plant sites.

The statement of the National Emergency Supply Agency (HVK) concludes that the supply security of our country is improved if electricity production is decentralised and located expediently with respect to consumption and the transmission grid. Large local concentrations of production cause challenges particularly to the performance of the surrounding infrastructure and standby power systems in conditions, where the entire local concentrated production is inoperable for some reason.

HVK further concludes that the deliberation process on the decision-in-principle could and should include the consideration of the expansion of ownership of nuclear power in terms of the number of owners among both significant consumers of electricity and distributors. In HVK's opinion, this has an improving effect on the performance of the electricity market. The National Emergency Supply Agency considers the additional construction of nuclear power extremely useful and current in terms of the functioning of electricity supply in Finland and the security of supply.

The Swedish Nuclear Safety Authority SSM (Strålsäkerhetsmyndigheten) concludes in its statement that the requirements for new building and safe operation of nuclear facilities are well covered in Finnish nuclear safety requirements. SSM is also of the opinion that Sweden and Finland share the same high level of requirements as far as nuclear safety is concerned and it is hoped that cooperation between the nuclear safety authorities of the two countries continues. SSM still wants to monitor the development of nuclear safety issues in Finland.

4 Statements and opinions submitted to the Ministry of Employment and the Economy in writing

The purpose of this summary is to bring up the matters and viewpoints presented and emphasised in the other statements and opinions. A total of 177 other statements or opinions were submitted; seven were received from communities and organisations and five private persons submitted a total of 170 statements or opinions. Four of the statements submitted by communities and organisations were in favour of the decision-in-principle, one was neutral and two against. All five private persons were against the decision-in-principle.

The following communities presented a statement in favour of the application for the decision-in-principle: Rauman Seudun Kehitys Oy, Ydinenergianuoret ry, Pohjois-Savon Kokoomusnuoret and Rauma Chamber of Commerce. The communities conclude that it is in line with the overall good of society to grant the decision-in-principle and justify their stance with economic factors and by concluding that there is need for the electricity produced by the new plant unit.

The following communities presented a statement against the application for the decision-in-principle: International network "Artists for A Clean Future" and the people's movement "Lapp People Against Uranium Power". Mr. Arto Lauri opposes the application for the decision-in-principle in the 166 statements and opinions he has submitted. Four statements or opinions were received from other private persons and they were all negative.

Several of the negative statements or opinions address the social significance of the project and bring up the need to assess other alternative forms of energy production. Many statements or opinions oppose the use of nuclear power in general.

People who own holiday homes in the water area of Sorkka propose that the discharge of condensate water from the fourth plant unit be implemented on the north side of the island of Olkiluoto. This so as to reduce the load caused by the condensate water on the Sorkka archipelago

The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management acts as the representative of Austria in the EIA procedure of Olkiluoto 4, which included the procedure referred to in the Espoo Convention, and also wanted to participate in the review of the application for the decision-in-principle.

The Ministry of the Environment organised on 26 May 2008 in Helsinki a consultation with Austria pursuant to the Espoo Convention. After this, Austria sent on 11 June 2008 a letter in which recommendations were made to Finland regarding

the EIA procedure. Austria also announced in this context her desire to participate in the decision-in-principle procedure for Olkiluoto 4 in the form of the recommendations and expressed a wish for the licensing decision on Olkiluoto 4 to be submitted to Austria for information. The recommendations pertained to the phenomenon of a severe reactor accident, particularly the so-called source term.

5 Opinions presented in public hearing in Eurajoki

The Ministry of Employment and the Economy organised in Eurajoki the public hearing referred to in the Nuclear Energy Act. A total of four opinions or statements were presented on this occasion.

The Minutes of the public hearing are shown below, with summaries of the opinions and statements.

Minutes

13 October 2008

The public hearing referred to in Section 13 of the Nuclear Energy Act, organised by the Ministry of Employment and the Economy

Time Monday 13 October 2008 at 18.00-19:35

Place Eurajoki Municipal Hall, Council Room, Kalliokatu 5, Eurajoki

Representatives of authorities

Jorma Aurela, Senior Engineer, Ministry of Employment and the Economy (TEM), Chairman
Pasi Mustonen, Senior Officer, TEM, secretary
Jaana Avolahti, Senior Officer, TEM
Mauri Vieru, Communications Officer, TEM
Keijo Valtonen, Assistant Director, Radiation and Nuclear Safety Authority (STUK)

Number of participants: 23.

1 Opening of event

Senior Engineer Jorma Aurela (TEM) welcomed the participants and concluded that the purpose of the event was to hear opinions on the application for the decision-in-principle on the Olkiluoto 4 project. The Ministry of Employment and the Economy is the contact authority for this project and is, pursuant to the Nuclear Energy Act, obliged to organise this public hearing. Mr. Aurela outlined the main content of the event.

2 Introductions

Mr. Aurela introduced himself and announced that he would act as the Chairman of the event by appointment of the Ministry. He also concluded that present from the Ministry were Senior Officer Jaana Avolahti, Senior Officer Pasi Mustonen acting as the secretary for the event and Communications Officer Mauri Vieru, who would assist the media present in the event. The Chairman also announced that the presentation of the Radiation and Nuclear Safety Authority focusing on the safety aspects of the project would be given in the event by Assistant Director Keijo Valtonen.

3 Procedures in public hearing event

The Chairman explained the procedures to be complied with in the event as follows. After the presentations on the Olkiluoto 4 project, a 15-minute break will be held during which participants can submit requests to address the event using the request form available for this purpose. The forms are to be submitted to the secretary of the event. The requests are granted in the order they were submitted. For an opinion of a community, the Power of Attorney of the community shall accompany the request, or be submitted afterwards to the Ministry of Employment and the Economy by 12 November 2008. Opinions can also be submitted to the Ministry in writing by the aforementioned date. Opinions in writing can also be submitted in this event. For opinions of communities, also opinions submitted in writing shall be accompanied by the Power of Attorney as described above for opinions presented orally.

The entire hearing and the addresses are recorded and filmed on video. After the event the addresses will be compiled in writing for later submittal to the Government together with the presentation on the application for the decision-in-principle. The written opinions and statements submitted to the Ministry will also be forwarded to the Government.

4 Decision-in-principle procedure on construction of the new nuclear power plant unit

Senior Officer Jaana Avolahti (TEM) told about the schedule of the decision-in-principle procedure on the project for the construction of the new nuclear power plant unit, about the review phases of the matter and the prerequisites for a positive decision-in-principle (e.g. statement in favour of the project from the municipality where the plant site is located and a preliminary safety assessment from the Radiation and Nuclear Safety Authority).

5 Safety aspects related to the project

Assistant Director Keijo Valtonen (STUK) told about the safety aspects related to the Olkiluoto 4 project and about the role of the Radiation and Nuclear Safety Authority in the assessment of the safety of the planned nuclear power plant unit.

BREAK at 18.30-18.45. The requests (4 of) to address the event were received during the break.

6 Presentation of opinions

The Chairman announced that four requests to address the event had been submitted, and defined the maximum length of each address as 15 minutes. He also asked the persons presenting the opinions to introduce themselves before their address.

A summary of the opinions presented in shown in the Appendix to these Minutes.

7 Closing of event

The Chairman concluded that all the requested addresses had been given and closed the event at 19:35.

In fidem

Jorma Aurela	Pasi Mustonen
Chairman	Secretary

Appendix

SUMMARY OF OPINIONS PRESENTED IN THE EVENT

A summary of the opinions presented in the hearing event in Eurajoki on 13 October 2008
Opinions in the order of presentation

Presented by: Heikki Kares
Domicile: Eurajoki
There will soon be one atomic power plant unit per every one million inhabitants in Finland. The nation does not need any new nuclear power plant units. The world could simply not tolerate there being an atomic power plant unit constructed for every one million inhabitants. I live near the Olkiluoto power plants and I have never received any reports related to the safety of the plant. Nature cannot tolerate the constant heating of the sea, either. These are all negative issues.

Presented by: Arto Lauri
Domicile: Eurajoki
The releases caused by the normal operation of the Olkiluoto nuclear power plant units have increased significantly. The problem is that radiation released into the soil, for example, cannot be registered with any indicators. However, this is something that is not talked about. TVO is also in violation of international regulations as it heats waterways more than allowed by limit values. Nuclear power plants are globally destroying valuable drinking water. An international assessment should be made of the suspicious operation of STUK.

Community: Rauma Chamber of Commerce
Presented by: Jaakko Hirvonsalo
Domicile: Rauma

The availability and price of electric energy are essential factors to Finnish industry and business life. We have to increase our own electricity production capacity so as to reduce dependency on imported energy. The availability of base load power could be ensured through the rapid implementation of the Olkiluoto 4 project, and this would also for its part contribute to the achievement of the climate objectives of the Kyoto Protocol. When assessing the overall interest of society, the construction of the new nuclear power plant unit on the site where the required infrastructure is already in place, is an important criterion. Nuclear power enjoys wide acceptance in Eurajoki and the region boasts a lot of expertise in this field.

Community: Rauman Seudun Kehitys Oy
Presented by: Hanna Tuominen
Domicile: Rauma

As an organisation established to promote the development of business activities in the Rauma region, Rauman Seudun Kehitys Oy is strongly in favour of the OL4 project. The attitude among the population of the Eurajoki area is very positive toward this project and the trust in TVO's expertise is great. A vast amount of competence in the nuclear industry has developed in Eurajoki over time and the framework for the construction of the new facility is in order. The huge positive effects of the nuclear power plant project on the business life of the region have been demonstrated in connection with the construction of Olkiluoto 3.

6 Applicants reply to statements issued and to preliminary safety assessment

The applicant, Teollisuuden Voima Oyj (TVO) has provided a reply to the statements and opinions issued and to the preliminary safety assessment and site assessment prepared by the Radiation and Nuclear Safety Authority (STUK). A summary of the viewpoints presented by TVO is presented below.

Financing and economy of the project

The Olkiluoto 4 nuclear power plant unit is the most economical option for the production of base-load power in Finland according to the analyses performed by TVO. Experience indicates that nuclear power is inexpensive, particularly in the long term, as capital costs decrease. TVO’s financial key figures and the ability to meet interest payments and repayments on loans will remain at a level satisfactory to financiers also throughout the construction period. According to analyses, the project’s funding can be organised without difficulties. The project will not require State subsidies or separate support tariffs.

TVO's excellent operating history at the existing plant units, the Company's position as a reliable producer of base load electricity in Finland as well as the stable and long-term ownership of the Company have created a solid base for the financial viability of TVO's operation. This is demonstrated by the commitment of an extensive international banking group to TVO's financing, the high ratings of international credit rating agencies and the trust of both domestic and international investors. This trust was reflected by the successful issuance of the Company's public bond loan in the Luxemburg Stock Exchange in June 2009. More than 200 investors subscribed to the loan. The economic recession and particularly the exceptionally unstable landscape of the financing market are affecting financing everywhere. Investors shy from uncertain ventures. The situation has not influenced the availability of financing to TVO.

TVO's price estimate for the project is based on preliminary confidential information received from plant suppliers, the existing, versatile infrastructure owned by TVO in Olkiluoto and the almost completed reserve power and grid solutions and in particular on the ability to arrange the processing and final disposal of nuclear waste. The exchange rates for the Euro in the plant supplier countries also affect significantly the price estimates. The current global economic situation has influenced the price level of products and services in general. Somewhat higher price information has been presented in international press, often based on the cost estimates of plant units constructed on sites that are in natural state.

The investment decision on Olkiluoto 4 as well as the commitments to arranging the financing are to be made in 2012. There is no cause to doubt that the financial viability of TVO and consequently the Olkiluoto 4 project would not remain as it is today.

Energy supply, energy efficiency and electricity procurement alternatives

The Ministry of the Environment concludes in its statement that the construction of new nuclear power plant capacity is justified from the point of view of achieving the objectives defined in the Government's Climate and Energy Strategy. However, the Ministry feels that TVO's application for the decision-in-principle describes in a very limited manner how the applicant plans to increase the efficiency of the Company's energy use and the share of renewable energy sources.

TVO joined the Energy Savings Agreement for the power plant industry in 1998. TVO has implemented and continues to implement extensive modernisation and energy efficiency projects at the Company's power plant. The Company joined on 29 February 2008 the energy efficiency action programme for the energy production sector, launched pursuant to the framework agreement concluded between the Confederation of Finnish Industries (EK), unions and the Ministry of Employment and the Economy. TVO has defined objectives in terms of both quantity and quality and the achievement of the objectives is monitored as part of the monitoring of all the objectives of the Company.

TVO has taken and will take energy efficiency into consideration in the Company's operation. The waste heat from the existing nuclear power plant units, for example, is utilised for district heating in the Olkiluoto area. The Olkiluoto 4 feasibility study will also include an investigation on the possibilities of expanding the deliveries of district heat to further improve energy efficiency.

Competition and ownership

The National Emergency Supply Agency addresses in its statement the effect of the ownership of the new nuclear power plant unit on the functioning of the electricity market. The Central Union of Agricultural Producers and Forest Owners (MTK) concludes in its statement that for competition reasons the owners of the new nuclear power plant units should be different from the owners of the existing plants.

TVO agrees with the National Emergency Supply Agency that a dominant market position would give the operator the opportunity to influence the operation of the electricity market. However, the influence of the new nuclear power plant unit on the electricity market is independent of the owner or operator of the plant unit, if such a dominant position is not created. The ownership of TVO is divided through shareholder companies to several different companies and none of the companies has a dominant market position in the Nordic electricity market.

Fingrid Oyj concludes in its statement that the Nordic power grids and the production and consumption related to these grids form a power system, which is interconnected in the sense of operating technology. For this reason the price level of electricity in the Nordic market will also in the future be primarily determined by the balance between

total demand and total supply rather than by the internal ownership of production in any one of the Nordic countries.

If the decision-in-principle on the construction of the new nuclear power plant unit is granted to TVO, ownership shares will not in TVO's opinion change significantly in the Nordic electricity market over the long term, when the removal of e.g. the ageing coal power capacity of TVO's owners from the market is taken into account.

National grid and security of supply

The Ministry of Defence concludes that the Olkiluoto 4 project increases supply security in terms of energy production, provided the availability of fuel is on an adequate level.

The statement of the National Emergency Supply Agency refers to the negative effects of local concentration on supply security in a situation where the entire local production conglomeration is for some reason inoperable. TVO has recognised this and will ensure that simultaneous interruption of production at the production plants is prevented. This is promoted by the separation of the most important systems of the plant units, the physical separation of the plant units, the separate grid connections of the plant units and the location of the plant units' connection lines in separate power line areas, the extension of the power lines to separate points of the national grid and the maintenance of a contingency stock of fuel.

Local concentration offers many advantages, such as wider competence of the personnel and more extensive, centralized resources available for e.g. safety, physical protection arrangements, operation, maintenance and emergency response arrangements.

Schedule of the project

TVO estimates that construction work for the power plant unit could be started in 2014 after the invitation to tender and construction licence processes following the decision-in-principle have been carried out. The construction and commissioning period for the plant unit will be approximately 6 years. The scheduling of the investment decision will take into account e.g. the status of the electricity market at the time and the shareholders' demand for electricity.

TVO agrees to a large extent with the views presented in some statements that the Olkiluoto 4 project specifically can be implemented on a tight schedule. TVO is the only applicant for the decision-in-principle with up-to-date experience in the design and implementation of a large nuclear power plant project in Finnish conditions. This experience for its part also guarantees the realism of the schedule of the Olkiluoto 4 project taking into consideration that safety takes priority in all activities.

The statement of Fennovoima Oy concludes that it is in line with the overall good of society to prepare and review TVO's and Fennovoima's applications for the decision-in-principle together. A total of three applications for the decision-in-principle on the construction of a new nuclear power plant unit in Finland have been submitted to the Government. TVO concludes that the concurrent review of the applications for the decision-in-principle on the nuclear power plant projects is justified in terms of the

overall good of society, provided that all the licensing processes of the projects also proceed at equal rate. TVO has submitted the application for the decision-in-principle to the contact authority on 25 April 2008 and hopes that the application be reviewed swiftly from now on.

Nuclear liability

Finland has together with 14 other OECD countries ratified the Protocol on the amendment of the Paris Convention on third Party Liability in the Field of Nuclear Energy. Nuclear liability is governed by the Nuclear Liability Act (484/1972). The Nuclear Liability Act takes into account the international treaties that Finland has ratified, which define the minimum limits to liabilities for nuclear damage. Increased liabilities can be enacted nationally, as is also done in some countries. Negotiations to develop the international treaties in question have been completed and the Finnish Nuclear Liability Act was updated in 2005 defining considerably higher liability minimums.

Greenpeace questions in its statement TVO's capability of acquiring the securities required under the Nuclear Liability Act. TVO concludes that as the licensee, TVO complies with all valid provisions of Finnish laws in all activities. The Nuclear Liability Act takes account of the international treaties that Finland has ratified, which define the minimum limits to liabilities for nuclear damage. According to the statement of the Radiation and Nuclear Safety Authority, no obstacles are foreseen to the applicant being capable of fulfilling the nuclear liability obligations defined in the valid Nuclear Liability Act.

Environmental impact

TVO has recognised the thermal load caused to the sea area off Olkiluoto as a result of the combined effect of the plant units as the most important environmental effect of the project.

Several statements and opinions discuss the cooling of the plant. The opinion submitted on behalf of holiday home owners near the plant, for example, brings up the need to develop a system replacing ice roads to the islands within the scope of influence of the cooling water. The West Finland Environmental Permit Office stipulates in the decisions regarding environmental permits that TVO shall secure access to the islands of Lippo and Susikari by arranging e.g. a storage site for boats. TVO is not in disagreement with the decisions of the Environmental Permit Office.

The statements and opinions have brought up the need to limit the spreading of the cooling water within an as small area as possible to prevent the scope of influence from expanding to completely new areas. However, other factors also need to be considered in the selection of the cooling water intake and discharge location, such as the implementation of construction work and the operating reliability of the plant structures and most of all, nuclear safety.

The statements bring up the need for the Natura assessment prior to the licensing procedure of the project. An assessment as referred to in the Nature Conservation Act was completed in the autumn of 2009 regarding the possible impact of cooling water from the Olkiluoto power plant on the Natura area in the archipelago of Rauma. The natural values protected in the Natura area will in the future be included in a monitoring system to make it possible to validate the results of the assessment later.

The Ministry of Agriculture and Forestry has in its statement brought up aspects related to the impact of the project on fish economy. TVO declares that no fish farming is carried out in the Olkiluoto sea area. Fish farming is carried out in the area of the Municipality of Luvia, at the northern borders of the scope of influence of cooling water from Olkiluoto, with the nearest fish farm located by the Santakari island. According to the modelling of currents, the mean temperature rise effect does not reach that area in the summer.

As concerns the impact of the Olkiluoto nuclear power plant on fish populations, TVO has conducted an analysis of the migration of fish to the power plant in the cooling water. This analysis is required under the water permits of the three plant units and was conducted in compliance with a plan approved by the South-West Finland Employment and Economic Development Centre.

The Southwest Finland Environment Centre brings up in its statement the need to also consider possible later utilisation of the cooling water, in addition to the as high immediate efficiency as possible. The structures of the plant unit will be implemented so as to allow later utilisation of the cooling water. TVO will prepare an environmental plan for the construction stage of the Olkiluoto 4 project in the same way that a plan was prepared for the Olkiluoto 3 project, and will submit the plan to the control authority for information at a suitable phase.

Applicant's personnel resources and expertise

TVO employs more than 750 experts in the different sectors of the nuclear field. During the construction of the Olkiluoto 1 and Olkiluoto 2 plant units and nearly thirty years of operation of these units and during the construction of Olkiluoto 3, TVO’s personnel have gained significant expertise. The operating results of the current plant units in Olkiluoto have been at the top level in the world.

Suitability of plant site

Svenska Landbruksproducenternas centralförbund concludes that if nuclear power is needed in addition to bioenergy to satisfy the energy demand of Finland, the nuclear power plant should primarily be constructed on an existing plant site.

The Radiation and Nuclear Safety Authority has in its preliminary safety assessment concluded that more than 30 years of experience has already been gained from the operation of Olkiluoto 1 and 2 plant units located in Olkiluoto and that safety analyses regarding external hazards (such as weather conditions) have been performed for the Olkiluoto site. Olkiluoto can on the basis of the analyses be considered a safe site with no significant hazards caused by phenomena affecting several plant units at the same time.

The Ministry of Agriculture and Forestry suggests in its statement that TVO has not had adequate studies conducted regarding the possible rise of sea level in Olkiluoto due to climate change. The occurrence of extreme weather phenomena and the impact of the climate change on them and on the fluctuations of sea level are taken into consideration in the design of the Olkiluoto 4 plant unit. TVO carries out for this purpose close and long-term cooperation with the Radiation and Nuclear Safety Authority and the Finnish Meteorological Institute e.g. in the national research programme on nuclear safety (SAFIR2010). According to the information available at present, the expected changes in sea level in Olkiluoto are not significant during this century taking land uplift into consideration. The Radiation and Nuclear Safety Authority has also concluded this in its preliminary safety assessment.

The Ministry of Transport and Communications pays attention to the improvement implemented on road No. 2176 for the Olkiluoto 3 project in 2004-2005, but concludes that new traffic arrangements will be needed for the Olkiluoto 4 project. The Municipality of Luvia also refers to the increased amount of traffic on highway No. 8. However, the Provincial Government of West Finland states that progress has been made in terms of traffic safety in Olkiluoto and there are no major problems.

TVO is of the opinion that the Company has for the application for the decision-in-principle conducted adequate analyses on the planned site with respect to power plant technology and safety.

Nuclear safety and plant alternatives

TVO presented five plant alternatives in the application for the decision-in-principle but also pointed out that other plant alternatives not included in the feasibility studies could also be considered in the selection of the plant alternative for implementation.

The statement of the Ministry of the Environment suggests that TVO cannot select a plant alternative, which was not known during the review of the application for the decision-in-principle. The Radiation and Nuclear Safety Authority has, in its preliminary safety assessment, assessed the five plant alternatives referred to in TVO's application. STUK concludes that all the alternatives can be made to fulfil Finnish safety requirements. TVO is at present not aware of any aspects that would call for the consideration of other alternatives.

Austria's statement is of the opinion that TVO should report the general results of the probabilistic safety analysis (PRA) as important safety indicators. These include e.g. the core-melt probability and the probability of a major release. TVO concludes that the Company works in cooperation with the plant suppliers to supplement PRA and will at the same time make the presumptions, reliability data and modelling used in the analysis more explicit. At this point the purpose of PRA analyses is to demonstrate that the plant alternative fulfils or can be made to fulfil the Finnish probabilistic safety objectives. The plant alternatives cannot at this stage be placed in an order of superiority on the basis of PRA analyses.

Greenpeace and the Municipality of Nakkila, among others, bring up the risks involved in the production of nuclear power and the possibility of a rare accident.

Austria also points out that unmitigated accidents and the radioactive releases resulting from them should also be analysed.

Pursuant to Section 10 of the Government Decree on the safety of nuclear power plants (733/2008), the limit for the release of radioactive material arising from a severe accident is a release which causes neither acute harmful health effects to the population in the vicinity of the nuclear power plant, nor any long-term restrictions on the use of extensive areas of land and water. The requirement regarding the use of areas of land and water will be satisfied if the release of cesium-137 does not exceed 100 TBq. In Finland, nuclear power plants are required to be designed so as to make the probability of accidents resulting in a release in excess of this value extremely small for a light water reactor designed in compliance with present safety requirements. The releases resulting from a severe reactor accident are in any case taken into account in the planning of emergency response and rescue arrangements.

The Radiation and Nuclear Safety Authority concludes that the design objectives and principles of the plant alternatives are in main parts consistent with Finnish safety requirements. Although the plant alternatives assessed in the application do not as such meet Finnish safety requirements in all parts, modifications can in the opinion of the Radiation and Nuclear Safety Authority be implement at later phases. This means that there are no obstacles to the requirements laid down in the Government Decree (733/2008) being fulfilled. The Advisory Committee on Nuclear Safety accepts the assessment of the Radiation and Nuclear Safety Authority.

Emergency response, rescue and physical protection arrangements

The statement of the Western Finland Provincial Government concludes, among others, that it is important that enough personnel resources are reserved in cooperation with the local rescue authorities, the access of rescue vehicles to the plant site is ensured and the performance of possible evacuations is secured under all conditions.

The Ministry of the Environment states that the licensee should record in the emergency plan the practical activities with which the environment will be restored after possible radioactive fallout and how the possibly substantial amounts of waste containing radioactive substances will be treated after such fallout.

Emergency response arrangements at nuclear power plants are governed by the Government Decree on Emergency Preparedness at Nuclear Power Plants 735/2008, YVL Guide 7.4, Decree 774/2001 of the Ministry of the Interior and VAL guide 1.1. As the licensee, TVO complies with these regulations in the preparation and maintenance of the emergency plan. TVO is also prepared to develop in cooperation with the authorities environment restoration plans on a tight schedule, if necessary. TVO's long experience in the processing and storage procedures of radioactive waste during normal operation creates a good basis for the waste management aspects included in such restoration plans.

The Ministry of the Environment also refers in its statement to provisions regarding chemical safety and the regulatory obligation for the preparation of an internal rescue plan. TVO has prepared for the existing power plant units internal rescue plans, which describe rescue arrangements and response arrangements for chemical accidents.

These rescue plans have been prepared in compliance with the Decree on the Handling of Dangerous Industrial Chemicals and Their Safe Storage (59/1999).

The Ministry of the Interior's Department for Rescue Services pays attention to the multiplicative effects of a potential accident in the area of a significant conglomeration of nuclear power plant units. However, in crisis conditions the protection of one local conglomeration can be organised faster and with less resources than the protection of decentralised production plants, as is concluded by the Western Finland Provincial Government. TVO has implemented in Olkiluoto in good cooperation with local and regional authorities already for more than thirty years the physical protection and emergency response arrangements referred to in the Nuclear Energy Act, which is also concluded by the Satakunta Rescue Services and the Western Finland Provincial Government.

Emergency drills are organised at the Olkiluoto nuclear power plant on a regular basis in collaboration with local rescue services as well as regional and national authorities. The near environment of Olkiluoto can be considered sparsely populated. The Western Finland Provincial Government concludes that it is justified and rational from the point of view of safety structures and the resources of the emergency services to locate the new nuclear power plant unit on the site of the existing units.

The matters referred to above are also brought up in the statement of the Radiation and Nuclear Safety Authority, which concludes that TVO meets all the prerequisites for the implementation of the licensee's regulatory physical protection and emergency response arrangements for the new nuclear power plant unit in Olkiluoto as well as for the other nuclear facilities related to the operation of the unit, as referred to in the application.

Procurement of nuclear fuel and associated environmental impact

The social responsibility policy of TVO stipulates that the products and services procured by the Company shall meet TVO's strict quality and environmental requirements. This policy is also applied to the procurement of nuclear fuel and uranium for the fuel.

The Ministry of the Environment urges in its statement TVO to accept its responsibility for the environment on a large scale and to require strict action from the suppliers of raw uranium for environmental conservation and radiation protection. WWF and the Finnish Association for Nature Conservation FANC, among others, also bring up in their statements the environmental and social impact of uranium production.

TVO concludes that the operators in the fuel supply chain, including uranium producers, have as a rule adopted an environmental system based on the ISO 14 001 standard as well as a quality management system based on the ISO 9 001 standard.

The Ministry of the Environment particularly brings up in its statement Kazakhstan, and is of the opinion that the environmental regulations and the enforcement of the regulations in Kazakhstan are not necessarily on par with Western countries. According to TVO, all the operators who supply nuclear fuel to the Company use

modern environmental and quality management systems, which have also been duly certified.

TVO will also in the future monitor the action of the operators of the uranium production and processing chain with respect to quality, environmental and occupational health and safety matters. Similarly, TVO will also in the future pay particular attention in the selection of the suppliers to the responsibility shown by the suppliers toward these matters.

Safety and costs of storage and transport of nuclear waste

Nuclear waste management for the Olkiluoto 4 plant unit is to be arranged using the methods and to some extent the facilities designed for the nuclear waste management of the existing Olkiluoto units.

As concluded in the statements of the Ministry of the Environment, Municipality of Eurajoki, Southwest Finland Environment Centre and several other bodies, Olkiluoto is well suited as the site for the potential new nuclear power plant unit, since all the required nuclear waste management operations will be available in Olkiluoto in the future. The Finnish Association for Nature Conservation FANC brings up, among others, the possible disturbances and problems related to the transport of nuclear waste, as well as the possibility of terrorism. The Åland Government pays particular attention to the risks involved in sea transports.

As far as this matter is concerned, TVO is also of the opinion that Olkiluoto is the best site for the new nuclear power plant unit owing to e.g. the fact that transport of spent nuclear fuel will be avoided. The nuclear safety risks involved in the transport of unirradiated (fresh) fuel are extremely small. In other respects, TVO refers to the application submitted by Posiva to the Government on 25 April 2008; "Application for a decision-in-principle regarding the expansion of the final disposal facility for spent fuel for the Olkiluoto 4 unit", and to the separate statement process conducted with respect to this application.

Participation and communication

Some statements and opinions address participation in the Olkiluoto 4 project and the restriction of certain communication activities to the near environment of Olkiluoto. Various stakeholder groups have been given the opportunity to obtain information about and participate in the design phases implemented so far, i.e. the Environmental Impact Assessment (EIA) and decision-in-principle procedures.

During the EIA procedure, debates and interactive events were arranged for various parties, in the form of e.g. follow-up group meetings, small group interviews, events for residents of the near environments as well as public events. Also, a survey was conducted among the residents of Eurajoki and Rauma, with a sampling of more than 1100 persons. The Ministry of Employment and the Economy, which is the contact authority for the project, invited statements and opinions at both the EIA procedure stage and EIA Report stage. The Ministry invited statements also during the decision-in-principle procedure from the bodies referred to in the Nuclear Energy Act as well as from other organisations.

TVO's objective is to tell realistically through open communication about the impacts of nuclear energy production and the risks involved in it.

Conclusions

In TVO's opinion, the conditions laid down in Section 14, Subsection 1 of the Nuclear Energy Act for the granting of the decision-in-principle are fulfilled for TVO's project. The Municipality of Eurajoki has supported the construction of the nuclear facility in the statement it has submitted pursuant to Section 12 of the Nuclear Energy Act. In TVO's view, no factors, which would indicate that TVO does not meet adequate preconditions to construct the nuclear power plant unit safely, have come up in the hearing process related to the decision-in-principle procedure. In TVO's view, the construction of the new nuclear power plant unit in Olkiluoto is in line with the overall good of society.

APPENDIX 2

Review on nuclear waste management

Decision-in-principle on the construction of a nuclear power plant unit and expansion or construction of nuclear facilities required for the operation of the unit

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1 Preface

Pursuant to Section 26 of the Nuclear Energy Decree (161/1988), the Ministry of Employment and the Economy must submit to the Government for the making of the decision-in-principle on a nuclear facility a special review on the available and planned methods for nuclear waste management, their safety, environmental impact, economy and applicability in Finnish conditions.

Five applications for a decision-in-principle on the construction of a nuclear facility are under review by the Government. Teollisuuden Voima Oyj (TVO) applies for a decision-in-principle on the Olkiluoto 4 nuclear power plant unit. Fortum Oyj and Fortum Power and Heat Oy applies for a decision-in-principle on the Loviisa 3 nuclear power plant unit. Fennovoima Oy applies for a decision-in-principle on a new nuclear power plant. Posiva Oy applies for a decision-in-principle on expanding the final disposal facility for spent nuclear fuel to accommodate spent fuel from the Olkiluoto 4 unit and from the Loviisa 3 unit.

This Appendix describes Teollisuuden Voima Oyj's overview plan for nuclear waste management and the statements submitted on this plan. According to Teollisuuden Voima Oyj's application for the decision-in-principle and the Radiation and Nuclear Safety Authority's preliminary safety assessment, nuclear waste management for the Olkiluoto 4 nuclear power plant unit is to be organised using the same plans, methods and to some extent also the same waste facilities as for the existing nuclear power plant units.

The description of the implementation of nuclear waste management is based on the report "Review of status of plans and implementation of nuclear waste management in Finland and other countries", prepared by VTT by order of the Ministry of Employment and the Economy (VTT Research Notes 2515, December 2009).

The producer of nuclear waste bears pursuant to the Nuclear Energy Act total responsibility for waste management. The responsibility covers research, design and implementation phases, including their costs. Waste management activities are subject to licence; the research phase is also controlled by authorities. Waste management is controlled using the same methods as in the control of the production of nuclear energy.

Being responsible for waste management, power companies must submit every three years their research and implementation programmes regarding waste management to authorities for review. The purpose of this procedure is to ensure that efforts in research and design regarding waste management proceed in an adequate extent and according to plans. In addition, the parties responsible for waste management must at regular intervals update the technical plans prepared for the decommissioning of power plants as well as the safety analyses of waste management, including final disposal facilities.

After the party responsible for waste management has closed the final disposal repository in an approved manner and paid the Government the fee for the future surveillance and control of nuclear waste, the title to and the responsibility for the waste is transferred to the Government. Pursuant to the Nuclear Energy Act, final disposal must in all aspects be implemented so that no subsequent control is required to guarantee safety.

In Finland, nuclear waste management covers the activities related to the processing, storage, transport and final disposal of low and intermediate level operating waste generated as a result of the operation of the reactors, spent nuclear fuel as well as decommissioning waste. However, this review addresses nuclear waste management in connection with all the phases of the nuclear fuel cycle, including uranium mining, isotope enrichment and the production of fuel.

Most of the radiological impact caused by the fuel cycle on the environment results from the mining of the uranium ore and enrichment of the ore as well as from the production of electricity. The radiation doses that these activities cause to the population in the near environment of the production plants are in practice a fraction of the dose caused by natural background radiation. The impact caused by the isotope enrichment of uranium, the production of fuel and the storage and final disposal of the spent fuel is even smaller. Most of the radiation doses caused to people working at various phases of the fuel cycle (uranium mining and ore enrichment, uranium enrichment, fuel production, power generation, handling and final disposal of spent fuel) result from the power generation.

2 Environmental impact of initial fuel cycle phases

The uranium required for the production nuclear fuel is mined in both opencast and underground mines. Uranium is also extracted directly from the ground. In some mines, uranium is a by-product of e.g. copper and gold, whereby the separation of uranium does not significantly increase the environmental impact of the mine.

Apart from the impact caused by radiation, the other environmental effects of mines producing uranium are similar to those of other metal mines and directly proportional to the amount of the mined ore. On the other hand, when uranium is separated from by-product rock in mines that focus on other metals, the amount of radioactive material left in the area is reduced.

The radiation effects caused by the mining of uranium are caused when the radionuclides contained in the uranium ore are released into the atmosphere and waterway. The release of radioactive material is reduced by isolating the waste heap ore from groundwater with clay. Releases of radioactive gases into the atmosphere are also restricted by covering the rock heaps with a tight layer of soil. In the largest production countries, Australia and Canada, mining operation is subject to an environmental impact assessment procedure.

The natural uranium is for the production of fuel enriched for most reactor types by increasing the proportion of uranium-235 isotope. After the enrichment process about 15 percent of the original amount of uranium proceeds to the fuel production process. The remaining depleted uranium is stored in special storage tanks near the enrichment plants. Depleted uranium is only mildly radioactive but, due to its chemical toxicity, it has to be processed so as to prevent the uranium from accessing the organic nature. If no use is found for depleted uranium, it must be placed for final disposal in the ground in the same way as other low and intermediate level nuclear waste. The activities and the environmental impact related to the production of fuel are regulated and controlled pursuant to the national laws in each country.

3 Spent nuclear fuel management

3.1 Direct final disposal

3.1.1 Main principles of direct final disposal

The description presented here is based on the report "Review of status of plans and implementation of nuclear waste management in Finland and other countries", prepared by VTT (VTT Research Notes 2515, December 2009).

The spent nuclear fuel used in the open fuel cycle is placed for final disposal deep in the bedrock, for example crystalline bedrock or argillaceous rock or evaporate deposits. The safety of final disposal is in the proposed technical solutions based on multiple release barriers. They ensure that nuclear waste cannot gain access in adverse amounts in the organic natural or come into contact with humans. At present the general perception is that final disposal deep in the bedrock, i.e. geological final disposal, offers the technically best and most realistic possibilities of all the studied final disposal alternatives to isolate high level nuclear waste from the living environment for an adequately long period of time.

In the basic model for final disposal presented by the Finnish Posiva Oy and the Swedish Svensk Kärnbränslehantering Ab, the spent nuclear fuel is placed in separate canisters made of copper and cast iron in the final disposal repository located in the bedrock at a depth of ca. 500 metres. The canisters are surrounded with bentonite clay, which is used to e.g. restrict the flowing groundwater from coming into contact with the canisters. After the last canisters have been placed in the final disposal repository, all the tunnels are backfilled with blocks and pellets of clay and the access tunnels are closed.

In several countries, the safety requirements stipulate that a method must be used which allows subsequent retrieval of the spent nuclear fuel for reprocessing. In many countries it is required that the plans for the long-term safety of the final disposal of spent nuclear fuel or high level waste incorporate a possibility to retrieve the spent nuclear fuel of the high level waste from the storage or repository back to the surface.

Retrieval can be considered necessary in the future if a significant leap is made in transmutation technology, for example, and the separation of raw material suitable for power production is considered to be advantageous in terms of the total economy. Retrieval may also become necessary if deficiencies or damages to the release barriers that could essentially affect the long-term safety of final disposal are detected during the final disposal process or some time afterwards. Moreover, the reusability of nuclear fuel in the production of energy as a result of technological development could create a need to retrieve the fuel or to give up the direct final disposal of nuclear fuel.

In geological final disposal the fuel canisters are surrounded with a rock mass, which completely attenuates all direct radiation to the ground surface. The final disposal depth of hundreds of metres also protects the underground structures of the final disposal facility against the eroding effects of the ice ages on the bedrock. The groundwater flowing in the cracks and crevices of the bedrock forms the only access route for the radioactive material contained in spent nuclear fuel to come into contact with humans and the rest of the organic nature. The multiple barrier system (e.g. encapsulation of fuel and bentonite backfilling of repository) included in the plans for final disposal incorporates engineered barriers designed to restrict the groundwater from coming into contact with the spent nuclear fuel. The objective of the design of the multiple barrier system for the final disposal facility is to ensure that the failure of any one individual release barrier will not essentially reduce the performance of the whole system.

The final disposal of encapsulated spent nuclear fuel deep in the bedrock is not seen to involve any accidents resulting in major single releases, which would cause rapidly appearing radiation effects in the population. The possible radiation effects of final disposal concern residents in the near environment of the plant and probably will not occur until far in the future.

Should the engineered barriers become damaged, the radioactive material contained in the spent nuclear fuel emplaced in the bedrock can be released first into the bedrock when they are dissolved in the groundwater and then be carried by the groundwater currents from the bedrock to the biosphere causing radiation doses through various exposure routes. According to current calculations, if the natural release barriers (primarily rock) and the engineered barriers for radionuclides act as planned, they will ensure that the increase in the annual radiation exposure to the residents of the near environment would be in the order of 0.001 mSv. The doses caused to larger population groups would be significantly lower than this. Thus, the population dose would only be a small fraction of the population dose caused by background radiation.

Faulting following an ice age could constitute the most severe hazard to the multiple barrier system of the final disposal facility. The effects of such conditions have been evaluated with the extremely pessimistic assumption that a major fault intersecting the final disposal facility would damage tens of canisters simultaneously already after just 1000 years. According to the results, the increase in the radiation dose caused to the residents of the near environment would be minor in comparison with natural background radiation and the expected dose would be lower than the limit dose defined in safety requirements. However, for reasons of safety the final disposal repositories are located in as integral bedrock areas as possible, since faulting movement will probably primarily take place along existing joints (e.g. fracture zones

and crushed zones). The bentonite used for backfilling also protects the canister against minor bedrock movement taking place in the repository.

3.1.2 Teollisuuden Voima Oyj's overview plan and statements issued on it

According to the application for the decision-in-principle, the spent nuclear fuel is to be placed for final disposal in the final disposal facility under planning by Posiva Oy and owned by TVO and Fortum Power and Heat Oy. A research facility (ONKALO) is under construction on the site to allow research to verify the suitability of the site for final disposal. A separate application has been submitted to the Government regarding the final disposal of spent nuclear fuel generated at the Olkiluoto 4 unit,

According to the preliminary safety assessment, the Radiation and Nuclear Safety Authority assesses the suitability of the solution and the site proposed for the final disposal of spent nuclear fuel in a separate preliminary safety assessment, which concerns Posiva Oy's application to expand the final disposal facility for the Olkiluoto 4 plant unit.

The Southwest Finland Environment Centre concludes that Olkiluoto is excellently suited as the site for the new nuclear power plant units possibly constructed in Finland, as the existing units and the unit under construction on the site require many solutions, which it would not be rational to implement on several sites. Many of the operations of the new unit, such as waste management and final disposal of waste, can be best organised by increasing the capacity of the methods used at the existing plants.

The statement of the Regional Council of Satakunta brings up factors that specifically support Olkiluoto in Eurajoki as the site for possible additional construction of nuclear power. One of these factors in favour of Olkiluoto is that that Posiva Oy has submitted an application for the decision-in-principle on the expansion of the final disposal facility for spent nuclear fuel for the needs of the Olkiluoto 4 unit; in other words, the facilities that are being studied and investigated, also accommodate spent fuel from the Olkiluoto 4 unit.

3.2 Encapsulation of spent nuclear fuel – overview

Any releases of radioactive material from the final disposal facility in connection with the encapsulation of the spent fuel are under normal conditions smaller than corresponding releases from the nuclear power plant and insignificant in comparison with natural background radiation. Similarly, according to estimates, the radiation doses caused to the personnel of the encapsulation plant are smaller than the doses caused to the personnel at nuclear power plants.

The amounts of radioactive material handled at the encapsulation plant at any one time are also small in comparison with the amounts of material at nuclear power plants. Encapsulation takes place in insulated chambers under remote control at a low temperature and low pressure, which reduces the probability of handling disturbances and decreases the amounts of releases caused by such disturbances. The radioactive material does not need to be processed prior to encapsulation, so the risks involved

with the process are clearly smaller than the risks associated with reprocessing plants. Releases of radioactive material can only occur if the fuel assemblies are damaged as a result of e.g. falling. So far no actual operating experience is available of encapsulation plants, but the encapsulation process can justifiably be presumed to be easy to implement as far as radiation safety is concerned. The experience gained from the fuel transfer and handling technology used at interim storages and reprocessing plants support this presumption.

3.3 Interim storage of spent nuclear fuel

3.3.1 Main principle of interim storage

The description presented here is based on the report "Review of status of plans and implementation of nuclear waste management in Finland and other countries", prepared by VTT (VTT Research Notes 2515, December 2009).

Very long-term interim storage has been proposed as an alternative solution for spent nuclear fuel management. The technology for the interim storage of spent nuclear fuel is not in principle dependent on whether the storage is planned to be short or long-term. The significance of subsequent control and maintenance of safe operating conditions are emphasised the more the longer the planned duration of interim storage. Alternative interim storage methods include e.g. water pool and dry storage methods.

Spent nuclear fuel is nowadays usually stored in water pool storages. This is the method used e.g. at Finnish nuclear power plants. Experience in this so-called wet storage method has been gained already for several decades. Operating experience has shown that all the imaginable mechanisms that could potentially damage the fuel can be prevented, provided the correct conditions are maintained in the storage pools. It can be predicted on the basis of the operating experience from water pool storage that the fuel assemblies stored in the water pools will remain undamaged for more than 50 years. Estimates based on operating experience from the Swedish underground central interim storage CLAB refer to more than 100 years without damage. However, the fuel assemblies will only remain undamaged provided the chemical properties of the water in the storage pool are maintained at correct values throughout the storage period. In carefully controlled conditions even extremely long-term interim storage will not cause radiation hazards to the residents of the near environment or the operating personnel.

Dry storage can be implemented either above ground or underground. The fuel assemblies need to be stored in the water pools provided near the reactor or in interim water pool storage for a few years before they are transferred to the dry storage. After this water pool storage period, the cooling based on natural air circulation in the dry storage is adequate to remove the residual heat generated in the spent fuel. In comparison with wet storage, the requirements for monitoring and control are less stringent in dry storage than in water pool storage. Operating experience gained from dry storage has been positive and the possibility to continue interim storage for up to 50-150 years is considered good. However, the dry storage facilities in use at present are designed for interim storage of similar periods as the water pool facilities used also

in Finland. In some countries, such as France, plans have been presented for dry storage facilities designed for clearly longer interim storage periods of up to hundreds of years.

The releases caused by the interim storage of spent nuclear fuel either at the power plant or in a separate interim storage facility are in normal operation essentially smaller than releases from the actual nuclear power plants, or insignificant in comparison with the doses caused by natural background radiation.

Practical experience has shown that interim storage of spent nuclear fuel in wet or dry storage facilities is based on proven and safe technology. The key safety issue related to water pool storage is the assurance of uninterrupted cooling. The storage facilities are for this reason constructed to withstand considerable mechanical stresses and other disturbances, such as e.g. power cuts.

3.3.2 Teollisuuden Voima Oyj's overview plan and statements issued on it

Spent nuclear fuel is cooled for 3-10 years in water pools at the Olkiluoto power plant. The spent nuclear fuel is then transferred to the interim storage for spent fuel located in Olkiluoto. According to the application for the decision-in-principle, either the existing interim storage facility is expanded or a new facility is constructed for the spent nuclear fuel generated at the Olkiluoto 4 plant unit.

The Radiation and Nuclear Safety Authority (STUK) concludes in its preliminary safety assessment that geological investigations have been carried out in the area. No geological or seismic features in the area or other factors are known of that would constitute an obstacle to the interim storage of spent nuclear fuel as described in the application for the decision-in-principle.

3.4 Transport of radioactive material

3.4.1 Overview

The description presented here is based on the report "Review of status of plans and implementation of nuclear waste management in Finland and other countries", prepared by VTT (VTT Research Notes 2515, December 2009).

A lot of experience is available in the transport of spent nuclear fuel and other radioactive materials and functioning systems as well as comprehensive internal safety regulations are in place for such transports. The transport cask solutions have been tested in view of diverse disturbances (e.g. intense collisions, fires and sinking in water).

The safety analyses made to assess the risks caused by the transports have covered both normal transports and various disturbances and accidents. The results indicate that the radiation doses caused by transport operations are minor in comparison with natural background radiation and the defined safety requirements. Even in extremely severe damages of the transport cask the maximum doses caused by the release of radioactive material to the population of the near environment (within less than 1 kilometre) are clearly smaller than the dose obtained from natural background radiation over an equal period of time.

3.4.2 Teollisuuden Voima Oyj's overview plan and statements issued on it

The spent nuclear fuel is transferred on the Olkiluoto power plant site from the reactor building to the interim storage and further from the interim storage to the final disposal facility. According to the application for the decision-in-principle, all transfers of fuel take place within the closed plant site and fuel need not be transported on public roads.

The Ministry of the Environment concludes in its statement that the risks involved in the transport of spent nuclear fuel are reduced when spent nuclear fuel need not be transported on public roads, railways or waterways. Preparedness for emergency response action is on a high level should accidents occur, and there are no residences in the area. Another factor in favour of the applicant is that all the required waste management activities are in the future available on the island of Olkiluoto.

The statement of the Municipality of Eurajoki concludes that the final disposal of spent nuclear fuel on the site of the nuclear power plant will not increase the need for transport and therefore is the best solution for the residents of both Eurajoki and the whole of Finland.

4 Alternative methods for spent fuel management and their environmental impact

4.1 Reprocessing

In a closed fuel cycle, the spent fuel is reprocessed and uranium and plutonium, which can be utilised as fuel, are reused. Reprocessing produces strongly radioactive reprocessing waste, which has to be placed in a final disposal facility. In practice, however, only a part of the plutonium and uranium separated in reprocessing can be utilised in the production of fuel for light water reactors of the current type.

The expediency of reprocessing can be analysed not only from the point of view of safety and technology but also in terms of e.g. economy. Direct final disposal has been selected particularly in countries where foreign reprocessing services would have to be used and where the nuclear power capacity is relatively small. Reprocessing services are only available in a few countries and the implementation of reprocessing in a national plant built solely for the needs of e.g. Finland is not sensible in terms of safety and technology. On the other hand, the Finnish Nuclear Energy Act prohibits the export of spent nuclear fuel generated at power plants, which in the current situation prevents spent nuclear fuel generated in Finland from being reprocessed abroad.

The high level radioactive liquid waste produced in reprocessing is vitrified, i.e. dried and mixed with molten glass. The glass is poured in steel containers. In principle, the vitrified waste requires final disposal in the way as the spent nuclear fuel generated in the open fuel cycle, and the implementation of final disposal is as demanding in terms of safety and technology.

The population doses caused by the long-lived radioactive material released during normal operation of the reprocessing plant are estimated to be larger than the population dose caused by a nuclear power plant.

The risks involved in accidents depend essentially on the nature of the materials processed at the plant and the amounts of radioactive material contained in them. A significant difference between a reprocessing plant and a nuclear power plant, for example, is that the amount of radioactive material handled simultaneously is essentially smaller at a reprocessing plant. On the other hand, the material is at a reprocessing plant in a more easily dispersible form (solutions, powders, gases) and undergoes strong physical and chemical reactions. The solidification process or the vitrification of high level liquid waste does not, according to experience, involve any significant safety problems.

4.2 Intensified reprocessing and transmutation

Efforts have been made to develop for the processing of spent nuclear fuel technology, which would enable the most highly radioactive material to be converted by a nuclear-physical process into a less harmful form. The objective of this so-called transmutation is to shorten the period of time during which the material can cause danger. According to the most recent plans that have been presented, the first phase of the method would be a separation process more intense than the reprocessing method used at present. At this phase not only uranium and plutonium would be separated from the spent nuclear fuel, but also some long-lived fission products and also other actinides. The separated substances would then be converted in nuclear reactions, i.e. transmuted, into other substances using either normal reactor or specific transmutation plants.

Even the most efficient methods that have been designed could not completely treat with all the radioactive substances, or at least the time required for this would be technically unreasonably long. This means that a certain part of the waste will in any case have to be eventually placed in final disposal

Transmutation projects are still at initial development stages and the true technical possibilities of the method are yet to be proven. The principle of transmutation as an alternative is not a new idea, however, as the physical arguments for the method were presented already several decades ago. Transmutation, and the more efficient separation technology that it requires in comparison with the current reprocessing plants, have been estimated to be clearly more expensive than direct final disposal.

Transmutatation can at present be considered primarily an area for long-term research regarding the general development or expanding use of nuclear energy. The potential industrial application of transmutation is according to current perception at least decades away.

Due to its initial development stage, it has not been possible to estimate the costs of transmutation with any real accuracy.

5 Operating waste and its management

5.1 Main principle of operating waste management

The description presented here is based on the report "Review of status of plans and implementation of nuclear waste management in Finland and other countries", prepared by VTT (VTT Research Notes 2515, December 2009).

Operating waste generated in the operation of the power plant consists of ion exchange resins used in the cleaning of process water, evaporation slurries, filters and filter components, contaminated scrap metal, activated metal waste and diverse mildly contaminated tools, protective clothes and cleaning materials. Operating waste is usually very low-level waste and their activity decreases to a completely safe level within a few hundred years.

The processing of low and intermediate level waste is usually divided into three stages: (1) pre-processing, (2) volume reduction and (3) final processing and packing. The main purpose of pre-processing is to make the waste easier to process further. Pre-processing can include the collection, sorting, neutralisation or some other chemical regulation, decontamination and initial characterisation of waste.

Wet waste comprises various masses and slurries from ion exchangers, filters and evaporators. The volume of liquid waste can be reduced by means of the following methods, for example: ion exchange, mechanical filtration, evaporation, chemical precipitation, centrifugation, ultra filtration, reverse osmosis and burning. The volume of solid waste, on the other hand, can be reduced by burning, compression, fragmentation or melting. In final process the waste is put into permanent form and packed in a container for storage, transport and final disposal. Liquid waste and fine-grained waste are usually put into more permanent form by solidifying them e.g. in concrete (Loviisa nuclear power plant) or bitumen (Olkiluoto nuclear power plant).

Dry operating waste comprises so-called maintenance waste, dismantled metal components and air filters. Filters are usually placed in the container without any processing. Maintenance waste can be compacted and packed into a container or part of it can be burned with the ash then placed in a container as such or after solidification. Metal components can be decontaminated and fragmented before they

are placed in the container. Final disposal can be implemented in the same way as for solidified wet operating waste.

Finland adopted already at the beginning of the 1980s the policy of constructing the final disposal repositories for low and intermediate level waste from nuclear power plants in the bedrock of the plant site in question. The Olkiluoto final disposal repository was commissioned in 1992. The repository consists of two large silos, one for low level waste and the other, which is provided with an inner concrete silo, for intermediate level waste. The interim storage for small waste, managed by the Government, is also located in this repository. A similar final disposal repository constructed in the bedrock at a depth of ca. 100 metres was commissioned on the Loviisa Hästholmen power plant site in 1998. A solidification facility for liquid waste was commissioned in Loviisa in 2008 and the final disposal repository has a separate tunnel for waste processed in the solidification facility.

Fortum Power and Heat Oy and Teollisuuden Voima Oyj also plan to organise the final disposal of all low and intermediate decommissioning waste in the same way by expanding the existing final disposal repositories.

At present, two conceptual solutions are primarily used for the final disposal of operating waste: a concrete bunker in the top layers of the ground and a system of caves at medium-depth in the bedrock. In both solutions the isolation of radioactive material is to a large extent based on the same phenomena: (1) durable waste packages, (2) isolation capacity of concrete structures and the favourable chemical environment created by them, (3) low groundwater flow volume near the repository, (4) slow propagation of radionuclides from the repository through the surrounding soil or bedrock into the human living environment. The most significant difference between these two solution models is the fact that a final disposal repository located in the top layers of the ground requires control for a period of some hundreds of years after the repository is closed. Control is necessary in order to ensure that the insulation layers on top of the repository are not weakened as a result of erosion or human action, for example. Final disposal repositories built in the bedrock, on the other hand, require no subsequent control after the closing of the repository for safety reasons.

5.2 Teollisuuden Voima Oyj's overview plan and statements issued on it

The final disposal repositories for low and intermediate level waste, which are in use in Olkiluoto, can be expanded to accommodate for the needs of the Olkiluoto 4 unit. According to the application for the decision-in-principle, more repository space will be excavated for final disposal in the vicinity of the existing repositories.

According to the preliminary safety assessment of the Radiation and Nuclear Safety Authority, each presented plant alternative includes adequate facilities for the handling and storage of low and intermediate level operating waste at the Olkiluoto 4 plant unit. Operating waste will be emplaced in the existing final disposal repository (VLJ repository), which will need to be expanded later. Geological investigations have been carried out on the site. No geological or seismic features of the area or other factors are known of that would constitute an obstacle to the implementation of the

expansion of the final disposal repository for operating waste as described in the application for the decision-in-principle.

The Advisory Committee on Nuclear Safety concludes in its statement that the processing, storage and final disposal of low and intermediate level operating waste has been adequately assessed in the application for the decision-in-principle and that the processing, storage and final disposal of operating waste can be organised in a safe manner.

The Satakunta Employment and Economic Development Centre concludes in its statement that the final disposal facilities available in Olkiluoto for low and intermediate level operating waste can be expanded to also accommodate for the needs of the planned new unit.

6 Decommissioning of nuclear power plants and decommissioning waste

6.1 Principles for implementation of decommissioning waste management

The description presented here is based on the report "Review of status of plans and implementation of nuclear waste management in Finland and other countries", prepared by VTT (VTT Research Notes 2515, December 2009).

Certain systems and components become radioactive during the operation of the nuclear power plant. The purpose of decommissioning is to ensure that such radioactive materials do not cause adverse effects on the environment after the operation of the plant is discontinued.

Methods normally used for the dismantling of buildings can to a large extent be utilised in the dismantling of nuclear facilities. Special tools and methods are required for the dismantling of the most contaminated systems, such as the reactor pressure vessel, and the structures located in the immediate vicinity of these systems. Several nuclear power plants have already been dismantled in the world, and dismantling methods have been developed and tested in this connection. The costs of decommissioning can also be estimated quite reliably on the basis of the experience gained previously.

The dismantling of the nuclear power plant can technically be started within a few years after the operation of the plant has ceased. Deferred decommissioning, which entails the dismantling of the activated components and structures after safe enclosure, reduces the number of protective measures required to protect the employees involved in dismantling, and further the costs of dismantling. On the other hand, deferral causes costs as the plant must be looked after during safe enclosure and the systems needed for dismantling have to be kept in operating condition. In addition, the maintenance of the competence required at dismantling stage may be endangered during safe enclosure.

The selection of a dismantling method for the dismantling of large metallic systems is essentially influenced by whether the radioactive decommissioning waste is to be placed in the immediate vicinity of the plant or has to be transported over a longer distance. If the final disposal repository is located in the vicinity of the plant, large components, such as the pressure vessel and steam generators can be transported to the repository as such. For longer transport distances they have to be fragmented and in some cases also packed separately. The method used for the processing of such large components affects the decommissioning costs significantly.

The dismantling of nuclear plants consists to a large extent of management of low and intermediate level waste: fragmenting, packing and final disposal of steel and concrete structures. The work is demanding technically and in terms of radiation protection, as some of the structures, primarily the reactor pressure vessel and its internals, are highly radiant and have to be handled under remote control. The dismantling of contaminated structures, on the other hand, requires that the radioactive dust is prevented from spreading and accessing breathing air.

The most active concrete structures – the biological shield round the pressure vessel, which has been activated in the neutron flux – are disassembled fully. For other structures, only the contaminated surface layer is removed in most cases, using various methods.

According to plans, decommissioning waste will at both Loviisa and Olkiluoto plants be emplaced for final disposal in the operating waste repositories, which will be later expanded for this purpose.

Other nuclear facilities, such as temporary waste storage facilities, are decommissioned in the same way as power plants. The dismantling of other nuclear facilities is easier as they do not contain parts activated by neutron radiation the way the reactor pressure vessel and the structures in its vicinity are activated: thus activity levels are lower and the amount of radioactive substances smaller.

6.2 Teollisuuden Voima Oyj's overview plan and statements issued on it

According to the application for the decision-in-principle, the final disposal repositories for operating waste, which are to be constructed on the Olkiluoto site, will be expanded to accommodate also decommissioning waste from the Olkiluoto 4 unit.

According to the preliminary safety assessment of the Radiation and Nuclear Safety Authority, the expansion of the repositories will be made in compliance with the safety requirements laid down in Government Decree 736/2008.

The Advisory Committee on Nuclear Safety concludes in its statement that the processing, storage and final disposal of low and intermediate level operating waste has been adequately assessed in the application for the decision-in-principle and that the processing, storage and final disposal of operating waste can be organised in a safe manner.

The Satakunta Employment and Economic Development Centre concludes in its statement that the final disposal facilities available in Olkiluoto for low and intermediate level operating waste can be expanded to also accommodate for the needs of the planned new unit.

7 Costs of nuclear waste management and provisions for them

Pursuant to Finnish legislation, the producers of nuclear waste are responsible for all activities included in nuclear waste management and for making provisions for the costs caused by waste management. The costs also include the decommissioning of the facilities and the final disposal of dismantling waste. Thus the costs of nuclear waste management are also included in the price of electricity produced with nuclear power. The cost effect of waste management as a whole accounts for about 10 percent of the overall production costs of nuclear electricity.

In order the ensure the implementation of the causality principle, the State Nuclear Waste Management Fund has been established under the Ministry of Employment and the Economy. Funds are collected from the producers of nuclear waste into this Fund on an annual basis to ascertain that all the activities related to nuclear waste management can be implemented in the future in all conditions.

The amount of liability of the parties responsible for nuclear waste management refers to the total amount of the future costs of the management of the nuclear waste produced by the end of the previous calendar year. The party responsible for nuclear waste management has to present the plan on which the cost estimates are based, or the waste management scheme to the Ministry for approval for the first time well in advance of the start of operation that produces nuclear waste and at the latest in connection with the application for a licence for such operation. The party responsible for waste management shall subsequently supplement the waste management scheme at intervals of three years and present an estimate based on adequately detailed plans of the costs of waste management. The waste management plan must be based on basic solutions, which according to the information available are viable. The uncertainty of the cost information must to a reasonable extent be taken into account as a factor increasing the estimates.

In order to collect the funds corresponding to the amount of liability, the parties responsible for waste management have to make nuclear waste management payments to the State Nuclear Waste Management Fund. The Ministry of Employment and the Economy confirms every year the target for the Fund for the facilities that produce nuclear energy. This target is defined so that the Fund share gradually increases to cover the amount of liability and is equal to it in the year following the 25th year of operation, at the latest. The difference between the amount of liability and the current Fund share is covered with securities issued by the party responsible for waste management.

The total amount of liability of the nuclear power plant units in operation in Olkiluoto and Loviisa was a little over EUR 2 billion at the beginning of 2010; this amount is an estimate calculated on the basis of the nuclear waste generated so far. The amount of liability of the Olkiluoto power plant is at present ca. EUR 1160 million. The total amount of deposits made in the Fund is ca. EUR 1.9 billion. The power companies

have issued securities to the Government for the difference between the amount of liability and the deposits already made in the Fund. The funds collected in the Fund can be lent to a party responsible for waste management or to the Government at the twelve-month Euribor interest rate. The purpose of such loans or some other investments considered safe is to secure the real value of the assets collected in the Fund.

APPENDIX 3

Review on additional nuclear power in terms of energy economy

This report presents the review on the significance of the new nuclear facility project to the energy supply of the country, which is required pursuant to Section 26 of the Nuclear Energy Decree (YEA) of facilities that produce energy. This report is not intended to present a complete description of the status of the Finnish energy economy, or of its problems or solutions of problems, but to focus on describing the significance and the effect of the nuclear power plant project in terms of the public energy economy.

The description of the development of energy economy presented in this report is primarily based on the Government report "Long-term climate and energy strategy" submitted to the Parliament on 6 November 2008, and on the background studies made for that report. More detailed arguments for the description of the energy economy can be found in these documents, if necessary. The consumption estimate of the Department of Energy of the Ministry of Employment and the Economy, prepared in November 2009, is also used as more recent information in the review of the changed economic situation and the structural change of the industry.

1 Significance of outlines of Long-Term Climate and Energy Strategy

The electricity production capacity and the procurement of electricity have to be assessed from the point of view of both, power adequacy (measured in Megawatts, MW) and energy adequacy (measured in Terawatt-hours, TWh). The Government outlines these objectives in the "Long-Term Climate and Energy Strategy" as follows: "The stance of the Government is that the procurement of electricity shall primarily be based on domestic capacity and that domestic capacity shall be able to cover peak consumption and any production disturbances." The first part of the sentence refers mainly to energy adequacy and the second part to power adequacy.

The policy outlined above means that in order to secure the energy adequacy of electricity procurement, enough additional capacity would have to be constructed to eliminate the present dependence on import, to replace power plants that are removed from operation and to cover the increase in consumption. This need can be satisfied by the producers and distributors of electricity as well as by certain electricity consumers by constructing different power plants, which can represent base load power (includes nuclear power, combined heat and power, normal condensing power and hydropower) as well as peak-load power, and to an increasing extent, by wind power. As concerns the base load power plant, nuclear power plants and hydropower plants usually produce electricity with the lowest production costs. The possibilities for constructing additional hydropower are small and the expansion of combined production is limited by the thermal loads, which are reduced through efforts designed to increase energy efficiency and the structural change of the industry.

The Government has in the same report also outlined that the starting point in the review of a decision-in-principle (regarding nuclear power) is that nuclear power is not to be constructed in Finland for permanent export of electricity. The content of this policy is assessed here.

In order to secure the supply reliability and availability of electricity, the electricity capacity must be adequate in terms of power amounts also during the highest consumption peaks of the winter. This requires that either:

a) Base-load power (incl. nuclear power) is constructed as well as peak-load power and regulating power, which will only be operated during consumption peaks (includes gas turbines, hydropower and normal condensing power). The operating times of peak-load power plants are usually short. The construction and combined use of base-load power and peak-load power is an established and cost-efficient practice in the electricity market. Reserve power is also maintained to allow for equipment failures, disturbances in import, etc. In this alternative, electricity is imported and exported and the amount of border lines is dimensioned on the basis of the electricity customers' reasonable demand.

Or alternatively:

b) Base-load power is constructed in excess of the domestic demand and used to cover power adequacy also during peak consumption. The electricity produced with base load power is in this case exported to the neighbouring countries outside the peak consumption periods, or in practice, for most of the year. To dimension border lines accordingly would require massive investments in border lines and in the reinforcement of the national grid, as the electricity has to be transmitted to the border and beyond. A border line alone would not necessarily be enough.

As a result of the policy outlined by the Government, alternative b), which involves substantial export of nuclear electricity on a permanent basis, has to be ruled out, although additional nuclear power would secure power adequacy.

2 Basic strategy for assessment of need for additional nuclear power

In order to keep the electricity bill of the society as small as possible and to keep the wheels of the business life in motion, the majority of electricity should be produced in base load power plants, which produce inexpensive energy and meet the requirements in terms of releases as well as other requirements. In addition, electricity supply must be secured also during peak economic cycles. In order to prevent the procurement of electricity from becoming a restricting factor for the business life, the estimate of the demand for electric energy and the assessment of the adequacy of power capacity based on this estimate, are based on the presumption of the economic development meeting the targets.

3 Aspects related to electricity demand

Annual electricity consumption reached the record value of 90 TWh in 2006 and 2007. Due to the recession experienced at the end of 2008 and during 2009 as well as the structural change of the forest industry, electricity consumption has decreased by almost 10 TWh from the values reached before the recession. Consumption will be restored to some extent, but the decrease caused by the structural change and the

discontinuation of the operation of energy consuming production plants as well as by the improved efficiency of electricity use will be permanent. The forest industry has assessed that the closing of the mills has resulted in a permanent decrease of ca. 3.5 TWh in annual electricity consumption.

The economic recession, the structural change of the forest industry and the improved efficiency of electricity use in households and the service sector are turning the consumption of electricity permanently into a lower than expected growth trend. On the other hand, consumption will be increased by the increasing popularity of electric cars, the increase in the use of heat pumps to replace fossil energy sources as well as the introduction of new products and bio-processing plants in the forest industry and the positive outlook for the metal processing industry. According to the consumption estimate published by the Department of Energy of the Ministry of Employment and the Economy in November 2009 – "Energy demand by 2030" – the consumption of electricity will be ca. 91 TWh in 2020, while in 2009 it was ca. 81 TWh. The same estimate also concludes that the consumption of electricity amounts to ca. 100 TWh in 2030. The estimate is based on the perception of the Finnish Forest Research Institute on the development of forest industry.

The estimate of the consumption of electricity is strongly dependent on the development of the production of traditional forestry products. The new products of the forest industry as well as the plants that produce bio fuels based on wood as a raw material also influence the estimates of electricity consumption.

The electric energy required by electric cars will remain at the level of a few Terawatt-hours in the next few decades and will not be a significant factor for the dimensioning of electricity supply.

According to recent estimates, the production of the forest industry could be higher in 2020 than the figure used in the estimates of the Ministry's Department of Energy. A new estimate suggests that the consumption of electricity will increase to the extent that the electricity supply capacity could be dimensioned by 2020 on the basis of ca. 98 TWh.

The new consumption estimate, together with the previous estimate of the Ministry's Department of Energy, means that the volume of electricity supply corresponding to existing condensing power, imported electricity and electricity capacity to be removed from operation will increase by 2010 to about 17 TWh and would continue to increase after the year 2020.

The electrical output of one large nuclear power plant unit is ca. 13 TWH per year; in other words, Finland could be self-sufficient in electricity supply in the situation prevailing after 2020 if two more new nuclear power plant units, in addition to the Olkiluoto 3 unit currently under construction, were built and commissioned in 2020 or later. In practice, trading in electricity would still continue in the Nordic, European and maybe in part also in the Russian electricity market. Electricity would then be exported from Russia through Finland to the European market, if Russia had electricity to sell. Electricity produced in the Nordic countries and in Finland would also be exported to the European market from time to time.

4 Aspects related to electricity procurement and power adequacy

Finland has already for years been dependent on imported electricity for peak load power (MW); an average of a little over 1000 MW since the year 2000. In 2006 - 2007, the deficit during consumption peaks (TWh) or the difference between the consumption peak and the available domestic production capacity was almost 2 000MW. The decrease in consumption (TWh) has since reduced the demand for peak load power (MW), but the closing of mills in forest industry has also reduced the production capacity.

According to the scenario of the Ministry of Employment and the Economy and the new consumption estimate, in order to secure electricity procurement with domestic capacity during consumption peaks, ca. 2 000 - 3 200 MW of new production capacity would have to be constructed by the beginning of the 2020s and 4 000 – 4 500 MW by 2030. Also, 980 MW of new capacity is needed to replace the existing nuclear power plant in Loviisa, i.e. the total need for new capacity is ca. 4 500 – 5 500 MW. As concluded in Section 1, this would consist of base load power, and of peak load power that is needed on a temporary basis.

It has been presumed in the estimates that the combined heat and power production plants would be replaced with new plants of the same type. It is also presumed in the calculations that part of the conventional condensing power plants can be used as peak load power plants until the end of 2023 to secure the power demand-supply situation, despite the fact that the decommissioning of these plants will have to start after 2016 due to the requirements of the IE Directive regarding emissions of particles. With the exception of the Meripori plant, all the condensing power plants are expected to be removed from operation for good or transferred to power reserve by the end of 2023, at the latest.

Electricity is being imported and exported by the market parties. In recent years, ca. 10 - 12 TWh of electricity has been imported every year from Russia pursuant to contracts. Electricity is imported and exported between Finland and Sweden according to the market situation. Typically electricity is imported to Finland when the hydropower situation is good in the Nordic countries, and exported from Finland when the production of hydropower is on a low level in Sweden and Norway. The maximum import and export volumes with Sweden have been ca. 7 TWh in both directions in the recent years. Some 2 TWh of electricity has in some years been imported from Estonia.

The outlook for export and import is influenced by the changes made in the border connections between the countries. In addition, the final closure of the Ignalina nuclear power plant in Lithuania at the end of 2009 will affect electricity procurement in the Baltic region. For this reason, no permanent export to any significant extent utilising the increasing transmission connection (Estlink-2) is expected from Estonia to Finland, but maybe from Finland to Estonia. Electricity flows from the cheaper area to the more expensive area. This limits export to Estonia, but supports the concept of electricity being imported from Russia to the market area (Nordic countries and Baltic countries) via the Finnish connections.

During peak consumption, i.e. extremely cold periods, the import of electricity from the neighbouring countries can be restricted, if the neighbouring countries impose restrictions to secure their own electricity supply. This has happened a few times regarding import from Russia and Sweden.

5 Production costs of nuclear power and their effect on the price of electricity

In the open electricity market, the developers of a power plant assess the viability of a project themselves. The production cost and viability calculations for nuclear power are, as a rule, internal matters of the companies applying for a decision-in-principle. The applicants have submitted the descriptions of their financial prerequisites for operation and of the economic viability of the projects, as required by the Nuclear Energy Decree. The Ministry of Employment and the Economy has also had a study conducted regarding the financing possibilities of the power companies' projects. According to this study, financing can be arranged for each individual project. The realised production costs of nuclear power have no effect on government finances.

Many kinds of estimates are presented about the production costs of nuclear power. For the electricity market, the most important thing is that the power company itself is convinced of the viability of the investment. The price of the emission right does not affect the price of electricity produced with nuclear power and fuel contributes little to the total costs. However, an increase in the price of emission rights will increase the market price and can thereby improve the profitability of nuclear power. On the other hand, the increase in the investment costs of nuclear power has in the recent years weakened the assumption of the viability of new nuclear power investments.

The production of nuclear power involves special cost items, which have been taken into consideration in the calculations of the power companies. The licensee is, pursuant to the Nuclear Energy Act, responsible for the costs of nuclear waste management and decommissioning of plants, and the financing required for this is collected in the State Nuclear Waste Management Fund. The balance of the Fund is ca. EUR 1.8 billion at present. The Nuclear Liability Act, on the other hand, stipulates that the licensee shall take out liability insurance for potential nuclear accidents. The insurance amount of the licensee is at present ca. EUR 200 million, but international treaty arrangements and an amendment of the Act will increase it to EUR 700 million. Furthermore, power companies are liable to compensate the Radiation and Nuclear Safety Authority for the costs resulting from the control conducted by the Authority regarding nuclear safety, nuclear waste management and nuclear proliferation safeguards.

The price is on the electricity market theoretically always determined on the basis of the variable costs (fuel, emission right, other variable costs plus profit margin) of the most expensive production form required at any moment. It is coal-fired condensing power as a rule. The more production less expensive in terms of variable production costs is available, the more there will be moments when the price is not determined by coal-fired condensing power and the market price falls. The production of nuclear power can thus reduce the price of electricity in the Nordic market. There are no differences between the projects in this respect.

The effects of the projects on the electricity bills of consumers are also influenced by whether the consumers are involved in the project as shareholders who can buy shareholder electricity. Participants in TVO's project include e.g. forest industry, for which inexpensive electricity is an important pre-condition for operation. The shareholders in Fennovoima's project include e.g. metal industries and other representatives of business life. The benefits of Fortum's project are distributed to buyers of market electricity.

6 Aspects related to national grid and power system

The national grid company Fingrid engages in licensed power grid operation as prescribed in laws pertaining to the electricity market. The owner of the grid has an obligation to transmit electricity and the obligation to provide connections to power companies and consumption locations. The grid owner also has the obligation to develop the grid. The electricity transmission grid must be developed to meet the requirements of electricity production, transmission and consumption. Fingrid fulfils the development obligation by maintaining, operating and developing the national grid as well as connections to other grids according to the needs of the customers and in compliance with the principles agreed on between the Nordic national grid organisations, and the national design practice.

System responsibility for the Finnish electricity production and transmission system, or the power system being maintained and operated in a technically expedient manner, has pursuant to the Electricity Market Act been assigned to Fingrid. The party responsible for the system can specify conditions necessary for the implementation of the system responsibility, as concerns the use of the power plants connected to the system grid and the use of other grids.

As part of the European electricity system, the Nordic power system is based on common design and operating principles. The central dimensioning principle is preparedness for a single fault at a time with the operability of the power system maintained despite the fault. The disturbance reserves of the Nordic power system are dimensioned on the basis of the largest production unit or the most severe grid fault. The grid must withstand the consequences of the fault and, after the fault, the use of the grid is adapted within 15 minutes to the new situation. The system responsibility that Fingrid Oyj bears, means that the Company is responsible for the adequacy of the frequency-controlled normal operation and disturbance reserves and the fast active disturbance reserve. The operability of the electricity market, on the other hand, requires adequate transmission connections between countries and regions to ensure that transmission restrictions in the power system do not unreasonably impede the operation of the market.

The connection of one additional nuclear power plant unit to the national grid, together with the connection of the large wind power capacity outlined in the Climate and Energy Strategy and the general maintenance and development of the grid, are included in Fingrid's development outlook for the next few years. The cost level of the investment programme would be in the order of ca. EUR 1.6 billion. The planned site of one of the additional nuclear power plant units will to some extent affect the investments required for the connection of the plant and the development of the

national grid. All in all, however, the differences are not significant, at most some percent of the investments in the national grid. In addition, the increased size of the largest power plant unit connected to the system will have both technical and financial effects on the power system. The dimensioning of the disturbance reserve is in the power system based on a plant unit of ca. 1 600 MW. A 1 600 MW unit or two ca. 1 250 MW units, which fulfil the operating prerequisites of the power system, can be connected to the Finnish national grid in the planned site localities without any major improvement needed in the performance of the power system. If the size of the unit exceeds 1 600 MW, the fault on which the dimensioning of the power system is based would increase correspondingly, and investments would be needed in the disturbance reserves to meet the change in the dimensioning criterion.

The construction of two additional nuclear power units would increase transmission inside the country and require more investments in the grid than the alternative of one additional unit. If two units of additional nuclear power were commissioned round 2020, transmission within the Finnish national grid would increase between northern and southern Finland in comparison with the alternative of one additional unit. This would make it necessary to reinforce the national grid in order not to impair the operability of the electricity market over the present situation. If the production and consumption of electricity develop as assumed, the existing transmission lines and the lines included in the investment plans will experience significant congestion. In order to secure the operability of the electricity market, a new additional connection line from southern Finland to Sweden would also be needed in this alternative.

The effect of three additional nuclear power projects on the national grid investments would be even more significant than the alternative of two additional units. The need to increase the international transmission line capacity would in this case appear as a need to increase the capacity also in the direction of the Baltic countries as well as the export capacity to Russia, in addition to the aforementioned investments. No provisions have been made in the Baltic and Scandinavian transmission grids for any new significant transmission connections from Finland to the grids of the neighbouring countries, apart from the border connections included in the current grid plans. It would also become necessary to investigate the possibility of stronger integration of systems in terms of grid technology all the way to the European Continent. The environmental impact assessment processes required for the grid reinforcement projects would also be demanding.

The power system would technically operate in the alternatives involving several additional units even if new national and trans-border line projects required to secure the operability of the electricity market were not implemented in the extent described above. There would probably be a lack of regulating power as the system would primarily consist of unregulated base load production; nuclear power, wind power and combined production. Foreign connections would become congested. Congestion in the national grid would also result in the risk of Finland being divided into different price areas. Due to the congested transmission connections, electricity production would possibly need to be restricted from time to time in the management of the national grid by order of the party responsible for the system.

7 Effect of additional nuclear power on other forms of energy procurement

The competitive situation on the electricity market would hardly be affected at all by whether additional nuclear power is constructed by one, two or three applicants of the decision-in-principle. In the market analysis, the relevant analysis area 10-50 years from now is at least the Nordic market area, which is at the borders integrated with Central Europe and the Baltic region. None of the applicants would then obtain a too large a market share. In a wider context, there are several operators on the market whereby no individual operator will increase competition to any significant extent. Since the owners are different in each project, the projects have different effects on the costs of electricity procurement for the owners.

As concerns the progress and promotion of the use of renewable energy, additional nuclear power can be considered to have both increasing and decreasing effects. Additional nuclear power would secure for the forest industry the electricity that it wants and reinforce the preconditions for production in Finland. Most of our renewable energy, about two thirds, comes from the production of the forest industry. Also, with the forest industry procuring wood for use as raw material, inexpensive logging residue chips become available using the same logistics.

In as far as additional nuclear power reduces the market price of electricity, it reduces the competitiveness of electricity produced with renewable energy, which requires subsidising, and thereby increases the need for subsidies. Also, there is the risk that the additional construction of nuclear power will impair the profitability of combined heat and power (CHP) production and as a result of this may reduce the amount of renewable energy used as fuel in CHP production.

The reduction in consumer price also has a weakening effect on energy conservation and improvement of energy efficiency. This can be taken into account when dimensioning efforts focused on energy efficiency. Adequate monitoring is required for the energy efficiency programme, if only for this reason.

8 National economy aspects

The effects of nuclear power investments on the national economy have been assessed in the report prepared by the Government Institute for Economic Research. A nuclear power plant investment of ca. 1 700 MW would increase the total investment of the national economy by 2 - 3 per cent during the construction stage of the project and would also permanently increase the investment level. A project of this magnitude would even on the national economy scale be such a significant investment that it would have a clear impact on total investments and consequently on the national product. Investment in another nuclear power plant unit of equal size would double the investment effect during the construction stage, but would not relatively have the same permanent effect as the first power plant unit.

The investments would increase the gross national product over long term by ca. 0.5 per cent compared with a situation where the investments were not implemented. The

effect on the national product is diminished by the large import share of the investments. A central mechanism of influence on the growth of the national product would be lower electricity price, in addition to the investment boost.

Investments bring additional income to the national economy through employment growth, which also increases private consumption demand. Investments increase employment especially during the construction stage, but employment is improved also over a longer period of time. The employment effect of the construction stage of one nuclear power plant unit is estimated to be in the order of 30 000 person years, but the share of foreign labour may be considerable. The permanent increase in domestic employment would be ca. 10 000 person years, including multiplicative effects.

It is clear that the investments would have considerable regional effects both during the construction stage and the operating stage of the plant units.

9 Conclusion

Additional nuclear power is not dimensioned according to peak load power demand, as this would make permanent export the starting point. Regardless of the amount of nuclear power capacity, the adequacy of peak load power shall be secured as stipulated in the Climate and Energy Strategy.

The capacity of the existing nuclear power plant units in Loviisa will have to be replaced at the end of the 2020s, unless their operation is continued. The decision on this should be made in mid-2010s or towards the end of the 2010s, at the latest.

The consideration of new power plant units scheduled beyond the start of the 2020s will become necessary, if the competitiveness of the industry develops favourably. When decisions on these power plant units come up for consideration, information based on experience will also be available regarding the effects of the objectives defined in the climate and energy policy for renewable energy and energy conservation, as well as the content of action taken and the development outlook of the industry.

On the basis of what is presented above, either one, or two or even several nuclear power projects can be supported, when the different aspects are assessed separately. If the central policies related to the matter, as outlined in the "Long-Term Climate and Energy Strategy" of the Government, are considered at once, and if the development of the economy is assessed on the basis of the defined development targets, and if it is further considered necessary to make decisions on units to be commissioned during 2020-2025, the maximum number of required units is two.

APPENDIX 4

Preliminary safety assessment of the Radiation and Nuclear Safety Authority on Olkiluoto 4 nuclear power plant project

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1 Foreword

Teollisuuden Voima Oyj (TVO) submitted on 25 April 2008 an application for a decision-in-principle to the Government concerning the construction of a new nuclear power plant unit in Olkiluoto. The Ministry of Employment and the Economy asked the Radiation and Nuclear Safety Authority (STUK) on 12 September 2009 to draw up the preliminary safety assessment referred to in Section 12 of the Nuclear Energy Act.

Pursuant to Section 12 of the Nuclear Energy Act, STUK is to draw up a preliminary safety assessment concerning an application for a decision-in-principle. STUK's safety assessment shall show that no facts indicating lack of sufficient prerequisites for constructing a nuclear facility, as required in Section 6 of the Act, have arisen. According to Section 6, the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property.

The subject of the application for the decision-in-principle is a new nuclear power plant unit (Olkiluoto 4) as well as the on-site nuclear facilities required for the storage of fresh nuclear fuel, interim storage of spent nuclear fuel and processing, storage and final disposal of low and intermediate level operational wastes.

TVO's application for the decision-in-principle was accompanied by documents on five alternative plant types for the purpose of the preliminary safety assessment. STUK requested on 19 September 2008 elaborations on the plant alternatives and implementation of them. TVO submitted a reply to the request for further clarifications on 28 November 2008 and later supplemented the documentation.

This preliminary safety assessment consists of an assessment of the safety of the plant alternatives and the plant site in Olkiluoto as well as of an assessment of the organisations and the quality management of the applicant and the plant suppliers. The safety assessment also covers the physical protection and emergency response arrangements, nuclear fuel and nuclear waste management, nuclear liability and non-proliferation.

2. Plant alternatives

General

In this preliminary safety assessment STUK presents a summary of the compliance of the design objectives and principles of each plant alternative presented in the application for the decision-in-principle with the requirements set forth in the Government Decree on the Safety of Nuclear Power Plants (733/2008). The detailed assessments on which the summary is based are presented in Appendix 1.

The preliminary safety assessment encompasses two nuclear power plants with a boiling water reactor; ABWR and ESBWR, and three nuclear power plants with a pressurised water reactor; APR1400, EU-APWR and EPR. Table 1 presents the main technical data on the plant alternatives.

Table 1. Plant alternatives.

Plant	Supplier	Type	Thermal power [MWt]	Electrical output [MWe]
ABWR	Toshiba-Westinghouse	Boiling water reactor	4 300	ca. 1 600
ESBWR	GE-Hitachi (GEH)	Boiling water reactor	4 500	ca. 1 600
APR1400	Korean Hydro & Nuclear Power (KHNP)	Pressurised water reactor	4 000	ca. 1 400
EU-APWR	Mitsubishi Heavy Industries (MHI)	Pressurised water reactor	4 450	ca. 1 700
EPR	AREVA	Pressurised water reactor	4 590	ca. 1 700

The starting points in the preparation of the preliminary safety assessment include the key requirements set forth in the Government Decree on the Safety of Nuclear Power Plants (733/2008):

- assessment and verification of safety (Section 3),
- restriction of exposure to radiation and releases of radioactive substances (Sections 7-10),
- engineered barriers for releases of radioactive substances (Section 13),
- safety functions and ensuring them (Section 14),
- protection against external events (Section 17),
- protection against internal events (Section 18) and
- monitoring and control of a nuclear power plant (Section 19)).

In addition, STUK has made a decision on the consideration of design extension conditions in new nuclear power plant units (Y255/3, 8 April 2009).

The fulfilment of the requirements presented in YVL Guides will be assessed in more detail at later stages of the licensing procedure.

ABWR - Advanced Boiling Water Reactor, Toshiba-Westinghouse

ABWR is a boiling water reactor with an electrical output of ca. 1 600 MWe, designed by the Japanese Toshiba-Westinghouse. The first ABWR plant (KK6) designed and constructed by Toshiba was built in Kashiwasaki-Kariwa in Japan at the beginning of the 1990s and the second (KK7) immediately after the first one. The reference plant of the plant tendered to Finland is Hamaoka 5, which was completed at the beginning of 2005. In addition to the aforementioned plants, there is one more ABWR plant unit in operation in Japan, two under construction and several at design stage.

Toshiba-Westinghouse has for the Olkiluoto 4 project enhanced the reference plant unit by adding certain safety features required by Finnish safety requirements. The rated service life of the plant unit is 60 years. The level of maturity of the plant design with respect to basic engineering is high. The design objectives and principles are in main parts consistent with Finnish safety requirements.

In the ABWR plant, both active and passive systems are used for the implementation of safety functions. Some technical details require further analyses and qualification based on tests as well as further engineering. In STUK's opinion, these can be carried out at later licensing stages in such a manner that the requirements set forth in the Government Decree (733/2008) can be fulfilled. The technical details, which in STUK's current opinion do not meet the requirements of the Decree, are presented in Appendix 1.

ESBWR - Economical and Simplified Boiling Water Reactor, GE Hitachi

ESBWR is a ca. 1 600 MWe boiling water reactor designed by General Electric-Hitachi (GEH). GE has gained extensive experience in the design of boiling water reactors since the 1960s. All the boiling water reactors constructed in the United States as well as several plants all over the world, e.g. the oldest boiling water reactors in Japan and all the boiling water reactors in Spain and Switzerland, have been designed by GE. Hitachi has designed several boiling water reactors in operation in Japan. GE and Hitachi have founded GEH as a company that combines the expertise of the two companies.

The ESBWR plant is based on boiling water reactors previously engineered and constructed by GE, and the objective of the design has been to simplify construction and to minimise the number of components requiring service and maintenance. No ESBWR plants have so far reached construction stage.

GEH has for the Olkiluoto 4 project further developed the plant concept used as a starting point by adding certain safety features required by Finnish safety requirements. The rated service life of the plant unit is 60 years. The level of maturity of the design with respect to engineering is lower than the level of the other plant alternatives. The design objectives and principles are in main parts consistent with Finnish safety requirements.

The safety of the ESBWR plant is primarily based on new types of intrinsic properties and passive safety systems designed to replace active systems. Thorough experimental and computational qualification of the presented new solutions is required before they can be introduced to the plant.

In the ESBWR, alternative systems required for the removal of residual heat are located in the turbine building. These systems are the only systems capable of bringing the plant from a controlled (hot) state into a safe (cold) state. Finnish requirements stipulate that it must also be possible to bring the plant into a safe state in a situation where the turbine building has been lost as a result of e.g. a fire or an airplane crash. The fulfilment of Finnish requirements is an open issue in this respect.

The strategy selected in the design of the containment against the impact of a large passenger aircraft on the containment is based on structures, which are not completely resistant to airplane crashes, but for which partial building damages are approved. The strategy also encompasses an assessment of postulated damages and a demonstration of the ability to bring the plant into a safe state regardless of the damages. STUK assesses that it will be difficult to prove that the selected strategy fulfils Finnish requirements. The fulfilment of Finnish requirements is an open issue in this respect.

Some other technical details of ESBWR require further analyses, qualification based on tests and further engineering. In STUK's opinion, the required tests, further engineering and modifications can be carried out at later licensing stages in such a manner that the requirements set forth in the Government Decree (733/2008) can be fulfilled. The technical details, which in STUK's current opinion do not meet the requirements of the Decree, are presented in Appendix 1.

APR1400 - Advanced Power Reactor 1400 - KHNP

APR1400 is a ca. 1 400 MWe pressurised water reactor designed by the Korean KHNP. It is based on Combustion Engineering's System 80+ plant originally designed in the United States. KHNP started the construction of nuclear power plants of this type in Korea towards the end of the 1980s. Plant engineering and component manufacture were gradually transferred to Korea and each new plant was improved on the basis of the experience gained from the previous plants. As the degree of domestic origin rose to a significant level, the plants representing the same origin were referred to by a common abbreviation OPR1000. At present there are eight OPR1000 plant units in operation in Korea and four under construction.

APR1400 is an advanced reactor type based on the OPR1000 concept, a new generation reactor with higher output. The first APR1400 plants Shin-Kori 3 and 4 are currently under construction and expected to be completed in 2013−2014. Preparations have also been started in Korea for the construction of the next two APR1400 plants.

KHNP has for the Olkiluoto 4 project developed the plant designed for the Korean market by adding certain safety features required by Finnish safety requirements. The rated service life of the plant unit is 60 years. The level of maturity of the design with respect to basic engineering is high. The design objectives and principles are in main parts consistent with Finnish safety requirements.

In the APR1400 plant, safety functions have been improved over the OPR1000 plant and the plant concept includes severe accident management systems. Safety functions are as a rule implemented by means of active systems, supplemented, as is typical for pressurised water reactors, with passive, exceptionally large pressurised water tanks for use in emergency cooling situations.

The cooling of core melt, which is needed for the management of severe accidents, takes place from outside the reactor pressure vessel and in STUK's opinion is not adequately reliable for core melt stabilisation considering the size of the APR1400 plant. The plant supplier has announced that they will investigate other alternatives for the improvement of severe accident management. The fulfilment of Finnish requirements is an open issue in this respect.

Some other technical details of APR-1400 require further analyses and qualification based on tests as well as further engineering. In STUK's opinion, the required tests, further engineering and modifications can be carried out at later licensing stages in such a manner that the requirements set forth in the Government Decree (733/2008) can be fulfilled. The technical details, which in STUK's current opinion do not meet the requirements of the Decree, are presented in Appendix 1.

EU-APWR - Advanced Pressurised Water Reactor - Mitsubishi Heavy Industries

EU-APWR is a ca. 1 700 MWe pressurised water reactor designed by the Japanese Mitsubishi (MHI). MHI has since the 1970s constructed in Japan a total of 23 operating pressurised water reactors and one plant is under construction at present. The reference plants for the APWR plant alternative include Tsuruga 3 and 4, which are the first APWR type plants designed by MHI for Japan. The construction of the plants is still at preparatory stage and they are scheduled for completion in 2016−2017.

MHI has for the Olkiluoto 4 project developed the plant designed primarily for the Japanese and US market by adding certain safety features required by Finnish safety requirements. The rated service life of the plant unit is 60 years. The level of maturity of the design with respect to basic engineering is high. The design objectives and principles are in main parts consistent with Finnish safety requirements.

Safety functions are as a rule implemented by means of active systems, supplemented, as is typical for pressurised water reactors, with passive, exceptionally large pressurised water tanks for use in emergency cooling situations.

The stabilisation of core melt in the containment, required for the management of severe accidents, does not meet Finnish requirements at conceptual level. The plant supplier has promised to investigate the possibility of supplementing the concept with a core catcher that fulfils Finnish requirements. The fulfilment of Finnish requirements is an open issue in this respect.

Some other technical details of EU-APWR require further analyses and qualification based on tests as well as further engineering. In STUK's opinion, the required tests, further engineering and modifications can be carried out at later licensing stages in such a manner that the requirements set forth in the Government Decree (733/2008) can be fulfilled. The technical details, which in STUK's current opinion do not meet the requirements of the Decree, are presented in Appendix 1.

EPR - European Pressurised Water Reactor - AREVA

EPR is a ca. 1 700 MWe pressurised water plant designed by the French AREVA. The reference plant unit for this plant alternative is Olkiluoto 3. EPR is originally based on the German 1 300 MWe Konvoi series plants and the French 1 450 MWe N4 series plants. The safety assessment of the EPR plant is based on the documentation submitted for the Olkiluoto 3 plant unit.

The safety functions of the EPR plant are as a rule implemented by means of active systems, supplemented, as is typical for pressurised water reactors, with passive pressurised water tanks for use in emergency cooling situations. The rated service life of the plant is 60 years.

The output of the tendered EPR plant has been increased by ca. 7 percent over Olkiluoto 3. The increase in output affects the design of the plant's safety functions and the behaviour of the plant in transient and accident conditions. The effects of the output increase must be taken into account if an application for a construction licence is to be submitted.

The design objectives and principles of this plant alternative are consistent with Finnish safety requirements.

3. ORGANISATIONS

The Government Decree on the Safety of Nuclear Power Plants (733/2008) stipulates for the licensee tasks, which are related to the implementation of the plant project. These tasks require versatile expertise of the organisation. The Decree also sets forth requirements for the management system. STUK utilises YVL Guide 1.4 "Management systems for nuclear facilities" published by STUK as well as the recent experience in the construction of nuclear power plants in the interpretation of the Decree.

The assessment at this point primarily focuses on the applicant for the decision-in-principle and the plans the applicant has prepared for the guidance and control of the other organisations involved in the plant delivery.

Expertise

TVO has gained experience from the operation of Olkiluoto 1 and 2 and from the Olkiluoto 3 project. TVO maintains and develops the competence of the personnel. TVO has systematically prepared for having the required number of experts available at the competitive bidding, construction and commissioning stages of the Olkiluoto 4 project for the tasks referred to in the Government Decree (733/2008). The experience gained in the Olkiluoto 3 project has shown in practice in which areas the organisation needs to be reinforced for the new project.

TVO's preliminary plan for resources for the commissioning stage presents plans for preparing for the needs of direct operation of the plant. The resources required for the long-term operation and management of modifications depend on the delivery mode of the project and the plant type and for this reason detailed personnel plans cannot be prepared until after decisions have been made on these matters.

Management system during construction project

The requirements set forth in Section 7 of the Government Decree on the Safety of Nuclear Power Plants (733/2008) for safety culture as well as for safety and quality management apply not only to TVO but also to all organisations involved in the design and construction of the Olkiluoto 4 plant unit in a role influencing the safety of the plant unit.

Regardless of the plant delivery mode, the licensee is responsible for the guidance and control of the plant supplier, the manufacturers of the main components, the building contractors as well as the subcontracting chains of all the aforementioned organisations in the extent required for the implementation of safety and quality management. TVO promises to play a strong role in the Olkiluoto 4 project in terms of project management and to ensure meeting the required prerequisites for the control of the implementation of the plant unit. TVO also states that good design management will be required of the Olkiluoto 4 reactor plant supplier.

The Olkiluoto 4 project is part of TVO's management system and complies with the principles and procedures of the management system. TVO has compiled OL4 DiP Manual, which describes operation at the decision-in-principle stage of the Olkiluoto 4 project. TVO will update the OL4 DiP Manual to cover operation at the competitive bidding stage, if a favourable decision-in-principle is issued. As concerns the project implementation stage, TVO has plans to establish a separate management system for the construction stage, which will also be in conformity with the general part of TVO's integrated management system.

According to TVO's presentation, the following will be verified before a plant unit delivery contract is awarded:

- maturity of plant engineering
- expertise of plant supplier
- plant supplier's prerequisites for quality management
- plant supplier's procedures for the assessment, selection, control and monitoring of subcontractors and the communication of safety requirements to subcontractors
- constructability of plant
- fulfilment of Finnish safety requirements
- assurance of the approvability of supply chains and suppliers with respect to structures, systems and components critical to safety.

According to TVO, the following will be defined in the plant delivery contract:

- requirements for the level of maturity of plant engineering and for the verification of the level of maturity
- requirements for design control
- procedures for verification of the expertise of the plant supplier
- key specifications related to the operation of organisations, power plant systems, components, structures and the scope of documentation
- approved suppliers for structures, systems and components critical to safety.

TVO has announced it will ensure that quality assurance requirements will be set forth for the products or functions most critical to nuclear and radiation safety on the basis of their safety criticality. The requirements will be based on systematic classification.

According to TVO's presentation, the conformity of operation with requirements will be verified by audits performed by TVO in an adequate extent on the operation of the organisations involved in the implementation of the project. The assessment of suppliers shall not depend on the position of the supplier in the subcontracting chain but on the safety criticality of the product manufactured by the supplier. STUK requires that TVO assesses in a systematic and comprehensive manner each supplier's

ability to produce conforming products before an order for a safety critical product is awarded.

Pursuant to Section 29 of Government Decree 733/2008, systematic procedures must be in place for the identification and correction of any significant non-conformities. STUK expects that in all contracts related to the possible Olkiluoto 4 project, TVO define fluent procedures for the reporting and management of non-conformities, taking the subcontracting networks into account.

STUK requires that TVO create procedures encompassing the entire project for the assessment, development and monitoring of safety culture and agree on such procedures in advance with the plant supplier and the key subcontractors.

Pursuant to Section 29 of Government Decree 733/2008, the organisations involved in the design and construction of the nuclear power plant unit shall have in place a management system, which ensures the management of safety and quality. The management systems of all the plant suppliers are based on one or several requirement documents published in the nuclear field (IAEA 50-C-Q, 10 CFR part 50 Appendix B, ASME NQA-1 or JEAC 4111-2003). YVL Guide 1.4 requires that organisations involved in the design and construction of the nuclear power plant comply with IAEA standard GS-R-3. The requirements set forth in this standard can be taken into account in the project-specific quality plan and guidelines.

The experience gained in the construction of the Olkiluoto 3 plant unit is reflected in the plans presented by TVO. Against this background, it is justifiable to expect that TVO is capable of establishing the management system required to ensure safety and quality management and good safety culture at the construction stage of the Olkiluoto 4 plant unit.

Management system during operating stage

Pursuant to Section 28 of Government Decree 733/2008, organisations involved in the operation of the nuclear power plant unit shall have in place a management system, which ensures safety and quality management. According to TVO's application for a decision-in-principle, the operation of Olkiluoto 4 would be included in the integrated management system of TVO. This would result in a common management system for the operating stage for the existing Olkiluoto 1 and 2 units currently in operation, for the Olkiluoto 3 plant unit currently under construction and for the Olkiluoto 4 plant unit, to which the decision-in-principle pertains.

At present, the management system of TVO meets primarily the requirements set forth in YVL Guide 1.4 "Management systems at nuclear facilities". STUK's decision issued in 2008 on the enforcement of YVL Guide 1.4 required that TVO further develop the management system with respect to operational processes, procurement procedures and controlled implementation of organisational changes.

Owing to TVO's wide experience and on-going continuous development, TVO has the prerequisites for establishing the management system required to ensure safety and quality management and good safety culture at the operating stage of the Olkiluoto 4 plant unit.

4 SITE

By virtue of the Nuclear Energy Act (YEL), the suitability of the intended site of the nuclear facility (YEL Section 14, subsection 2) is one of the factors to be taken into account in the deliberation of the decision-in-principle. The location of the nuclear facility must be appropriate with respect to the safety of the planned operations and environmental protection must be appropriately taken into account in the planning of operations (YEL Section 19, subsection 2). In addition, the site must have been reserved for constructing a nuclear facility in a town plan or a building plan in accordance with the Land Use and Building Act (132/1999), and the applicant must have possession of the site required for the operation of the facility (YEL Section 19, subsection 4).

Pursuant to Section 11 of the Government Decree on the Safety of Nuclear Power Plants (733/2008), the effects of the local conditions on safety as well as physical protection and emergency response arrangements shall be taken into account in the selection of the site for the nuclear power plant. The site must be selected so that the detrimental effects and risks caused by the plant to the environment are minor and the removal of heat from the plant into the environment can be implemented reliably.

The planned site of the new nuclear power plant unit is on the island of Olkiluoto in the municipality of Eurajoki. Distance to the town of Rauma is about 13 km and to the town of Pori about 33 km. There are two existing nuclear power plant units Olkiluoto 1 and 2 in Olkiluoto, and the Olkiluoto 3 nuclear power plant unit is currently under construction. In addition, there are several buildings and facilities in the area related to the production of nuclear power, such as an interim storage for spent nuclear fuel (KPA storage), interim stores for operating waste, a final disposal repository for operating waste (VLJ repository), Posiva's ONKALO construction site (a research tunnel for the final disposal facility of spent nuclear fuel), an accommodation village for ca. 1 000 workers, a Visitor centre as well as a gas turbine plant owned jointly by the national grid company Fingrid Oyj and Teollisuuden Voima Oyj.

The island of Olkiluoto is ca. 6 km long and 2 km wide and connected with the mainland by a short bridge. TVO owns an area of 745 hectares, or 85% of the island of Olkiluoto. In addition, TVO owns water areas and islands around Olkiluoto either completely or in part. There are some built holiday homes and unbuilt plots for holiday homes in the east part of the island as well as a few larger land areas owned by private persons. The planned site for the new power plant unit is located in the west end of the island, north of the existing units.

In the local plan of Olkiluoto the planned construction site of the new nuclear power plant unit is reserved for nuclear power plants. No amendments are needed in the valid

plans of the area due to the construction of the new nuclear power plant unit. However, the plan for Olkiluoto is being updated with respect to the east end of the island to comply with the content requirements of the new Land Use and Building Act and to take account of the requirements set forth for the final disposal of nuclear fuel. The plans will be amended taking also account of the new power lines required to strengthen connections to the national grid. STUK will issue a statement regarding the plan amendments in compliance with Section 58 of the Nuclear Energy Act.

More than 30 years of experience has already been gained from the operation of Olkiluoto 1 and 2 plant units located in Olkiluoto. The conditions and the suitability of the site have been investigated during the design process of the nuclear facilities in operation and under construction. The site has not been found to have any features that would be unfavourable in terms of the location of nuclear facilities.

The geological and seismological characteristics of Olkiluoto have been studied in the design process of the nuclear power plant units in operation and under construction and the final disposal repositories for nuclear waste. The bedrock in Olkiluoto is suited to the construction of nuclear facilities on the ground and final disposal repositories underground. Olkiluoto is located in the seismically inactive zone of Southern Finland. Earthquakes are taken into account in the design of the new nuclear facilities. The design earthquake for the plant site has been defined in the design process of the Olkiluoto 3 plant unit. The studies will be updated for the design of the new plant unit and assessed in connection with the review of the possible application for a construction licence.

Extreme weather phenomena on the plant site and extreme seawater level have been investigated in the risk analyses of the existing plant units and in the design of the Olkiluoto 3 plant unit. In the design process of the Olkiluoto 3 plant unit studies focused on exceptionally high and low outdoor temperatures and on the extreme values and frequencies of strong local winds (tornados). Weather conditions on the plant site do not display any unfavourable features deviating from conditions in the rest of Southern Finland and the extreme weather phenomena in the area can be taken into account in the design of the nuclear power plant unit. Variations in seawater level on the coast of the Bothnian Sea are fairly small in Finnish conditions and ice conditions are normal.

The occurrence of extreme weather phenomena and the impact of the climate change on them are investigated in the ongoing national research programme on nuclear safety, SAFIR2010. For the new nuclear power plant unit, the adequacy of design bases related to extreme weather phenomena will be assessed in cooperation with the Finnish Meteorological Institute in connection with the review of the possible application for a construction licence utilising the most recent knowledge in the field.

Large volumes of seawater will be needed for the cooling of the turbine condenser in the new unit. No obstacles are foreseen to the implementation of the seawater intake and outlet arrangements as presented in the application for the decision-in-principle. TVO will have the detailed geological studies required for the construction of the seawater tunnels carried out for the possible application for a construction licence. The effects of discharging the cooling water at an elevated temperature to the sea have been analysed in the Environmental Impact Assessment Report.

The processes at a nuclear power plant require a lot of purified fresh water. There are

plants in Olkiluoto for the pumping, storage, purification and demineralisation of fresh raw water. The raw water is supplied via a pipeline from a distance of about 8 km from River Eurajoki. The application for the decision-in-principle does not include a separate analysis of the supply of fresh raw water. TVO has announced that it has a long-term plan pertaining to this and that a clarification of the adequacy and reliability of raw water supply in different operating conditions will be enclosed to the application for a construction licence for the Olkiluoto 4 plant unit.

There are no industrial plants, storage facilities, traffic routes or gas pipes near Olkiluoto that could pose risks to the nuclear power plant as a result of accidents. The oil transport routes in the Gulf of Bothnia do not run near Olkiluoto. The probability of an oil spill affecting the supply of seawater to the Olkiluoto power plant is considered low. The clogging of the seawater systems due to oil, algae and freezing is taken into account in the design of the new plant unit. Although the risk caused by oil spills is considered to be low in Olkiluoto, TVO continues to focus efforts on effective oil destruction in the areas near Olkiluoto in cooperation with rescue services and environmental authorities.

The new nuclear power plant unit will have to be connected to the Finnish national grid. Pursuant to the Electricity Market Act, the responsibility for the development of the national grid and for the systems rests with Fingrid Oyj. Accordingly, Fingrid Oyj is responsible for the required reinforcement of the national grid and for the adequacy of disturbance capacity. A new 400 kV connection line to the national grid as well as a power corridor to Rauma will be built for the new power plant unit. The transfer connections from Rauma to the national grid will also be reinforced. Reliable connections between the nuclear power plant and the national grid are necessary to ensure uninterrupted production and transmission of electricity and to supply power from the grid to the plant, if required. The nuclear power plant units are also equipped with their own emergency generators to ensure power supply to the safety systems of the power plant in transient and accident situations.

The new power lines are taken into account in local planning, first as markings provided for guidance. Decisions about the routing of the power lines will be made at the detailed design stage. A separate EIA procedure will be conducted for the power lines if the extent of the projects makes it necessary.

The gas turbine plant in Olkiluoto, which is owned jointly by Fingrid Oyj and TVO, is an emergency power plant designed for the management of disturbances in the national grid. The gas turbine plant also increases the security of power supply to the safety systems of the Olkiluoto power plant.

The clarifications pertaining to the planned site of the Olkiluoto 4 plant unit are adequate for the review of the application for the decision-in-principle. In the opinion of the Radiation and Nuclear Safety Authority, the new plant unit as well as the other nuclear facilities related to the operation of the unit can be implemented on the planned site in conformity with the requirements set forth in Section 6 of the Nuclear Energy Act.

A detailed assessment of the plant site is presented in Appendix 2.

5 Physical protection and emergency response arrangements

By virtue of Section 7 of the Nuclear Energy Act (YEL), a prerequisite for the use of nuclear energy is that physical protection and emergency response arrangements as well as other arrangements are adequate to limit nuclear accidents and to protect the use of nuclear energy against unlawful actions.

Emergency response arrangements refer to advance preparedness for accidents or events that impair safety at the nuclear facility or in its precincts (YEL Section 3). The planning of emergency response arrangements must encompass the possibility of significant amounts of radioactive substances being released from the plant, even if the probability of such an event is low. Requirements for emergency response arrangements are presented in Section 7 p of the Nuclear Energy Act and in the Government Decree on Emergency Preparedness at Nuclear Power Plants (735/2008). The emergency response arrangements to be implemented by the licensee include e.g. an emergency plan, a trained emergency response organisation as well as the facilities, equipment and communication systems required for each task.

Pursuant to the Government Decree on Emergency Preparedness at Nuclear Power Plants (735/2008), the nuclear power plant shall be surrounded by a protective zone and an emergency planning zone. The protective zone extends over a distance of ca. 5 km from the plant and land use restrictions apply within the zone.

The emergency planning zone extends over a distance of ca. 20 km from the plant and the zone shall be covered by the rescue plan referred to in Section 9, subsection 2 of the Rescue Act. The rescue plan shall encompass the alerting of the population and protection measures. Possible protection measures to be implemented in case of a severe nuclear power plant accident include e.g. seeking shelter indoors, taking iodine pills and as an extreme protection measure, evacuation of the hazard area. This means that the construction of a nuclear power plant also results in obligations for the authorities.

TVO has implemented in Olkiluoto, in cooperation with local and regional authorities, the physical protection and emergency response arrangements referred to in the Nuclear Energy Act.

A protective zone in compliance with the Government Decree on Emergency Preparedness at Nuclear Power Plants (735/2008) has been defined for the Olkiluoto power plant as well as an emergency planning zone, which covers the municipalities of Eurajoki, Rauma and Luvia. Satakunta Rescue Services have prepared a rescue plan for the area and STUK has issued a statement on the plan. The protective zone and the land use restrictions applied within the zone are presented in the master plan of the

area. The construction of the new plant unit referred to in the application for the decision-in-principle and the extensions of the nuclear waste facilities will not require any significant changes in the protective zone or in the emergency planning zone.

The licensee shall be prepared to carry out radiation measurements in an emergency in the power plant area and in the protective zone as well as meteorological measurements to evaluate the spreading of radioactive substances in the emergency planning zone (Government Decree 735/2008, Section 5). TVO has implemented such arrangements at the Olkiluoto power plant and in the protective zone of the plant.

The licensee shall in cooperation with the local rescue services provide the population in advance with instructions for action to be taken in an accident situation within the emergency planning zone and distribute iodine pills to the population within the protective zone. In an accident situation the licensee shall take part in alerting the population in immediate danger (Government Decree 735/2008, Section 12). TVO has fulfilled these requirements.

The most favourable alternative from the point of view of emergency response arrangements is to site the plant in a sparsely populated area away from significant population centres. This means that the emergency response measures that need to be taken only encompass a small population group. The area near Olkiluoto can be considered sparsely populated. At present there are 33 permanent residences and some 550 holiday homes within the protective zone. Population within the emergency planning zone, i.e. within a 20 km radius from the plant, is ca. 46 000 and population within a radius of 100 km is ca. 500 000.

In order to ensure the effectiveness of emergency response arrangements emergency response exercises are organised at the Olkiluoto nuclear power plant on a regular basis in cooperation with local rescue services as well as regional and national authorities.

Physical protection refers to the measures needed to protect the use of nuclear energy against unlawful activities in the nuclear facility, its precincts and other places or vehicles where nuclear energy is used. Pursuant to Section 71 of the Nuclear Energy Act, the nuclear power plant shall employ security personnel with training in the planning and implementation of security arrangements (security organisation). The duties of and the training requirements for the security organisation and the security personnel shall be defined and the monitoring equipment, communication equipment, protective equipment and security equipment required for the execution of the duties shall be made available to them.

Pursuant to Section 8 of the Government Decree on the Physical Protection of Nuclear Power Plants (734/2008), physical protection entails e.g. the inspection of vehicles, persons, items and substances as well as means of goods transport to ensure that no dangerous objects are brought into the nuclear facility. Movement must be restricted and controlled at a nuclear facility in such a manner that physical protection and security aspects can be effectively taken into account. The licensee shall particularly ensure that no nuclear substances, nuclear waste, radioactive materials or confidential data can be removed from the nuclear facility without appropriate authorisation.

The physical protection arrangements referred to in the Nuclear Energy Act are in place at the Olkiluoto nuclear power plant. The changes taking place in the general

operating environment and in local conditions may result in changes also in the requirements set forth for the physical protection and emergency response arrangements of nuclear power plants and in the threats on which they are based. The physical protection and emergency response arrangements are being continuously assessed and developed. A thorough assessment is carried out at intervals of ca. ten years in connection with the renewal of operating licences and regular safety assessments.

According to TVO's application for the decision-in-principle, the current security and emergency plans of Olkiluoto can be extended to cover the new nuclear power plant unit and the extensions of the nuclear waste facilities. The preliminary security and emergency plans for the new nuclear power plant unit will be submitted to STUK for the review of the possible application for a construction licence and the final plans in connection with the possible application for an operating licence.

In STUK's opinion, TVO meets the prerequisites to implement in Olkiluoto physical protection and emergency response arrangements for the new nuclear power plant unit referred to in the application for the decision-in-principle as prescribed in law. In STUK's opinion, the alert and rescue arrangements in the areas near the power plant, for which the rescue services are responsible, are adequate but it is advisable to further develop them taking into account the possibilities offered by the advances made in communication technology.

6 Nuclear fuel management

Nuclear fuel management with respect to the new plant unit is described in the Appendix to the application for the decision-in-principle. The starting point in the procurement of fresh fuel is usually that only the initial fuel for the plant unit is included in the plant delivery. The normal practice on the nuclear fuel market is to invite tenders from the suppliers involved in the nuclear fuel manufacturing chain and the choice of the plant type does not in itself limit the possibilities to purchase nuclear fuel. Fuel types are constantly developed, which makes it necessary to take into account that different fuel types procured from different manufacturers will be used in the reactor. The nuclear fuel would be manufactured abroad and only transport and storage of fresh fuel would take place in Finland. These activities represent advanced technology and do not involve any significant safety risks.

7 Nuclear waste management

TVO presents in the application for the decision-in-principle an overview of the organisation of nuclear waste management for the Olkiluoto 4 plant unit. According to plans, nuclear waste management will be organised utilising the same methods and in part the same facilities that are used for the nuclear waste management of the units in operation and under construction in Olkiluoto.

Each presented plant alternative includes adequate facilities for the processing and storage of low and intermediate level operating waste at the Olkiluoto 4 plant unit.

Part of the low and intermediate level operating waste from the Olkiluoto 4 plant unit could be emplaced in the final disposal repository (VLJ repository) built in the bedrock near the plant site and commissioned in 1992. This final disposal repository will need to be expanded later, probably in the 2020s. According to plans, decommissioning waste will also be emplaced in facilities to be built in connection with the VLJ repository. The expansion of the VLJ repository will be implemented in compliance with the safety requirements defined in Government Decree 736/2008.

According to plans, spent fuel from the Olkiluoto 4 plant unit will be dealt with in the same way as spent fuel from the existing plant units, i.e. emplaced in a final disposal repository in the bedrock after an interim storage period of ca. 50 years. The designs for the Olkiluoto 4 plant unit include fuel storage pools in which spent fuel is stored for some years before it is transferred into a separate spent fuel storage facility. A new interim storage for spent fuel can be built for the needs of the Olkiluoto 4 plant unit or the existing interim storage (KPA storage) in the plant area can be expanded to accommodate also fuel from Olkiluoto 4. The design bases for the interim storage of fuel at the Olkiluoto 4 plant unit include the design earthquake defined for the site as well as the impact of a large passenger airliner.

Geological studies have been carried out in the Olkiluoto plant area and particularly in the area of the VLJ repository. No geological or seismological features or other factors have come up that would prevent the implementation of the expansion of the interim storage for spent fuel and the expansion of the final disposal repository for operating waste as described in the application for the decision-in-principle in compliance with the requirements set forth in Sections 6 and 2a of the Nuclear Energy Act and in Government Decrees 733/2008 and 736/2008.The fulfilment of the safety requirements will be assessed in connection with the review of detailed design documentation.

The Finnish Parliament ratified in 2001 the Government's decision-in-principle on the construction of the final disposal facility for spent nuclear fuel in Olkiluoto. The

decision pertained to the encapsulation plant and to the final disposal repositories for spent fuel from the Olkiluoto 1 and 2 as well as Loviisa 1 and 2 plant units. In 2002 the Parliament ratified the Government's decision-in-principle on the expansion of the final disposal facilities to accommodate spent fuel from the Olkiluoto 3 plant unit.

Posiva Oy has submitted on 25 April 2008 to the Government an application for a decision-in-principle on the expansion of the final disposal facilities for spent fuel to accommodate spent fuel from the Olkiluoto 4 plant unit. STUK assesses the presented final disposal solution and the suitability of the site in a separate preliminary safety assessment issued on the application submitted by Posiva.

8 Nuclear liability

Nuclear liability is governed by the Nuclear Liability Act (484/1972). The Nuclear Liability Act takes into account the international treaties that Finland has ratified, which define the minimum limits to liabilities for nuclear damage. Increased liabilities can be enacted nationally, as is also done in some countries. Negotiations to develop the international treaties in question have been completed and the Finnish Nuclear Liability Act was updated in 2005 defining considerably higher liability minimums. The amended Nuclear Liability Act also defines an unlimited liability to the owner of the nuclear facility for damages in case the assets covered by insurance policies are not adequate for the compensations. The amended Act has not been enforced yet, but a separate Decree on the enforcement of the Act will be issued when the amendments of the international treaties, which define the grounds for the new compensation amounts, are enforced.

STUK foresees no obstacles to the applicant being capable of fulfilling the nuclear liability obligations defined in the valid Nuclear Liability Act.

9 Nuclear proliferation safeguards

The purpose of nuclear proliferation safeguards is to ensure that nuclear materials and other nuclear products are only used in peaceful applications in compliance with licences and notifications and that nuclear plants and nuclear technology are only used for peaceful purposes. The licensee has the obligation to control and account for the nuclear substances in the possession of the licensee, to submit reports to the authorities and to allow the nuclear inspectors of the European Commission and the International Atomic Energy Agency (IAEA) access to the plants. The national control system maintained by STUK covers as prescribed in Section 118 of the nuclear Energy Decree the control of the use of nuclear energy and the control required on the basis of the international nuclear non-proliferation treaties, which Finland has ratified.

It can be assessed on the basis of the control carried out by STUK that TVO, as a user of nuclear energy and a licensee, has the required expertise and competence to organise nuclear proliferation safeguards in a manner that enables Finland to fulfil her international treaty obligations.

10 Conclusions

The plant alternatives assessed in the application do not meet Finnish safety requirements as such. The nature and extent of the required modifications vary between the plant alternatives. Some plant alternatives would only require fairly minor modifications; some would require more extensive structural modifications. The required technical solutions for some of the modifications are still open.

TVO meets the prerequisites for building up a management system ensuring safety and quality management and good safety culture during the construction and operating stage of the Olkiluoto 4 plant unit. TVO is also prepared to acquire adequate and competent personnel resources for the different implementation stages of the Olkiluoto 4 project.

The Radiation and Nuclear Safety Authority has assessed the suitability of the planned site of the Olkiluoto 4 nuclear power plant unit for the intended purpose as well as the prerequisites for the implementation of physical security and emergency response arrangements, nuclear waste management and nuclear proliferation safeguards. No obstacles have been foreseen in the assessment to the construction of the new nuclear power plant unit or to the extension of associated waste facilities in Olkiluoto.

Summary

Pursuant to Section 6 of the Nuclear Energy Act the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property. The preliminary safety assessment has not revealed any factors suggesting that adequate prerequisites do not exist for the construction of the Olkiluoto 4 nuclear power plant unit in compliance with the requirements set forth in Section 6 of the Nuclear Energy Act.

11 Appendices

Appendix 1 Assessment of the suitability of plant alternatives, 4 May 2009
Appendix 2 Assessment of the suitability of plant site, 25 May 2009

The Appendices are available on the web site of the Ministry of Employment and the Economy at www.tem.fi .