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Scoping Phase of the EIA Program for NPP Olkiluoto 4

Expert Statement

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Introduction

The company Teollisuuden Voima Oy (TVO) plans to construct a new Nuclear Power Plant (NPP) at Olkiluoto island in the municipality of Eurajoki. Olkiluoto is the location of two operating NPP units and a new one under construction (EPR). Electric capacity of the fourth NPP unit shall be 1,000 to 1,800 MWe.

According to the Finnish law the construction of a new nuclear power plant is subject to a decision-in-principle issued by the Government and ratified by the Parliament. The EIA process must be completed before submitting any application for a decision-in-principle concerning a new power plant.

TVO emphasizes that no decisions concerning action to be taken subsequent to the EIA procedure have been made. However, TVO wants to ensure on its part that if necessary, a new plant unit can be implemented in the latter half of the next decade.

If the decision-in-principle is ratified and, in addition to environmental issues, the technical and economic prerequisites for construction are fulfilled, construction of the plant could start in the early 2010s. Construction is estimated to take 4 to 6 years.

With reference to the Espoo Convention the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management, has expressed its interest to take part in the transboundary EIA. The Austrian Institute of Ecology was assigned by the Austrian Ministry of Agriculture and Forestry, Environment and Water Management to elaborate an Expert's Statement on the EIA Program for Olkiluoto 4 (OL-4) NPP.

The Experts Statement analyses the comprehensiveness of the proposed content of the EIA compared to the European Commission's EIA directive and the Espoo convention, respectively.

The task is to evaluate whether the information proposed to be provided by the EIA will allow to assess the safety of the new NPP concerning emissions into the environment in a transboundary context, both during normal operation and accidents (design base and beyond design base accidents). For Austria mainly airborne emissions could be relevant, in particular emissions due to severe accidents could contaminate not only the vicinity of the plant but depending on the climatological conditions at the time of a large accidental release also regions far from the NPP could be affected. The Experts Statement formulates information requirements which will allow the assessment of the significance of accidents with a large release of radioactive substances.

A team from the Institute of Meteorology of the University of Natural Resources and Applied Life Sciences, Vienna and the Austrian Institute of Ecology analysed the climatological risk that emissions due to severe accidents at NPPs in Europe could affect Austrian territory to an extent that would require radiation protection measures for risk groups (children and young people, expecting and nursing mothers) and normal population, respectively. „Climatological risk of the NPPs in Finland" means the probability of weather conditions in Europe which lead to transport and deposition of emissions released from NPP sites in Finland to Austrian territory, expressed as percentage of all weather situations. As a result of this study carried out on behalf of the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management, the climatological risk that an accidental release from a NPP in Finland causes a significant impact to Austria is in the range of 1- 5%. In particular, the climatological risk for the Olkiluoto site was assessed to be 1,12 % (general population) and 5,62% (risk group), respectively. [SEIBERT et al. 2004]

Even if the probability of such weather situations is small, an impact to Austria of a severe accident at OL-4 cannot be excluded. Depending on the amount of radioactive substances released due to an accident, the impact could be significant, i.e. protection measures could be required for people living in Austria. Therefore, Austria has an interest in the planning of this large new NPP in Finland.

This Experts Statement refers to the following documents:

> **Environmental Impact Assessment Programme Extension of the Olkiluoto Nuclear Power Plant by a Fourth Unit** by Pöyry Energy Oy Consulting, 2007, hereinafter referred to as [EIA, page]
>
> **ENVIRONMENTAL IMPACT ASSESSMENT PROGRAMME FOR THE OLKILUOTO 4 NUCLEAR POWER PLANT UNIT**; STATEMENT BY THE CONTACT AUTHORITY, Ministry of Trade and Industry, 2007 hereinafter referred to as [MTI, page]

This Experts Statement concerns the scoping phase of the EIA procedure, therefore this statement will formulate requests for information. The statement consists of two parts:

The first part "Summary and Conclusions" presents the most important findings and recommendations for the content of the EIA Report. The following chapters deal with the issues, presented in the EIA Program and relevant from the Austrian point of view, in more detail.

The EIA procedure has begun in May 2007 and shall be finished during summer 2008. Display for public inspection is intended for July and August 2008.

The Finnish Ministry of Trade and Industry is responsible for the EIA process. For the International participation the responsible authority is the Finnish Ministry of Environment.

Summary and Conclusions

The EIA program presents the content of the EIA report in a comprehensive manner. Aspects of particular interest from an Austrian point of view, are stressed in this statement. Our assessment of the EIA program deals with issues of general interest as the discussion of the options for electricity production or the management of nuclear fuel. On the other hand all issues relevant for the assessment of environmental impact caused by airborne emissions of radioactive substances are treated and in particular the question of accidents and transboundary emissions is discussed.

Options under assessment

We recommend to include a comprehensive justification of the need to construct a new NPP in the EIA report. We support the Ministry of Trade and Industry's (MTI) suggestion to include information on the cost structure of the project and its alternatives in the EIA report, provided that all options will be considered equally: not only generation technologies including renewable energy, but also options for demand side management and efficiency enhancement.

Nuclear Fuel

The information presented in the EIA report should contain an assessment of all environmental burdens and hazards connected with the total nuclear fuel chain. The EIA report should provide this data for comparison with the environmental and health impacts to other power generation technologies.

Environmental and health impacts

In the assessment of health impacts due to radioactive emissions, not only new ICRP guide lines should be considered but also the results of studies in Germany which show that children living near to NPPs, compared to others have a higher risk to develop leukemia.

An important impact to the environment is the release of a large amount of heat from new large NPP into the Sea which must be considered in the EIA in connection with the existing environmental burden from NPPs and other pollutants around the Baltic Sea.

Safety and Risk Analysis

For Austria the safety and risk analysis of the new NPP is the most important issue of the transboundary EIA process.

Since a detailed safety review can only be conducted in the construction licensing phase a serious debate of the impacts of accidents to the environment seems hardly possible in the EIA process.

Therefore as a minimum more detailed information on safety and design requirements for LWRs must be provided by the EIA report. Otherwise it is impossible to evaluate the potential impact of severe accidents in Olkiluoto 4 on Austrian territory.

Influences of the different facilities to each other at the site (LILW storage, interim fuel storage, the two existing units and unit 3) as well as common cause failures (e.g. due to external events) should be discussed in the EIA report as well as the potential challenge on the NPP's safety due to global change.

We expect that the EIA report contains detailed information about the postulated initiating events (internal and external) for the design basis, as well as on targets for DBA and BDBA frequencies and related source terms to be met by the new reactor. Also parameters which are relevant for the assessment of potential source terms should be given in the EIA report e.g. the radioactive core inventory.

The EIA report should cover all the issues necessary for an assessment of accident impacts on a transboundary level. In this context severe accidents are of particular interest. Therefore we recommend that a worst case scenario concerning the amount of radioactive release is analysed, even if the applicant thinks that this scenario will have a very low probability of occurrence.

Moreover we demand that the EIA report includes a description the emergency information system in case of an accident with a potential transboundary impact.

The proposed project

Teollisuuden Voima Oy (TVO) is examining the construction of a nuclear power plant unit with approximate net electrical output of 1,000 to 1,800 MW and thermal power of 2,800 to 4,600 MW at Olkiluoto,which is the location of two existing nuclear power plant units (OL1 and OL2) and a third one (OL3) under construction. In order to improve its facilities for constructing additional production capacity, the company has initiated the environmental impact assessment (EIA) procedure. Besides the NPP units at the Olkiluoto site other nuclear facilities are located: the intermediate storage facility for spent fuel , the intermediate storage facilities for low-level and intermediate-level (LILW) operating waste, the final repository for operating waste and Posiva's ONKALO construction site. [EIA, 8ff]

According to the stage of the project information on the plant itself is scarce, but it is said that the plant will be either a Pressurized Water Reactor (PWR) or a Boiling Water Reactor (BWR)

Preliminary technical information is given in Table 5.1 [EIA, 29] :

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

Technical Lifetime of the plant is about 60 years.

Options under assessment

The primary option for the project is a new nuclear power plant unit at Olkiluoto. TVO does not have any other realistic options for the location because it is essential for the project to utilise existing land use planning and infrastructure. [EIA, 18]

The zero option

As zero option the EIA Programm defines that no fourth NPP unit will be constructed at Olkiluoto. In this case the shareholders of TVO will purchase their electricity elsewhere and the situation in Olkiluoto will remain unchanged. '*The discussion of the zero-option assesses the environmental impacts that would arise if the amount of electricity equal to the electricity production volume of the nuclear power plant unit were produced with the average Nordic electricity production structure.' [EIA, 46]*

Option excluded from the investigation

Environmental NGOs emphasize in their comments that the need for the project should be justified sufficiently and demand that the EIA programme should give equal weight to different options. Moreover the zero-option should include a sustainable energy scenario. [EIA, 18]

`The Ministry of Trade and Industry itself maintains that the applicant for the NPP is a company that generates electricity only for its shareholders. Therefore, it cannot access any significant means of energy conservation or efficiency.` [MTI, 16]

Moreover it seems, that the the Ministry of Trade and Industry is currently preparing a long-term climate and energy strategy and points out that ' *the report on the importance of a new nuclear power plant or power plants to the national energy supply, supporting the Government's decision-making with regard to reaching the decision-in-principle, will include information on energy conservation and efficiency'. [MTI, 16]*

We recommend to include a comprehensive justification of the need to construct a new NPP in the EIA report. It could be useful to include also information on the cost structure of the project and its alternatives in the EIA report, provided that all options including renewable energy, efficiency enhancement and demand side management will be considered equally.

Nuclear Fuel

Approximately 20 to 40 tonnes of fuel will be consumed by the new NPP. Uranium mining, processing of the ore, enrichment and fuel fabrication have a significant impact on the environment.

'The most important potential procurement sources of uranium and its enrichment and fuel manufacture will be examined. The environmental impacts of nuclear fuel production and transportation of nuclear fuel will be described based on the existing specifications. The EIA report will describe the mining operations of the uranium supplier typically used by TVO ' [EIA, 46]

Since the Ministry of Trade and Industry *'finds it reasonable that the organisation responsible for the project should examine the environmental impacts of the entire fuel supply chain in general and, additionally, the company's opportunities to influence this chain.' [MTI, 19]*
*W*e expect that this will be considered in the EIA report.

At the back end spent fuel has to be stored at first at the plant in the storage pool. After a few years the spent fuel is taken to intermediate storage and cooled in water pools at the spent fuel interim storage facility (KPA Store) at the Olkiluoto power plant. Intermediate storage in the KPA Store will continue for decades until the final disposal of the spent fuel. An extension to the interim storage facility will be required once the OL-3 power plant unit has been commissioned. An extension to the KPA Store is scheduled for the years 2011 to 2014. [EIA, 21ff 9]

In Finland spent nuclear fuel is planned to be disposed of in a final repository to be excavated in bedrock. Posiva Oy is the company responsible for the disposal of nuclear fuel. Posiva is owned by TVO (60%) and Fortum Power and Heat Oy (40%), who are also responsible for the costs of nuclear waste management. The intention is to dispose of spent nuclear fuel in the bedrock of Olkiluoto at a depth of approximately 400 to 500 metres. The construction of ONKALO (an underground laboratory) started in the autumn of 2004. The objective of the project is to obtain detailed information concerning the bedrock for the purpose of designing a disposal facility and assessing its safety, and to test disposal technology in actual deep underground conditions. Posiva's present target is to submit an application for a construction licence for the spent fuel disposal facility by the end of 2012. The disposal of spent fuel is scheduled to start in 2020. [EIA, 22]

The information presented in the EIA report should contain an assessment of all environmental burdens and hazards connected with the total nuclear fuel chain. The EIA report should provide this data for comparison with the environmental and health impacts to other power generation technologies.

Environmental and health impacts

The radiation dose to nearby residents due to emissions into the air and sea in 2006 was approximately 0.27 µSv/inhabitant. The allowed maximum annual dose caused by emissions from Olkiluoto is 100 µSv. [EIA, 40].

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

In the assessment of health impacts due to radioactive emissions, not only new ICRP guide lines should be considered but also the results of studies in Germany which show that children living near to NPPs, compared to others, have a higher risk to develop leukemia.
[KIKK STUDIE 2007]

An important impact to the environment is the release of the large amounts of heat from another new NPP into the Sea, which must be considered in the EIA in the context of the existing environmental burden from NPPs and other pollutants around the Baltic Sea. The situation of the environment in this region affects not only the marine ecosystem but also coastal regions and should be evaluated from a holistic point of view.

Safety and Risk Analysis

For Austria the safety and risk analysis of the new NPP is the most important issue of the transboundary EIA process. Accidents with a large release of radioactive substances into the atmosphere could also affect Austria. Whether Austria could be significantly affected by an accident in Olkiluoto depends on a) the climatological conditions at the time of the accident and b) on the amount of radioactive substances released. The maximal source term is plant specific, therefore the EIA report should present either the maximal release in case of a severe accident or more detailed information on the design and safety features of the NPP.

A team from the Institute of Meteorology of the University of Natural Resources and Applied Life Sciences, Vienna and the Austrian Institute of Ecology analysed the climatological risk that emissions due to severe accidents at NPPs in Europe could affect Austrian territory to an extent that would require radiation protection measures for risk groups (children and young people, expecting and nursing mothers) and normal population, respectively. 'Climatological risk Olkiluoto site ' means the probability of weather conditions in Europe which lead to transport and deposition of emissions released from the OL-4 site to Austrian territory, expressed as percentage under consideration of all assessed weather situations. As a result of this study the climatological risk for the site of TVO was assessed to be 1,12 % (risk group) and 5,62% (for general population), respectively. [SEIBERT et al. 2004]

The source term assumed for this analysis is a worst-case scenario for the release due to a severe accident at a PWR 1000 MW reactor. Only the source term for Cs-137 of 6.75 E16 Bq, as a characteristic nuclide, was considered in the dispersion model. A simple conversion factor to derive dose estimates from the total Cs-137 depositions was applied, which is based on results of previous calculations carried out with mainframe COSYMA.

Transport, diffusion and deposition of the released substances were calculated with the Lagrangian particle dispersion model FLEXPART. FLEXPART is a model suitable for the meso-scale to global-scale calculations, which is freely available and used by many groups all over the world. The calculations were made for 88 different dates in the year 1995 as a part of the RISKMAP study. This year has been shown to be climatologically representative at least for the Alpine region. [SEIBERT et al. 2004]

Chapter 5.2 of the EIA program deals with nuclear safety. `*A nuclear power plant must be designed in accordance with nuclear energy legislation and regulatory guides (YVL Guides) published by the STUK (*Radiation and Nuclear Safety Authority) *in order to ensure the safety of its operation.* N*uclear power plants have been developed and are continuously being developed in many ways to improve their safety and operational reliability. The latest safety requirements will be taken into account in the potential new power plant unit. The potential plant unit will be one in which provisions have been made for severe accidents and the mitigation of their consequences.` [EIA, 21]*

Unfortunately the safety requirements are not described in detail. But it is stated that the EIA report will discuss the environmental impacts of accidents based on the safety analyses of the existing power plant units and the requirements imposed on the new unit. [EIA. 45]

Therefore as a minimum more detailed information on safety and design requirements for LWRs must be provided by the EIA report. Otherwise it is impossible to evaluate the potential impact of severe accidents in TVO 4 on Austrian territory.

We expect that the EIA report contains detailed information about the postulated initiating events (internal and external) for the design basis, as well as on targets for DBA and BDBA frequencies and related source terms to be met by the new reactor. Also parameters which are relevant for the assessment of potential source terms should be given in the EIA report as the radioactive core inventory, the average and maximum burn-up of the fuel.

Influences of the different facilities to each other at the site should be discussed in the EIA report as well as the potential challenge on the NPP's safety due to global change.

The Ministry of Trade and Industry comments that the *'EIA report should include a review of current nuclear power plant types on the market which are suitable for the project under review*'.[MTI, 15] Therefore we expect that the EIA report will provide detailed information on the type of plants under consideration for OL-4.

Influences of the different facilities under construction and in operation at the TVO site to each other (4 NPPs, interim and final storage facilities) should be considered in the EIA report. Common cause failures (e.g. due to external events) should be discussed in the EIA report as well as the potential challenge on the NPP's safety due to global change.

According to both documents the EIA program and the Statement of the Ministry of Trade and Industry, safety issues and discussion of accidents are seen as part of the EIA report. But it is still unclear how a serious assessment can be carried out, without a clear decision on the plant. The description of how the safety assessment will be carried out for the construction and operating license is no substitution of the safety assessment itself.

The Ministry of Trade and Industry states that '*the safety planning criteria for the prospective plant must be presented with respect to the limitation of emissions of radioactive substances and environmental impacts, as well as an assessment of the possibilities of meeting the safety requirements in force*'**. [**MTI, 15ff]

In its comment the radiation and nuclear safety authority STUK says *' that the EIA report should describe the key grounds and objectives for planning the limitation of emissions of radioactive substances and environmental impacts, alongside an assessment of the feasibility of meeting the safety requirements in force.'* [MTI, 7]

In Finland radiation exposure of the general public is limited by the general regulations of the government [STATE (395/91)] for the safety of NPPs, which are as follows:

The limit for the dose commitment of the individual of the population according to [STATE(395/91)]**:**

- arising from **normal operation** of a nuclear power plant in any period of one year, is 0.1 mSv.
- arising from an **anticipated operational transient** in the period of one year is 0.1 mSv.
- the limit for a **postulated accident** in the period of one year is 5 mSv.
- for **a severe acciden**t an atmospheric release of cesium-137 should not exceed 100TBq. (The combined fall-out consisting of nuclides other than cesium-isotopes shall not cause, in the long term, starting three months from the accident, a hazard greater than would arise from a cesium release corresponding to the above-mentioned limit.) The possibility that, as the result of a severe accident, the above mentioned requirement is not met, shall be *'extremely small'*, which is < 5E-7 according to [STUK YVL2.8]

This probabilistic objective for the limited release due to a severe accident set by Finland's nuclear regulatory authority STUK is more ambitious than the limited release target defined by the European Utilities [EUR 2001].

We expect that the EIA report describes the design objectives and the provisions for limitation of emissions due to accidents with sufficient details to make it plausible that the limits will not be exceeded. The comment of the Ministry of Trade and Industry states that *'the EIA report must present various emergency scenarios involving radioactive emissions and, with the help of illustrative examples, should describe the extent of the affected zones and the impacts of emissions on people and the environment' [EIA,19]*

In a transboundary context severe accidents are of particular interest. Therefore we recommend that a worst case scenario concerning the amount of radioactive release will be analysed among the '*illustrative examples*', even if the applicant thinks that this scenario will have a very low probability of occurrence.

Moreover we demand that the EIA report describes the information system in case of an accident with a potential transboundary impact.

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[STATE (395/91)] Decision of the Council of State on the general regulations for the safety of nuclear power plants

[STUK YVL2.8] PROBABILISTIC SAFETY ANALYSIS IN SAFETY MANAGEMENT OF NUCLEAR POWER PLANTS, 2003

Glossary

BDBA	Beyond Design Basis Accident
BWR	Boiling Water Reactor
DBA	Design Basis Accident
EIA	Environmental Impact Assessment
EPR	European Power Reactor
EU	European Union
GHG	Greenhouse Gas
LILW	Low and Intermediate Level (radioactive) Waste
HLW	High Level (radioactive) Waste
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiation Protection
LWR	Light Water Reactor
MTI	Ministry of Trade and Industry
MW	Megawatt
MWe	Megawatt electric
NGO	Non Governmental Organisation
NPP	Nuclear Power Plant
PWR	Pressurized Water Reactor
SNF	Spent Nuclear Fuel