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NPP Loviisa-3

Bilateral Consultation
June 27th 2008, Helsinki

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CONTENT

1 INTRODUCTION

The company Fortum Power and Heat Oy (Fortum) plans to construct a new nuclear power plant (NPP) at the island of Hästholmen in Loviisa. Loviisa is the location of two operating NPP units. Electric capacity of the third 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[1] issued by the Government and ratified by the Parliament. For this decision-in-principle an Environmental Impact Assessment (EIA) is necessary.

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 Federal Ministry of Agriculture and Forestry, Environment and Water Management to elaborate an Expert Statement on the EIA Program for Loviisa 3 (LO 3) NPP. In the second stage of the EIA process the Austrian Institute of Ecology in cooperation with Dr. Helmut Hirsch was engaged by the Federal Environmental Agency on behalf of the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management.

The findings of this evaluation are presented in an Expert Statement (WENISCH et al. 2008) which is published at the website of the Umweltbundesamt[2].

This Expert Statement includes a list of questions resulting from the evaluation of the EIA Report. Bilateral consultations were held in Helsinki on June 27th, 2008. During this consultation the questions of the Austrian side were discussed with the competent Finnish authorities and the applicant Fortum.

For the Austrian side the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the Federal Environment Agency, a representative of the provinces and the consultant took part in the consultation.

For the Finnish side representatives of the Ministry of Environment (ME), the Ministry of Employment and the Economy (MEE), the Radiation and Nuclear Safety Authority STUK as well as Fortum attended the meeting.

The consultation included a general presentation on the subject by Fortum and a presentation of short answers to the questions filed by Austria before the meeting.

The discussion followed the structure proposed in the Austrian Expert Statement. This report follows the same thematic structure and presents the results of the discussions as follows:

1. Summary of treatment of the respective issue in the EIA Report
2. Comments of the Austrian Expert Statement
3. Questions posed in the Austrian Expert Statement
4. Answers of the Finnish side and the results of the discussion
5. Evaluation of the results by the Austrian consultants.

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[1] Now: favourable resolution.

[2] http://www.umweltbundesamt.at

2 CONCLUSION AND RECOMMENDATION

During the consultation most of the questions of the Austrian side were answered to the extent possible at the present stage of the procedure.

Concerning the EIA procedure the Finnish side considers changes, because completion of the EIA procedure before the project phase seems to be too early and only few details about the project are available. It is highly appreciated by the Austrian side that the Finnish side considers changes in the EIA process.

It is likely that several open questions will be treated in the following procedures. Preparation for the decision-in-principle includes feasibility studies which have to be provided by the companies. The complete application for the decision-in-principle will be publicly available and open for comments. Concerning the involvement of Austria, the modus of these consultations remains to be defined.

At present, several overlapping procedures are ongoing. Concerning the reactor safety in particular the assessment of STUK is of high interest. A preliminary assessment of the safety of the reactors will be provided by STUK for the decision-in-principle in the Parliament. Date and modus of publishing and discussion of this assessment is open.

A complete PSA level 1 and level 2 have to be provided for the construction license. Core issues concerning potential significant transboundary emissions of severe accidents are still open until (preliminary) PSA level 2 results are available. The assessment of source terms and their related frequency of occurrence is also subject of the PSA level 2.

At present it is not possible to exclude that due to a severe accident with a probability of occurrence of less than 5E-7 per year a release exceeding the limit posed by Finnish regulation (100 TBq Cs-137, 1500 TBq I-131, 100% noble gases) could occur. This limited impact is a probabilistic target and no prove that a larger release can be excluded.

Therfore, with a probability of occurrence below 5E-7 per year an emission exceeding the limited release could occur. An informed discussion of accident scenarios and source terms will be possible only at a later stage of the procedure, when level 2 PSA results are available.

It is recommended to provide a worst case accident scenario and the related source term in order to assess transboundary impacts.

Because of several open safety questions it is of high relevance for Austria to be able to follow the still ongoing procedures. Therefore, it is recommended to establish an information exchange between the competent Authorities of Austria and Finland covering the results of feasibility studies and safety assessments, which are of high relevance for Austria.

3 PROCEDURE

Treatment of issue in the EIA Report

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 has to be completed before the decision-in-principle concerning a new nuclear power plant can be issued. The EIA Report does not present a certain project and alternatives. In the EIA Report, Fortum examines the construction of a nuclear power plant unit with an approximate net electrical output of 1,000 to 1,800 MW and thermal power of 2,800 to 4,600 MW at Loviisa. The reactor type could be a BWR or a PWR. A list of ten reactor types is presented, which all belong to generation III. But Fortum stated that "[t]he plant options are not limited to those" (FORTUM 2008, 40).

The Finnish procedure allows the applicant to deal with the different reactor projects as a "black box" which has to follow Finnish nuclear regulations.

Comments on the issue in the Austrian Expert Statement

Regarding the reactor as "black box" is very vague because reactor type and output are not determined. The bandwidth of capacity and the differences between the proposed generation III reactors are huge. Therefore, it is not possible to properly assess the potential impact of an accident at the plant and the potential transboundary impacts. It might be questionable if this very general description of the project complies with the EIA-Directive of the EC and with the ESPOO-Convention.

Questions formulated in the Austrian Expert Statement

1. Why is the information about the reactor types in discussion not made public by the applicant, especially as in a similar UK procedure the availability of comprehensive information is obviously possible?
2. Why did Fortum neglect the requirements of the MTI's[3] statement of the scoping stage of the EIA to provide a review of current power plants on the market which are suitable for the project under review?
3. Since – beside limited emission targets – no detailed safety requirements seem to be published, could STUK provide a comprehensive list of the specific safety requirements for Generation III reactors in Finland for orientation?
4. Will the Ministry demand the fulfilment of issues required in the MTI's statement of the scoping stage of the EIA?
5. Is there a timetable for presenting missing information to the public and to the ESPOO partners?
6. Is the understanding correct, that the decision-in-principle will be made in spring 2009, after the new Finnish Climate and Energy Strategy will have been dealt with in Parliament in autumn 2008?

[3] MTI = former Ministry of Trade and Industry, since 2007 Ministry of Economy and the Employment (MEE)

Answers and results of the discussion

From the viewpoint of Fortum it was explained that at this stage of the project (before issuing of the decision-in-principle) the only criterion the vendors' proposals have to fulfil is meeting the Finnish emission criteria – all other criteria are only for internal use. Before the decision-in-principle vendors are asked if they are willing to adapt their project proposals to the Finnish safety requirements. Then discussions between the vendors and STUK can start.

Representatives of STUK added that the general requirements are outlined in the YVL guides[4]. These guides are now in revision and will be newly issued in autumn 2008. Generally, STUK does not issue precisely defined requirements for safety, because the vendors should have enough room for creating innovative solutions. The new safety guides will become part of first stage legislation.

Together with the new issue of the YVL safety guide for design basis and safety analysis a background paper will be issued which will compare the Finnish regulation with EUR and WENRA[5] reference levels.

Concerning Olkiluoto-3 (OL-3), STUK had issued specific requirements for the EPR construction such as to add separate and independent systems to maintain containment integrity in severe accidents (e.g. independent electric power supply), and STUK required that the containment must be able to resist an airplane crash.

The Finnish ministries explained that during the further procedure the "black box" thinking will be changed. The decision-in-principle relies on a discussion between STUK and the vendors. Therefore, more safety relevant information about the projects (feasibility studies) is necessary.

Preparation for the decision-in-principle includes appendices, i.e. homework for the companies – this is to be publicly available and open for comment, e.g. MEE has published a brochure on OL-3. Nevertheless, details about the following process and the modus for participation of the public are still unclear.

The decision-in-principle is due in 2010, and it was confirmed that the Finnish Climate and Energy Strategy will be considered for this decision. It could be clarified that every applicant for the 6th Finnish reactors could get a decision-in-principle; this could result in up to four reactors (because one of the applicants considers building two smaller plants).

It is likely that several open questions will be treated in the following procedures. Preparation for the decision-in-principle includes feasibility studies which have to be provided by the companies. The complete application for the decision-in-principle will be publicly available and open for comments. Concerning the involvement of Austria, the modus of these consultations remains to be defined.

[4] YVL-Guides = Regulatory Guides on Nuclear Safety

[5] EUR = European Utilities Requirements; WENRA = Western European Nuclear Regulators' Association

Evaluation

It is highly appreciated by the Austrian side that the Finnish side considers changes in the EIA process, because completion of the EIA procedure before the project phase seems to be too early. Relevant details about the reactor project are available only at a later stage of the procedures. The goal of the changes is a better harmonization of the parallel political decision and licensing processes and more opportunities for interested parties to discuss questions of nuclear safety based on concrete information about the project.

The Finish Environmental Ministry also considers demanding the presentation of a worst case accident scenario and a discussion of mitigation measures as it is required in an EIA process. It has to be emphasized that the presentation of a maximal source term is of great importance for the assessment of transboundary impacts of emissions due to a severe accident.

4 REACTOR TYPES

Treatment of issue in the EIA Report

The EIA Report does not provide sufficient information about the reactors considered for LO 3. Based on the information given in the EIA, an evaluation of safety, the maximal source term and its probability of occurrence is not possible.

Comments on the issue in the Austrian Expert Statement

There is very little operational experience with the reactor types listed in the EIA. Only one of those types (ABWR) has been in operation so far. The majority of the reactor types listed relies on ex-vessel cooling (i.e., installation of a core catcher) for control and mitigation of severe accidents.

In order to discuss the bandwidth of properties of the proposed projects two reactors have been chosen by the Austrian experts. They are not only of different type, but also have fundamentally different safety concepts: The EPR is the most conservative of the proposed reactors. It is an evolutionary development of the German KONVOI and the French N4 reactor and relies mainly on active safety systems. The ESBWR is among the reactors with most advanced new design and relies mainly on passive safety systems.

Questions formulated in the Austrian Expert Statement

1. The reactor types listed in the EIA Report as being in non-binding consideration for LO 3 are in different stages of development; most of them are still at the design stage, only one of them (ABWR) has operational experience. Especially the accuracy and reliability with which the hazards can be assessed will also vary considerably and should therefore be described in detail. How will the Finnish authorities address this circumstance during the following decision process?
2. Which criteria has Fortum defined for the selection of the reactor? Can they be described and reported to the public before a governmental decision is taken?

Answers and results of the discussion

Concerning assessment of safety, hazards and layout of the plant, vendors know the requirements which have to be fulfilled. If changes are necessary to meet the Finnish requirements, early preparation should be discussed with STUK (costs for this consultations have to be paid by the companies). The results are presented in the feasibility study (e.g. see statement of STUK for OL-3). Only reactor types which can be changed in order to fulfil the Finnish regulation and for which the vendor is prepared to make these changes are allowed for bidding. STUK has an absolute veto right, STUK can decide that a proposal cannot meet the Finnish regulations.

Fortum declared that it will use the European Utilities Requirements as criteria for its decision on the reactor type.

Questions concerning the EPR

1. Does the Finnish side agree to the assessment that the main advantage of the measures for core melt mitigation implemented at the EPR appears to be that filtered venting can be avoided; and that the core catcher yields no significant improvement regarding the probability of large releases, compared to modern generation II PWRs?
2. For Olkiluoto-3, CDF[6] from internal events is about 1.44E-6/yr, more than twice as high as the results for the UK-EPR. The CDF for internal events does not depend significantly on the site selected; how can this discrepancy be explained – different PSA methodology, additional safety measures to be implemented at the UK-EPR?
3. Does the Finnish probabilistic target of 5E-7/yr for large releases cover all accident initiators – internal events, internal hazards and external events?
4. Are there more detailed PSA results for Olkiluoto-3 available today, compared to the state of 2005, particularly concerning containment behaviour, including internal and external hazards?
5. What is the status of the analyses performed for Olkiluoto-3 regarding the crash of a commercial airliner, including analyses of vibrations? Are there more results available today, compared to the state of 2005?
6. 2A-LOCA is a design base accident (DBA) for the Olkiluoto-3 EPR, as opposed to Flamanville and the UK-EPR, where it is dealt with in the context of risk reduction. Regarding the analyses supporting this statement – were all parameters and assumptions entering them selected in a conservative manner (regarding output of safety systems, thermo-hydraulic assumptions, methodology used for thermo-hydraulic safety analysis, operational state of the reactor etc.)?

Answers and results of the discussion concerning the EPR

These questions have been answered mainly by STUK. The information is summarized below:

High pressure containment failures are prevented by depressurization valves (3 for DBA, and 2 for severe accident management). Thus early containment failures are prevented. The core catcher is no contribution for prevention of early containment failure. However, new phenomena – interaction of molten core and concrete – are to be considered as a hazard for the containment integrity.

The PSA results of Areva and STUK are different, which is surprising but likely to be caused by differences in the methodology. PSA level 1 and 2 are required for the construction license.

Concerning airplane crashes there exists a test facility of VTT, more information can be found on the project website of the EU project “IMPACT”.

Concerning the availability of systems during “2A-LOCA” some confusion exists at OL-3. According to the YVL guide 2.2 this 2A-LOCA is a design base accident – only one of four systems has to be assumed to be available.

[6] CDF = Core Damage Frequency

Questions concerning the ESBWR

1. Does the Finnish side agree that passive safety can have drawbacks regarding flexibility of reaction in critical situations – particularly in case of high power density?
2. Does the Finnish side agree that the core catcher concept of the ESBWR, without prior melt retention, might lead to specific problems (in addition to the general uncertainties involved in core catcher functioning)?
3. The CDF values published for the ESBWR are low, particularly when compared, e.g., to those for the EPR. How meaningful are the ESBWR CDF values in the view of the Finnish side, taking into account the relatively early stage of development of the ESBWR and the fact that PSA results in the order of 1E-08 or 1E-09/yr are beset with particularly high uncertainties?
4. To the knowledge of the authors of this statement, no results of level 2 PSA, particularly no values for large release frequencies, have been published for the ESBWR. Does the Finnish side have such results?
5. What is the assessment of the Finnish side of the general vulnerability of the ESBWR to external hazards, particularly to attacks?

Answers and results of the discussion concerning the ESBWR

In general, passive systems are preferred by STUK, but also other solutions can be accepted (YVL guide 2.0).

Concerning the core catcher for the ESBWR, specific questions have to be considered, e.g. steam explosion.

At present, the Finnish side does also have no results of level 2 PSA for ESBWR. PSA level 1 and 2 have to be provided for STUK at a later stage of the procedures.

Low probability figures are important but not enough. Deterministic requirements have to be fulfilled, like 100% independent safety systems for containment depressurization.

Vulnerability of the ESBWR to external hazards has been and will be discussed in future. This issue will be included in the new general requirements. STUK has submitted the companies a letter with a list of requirements concerning hazards which are to be considered by the design. Companies shall give these requirements to the vendors. Detailed open discussions of issues of vulnerability are not intended because of security reasons.

Evaluation

STUK has provided information about the further requirements of vendors to provide information on safety relevant issues. At the present stage of the procedure not much information is available. The vendors are now in discussion with STUK about the necessary adaptations of their reactor proposals to meet the Finnish regulations. After this first discussion Fortum has to decide which vendors are invited for bidding. Precondition is that the vendors are willing to carry out the required modifications. Proposals can be excluded by STUK, if STUK comes to the decision that an adaptation to fulfil the Finnish YVL guides is not possible. Internal and external hazards are to be considered in the design. Complete level 1&2 PSA have to be provided for the construction license.

5 SAFETY AND ACCIDENTS

Treatment of issue in the EIA Report

PSA results for the reactor types can be found in open literature. Core damage frequencies span two orders of magnitude. The source term, as assumed in the EIA Report for exemplary dose calculations, does not take all nuclides into account, which are required for checking European Utilities Requirements (EUR) release criteria (Criteria for Limited Impact). Even so, not all EUR criteria are kept by the source term in the EIA Report. In the EIA Report a dose assessment of the accidental release with the exemplary source term is presented for a region of 100 km. For a distance up to 1,000 km the dose is evaluated by extrapolation and estimations. The information of the EIA Report is not sufficient for an assessment of the potential impact of a severe accident at the LO 3 NPP. A worst case has to be discussed and the source term has to be proved to be the maximum release. Sufficient information about the used weather conditions and the type of dispersion model used by the computer programs have to be provided.

Comments on the issue in the Austrian Expert Statement

The information of the EIA Report is not sufficient for an assessment of the potential impact of a severe accident at the LO 3 NPP. A worst case has to be discussed and the source term has to be proved to be the maximum release. Sufficient information about the used weather conditions and the type of dispersion model used by the computer programs have to be provided.

Questions formulated in the Austrian Expert Statement

1. Why has Fortum ignored the requirement of the MTI in its statement on the scoping procedure of the EIA to present the safety planning criteria of the prospective plant with respect to the limitation of radioactive emissions as well as an assessment of how the safety requirements in force will be met?
2. Concerning the source term, what is the relation between EUR Criteria and the Finnish Regulation for Limited Impact?
3. Method and input data for the dose assessment are not explained in the EIA Report. For the dose assessment three computer models are used; please, provide a description of the dispersion models and the weather data used for the assessment. Is one of these programs appropriate for modelling long-range transport and dispersion of radionuclides?
4. Concerning the large bandwidth of 2 orders of magnitude of CDF and LRF assessments for the reactors under review, will the release frequency and the related emissions (source term) be criteria for the selection of the reactor?

Answers and results of the discussion

Fortum explained that it depends on the vendor which information is provided publicly. Fortum itself is not allowed to present much information before the bidding procedure is finished, because of competition reasons. In the framework of updating the YVL guides, a comparison of YVL and EUR safety criteria will be provided.

Concerning the methodology of impact assessment of severe accidents a specialist from Fortum presented information about the models used for dispersion and dose calculation. Three different models were used, two Gauss models for the distance up to 100 km (LENA 95, TUULET) and a Lagrangian transport model (TRADOS) for larger distances.

Dose assessment models

	TUULET	LENA	TRADOS
Range	0-100 km	0-300 km	0-7000 km
Weather data	from one point	from one point	global observations & 3D-weather model
Use of weather data	hourly averages chronologically		for statistical analyses data is classified into PINs.
Dose paths	cloud shine ground shine inhalation food products products from nature	cloud shine ground shine inhalation	cloud shine ground shine inhalation food products
Seasonal variations	12 months		2 seasons: growing & dormant seasons
Dispersion model	Gaussian, straight line	Gaussian, straight line	K_z-model, changing weather along trajectory

For the dose assessment some extrapolation was required, because TRADOS can be used for assessing doses for 50 years, including ingestion, but only for impacts in Finland from a source outside of the county. TRADOS is a global-scale model of Finnish origin described in the paper “Description and application of a system for calculating radiation doses due to Lagrange transport of radioactive releases”. It has to be stated, that the dose results of the interpolation for the long range presented in the EIA report are not applicable to assess a potential impact to Austria.

The result presented in the EIA report for represents the most probable weather situation and is used to assess the impact for emergency exercise.

Evaluation

The impact assessment is based on the allowed maximal release (100% noble gases, 100 TBq Cs-137, 1500 TBq Iod-131). With this source term Fortum proves that the Finnish dose limits are fulfilled. This limited impact is a probabilistic target and no prove that a larger release can be excluded.

With a probability of occurrence below 5E-7per year an emission exceeding the limited release could occur. An informed discussion of accident scenarios and source terms will be possible only at a later stage of the procedure, when level 2 PSA results are available.

It is recommended to provide a worst case accident scenario and the related source term in order to assess transboundary impacts.

6 SPENT FUEL MANAGEMENT

Treatment of issue in the EIA Report

Spent fuel is stored in interim storage at the Loviisa nuclear power plant site. Storage in a pool is not an optimal technology for long-term interim storage. Critical aspects are the integrity of the fuel rods and their handling after several decades in the pool. According to the EIA Report, a further extension of the interim fuel storage is envisaged in order to prepare a place for the fuel from LO 3.

Comments on the issue in the Austrian Expert Statement

Since it is planned to store the spent fuel in interim storage over several decades up to 60 years, the disadvantage of the storage pool compared to a dry one should be considered. Furthermore, an assessment of the risk of accidents caused by external impacts to the pool storage should be given.

Questions formulated in the Austrian Expert Statement

1. The interim storage of spent fuel in a pool over long periods seems not to be an optimal solution. An enlargement of the interim storage is envisaged. Considering the disadvantages of wet storage, would dry storage not be a safer option?

Answers and results of the discussion

Finland has long experience with pool storage and does not see problems with this type of storage. Although it was confirmed that concerning external hazards a dry vault storage might be favourable.

7 ALTERNATIVES AND ZERO OPTION

Treatment of issue in the EIA Report

No alternative options for electricity production or options for investment in energy efficiency are discussed in the EIA Report.

Comments on the issue in the Austrian Expert Statement

To use a nuclear power plant for production of combined heat and electricity is questionable because NPPs are usually located in remote areas because of their risk potential. Therefore it is questionable if there are enough consumers for the produced heat. From the point of efficiency and sustainability gas-powered combined plants located near the consumers would be a better solution.

Questions formulated in the Austrian Expert Statement

1. Are there potential heat consumers near the NPP? Wouldn´t it be a better solution to use gas-powered combined plants that can be located near the consumers?

Answers and results of the discussion

Fortum explained that because there are no relevant heat consumers near the NPP, they are thinking about building a pipeline from Loviisa to Helsinki (about 100 km) for the transport of hot water for long distance heating. However, the realisation is unclear because municipal heat providers probably will have to agree to this plan.

Evaluation

Fortum has not answered the question, but used it to present its proposal of building a pipeline for a long distance heating system.

8 REFERENCES

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9 GLOSSARY

ABWR ..... Advanced Boiling Water Reactor

APWR ..... Advanced Pressurized Water Reactor

BWR..... Boiling Water Reactor

CDF..... Core Damage Frequency

Cs..... Caesium

DBA..... Design Base Accident

EC ..... European Commission

EIA ..... Environmental Impact Assessment

EPR..... European Power Reactor

ERF ..... Early Release Frequency

ESBWR..... Economic Simplified Boiling Water Reactor

EUR ..... European Utilities Requirements

I-131..... Iodine isotope 131

LO 3 ..... Loviisa Unit 3, EIA procedure ongoing

LRF ..... Large Release Frequency

ME..... Ministry of Environment

MEE ..... Ministry of Employment and the Economy, Finland

NPP..... Nuclear Power Plant

OL-3 ..... Olkiluoto Unit 3, under construction

OL-4 ..... Olkiluoto Unit 4, topic of this EIA procedure

PSA..... Probabilistic Safety Assessment

PWR..... Pressurized Water Reactor

STUK ..... Radiation and Nuclear Safety Authority, Finland

TBq ..... Tera-Becquerel

TVO ..... Teollisuuden Voima Oy

VTT ..... Technical Research Centre of Finland

WENRA..... Western European Nuclear Regulators' Association

YVL ..... Regulatory Guides on Nuclear Safety

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