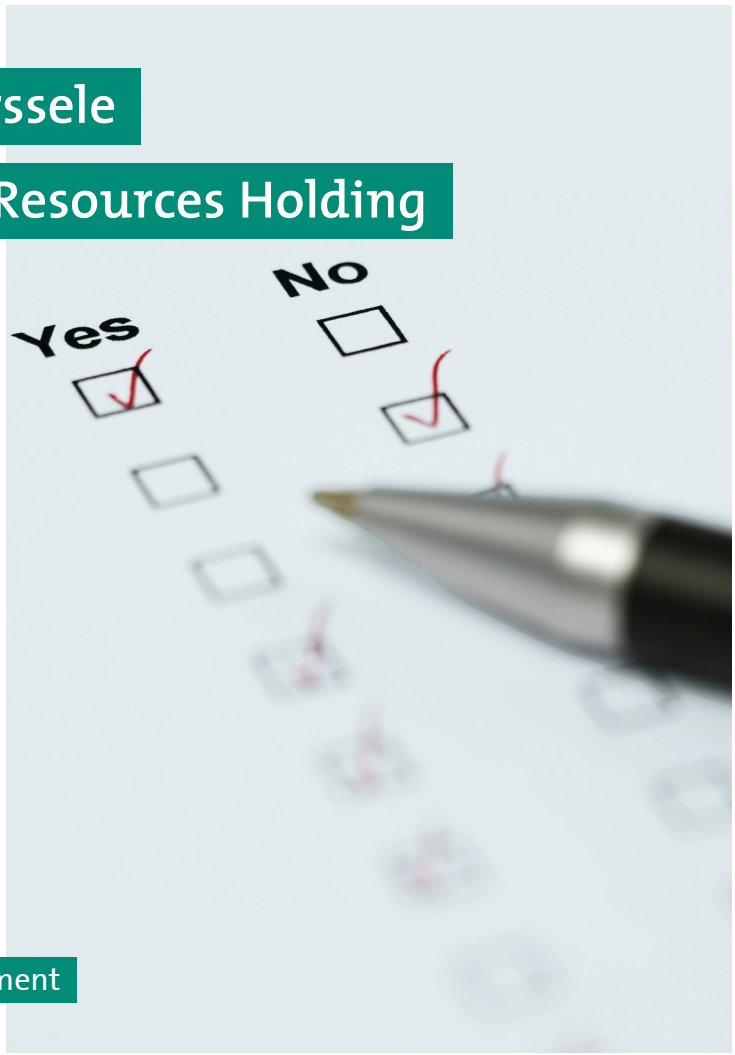
ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

NPP Borssele

Energy Resources Holding



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ÖSTERREICHISCHES ÖKOLOGIE INSTITUT

Expert Statement

ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE CONSTRUCTION OF A SECOND NUCLEAR POWER STATION AT BORSSELE (NL) – ENERGY RESOURCES HOLDING'S (ERH)

Expert statement

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commissioned by
Lebensministerium (A),
Abteilung V/6 "Nuklearkoordination"
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EXECUTIVE SUMMARY

The Minister for Housing, Spatial Planning and the Environment (VROM) also on behalf of the Minister of Economic Affairs (EZ) and the Minister of Social Affairs and Employment (SZW), announced in September 2010 that Energy Resources Holding (ERH) had presented a Notification for an Environmental Impact Assessment (EIA)[1] concerning its plan to construct and operate a new Nuclear Power Plant (NPP) at Borssele.

The Austrian Institute of Ecology and Dr. Helmut Hirsch were commissioned by the "Umweltbundesamt"[2] to elaborate an expert statement on the Notification of the Energy Resources Holding's (ERH) project to build and operate a new nuclear power plant (NPP) at the Borssele location. The plant shall consist of one or two production units with a total capacity of 2,500 MWe.

Within the maximum intended capacity of 2,500 MWe, the Notification considers the following options:

- One or two units of the type AP1000 (approx. 1,200 MWe);
- One unit of the type EPR (≥ 1,600 MWe);
- One unit of the type BWR.

These reactors (and if necessary, others) shall be compared to each other in the Environmental Impact Statement (EIS).

ERH emphasizes "that this plan is independent from Delta's intent to build a new NPP near the present NPP at Borssele "(ERH 2010, p.7).

In the past years, many plans have been presented in the Netherlands for implementing new production capacity. Since some large electricity generation capacities started operation in the last years, the Netherlands is now a self supporting country. At this time it is unclear which further plans will be realized. If all plans would be carried out, the Netherlands could change into a net exporting country. ERH wants to keep the option open to export electricity from the Netherlands to North West European Countries. The possibility to apply for another large NPP at the Borssele location is justified by the legislation on liberalization of the energy sector in the Netherlands.

ERH's indicates the following roadmap for the construction:

- Submitting notification September 2010
- Submitting application for construction permits and EIA 2012
- Granting permit based on Nuclear Energy Act etc. 2014
- Start construction 2015
- Delivery of first power to the network 2019

The Austrian expert statement is a review of the Notification focused mainly on the safety and risk analysis. The goal is to assess if the concept allows to anticipate that the Environmental Impact Statement (EIS) will contain sufficient information on design and beyond design basis accidents (DBA and BDBA) in or-

[1] Notification of the intent to build: a new nuclear power plant for Energy Resources Holding B.V. at the location Borssele in Zeeland, The Netherlands, September 2010

[2] Environment Agency Austria

der to make reliable conclusions about the potential impact of transboundary emissions. In this context, the Austrian expert statement formulates in detail the information required for the evaluation of hazards which could have impacts with large radioactive emissions.

In the Notification the description of the content of the envisaged EIS considers all issues required by the Council Directive 85/337/EEC as amended. However, the explanations are short and general. Thus, it is not possible to evaluate whether the necessary data and information for the assessment of transboundary impacts will be included in the EIA Report.

Therefore, from our point of view, the requirements about the content of the EIS are summarized below:

- The EIS should analyze the risk of interaction in case of an accident in one facility to all the others at the location and the potential impacts to the new planned NPP. This refers to the requirements related to the IAEA Safety Guide No. 3.1 (IAEA 2002). The EIS should include a map of the location with all facilities and their infrastructure and the sites of both proposed new NPPs.
- If all proposed NNP would be realized 5,000 MWe (maximum capacity of the two new plants) could have significant impact to the environment because of radioactive airborne emissions and the heat emissions even in normal operation. Moreover such a big NPP could be a particular hazard in case of external events and malevolent aggression. This aspect should be discussed in the EIS.
- Besides basic technical data, the EIS should include extensive descriptions on the fulfillment of the preconditions formulated by ERH in the Notification. Therefore the EIS should include information on fuel characteristic, details on active and passive safety systems, containment and protective building structures, as well as details of the concept of defense-in-depth of the envisaged reactor types. The related description should present the envisaged reactor types in relation to each other.
- Requirements for load following operation should be specified as well as the extent of load changes possible in the envisaged reactors.
- Description of technical concepts for the prevention of major discharges following a core meltdown including a discussion of their development status of the envisaged reactor types.
- The actual safety regulation in the Netherlands should be presented, standards for design and construction of the new NPP should be specified. The requirements for the safety systems of the envisaged reactor types should be described in more detail; the requirements regarding the proof of the functioning of the provisions for preventing containment breaching and major discharges should be presented.
- The airplane crash which the shell of the reactor building must be able to withstand should be specified in detail (mass of plane, speed, area of impact) for each of the envisaged reactor types.
- Regarding the ability to prevent the core from breaching the containment in case of a meltdown, it should be discussed to which extent this relies on technical concepts still under development, with open questions yet to be clarified;

- The selection process should be described, referring the safety relevant aspects in detail.
- Regarding core damage frequency, PSA results of the candidate reactor types should be presented in detail (e.g. contribution of different plant states and types of initiators). An indication of the uncertainty of the PSA results should be provided (e.g. 95%-fractile). It should be explained how the uncertainty was taken into account in the selection process.
- For the assessment of potential transboundary impacts a complete description of the core inventory, accident sequences, frequency of occurrence and release rates for the proposed NPP should be presented in the EIS.

1 INTRODUCTION

The Minister for Housing, Spatial Planning and the Environment (VROM) also on behalf of the Minister of Economic Affairs (EZ) and the Minster of Social Affairs and Employment (SZW), announced that Energy Resources Holding (ERH) had presented a Notification for an Environmental Impact Assessment (EIA) concerning its plan to construct and operate a new Nuclear Power Plant (NPP) at Borssele.

The Austrian Institute of Ecology and Dr. Helmut Hirsch were commissioned by the "Umweltbundesamt"[3] to elaborate an expert statement on the Notification of the Energy Resources Holding's (ERH) project to build and operate a new (NPP) at the Borssele location. The plant shall consist of one or two production units with a total capacity of 2,500 MWe.

ERH emphasizes "that this plan is independent from Delta's intent to build a new NPP near the present NPP at Borssele" (ERH 2010, p.7).

As a consequence of recent constructions of large new power plants, the Netherlands is now self-sufficient in the area of electricity production. ERH wants to keep the option open to export electricity from The Netherlands to North West European Countries. The Netherlands' Transmission System Operator and administrator of the national high-voltage grid, TenneT describes the situation in the country as follows: "In the period after 2009 we can see a further increase in the planned realization of new large-scale production capacity. Assuming a scenario in which all plans are included, approximately 16.6 Gigawatt (GW) will have been created by 2017. If the decommissioning of production capacity units is taken into account, the net increase in installed thermal production capacity in the 2010–2017 planning period will amount to 14.6 GW. Wind power capacity is also expected to increase in the next few years from 2.3 GW in 2010 to 6 GW in 2017." (TENNET 2010)

In the past years, many plans have been presented in the Netherlands for implementing new production capacity. At this time it is unclear which plants will actually be realized. If all plans were carried out, and the current plants remain operational, an excess production capacity could be created in the Netherlands. In practice, we expect that not all initiatives will be implemented. The Netherlands was a net importing country, but geographically speaking ('gas roundabout', harbors for coal ships, cooling water from the sea), the Netherlands is well-suited to develop into a country for exporting electricity. (ERH 2010, p.10)

ERH emphasizes that the new liberalization legislation supports its plan to construct a NPP at the Borssele location. ERH emphasizes that this legislation assures:

- freedom of production of electricity;
- freedom for electricity producers to choose the fuel;
- freedom to choose suppliers of electricity;
- transport of electricity arranged through an independent network manager with regulated, non-discriminatory access to the national grid. (ERH 2010, p.7)

[3] Environment Agency Austria

ERH indicates the following roadmap for the construction:

- Submitting notification September 2010
- Submitting application for construction permits and EIA 2012
- Granting permit based on Nuclear Energy Act etc. 2014
- Start construction 2015
- Delivery of first power to the network 2019

The description of the content of the Environmental Impact Statement (EIS) in the Notification in principle considers all issues required by the Council Directive 85/337/EEC as amended. However, the explanations are short and general. Thus, it is not possible to evaluate whether the necessary data and information for the assessment of transboundary impacts will be included in the EIS.

Starting 1 July 2010, the Environmental Impact Assessment (EIA) regulations have been altered, differentiating between a 'limited' and an 'extended' procedure. In light of the fact that an appropriate assessment may be required for the project, an extended EIA procedure shall be followed for the new nuclear power plant. A significant difference with the former regulations is that a provisional memorandum is no longer required, but rather a "Notification of Intent". The competent authority gives advice on the contents of the EIS concerning scope and level of detail (previously: guidelines). Overall however the procedure has remained the same, specifically concerning:

- The possibility to submit opinions on the intent and on the EIS;
- Compulsory assessment advice from the EIA Commission. (ERH 2010, p.36)

The review of the Notification is focused mainly on the safety- and risk analysis. The goal is to assess if the concept allows to anticipate that the EIS will contain sufficient information on design and beyond design basis accidents (DBA and BDBA) in order to make reliable conclusions about the potential impact of transboundary emissions. In this context, the Austrian expert statement will formulate in detail the information required for the evaluation of hazards which could have impacts with large radioactive emissions.

2 DESCRIPTION OF THE PLANT

2.1 Content of the Notification

The plant shall consist of one or two production units with a total capacity of 2,500 MWe.

Within the maximum intended capacity of 2,500 MWe, there are the following possibilities:

- One or two units of the type AP1000 (approx. 1,200 MWe)
- One unit of the type EPR (≥ 1,600 MWe)
- One unit of the type BWR

These reactors (and if necessary, others) shall be compared to each other in the EIS.

The choice of the location Borssele shall be explained in the EIS, but in view of the advantages of the location, no location alternatives shall be addressed. Within the safeguarded location Borssele, the exact construction location barely has an impact on many aspects. Most of the nuclear consequences, such as safety and radioactive waste, barely depend on the exact location on the industrial estate. The choice of the construction location within the safeguarded location shall be explained, also in connection to the National Integration Plan. (ERH 2010, p.32)

The focus of the Notification is on scenic aspects and archeology. The new installations have to be seen against the backdrop of major industry, such as an oil refinery, a shipyard and an aluminum melting furnace. A new shipping terminal with its cranes and storage areas is also planned. Against this backdrop, the scenic impact of a new nuclear power plant is minimal. The possible ventilation shaft (“chimney”, some 90 m high) and the reactor building (“dome”, some 60 m high) are the main elements that can be seen from a distance. ERH’s present plan does not as yet include a large cooling tower. (ERH 2010, p.30)

ERH describes preconditions the new NPP has to comply with:

- The nuclear power plant should be ‘proven technology’ and not be considered a ‘prototype’.
- The nuclear power plant should be designed, built and operated with state-of-the-art technology.
- The nuclear power plant should use passive and automated safety systems as much as possible.
- The nuclear power plant should at least comply with the technical requirements in accordance with Dutch regulations (including the Nuclear Safety Rules and Regulations).
- To ensure safety, the following should be guaranteed:
  - The risk of a core meltdown accident is smaller than once in a million years[4],
  - Facilities are in place to prevent, in case of a core meltdown accident, the core coming outside of its containment (such as a “core-catcher”);

[4] CDF $<10^{-6}$

  - Facilities are in place preventing, after a core meltdown, large emissions occurring that would necessitate preventive measures;
  - The casing can withstand high overpressure from within and plane crashes from without;
- The nuclear power plant has a long response time in case of accidents. (ERH 2010, p.18)

Therefore ERH favors a 'Generation III' reactor. These reactors have improved features which shall significantly reduce the risk of severe accidents.

The Notification presents a simple scheme of a Pressurized Water Reactor (PWR) (ERH 2010, p.19) together with a short explanation. There are not many options for advanced reactors which would meet the criteria of ERH and the Netherlands government. In practice, the obvious choices shall probably be between:

- AP1000™ by Westinghouse, recently taken over by Toshiba, capacity approx. 1,200 MWe;
- Evolutionary Pressurized-water Reactor (EPR™) by Areva, capacity ≥ 1,600 MWe;
- Boiling Water Reactor (BWR) of the third generation. (ERH 2010, p.20)

The Notification includes no information on the BWR. According to the Notification also other reactors could be included in the comparison.

ERH considers load following operation: "The design of the new plant shall take into account the fact that the demand for ramp rate is increasing. This is necessary due to the larger part of sustainable energy, such as wind energy, that will become operational in the coming years." (ERH 2010, p. 24)

The capacity plan of the grid operator TenneT includes the reinforcement of the junction between Borssele and the national grid. This will generate adequate grid capacity to transport the nuclear power plant's extra capacity. (ERH 2010, p.25)

2.2 Discussion

ERH decided that the site for new NPP is within the safeguarded location Borssele. The focus of the description in the Notification is on scenic aspects. The location is an industrial area including an oil refinery, an aluminum melting facility. From the drawings and pictures it is not possible to allocate all industrial facilities, the existing NPP Borssele from EPZ, the radwaste storage facility of CORVA (including the high level waste storage) and the sites for the new planned NPPs of ERH and Delta plus other planned activities. The EIS should analyze the risk of interaction by an accident in one facility to all others at the location and the potential impacts to the new planned NPP as it is required by the IAEA Safety Guide No. 3.1 (IAEA 2002). The EIS should include a map of the location with all facilities and their infrastructure and the sites of both proposed new NPPs.

The general preconditions formulated by ERH describe in principle safety criteria for Generation III reactors. The topic of the list ("the nuclear power plant has

a long response time in case of accidents") is not completely clear. It probably means that accident sequences should develop slowly, leaving ample time for interventions.

ERH differentiates between Generation III reactors (proven technology) and Generation IV reactors now being developed. This assessment of Generation III reactors is probably somewhat overoptimistic:

In Europe, currently the EPR in Olkiluoto is regarded as the most advanced project. However, also this reactor did not yet achieve the planned power level of 1,700 MWe. Licensing in the US, UK and Finland is not completed yet and might be delayed even more. There are problems in several areas; most notably troubles with the EPR's I&C system (software reliability issues, architectural shortcomings etc.), which came up during a review by Finnish, French and UK regulatory authorities. According to the magazine "Nuclear Engineering International", the UK Nuclear Installations Inspectorate (NII) stated in a letter to AREVA and EDF in April 2009 that the EPR's digital I&C system architecture "appears overly complex". An NII[5] spokesperson later explained that the Inspectorate is not convinced that software used to control the plant and software used to protect the plant in case the control system stops working are sufficiently separate. Also, there are concerns that safety systems (level of defence 3 and higher) might be compromised by too many connections with less safety-critical systems (levels of defense 1 and 2). The NII letter pointed out that "the usual UK practice of only allowing one-way online communication from a safety system to systems of lower safety class is not applied in the UK EPR design" (NEI 2009). I&C problems also are a topic of the EPR design certification ongoing in the USA. Although some progress appears to have been made in 2010, there are still some issues without resolution (NRC 2010).

The AP1000 is based on the AP600 concept. Both reactor types are licensed in the US, however, the licensing for the AP1000 is not completed yet since a process for modifications of the licensing is still ongoing. Until now, no AP600 prototype was built. Two AP1000 are under construction in China. During licensing, both in the US and UK, doubts arose concerning the AP1000 containment resistance against airplane crashes; reactor manufacturer Westinghouse had to hand over additional documentation and might have to perform changes.

ERH does not exclude to build a BWR, but at present there is no specific plant design considered. In the EIS safety features of the plants which are under consideration should be compared in a concrete manner. Therefore, if any, a specific BWR should be considered.

[5] Nuclear Industry Inspectorate

2.3 Recommendations for the Content of the EIS

- The EIS should analyze the risk of interaction by an accident in one facility to all the others at the location and the potential impacts to the new planned NPP as it is required by the IAEA Safety Guide No. 3.1 (IAEA 2002). The EIS should include a map of the location with all facilities and their infrastructure and the sites of both proposed new NPPs.
- In the end 5,000 MWe NPPs (maximum capacity of the two new plants) could have significant impact to the environment because of emissions and heat even in normal operation. Moreover such a big NPP could be a particular hazard in case of external events and malevolent aggression. This aspect should be discussed in the EIS.
- Besides technical data, the fulfillment of the preconditions formulated by ERH in the Notification should be demonstrated. Therefore the EIS should include:
  - Detailed technical data like fuel enrichment, envisaged burn-up, fuel cycle for uranium and MO_x elements, envisaged plant lifetime
  - A detailed description of active and passive safety systems, including information regarding redundancy and diversity
  - Description of the containment and protective building structures (wall thickness etc.)
  - Information on the implementation of the concept of defense-in-depth
  - Description of technical concepts for the prevention of major discharges following a core meltdown including a discussion of their development status.
- Selection criteria for the reactor type should be presented in detail. Furthermore, it should be explained how the selection of reactor type is to be performed, if several reactor types fulfill the criteria. To which extent will it be possible to quantify criteria; how will criteria be weighed?
- Requirements for load following operation should be specified as well as the extent of load changes possible in the envisaged reactors.

3 REACTOR SAFETY AND RISK ASSESSMENT

3.1 Content of the Notification

During normal operations, there is minimal radioactive emission into the air and the surface water. When deviations from normal operation occur (unwanted events that will be corrected by the safety systems), emission will remain within the quantities for which permits will be issued. The EIS shall specify possible deviations from normal operation. Also, the radiation dose for employees and the population shall be calculated. (ERH 2010, p.26)

In nuclear power plants, extensive safety measures are taken, to protect people and the environment and to secure the installation. ERH will describe these technical and organizational measures in the EIS. However, one can never exclude all risks. ERH will show that for design basis accidents (DBA), the radiological doses permitted in the Netherlands will not be exceeded. (ERH 2010, p.27)

Beyond design basis accidents (BDBA) are highly unlikely. These types of accidents include the accidents where the core melts down and large amounts of radioactivity are released. “The Dutch risk policy sets standards for these types of accidents: the individual risk and the group risk[6]. The risks of modern nuclear plants of the third generation shall fall fully within these standards”. (ERH 2010, p.27)

Also, among other influences, terrorism shall be addressed, without going into too much detail about these measures. (ERH 2010, p.27)

Safety systems are described only in general:

“Modern nuclear power plants have several active and passive safety systems. They are designed to keep the radioactive materials within the plant as much as possible, under all circumstances. This applies to normal operations, but also to malfunctions and accidents.” (ERH 2010, p.24) Active and passive systems are mentioned and five barriers between the fuel and the environment are listed:

- nuclear fuel
- nuclear fuel casing
- primary (cooling)system
- the safety containment
- the secondary shielding

It is announced that the safety systems for severe accident management will be addressed extensively in the EIS. (ERH 2010, p.24)

The effects shall be quantified as much as possible. If this is impossible, there will be a qualitative description. Where necessary, the accumulated effects with other (known) initiatives in the area shall be addressed. (ERH 2010, p.26)

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[6] The individual risk or locally restricted risk = risk that someone dies outside the plant from a plant accident.
“The group risk” means risk that immediately during, or shortly after the accident, more than 10 victims die.

Transboundary impacts are dealt with in one paragraph: According to the Notification "it seems highly unlikely that the new nuclear power plant should have any impact whatsoever in Belgium (the distance to the border is at least 15 km)" (ERH 2010, p.31)

3.2 Discussion

In the Notification dose limits and standards for the health risk for individuals and the population in case of a nuclear accident are mentioned, but not specified.

The general preconditions formulated in the Notification are said to be based on a memorandum to the Dutch House of Representatives from 2006, drawn up by the then State Secretary of VROM (ERH 2010, p.18). The notification does not explain whether there are binding detailed regulations for new NPPs in the Netherlands.

The EIA report should contain detailed information about the postulated initiating events (internal and external) for the design basis and design extension, 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 like the radioactive core inventory, or the average and maximum burn-up of the fuel.

From the viewpoint of transboundary emissions the statement that a severe accident seems highly unlikely is not sufficient. The EIS 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. Risk analyses showed, that accidents cannot be excluded based only on their low frequency of occurrence if they result in very large radioactive emissions. Risk assessments for the EPR and AP1000 are published at the web sites of the US and UK nuclear regulators. For the assessment of impacts from transboundary emissions it is necessary to provide a complete description of the core inventory, accident sequences, frequency of occurrence and release rates for the proposed NPP option as well as a comprehensible description of the assessed impacts on the environment and health.

3.3 Recommendations for the Content of the EIS

- The actual safety regulation in the Netherlands should be presented, standards for design and construction of the new NPP should be specified.
- The requirements for the safety systems should be described in more detail; the requirements regarding the proof of the functioning of the provisions for preventing containment breaching and major discharges should be presented.
- The airplane crash which the shell of the reactor building must be able to withstand should be specified in detail (mass of plane, speed, area of impact).

- Regarding the ability to prevent the core from breaching the containment in case of a meltdown, it should be discussed to which extent this relies on technical concepts still under development, with open questions yet to be clarified.
- Regarding the ability to prevent major discharges following a core meltdown, it should be discussed to which extent this relies on technical concepts still under development, with open questions yet to be clarified.
- Regarding core damage frequency, PSA results of the candidate reactor types should be presented in some detail (contribution of different plant states and types of initiators). An indication of the uncertainty of the PSA results should be provided (e.g. 95%-fractile). It should be explained how the uncertainty was taken into account in the selection process.
- For the assessment of transboundary impacts a complete description of the core inventory, accident sequences, frequency of occurrence and release rates for the proposed NPP should be presented in the EIS.

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