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NPP FENNOVOIMA

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CONTENT

1 INTRODUCTION

In the framework of the EIA Directive, the Espoo Convention respectively, Austria has participated in the transboundary EIA procedure concerning the construction of a reactor by Fennovoima Oy (Fennovoima).

The company Fennovoima Oy plans to construct a new nuclear power plant (NPP) in Finland. Three different sites are in discussion: Hanhikivi (municipality of Pyhäjoki), Kampuslandet and Gäddbergsö (municipality of Ruotsinpyhtää near the site of the operating NPP Loviisa) or Karsikkoniemi (municipality of Simo). The alternatives for electric capacity of the new NPP ranges between be 1,500–1,800 MWe for one unit or 2,000–2,500 MWe for two units (with 1,000–1,250 MWe, each).

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. In the second stage of the EIA process the Austrian Institute of Ecology in cooperation with Dr. Helmut Hirsch and Dr. Petra Seibert (BOKU-Met) was engaged by the Austrian Environment Agency (Umweltbundesamt) to assess the Environmental Impact Assessment Report of Fennovoima.

The findings of this evaluation are presented in an Expert Statement (UMWELTBUNDESAMT 2008) which is published at the website of the Umweltbundesamt .

This Expert Statement includes a list of questions resulting from the evaluation of the EIA Report. The Bilateral consultation was held in Helsinki on January 28th, 2009. During this consultation the questions of the Austrian side were discussed with the competent Finnish authorities and the applicant Fennovoima Oy.

For the Austrian side the Federal Ministry of Agriculture, Forestry, Environment and Water Management, the Environment Agency Austria, a representative of the provinces and the consultants 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 Fennovoima Oy attended the meeting.

The consultation included a general presentation on the subject by Fennovoima Oy and a presentation of answers to the questions filed by Austria.

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 raised 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.

2 CONCLUSIONS AND RECOMMENDATIONS

From the Austrian point of view, it is of foremost importance to assess the potential consequences of a severe accident for Austrian territory.

In this context, possible influences of the reactor types envisaged on potential source terms for severe accidents are of major interest. Also, the methodology for risk assessment is of importance.

Therefore, taking into account the results of the consultation held in Helsinki on January 28, 2009, the Austrian side requests the following recommendations to be taken duly into account regarding the EIA procedure as well as regarding the next steps of decision making):

1. A conservative worst case release scenario should be included in the EIA, in addition to the limited release scenario according to Finnish regulations. Only results of a detailed safety assessment for the candidate reactor(s) would permit to exclude a larger source term – in case it can be proven beyond doubt that such a larger source term cannot occur.

   Such results, however, are not yet available. Therefore, a source term for e.g. an early containment failure or containment bypass scenario should be analyzed as part of the EIA – in particular because of its relevance for impacts at greater distances.
2. The potential differences between the reactor types under consideration should be duly considered in preparing the Decision in Principle (DiP[1]), as far as they can be relevant for safety.

   In particular, this should include differences which can influence the source term for severe accidents, as well as the basic safety philosophy (active/ passive safety concept) and the experiences available for the reactor types under consideration.
3. In the framework of the Decision in Principle as well as during later stages of the decision making and licensing, information concerning accident analyses, severe accidents and PSA results should be made available to the Austrian side. It has to be emphasized that PSA results are of considerable value for the orientation of designers and regulators (for example, to identify weak points in a reactor design). On the other hand, the inherent limitations of PSA should not be forgotten – such analyses are beset with considerable uncertainties, and some risk factors are difficult to include in a PSA. Therefore, for rare events the probability of occurrence as calculated by a PSA should not be taken at face value, but as an indicative number only.

It is requested also to take the following recommendations into account, which are of considerable general importance, although not of direct relevance for Austria:

4. For the Decision in Principle, the overall Finnish energy situation should be taken into account.
5. Concerning the final disposal of spent fuel arising from (an) additional reactor(s), the decision regarding the site of the disposal facility should be taken, first and foremost, taking the safety point of view into account (in particular, regarding the question whether there should be one or two repositories in all).

[1] Additional to the DIP documents will be submitted by the government for the parlamentarien decision making. These documents should adress the mentioned recommendation.

Austria highly appreciates, the announcement of the Finnish Ministry of Employment and the Economy (MEE) at the consultations in Helsinki that the following documents will be made available to the Austrian side as an important contribution to keeping the Austrian side well-informed:

- Decision in Principle application by Fennovoimy Oy
- Statement of MEE on the EIA
- Decision in Principle including the STUK report on the feasibility study of the reactor types (for all Decision in Principle applications).

3 PROCEDURE

3.1 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.

Fennovoima Oy considers three different alternatives for the location of the planned nuclear power plant (NPP). Alternatives for electric capacity shall be 1,500–1,800 MWe for one unit or 2,000–2,500 MWe for two units (with 1,000–1,250 MWe each).

3.2 Comments on the issue in the Austrian Expert Statement

Fennovoima's EIA Report seems to be complete according to the minimum requirements of the Espoo Convention. However, considering possible transboundary impacts, there is some general lack of information.

Without any description of the NPP's features it is not possible to assess the feasibility of compliance with the radiation protection targets.

Therefore it is of high relevance for Austria to be able to follow the still ongoing procedures. Preparation for the DiP includes feasibility studies – based on these documents the regulatory authority STUK has to assess whether there are safety issues to be foreseen which could prevent the plant from meeting the Finnish requirements. Establishing an exchange of information between the competent authorities of Austria and Finland covering the results of feasibility studies and safety assessments is recommended.

The Finnish Government approved a new Climate and Energy Strategy for Finland on 6th November 2008. This strategy indicates that the electricity demand will not grow as fast as it was assumed by Fennovoima's EIA Report. Besides, the Government stated in its strategy that "nuclear power will not be constructed in this country for the purpose of permanent export of electricity." (MINISTRY of EMPLOYMENT and the ECONOMY 2008). Furthermore, not only Fennovoima is planning a new NPP, but also Teollisuuden Voima Oy (TVO) and Fortum Oy. Even if the Finnish demand for electricity will grow, construction of three new big nuclear power plants will probably not be needed.

3.3 Questions formulated in the Austrian Expert Statement

1. How can an exchange of information between the competent authorities of Austria and Finland be established covering the results of feasibility studies?
2. The new Finnish Climate and Energy Strategy aims at reducing electricity consumption in Finland – how will the new objectives be considered during the EIA procedure and the Decision-in-Principle?
3. Which criteria will be decisive for the site selection?

3.4 Answers and results of the discussion

Q1. Regarding the further procedure it was explained that the year 2009 will be devoted to the preparation of the DiP by the MEE. All applications of the three utilities will be treated together. The governmental decision on the DiP is expected for early 2010 and the parliament's decision for late 2010. The outcome can be anything from zero to 3 new NPPs (with up to four units).

At present the DiP application for OL 4 is being processed by MEE, since the EIA procedure for this NPP is finished.

For LO 3 the EIA is completed, but Fortum did not yet send a DiP application. This application is expected to be submitted soon.

For Fennovoyma the DiP application has already been submitted, but the EIA has to be finished before it will be processed by MEE. The statement of the Ministry of Environment – contact authority for the transboundary EIA – has to be finished by the end of February.

Discussion and decision on these DiP´ will be pooled, but each applicant will get a separate answer to its application.

Q2. The longterm Climate and Energy Strategy has to be updated and in particular, changes in the Finnish and global economic situation will be considered. Because of the closure of some paper mills the electricity demand has decreased in the last year. The Energy strategy is not an issue for the EIA, but has to be considered by the MEE during preparation of the discussion of DiPs by the government. The government will take into account the new Climate and Energy Strategy when it considers the overall good of the society for the DiP.

Q3. Siting criteria are based on STUK and IAEA guides. There is no necessity to drop any of the proposed sites based on environmental effects or influences.

3.5 Evaluation

Austria highly appreciates the announcement of the Finnish Ministry of Employment and the Economy (MEE) during the consultations in Helsinki that the following documents will be made available to the Austrian side as an important contribution to keeping the Austrian side well-informed:

- **Decision in Principle application by Fennovoimy Oy**
- **Statement of MEE on the EIA**
- **Decision in Principle including the STUK report on the feasibility study of the reactor types (for all Decision in Principle applications).**

4 REACTOR TYPES

4.1 Treatment of issue in the EIA Report

The EIA Report provides only a basic technical description of the reactor project.

Following a preliminary assessment of all light water reactor types on the market, Fennovoima has chosen three reactor alternatives for further analysis. There is little operational experience with the reactor types chosen by Fennovoima. Only one of those types (ABWR) has been in operation so far.

It is the general practice in Finland, as laid down in the corresponding regulations, that specific and detailed technical information concerning the reactor types under consideration is not provided in the EIA Report.

In preparation for the Decision-in-Principle, the applicant will have to prepare feasibility studies for all reactor types under consideration. Based on these documents the regulatory authority STUK will assess safety issues to be foreseen and its compliance with the Finnish requirements.

After the Decision-in-Principle and the definitive selection of a reactor type, a much more detailed assessment of the NPP project will be performed, in the course of the nuclear licensing procedure by STUK.

4.2 Comments on the issue in the Austrian Expert Statement

It would be desirable that information which indicates that there could be significant and clear-cut differences between the reactor types under consideration would already be provided, discussed and evaluated in some detail in the EIA Report. In conclusion, it has to be stated that the information contained in the EIA Report does not permit a reliable assessment of the possible influence of the reactor type selection on accident consequences for Austrian territory.

4.3 Questions formulated in the Austrian Expert Statement

Q4. Which priority will be given to safety aspects, compared to other aspects, for the selection of the reactor type? Is it sufficient that a reactor type fulfills the safety requirements; or will there be an attempt to optimize safety (i.e. to select, if possible, among reactor types fulfilling the regulatory requirements, the type with the most advantageous safety characteristics)?

Q5. Is it possible to present an overview on significant differences between the reactor types under consideration in order to evaluate possible implications for the selection of a reactor type, with the focus on the large release risk due to a severe accident? For example, significantly different experiences with reactor types, basically different safety approaches as well as significant differences in PSA results should be regarded as indicators for this discussion and evaluation.

Q6.Which documents will be available for foreign states participating in the cross-border EIA during the selection procedure of the reactor type and how will they be informed about decisions?

4.4 Answers and results of the discussion

Q4: According to the company's representative nuclear safety is an overriding goal for the project. Every reasonable effort will be made to exceed the Finnish safety regulations by a significant margin. The whole process of plant selection involves balancing technical, operational, economic and other factors, without compromising safety.

Q5: A generic design usually is not acceptable in Finland "as is". Therefore, PSA results in the available literature will not be the same as those for the eventual Fennovoima designs.

Generally, PSA numbers are important indicators and very useful for comparisons between plants and to identify weak points of a plant design. However, they should not be taken at face value – for example, a CDF result of 1E-6/yr cannot be taken to mean "one severe accident in one million years".

Q6. The cross border EIA process ends when the whole EIA process is finished, probably on February, 20th 2009. But the Finish side announced that Austria will be informed by MEE about the further decisions, as it is explained in chapter 3.

Moreover, Fennovoima stated its DiP application is public and contains as much technical detail as possible without compromising vendors' intellectual property interests.

If Fennovoima gets a positive DiP, it is probable that the utility choses the reactor type itself after a commercial competition. It does not necessarily have to be one of the reactor types which were described in the EIA; however, it is very likely that it will be one of those. Once the selection has been made, it can be expected that it will be widely published.

4.5 Evaluation

Austria appreciates the intention for further information exchange as announced by the MEE.

The explanations of the Finish partners made clear that during the DiP process not only the government and the parliament are involved, but also municipalities and more detailed information will be published before the licensing procedure.

5 SAFETY AND ACCIDENTS

5.1 Treatment of issue in the EIA Report

The EIA Report provides a very basic introduction to nuclear safety issues. Concerning accident situations it is stated that in order to evaluate possible impacts caused by a nuclear power plant accident, two accidents (INES 6 and INES 4) have been assessed.

The caesium-137 emission caused by an INES 6 accident is assumed to be 100 TBq. This corresponds to the limit set by the Government Decision 395/1991. The source term for the INES 4 accident is not provided in the EIA Report.

According to the YVL Guide 2.8, the probability for core damage shall be less than 1E-5/yr. The probability for a core damage accident exceeding the limit of 100 TBq Cs-137 shall be less than 5E-7/yr.

5.2 Comments on the issue in the Austrian Expert Statement

The INES 6 accident which is the most severe accident assessed in the EIA Report does not constitute a worst-case scenario. Severe accidents with releases considerably higher than 100 TBq of Cs-137 cannot be excluded for the reactor types under consideration, even if their probability is required to be below 5E-7/a. Their effects can be widespread and long-lasting and even countries not directly bordering Finland, like Austria, could be affected.

In the EIA Report it is explained that a Gaussian model is used for dispersion calculation and that the German regulatory model is applied. The use of this model for assessment of transboundary impacts with unfavorable weather conditions as a worst-case is an acceptable approach, but in the EIA it suffers from the fact that the “worst-case” with respect to the emission is rather arbitrarily taken as 100 TBq Cs-137. Moreover, the EIA Report presents only one set of results of the dispersion calculation for all three proposed sites. Furthermore, no values are presented for the unfavorable weather conditions at distances beyond 50 km.

In summary, it is not easy to infer the consequences in Austria of possible severe accidents from the EIA Report.

5.3 Questions formulated in the Austrian Expert Statement

Q7. Why has no realistic worst-case source term been assumed for the transboundary impact assessment? (Severe accidents with releases considerably higher than 100 TBq of Cs-137 cannot be excluded for the reactor types under consideration.).

Q8. The Cs-137 deposition at the distance of 1,000 km is, according to Table 8-51, 0.28 kBq/m^2. But there are no values presented for the unfavorable weather conditions at distances beyond 50 km. What are the consequences (in terms of deposition and doses) under so-called unfavorable weather conditions at 1,000 km? What are the consequences at 1,500 km?

Q9. How are unfavorable conditions defined (wind speed, dispersion category or categories, mixing height)?

Q10. Why does the impact assessment not use the Finnish SILAM model and realistic weather data for the assessment of long range transport of radioactive substances?

5.4 Answers and results of the discussion

Q7: Fennovoima strongly rejects the notion that a source term of 5% Cs-137 inventory, as considered by the Austrian side, would be “realistic” for their plant, due to advanced safety features of the design. Fennovoima argues that even the 100 TBq is an overestimation for the worst case. This source term is a deterministic Finnish requirement, larger releases are “practically excluded".

Regarding the probability of a 10,000 TBq Cs-137 release (in the order of magnitude of the Austrian source term, which corresponds to about 25,000 TBq Cs-137), Fennovoima estimates a probability of <5E-9/yr, i.e. below the limit by a factor of 100.

Discussion mainly concerned the probability of emissions exceeding the 100 TBq. The Austrian side stated that published results of current safety studies (e.g. from the UK) did not support Fennovoima's claim of a probability below 5E-9/yr for a large release. Fennovoima's statement could only be taken as a statement of intent to reach such a low probability. From today's state of knowledge, it remains open whether this can indeed be achieved.

Fennovoima did not deny that according to the present state of knowledge, the probability for a large release could be higher than their estimate. On the other hand, they pointed out that severe accident releases could be lower than 10,000 TBq. In any case, Fennovoima was confident that because of technical improvements – for example, counter-measures against containment bypass sequences –, they would reach their goal (probability below 5E-9/yr for a 10,000 TBq Cs-137 release) in the end.

There was consensus that PSA results are beset with considerable uncertainties in any case (see also Q4), making it difficult to accurately verify whether a probabilistic safety goal is achieved.

Q8. For long-range transport effects only one point in the distance of 1000 km was assumed. For that the following results were given:

Fennovoima: unfavourable weather at 1000 km

depostion Cs 137: 1.3 kBq/m²		
effective dose [mSv]	**adult**	**child**
2 days	0.04	0.06
7 days	0.05	0.07
50 years	0.56	0.74
Food	0.78	1.6
Total	**1.4**	**2.3**

Distances exceeding 1000 km have not been calculated

Q9. Fennovoima gave the following information, on dispersion calculation:

Short range up to 20 km (Gaussian model)

Wind speed (10 m): 2 m/s
Stability class: D
Mixing height: 800 m, according to class D
Rain: 0.5 mm/h

Long range, from 20 km on

Windspeed (10 m): 2 m/s
Stability class: not applicable with Gaussian Puff Modell
diffusion coefficient: 6000 m²/s
Mixing height: 200 m (stable conditions)
Rain: 0.5 mm/h

Q10. According to Fennovoima results provided with the method used are on the safe side compared with the use of a Lagrangian model like SILAM using the information of the real distance traveled by the plume.

For a Lagrangian approach, a particular receptor of interest must be chosen, the results then are only valid for that receptor. Many of our neighboring countries are interested in possible impacts, which they can now determine for each desired area < 1000 km from our sites. However, no probability is given that a certain region is affected by the plume.

5.5 Evaluation

Main issue of the discussion was the severe accident source term.

A conservative worst case release scenario should be included in the EIA, in addition to the limited release scenario according to Finnish regulations. Only results of detailed safety assessments for the candidate reactor(s) would permit to exclude a larger source term – in case it can be proven beyond doubt that such a larger source term cannot occur.

Such results, however, are not yet available. Therefore, a source term for e.g. an early containment failure or containment bypass scenario should be analyzed as part of the EIA – in particular because of its relevance for impacts at greater distances.

Moreover, it has to be emphasized that PSA results are of considerable value for the orientation of designers and regulators (for example, to identify weak points in a reactor design). On the other hand, the inherent limitations of PSA should not be forgotten – such analyses are beset with considerable uncertainties, and some risk factors are difficult to include in a PSA. Therefore, for rare events the probability of occurrence as calculated by a PSA should not be taken at face value, but as an indicative number only.

The Austrian questions concerning the dispersion calculation were answered comprehensively and sufficiently.

6 SPENT FUEL MANAGEMENT

6.1 Treatment of issue in the EIA Report

Fennovoima Oy indicates that the quantity of produced spent fuel will amount to 40–60 tons per year, which entails an estimated total sum of 2,500–3,500 tons during the planned 60 years of operation (FENNOVOIMA 2008, p. 86).

Fennovoima leaves open, which of the two possibilities of interim storage (storing in a water-filled pool or dry storage) they are going to use.

Posiva Oy is currently developing solutions for geological final disposal of spent fuel. Fennovoima's EIA-Report states that it is most likely that there will not be any release of radioactive substances for millions of years with Posiva's concept. However, it is not indicated, whether Fennovoima is already in negotiation with Posiva.

6.2 Comments on the issue in the Austrian Expert Statement

Radioactive waste management is presented in the EIA report in a very general manner. It appears that Fennovoima has not yet developed a comprehensive nuclear waste management strategy. Fennovoima Oy should clarify whether they intend to dispose of the spent fuel in Olkiluoto like the other NPPs of Finland.

6.3 Questions formulated in the Austrian Expert Statement

Q11.Has Fennovoima asked for an agreement for disposal of spent fuel in the deep geological repository at Olkiluoto?

Q12. Is a further enlargement of the capacity of the deep geological repository at Olkiluoto feasible?

Q.13 Has Fennovoima elaborated plans for another final storage as an alternative?

6.4 Answers and results of the discussion

Q11. Fennovoima has sought contact with Posiva and their owners.

The response has been negative so far. Fennovoima definitely would prefer an agreement with Posiva. According to the MEE, it is up to the utilities to achieve an agreement on a common final disposal site; the government would prefer not to interfere.

Q12 An enlargement is planned up to the capacity needed by the Finnish power companies,. According to Posiva, however, there are also some restrictions for this enlargement (repository should not be under the sea, nor under the existing NPPs).

There is already a Decision in Principle for the final disposal of 6,500 t of spent fuel, for the Olkiluoto site. At present, an EIA procedure is performed for an enlargement to 12,000 t. This capacity corresponds to the requirements for six NPPs; it does not include the spent fuel from the Fennovoima project.

Q13. Fennovoima states that preparing an alternative final disposal site would violate the spirit and letter of previous Government decisions aiming at one final disposal facility for all spent fuel generated in Finland.

No technical problems have to be expected if Fennovoima's fuel is included in the Olkiluoto repository project. The properties of spent fuel produced so far are well known; no great deviations are expected in the future.

According to MEE, the Ministry would like that the problem is solved in time. There is no intention to exclude Fennovoima from the DiP because of repository issues.

6.5 Evaluation

The uncertainty concerning the final disposal of spent fuel from Fennovoima's NPP is probably due to the competition of the three applicants in the DiP procedure. It appears that an agreement after the DiP procedure will be possible.

Concerning the final disposal of spent fuel arising from (an) additional reactor(s), the decision regarding the site of the disposal facility should be taken, first and foremost, taking the safety point of view into account (in particular, regarding the question whether there should be one or two repositories in all).

7 REFERENCES

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8 GLOSSARY

ABWR.....Advanced Boiling Water Reactor

BWR .....Boiling Water Reactor

CDF .....Core Damage Frequency

Cs .....Caesium

DiP.....Decision in Principle

EC .....European Commission

EIA.....Environmental Impact Assessment

EPR .....European Power Reactor

EU .....European Union

Fortum .....Fortum Heat and Power Oy

I .....Iodine

IAEA .....International Atomic Energy Agency

INES .....International Nuclear Event Scale

LILW .....Low and Intermediate Level Waste

LO 3.....Loviisa Unit 3

LRF.....Large Release Frequency

LWR .....Light Water Reactor

MEE.....Ministry of Employment and the Economy (former MTI)

mSv .....Milli-Sievert

MWe .....Megawatt electric

NPP .....Nuclear Power Plant

OL 4.....Olkiluoto Unit 4

PSA .....Probabilistic Safety Assessment

PWR .....Pressurized Water Reactor

STUK.....Finnish Radiation and Nuclear Safety Authority

Sv .....Sievert

TBq .....Tera Becquerel

TVO .....Teollisuuden Voima Oy

yr .....Year

YVL.....Regulatory Guides on Nuclear Safety