ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Strategic Environmental Assessment for a second NPP in Borssele

Expert Statement

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ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR A SECOND NUCLEAR POWER PLANT IN BORSSELE

Expert Statement on the Draft Memorandum on Scope and Level of Detail

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Developed on behalf of
Bundesministerium für Land- und Forstwirtschaft,
Umwelt und Wasserwirtschaft
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CONTENT

EXECUTIVE SUMMARY

There are currently two specific plans to build a second nuclear power plant (NPP) in the Sloe area in the municipality of Borssele. Both initiators have already taken the first steps of the permitting procedures. **Delta Energy B.V.** was the first utility to file its application in 2009. The second application came from **Energy Ressources Holding B.V (ERH)**, which issued its notification of the intent to build a new NPP at Borssele one year later, in 2010.

The legal procedures in the Netherlands have changed recently. Thus the application procedure by Delta started under different legal conditions than the one of ERH.

The Minister of Economic Affairs, Agriculture and Innovation has decided to commence the necessary planning procedures for one single new nuclear power plant in the Sloe area. However, both initiatives could be followed through. The "Strategic Environmental Assessment for a second NPP: Draft Memorandum on Scope and Level of Detail" describes the procedures for both options.

If the two interested companies merge their plans into one single initiative, than it would be possible to prepare and publish the land-use plan and the Strategic Environmental Assessment (SEA) the applications for permits and the project-specific Environmental Impact Report (EIR) as one single coordinated procedure. In that case, it may be possible to prepare a single integrated EIR rather than a separate SEA report and project-specific EIR.

Currently it seems very likely that the two plans will be merged into a single initiative because of the decision of the Minister of Economic Affairs, Agriculture and Innovation to commence the spatial planning procedures required for one new nuclear power plant in the Sloe area. (NL-GOV 2011) It seems likely that one NPP with a maximum capacity of 2,500 MWe will be realized; this could be either one European Pressurized Reactor (EPR) with 1,700 MWe or two smaller reactor units, e.g. the AP 1000. However, the memorandum is not clear in stating whether the construction of a total capacity of 2,500 MW or two NPPs with 2,500 MWe each in the Sloe area is foreseen.

Austria has submitted proposals for the requirements in the scoping stage of both EIA procedures for new Dutch NPPs. On behalf of the Federal Environmental Ministry of Agriculture Forestry, Environment and Water Management the Umweltbundesamt has commissioned this expert statement on the "Strategic Environmental Assessment for a second NPP: Draft Memorandum on Scope and Level of Detail". This expert statement focuses on the actual requirements for the site selection and external impacts the EIR needs to deal with, however, without repeating the requirements formulated in the two previous expert statements which covered issues concerning reactor type selection, safety features and severe accidents. (UMWELTBUNDESAMT 2009 and UMWELTBUNDESAMT 2010)

The Proposal

The companies DELTA and EHR have practically applied for the same project: the construction of a nuclear power plant with a maximum capacity of 2,500 MWe. This NPP shall consist of one or two units of Generation III reactors: AP1000 (Westinghouse), EPR (AREVA), or ABWR which should come into operation in the Sloe area before 2020.

In the Sloe area ports and other industrial enterprises are situated. “In spatial terms the Sloe area can be described as a very large-scale landscape with a wide zone of (technical) infrastructure. The ports constitute the backbone of the region. Access by land is along the margins. A large part of the area is reclaimed and lies outside the dikes. Towards the Westerschelde the area is open, with no planting to provide shelter.” (NL-GOV 2011)

Preconditions for site selection according to the memorandum (NL-GOV 2011):

- the physical space necessary for the NPP (2,500 MWe) and all associated buildings of 20–25 ha.
- sufficient cooling water supply (at the Borssele location no cooling towers might be necessary) But if through-flow cooling is not possible, cooling towers are needed, which requires additional space (about 6 ha would have to be added to the minimum space for reactor buildings (about 15 ha).

Seven potential locations are nominated in the Sloe area where the NPP could be built because these locations have a minimum surface area of 15 ha. One is owned by EPC and adjoins the site of the existing NPP and the coal fired plant. The other locations are owned by the Zealand Seaports which has reserved 25 ha for a possible location for the new NPP. Some of the potential sites are also of interest for other enterprises.

Three locations are close to the mouth of the harbor and thus through-flow cooling is a realistic option. Other locations would be investigated only if at the three preferred locations through-flow cooling is not possible.

External Hazards

Flooding

Flooding is the most important external hazard for the new NPP, because all locations in the port area and very close to sea level. The flooding hazard for every location considered for siting needs to be assessed. The lessons learned from the Fukushima disaster and the European stress-test on operating NPPs specific design requirements to prevent fuel meltdown accidents in the new NPP caused by floods should be applied when assessing the different locations.

There are many operational records of experience of external flood induced accidents in which the functionality of safety related equipment has been impaired. Much evidence has been recorded recently on in-leakage, essentially through poor sealing in structural joints or cable conduits and inspection openings.

The Flood Defense Act regulates the sturdiness of dikes and stone cladding. The standard depends on the damage a storm can cause in a specific area. The design flood is a storm & flood event which a frequency of occurrence of once in 4,000 years. After the Fukushima accident, Minister Verhagen reported that the dike directly protecting Borssele has weakened and is at risk of breaking during a heavy storm with an incidence of once every 4,000 years (TWEEDE KAMER 2011b).

For most European NPPs the design flood is determined as the maximum flood level with an incident once every 10,000 years. The IAEA emphasizes that the flood hazard may change over time as a result of various causes:

- Changes in the physical geography of a drainage basin, including the estuaries;
- Changes to the offshore bathymetry, coastal profile and catchment areas;
- Changes induced by changes in climate.

Climate change leads to more extreme weather conditions such as storminess and higher precipitation. This will be of major importance for new NPPs, because of their planned lifetime of 60 years plus another 30 years for decommissioning and dismantling the plant. (IAEA 2003b)

The plant design should have sufficient margins to cover effects of climate change as well as the uncertainties of the estimation of the maximum flood level.

Earthquake

The Guidelines for the EIR (Annex II of the Memorandum) demand to include a description of the geotechnical and geophysical risks within the study area. These risks consist of soil setting, landslides and earthquake.

The preliminary memorandum of Delta and the Notification of ERH does not even mention the earthquake hazard. In general the region´s earthquake hazard is perceived as being small.

The region has a risk of an earthquake with a magnitude of 5 in the Richter scale of once in 500 years (PGA = 0.1 g). It is unlikely that such an earthquake would seriously damage a new NPP.

The site investigation needs to reassess the earthquake risk in the Sloe area with state of the art methods for a large area surrounding the potential NPP site.

In addition to the earthquake risk a geotechnical evaluation of each location assessing the stability of the geological set-up is very important for the base of the reactor building.

Explosions, fires and chemical accidents

All sites considered for the new NPP are located in the industrial and port area. Therefore man-made external impacts have to be analyzed regarding the risk of industrial accidents in the vicinity of the NPP location. Transports in the port and industrial area could cause explosions, fires and the release of chemicals.

Other external events as aircraft crash and sabotage are mentioned in the SEA memorandum as risks which have to be analyzed as Beyond Design Basis Accidents (BDBA) in the Probabilistic Safety Assessment (PSA).

A ranking of the considered sites according to the hazards mentioned would be an important piece of information.

Accidents and trans-boundary emissions

BDBAs are characterized as highly improbable accidents when the reactor can no longer be properly cooled and passive safety systems must limit the effects on the surroundings, of the NPP. If passive systems as the containment fail, the impact on health and environment can be substantial.

For an assessment of accident impacts on a trans-boundary level, the EIR should give an overview on the analyzed design base accident (DBA) and beyond design base accident (BDBA) scenarios.

- For the assessment of trans-boundary impacts a complete description of the core inventory, accident sequences, frequency of occurrence and release rates (source terms) for the proposed NPP should be presented in the EIR.
- The requirements for the safety systems should be described in detail; the requirements regarding the proof of the functioning of the provisions for preventing breach of containment 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). Analogue requirements for other external impacts (flood, earthquake, explosions, etc.) should also be specified.
- Interim storage of spent nuclear fuel should be described (technical, inventory, accident prevention and protection from external impacts).

Emergency planning

The Guidelines treat this issue under the heading “Risk control and response to calamities” by stating:

“Identify the risk contours during normal operation, in the event DBA and BDBA as well as external calamities and incidents. Describe the measures that will be taken to keep the risk contours within the operating limits to the fullest possible extent. These must be feasible, sufficiently validated, proven measures. And take into account the release of radioactive substances as well as other hazardous emissions. (NL-GOV 2011, Annex II)

Provide a transparent picture of the routing and volume of traffic in the event of a calamity in relation to the capacity of the present traffic network, taking into account traffic streams in two directions as the population will need to leave the area and the emergency services must enter the area. (NL-GOV 2011, Annex II)”

Each NPP should publish an emergency plan. The relevant EC directive recommends including the emergency plan into the EIR; the protection measures under severe accident conditions for the population working and living in the Sloe area should be explained in detail. (EC 1989)

The EIR needs to describe internal emergency measures (accident management) in general as well as assessing individual events and subsequent failures. The following issues deserve special attention:

- Accident management measures for the different stages of loss of core cooling,
- Accident management measures for preserving containment integrity after fuel damage (core or spent fuel pond),
- Accident management measures for the storage of spent fuel.

For each case the prevention of possible "cliff-edge-effects"[1] needs to be discussed. Issues of organization, of availability of equipment and supplies (fuel for the diesel-generators, cooling water etc.), prevention of radioactive releases (also releases of contaminated water) need to be taken into account. Attention should be devoted to possible impacts of a far-reaching destruction of the plant infrastructure, contamination of the plant site and similar effects. (ENSREG 2011)

The discussion needs to determine possible negative impacts on the implementation of accident management measures, which might arise due to severe damage at the other reactor units or fuel storages at the site. Guaranteed heat removal from the reactor core and the storage ponds needs to be proven for a long time period after the accident.

The IAEA recommends establishing an Emergency Response Center at each nuclear power plant site, which is sufficiently protected against external events and is equipped with displays for the most important safety relevant parameters, which are collected by robust instruments and transferred via robust lines. (IAEA 2011)

Recommendations

Austria has submitted proposals for the requirements in the scoping stage of both EIA procedures for new Dutch NPPs. The following recommendations focus on actual requirements for the site selection and the assessment of external impacts in the EIR, without repeating the requirements formulated in the two previous expert statements on the applications of Delta and ERH for new NPPs in the Netherlands. These statements covered issues concerning reactor type selection, safety features and severe accidents. (UMWELTBUNDESAMT 2009 and UMWELTBUNDESAMT 2010)

Flooding

For most European NPPs the design flood is determined as the maximum flood level with an incident once every 10,000 years. The IAEA emphasizes that the flood hazard may change over time.

- Climate change leads to more extreme weather conditions such as storminess and higher precipitation. This will be of major importance for new NPPs, because of their planned lifetime of 60 years plus another 30 years for decommissioning and dismantling the plant. (IAEA 2003b)

[1] Cliff edge = the point in an event sequence, when a catastrophy cannot be prevented any more.

- The plant design should have sufficient margins to cover effects of climate change as well as the uncertainties in assessing the maximum flood level.

Earthquakes

The region has a risk of an earthquake with a magnitude of 5 on the Richter scale of once in 500 years (PGA = 0.1 g). It is unlikely that such an earthquake would seriously damage a new NPP.

- The site investigation needs to reassess the earthquake risk in the Sloe area with state of the art methods for a large area surrounding the potential NPP site.
- In addition to the earthquake risk a geotechnical evaluation of each location assessing the stability of the geological set-up is very important for the construction of the reactor building base.

Explosions, fires and chemical accidents

All sites considered for the new NPP are located in the industrial and port area.

- Man-made external impacts have to be analyzed regarding the risk of industrial accidents in the vicinity of the NPP location. Transports in the port and industrial area could cause explosions, fires and the release of chemicals. Other external events as aircraft crash and sabotage are mentioned in the SEA memorandum as risks which have to be analyzed as Beyond Design Basis Accidents (BDBA) in the Probabilistic Safety Assessment (PSA).
- A ranking of the considered sites according to the external hazards mentioned would be an important piece of information.

Emergency planning

The EIR needs to describe internal emergency measures (accident management) in general and to assess individual events and subsequent failures:

- For each accident sequence the prevention of possible "cliff-edge-effects"[2] needs to be discussed. Issues of organization, of availability of equipment and supplies (fuel for the diesel-generators, cooling water etc.), prevention of radioactive releases (also releases of contaminated water) need to be taken into account. Attention should be devoted to possible impacts of a far-reaching destruction of the plant infrastructure, contamination of the plant site and similar effects. (ENSREG 2011)
- The EIR should include an assessment of possible negative impacts on the implementation of accident management measures, which might arise due to severe damage at the other reactor units or fuel storages at the site. Guaranteed heat removal from the reactor core and the storage ponds needs to be proven for a long time period after the accident.
- Each NPP should publish an emergency plan. The relevant EC directive recommends including the emergency plan in the EIR, the protection measures under severe accident conditions for the population working and living in the Sloe area should be explained in detail. (EC 1989)

[2] Cliff edge = the point in an event sequence, when the catastrophy cannot be prevented any more.

- The IAEA recommends establishing an Emergency Response Center at each nuclear power plant site, which is sufficiently protected against external events and is equipped with display panels showing the most important safety relevant parameters, which are collected by robust instruments and transferred via robust lines. (IAEA 2011). The site selection needs consider the space needed for an emergency center.

1 INTRODUCTION

The current government of the Netherlands included a section on nuclear energy in its government agreement (under the motto “Freedom and Responsibility”): “To reduce CO_2 emissions and energy dependence, more nuclear energy is necessary. Licensing applications to build one or more nuclear power plants that satisfy the requirements will be granted.” (NL-GOV 2011)

“To keep open the possibility of granting a permit for a new, safe nuclear power plant during this government’s period in office, it has commenced the planning procedures required to build a new nuclear power plant in the Sloe area in Zeeland (Sloegebied). Several procedures have to be completed before the process of designing and constructing a nuclear power plant (NPP) can actually start. These procedures are subject to the National Coordination Regulations, which will allow the decision-making process to proceed more quickly and efficiently.” (NL-GOV 2011)

One of these procedures is the amendment of the land use plan and another one is the nuclear licensing procedure. To amend the land use plan a Strategic Environmental Assessment (SEA) is required, while the first step towards a nuclear license consists of conducting an Environmental Impact Assessment (EIA) of the planned facility.

There are currently two specific plans to build a second nuclear power plant in the Sloe area in the municipality of Borssele. Both initiators have already taken the first steps in the necessary procedures. The first initiative is from **Delta Energy B.V**., who presented a preliminary memorandum for the construction of a new NPP at Borssele in 2009. The second application is from **Energy Ressources Holding B.V (ERH)**, which issued its notification of the intent to build a new NPP at Borssele one year later (2010).

It is not excluded, that the two initiatives will be consolidated into a single proposal. The Minister of Economic Affairs, Agriculture and Innovation has decided to commence the necessary planning procedures for one single new nuclear power plant in the Sloe area. However, both initiatives could be followed through. The Draft Memorandum on Scope and Level of Detail (NL-GOV 2011) describes the procedures for both options. However, the memorandum is not clear in stating whether the construction of a total capacity of 2,500 MW or two NPPs with 2,500 MWe each in the Sloe area is foreseen.

2 THE STRATEGIC ENVIRONMENTAL ASSESSMENT PROCEDURE

2.1 New Legislation on EIA from July 2010

The procedure for conducting an Environmental Impact Assessment changed substantially with effect from 1 July 2010 as a result of changes in the law. The procedure now starts with a memorandum on scope and level of detail instead of issuing a preliminary memorandum. (NL-GOV 2011). For the purposes of integrated decision-making the competent authority has chosen to apply the 'most stringent' regime including the National Coordination Regulations. This means that the extensive procedure is required also for the Integrated Environmental Impact Report (EIR):

Seven steps of the (integrated) EIR:

1. Public Notification: of further preparation of the plans. The public notification informs the public about documents which have to be made available for inspection, where and when they can be inspected, who can make statements during which period and in which form;
2. Consultation on Scope and Level of Detail: public authorities who might participate in the EIA procedure and the adoption of the land-use plan will be consulted on the scope and level of detail of the final Environmental Impact Report (EIR). At the same time, the public will be invited to make submissions on the proposal. The consultation will be based on the present draft memorandum on scope and level of detail which will be voluntarily made available to the public for inspection. The competent authority will determine the scope and level of detail of the EIR;
3. Drawing up the integrated EIR: in accordance with the guidelines and the prescribed scope and level of detail, as well as the information to be provided pursuant to the Environmental Management Act;
4. Inspection of Documents, Submission of Views: during this stage the integrated EIR, the draft land-use plan, the permit application, the draft permit under the Nuclear Energy Act and other permits will be available for inspection and consultations with stakeholders will take place. The Netherlands Commission for Environmental Assessment (NCEA) will review the integrated EIR. The NCEA is legally required to give its opinion on the land-use plan;
5. Statement of Reasons: the final land-use plan will determine how the results of the EIR, the submissions received and the NCEA's opinion will be dealt with;
6. Notification and Announcement: this step involves the notification and announcement of the plan in accordance with the procedure in the land-use plan;

Evaluation: the environmental impact that is actually caused by the implementation of the plan needs to be monitored and assessed. The EIR must already indicate which aspects of the plan need monitoring.

The present draft memorandum (NL-GOV 2011) plays also a role in step two of the procedure, because it contains information about the envisaged scope and level of detail of the EIR and will be submitted to the relevant authorities, who will be invited to give their reactions to it. In addition to the relevant public au-

thorities, the NCEA will also be asked for its advice on a voluntary basis and anyone who wishes will be allowed to express their views during the period that the draft memorandum is available for inspection. (NL-GOV 2011)

2.2 The Licensing Procedure for only one merged Initiative

If the two parties merge their plans into one single initiative, the land-use plan and the SEA required for it, the applications for permits and the project-specific EIR can be prepared and published as one single coordinated procedure. In that case, it may be possible to produce a single integrated EIR rather than a separate SEA report and project-specific EIR.

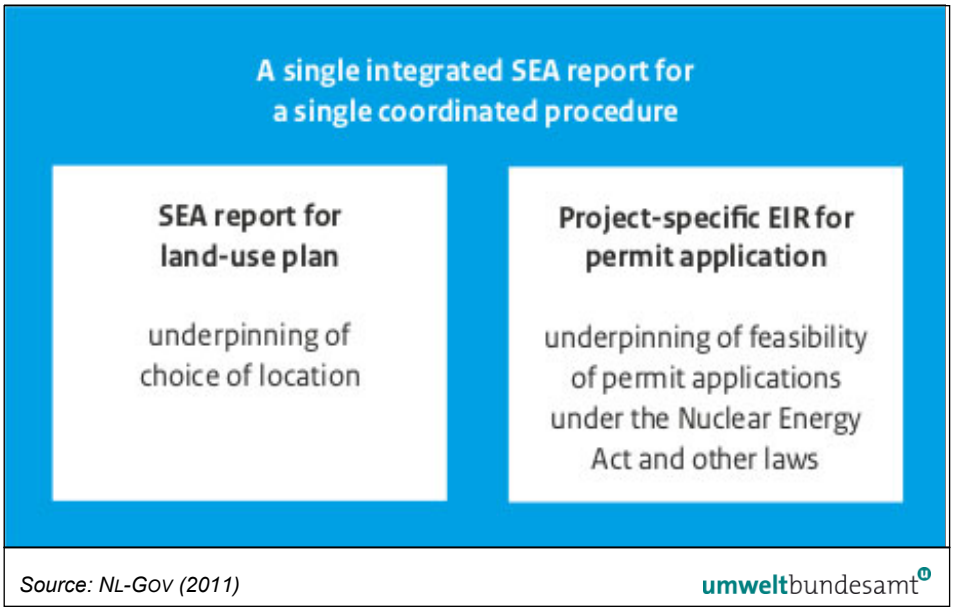
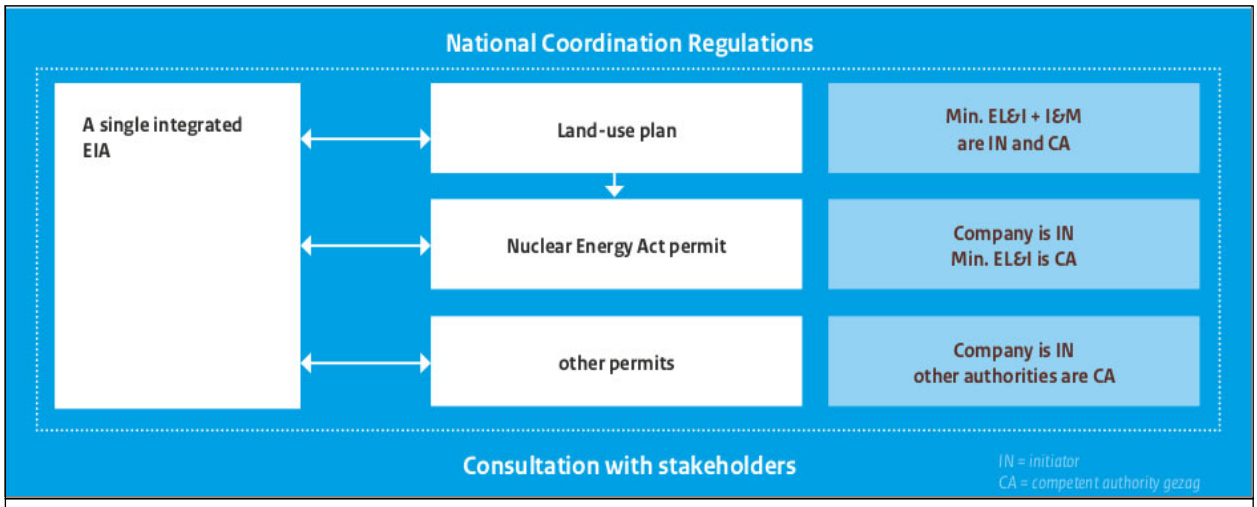


Figure 1: Relationship between the SEA report and the project-specific EIR in a single integrated EIR.

If a single integrated EIR is produced, its contents must comply with all the requirements ensuing from both the relevant land-use plan and decision (Nuclear Energy Act permit). In this case the EIR will have to comply with

- the scope and level of detail that is eventually adopted for the SEA report on the basis of this draft memorandum on scope and level of detail, the (mandatory) political consultation and the advice of the Netherlands Commission for Environmental Assessment (NCEA);
- the requirements laid down in guidelines or the scope and level of detail document that are adopted for the project-specific EIR. (NL-GOV 2011)



Source: NL-GOV (2011) umweltbundesamt

Figure 2: Diagram of the National Coordination Regulations.

Currently it seems very likely that the two plans will be merged into a single initiative since the Minister of Economic Affairs, Agriculture and Innovation has decided to commence the spatial planning procedures required for one new nuclear power plant in the Sloe area. Accordingly, for the purpose of the planned activity it is assumed that one new nuclear power plant will be constructed with a capacity of maximum 2,500 MWe. (NL-GOV 2011). This NPP could be either one EPR (1,700 MWe) or two smaller units (AP 1000).

2.3 The Licensing Procedure for two Initiatives

In June 2009, Delta Energy B.V. (Delta) submitted a preliminary memorandum as a step of the project-specific EIA procedure; afterwards the company conducted and completed the public consultation procedure. In the next step the Netherlands Commission for Environmental Assessment (NCEA) issued an advisory report. The competent authority adopted the guidelines for the Environmental Impact Report (EIR) in June 2010. (NL-GOV 2011)

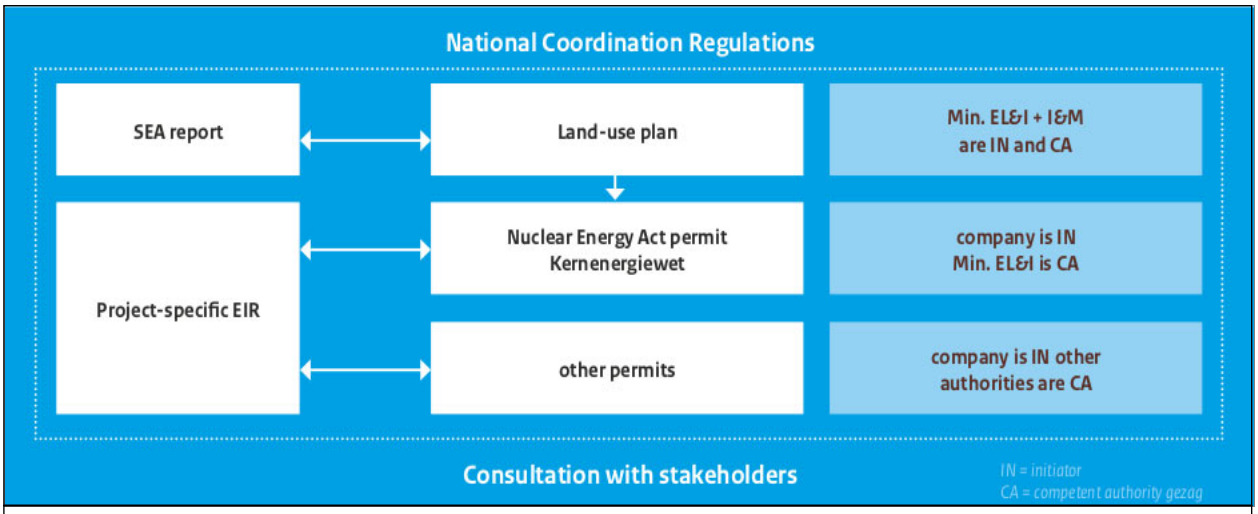
Energy Resources Holding (ERH) drafted a memorandum on scope and level of detail in September 2010. The public consultation procedure has been completed. In December 2010 the NCEA published its advice on the scope and level of detail of the EIR to be drawn up, and the competent authority published an advisory report on the scope and level of detail of the EIR in April 2011. (NL-GOV 2011)

Hardly any differences can be detected between the guideline and the document on scope and level of detail. Both documents are presented as annexes to the memorandum.

Since the planning for the two project-specific EIAs and the SEA procedure started at different times, the procedural requirements originally applied also differ (in addition to the National Coordination Regulations):

- the 'extensive' procedure set out in the Environmental Management Act applies to the SEA;
- ERH's initiative falls under the 'extensive' procedure;
- Delta's initiative still falls under the legislation on environmental impact assessments from before 1 July 2010.

The existence of two initiatives makes it impossible to conduct a coordinated procedure and permits cannot be prepared at the same time. Accordingly, there will be separate SEA and project-specific EIA procedures. Both initiators will then proceed separately with the permit application and the project-specific EIR and the Minister of Economic Affairs, Agriculture and Innovation and the Minister of Infrastructure and Environment will be responsible for drawing up the land-use plan and the related SEA report.



Source: NL-GOV (2011)

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Figure 3: Diagram of products if there is no coordinated procedure.

2.4 Structure Plan for Electricity Supply

In the past years, the government has been pursuing a policy designed to safeguard potential sites for nuclear power facilities. Under the Third National Structure Plan for the Electricity Supply (SEV III), the policy to safeguard locations for nuclear power facilities, as laid down in the government's designation order for sites for nuclear power plants, remains in force for the locations Eemshaven, Maasvlakte I and Borssele. The effect of that policy is to ensure that no developments take place that could prevent the construction of nuclear power plants at those locations. These three designated locations were evaluated based on earlier studies in the framework of the Spatial Planning procedure for NPP and the Structure Plans for the Electricity Supply (SEV II) and comply with the IAEA Guidelines for NPP site selection.

"The conclusion of the SEA for the 'safeguard policy' was that the three designated locations at Borssele, Eemshaven and Maasvlakte I complied well with the preconditions. The populations and the number of vulnerable objects within a radius of 5 kilometers are small. There are also sufficient escape routes to allow the public to leave the area quickly in the event of a disaster. The assessment of the environmental aspects yielded no clear preference for any one of the locations." (NL-GOV 2011)

3 THE PROPOSAL

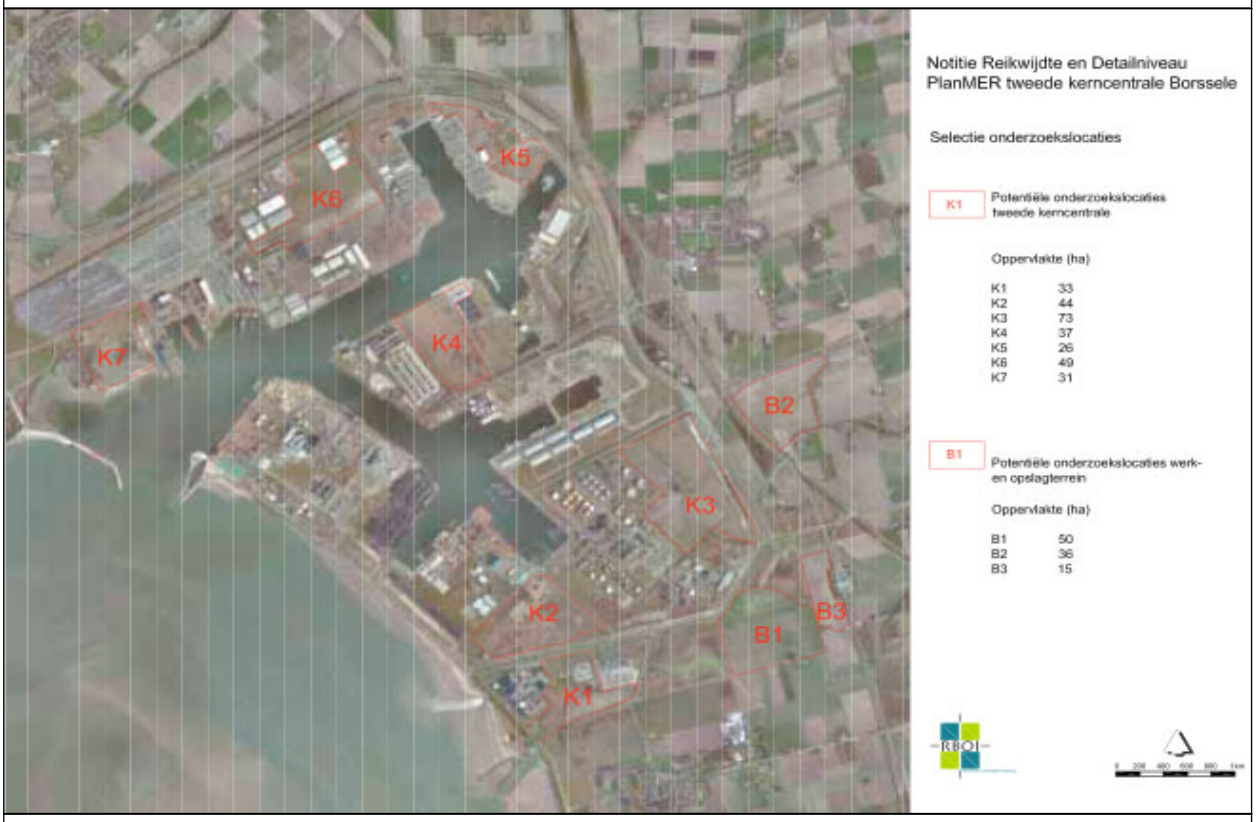
Both companies – DELTA and EHR have plans to put a new NPP with a maximum capacity of 2,500 MWe into operation in the Sloe area before 2020. At present only three types of Generation III reactors are available on the market. The new NPP could consist of one or two units AP 1000 (Westinghouse), one EPR (AREVA) or one ABWR (no company name given).The SEA memorandum for the Borssele II NPP mainly deals with the selection of an appropriate site in the Sloe area.

In the Sloe area ports and other industrial enterprises are situated. “In spatial terms the Sloe area can be described as a very large-scale landscape with a wide zone of (technical) infrastructure at the transition to the agricultural area. The ports constitute the backbone of the region. Access by land is along the margins. A large part of the area is reclaimed and lies outside the dikes. Towards the Westerschelde the area is open, with no planting to provide shelter.” (NL-GOV 2011)

Several factories such as tin-based chemistry owned by Billiton, a Hoechst manufacture of phosphorus-based products; a petroleum refinery; and an aluminum smelter as well as diverse transshipment companies and a waste processing company are situated in the Sloe area. The Borssele I NPP operated by EPZ and the COVRA nuclear waste storage are also in this area. But some parts of the area are still undeveloped. However, the Sloe area is developing rapidly: besides the second nuclear power plant (Delta/ERH) other facilities, among them the Westerschelde Container Terminal and several energy projects such as a combined gasification and power plant (C.GEN), a gas-fired power plant (Delta and EDF), a research reactor (PALLAS) and wind energy projects.

3.1 Site Selection on local Level

Sites that could be investigated for the nuclear plant and laydown area



Source: NL-GOV (2011)

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Figure 4: Sites that could be investigated for the nuclear plant and laydown area.

Preconditions for site selection according to the memorandum (NL-GOV 2011):

- the physical space necessary for the NPP (2500 MWe) and all associated buildings of 20–25 ha;
- sufficient cooling water supply (at the Borssele location no cooling towers might be necessary) But if through-flow cooling is not possible, cooling towers are needed, which requires additional space (about 6 ha would have to be added to the minimum space for reactor buildings (about 15ha).

The figure above shows the 7 potential locations (K1–K7) where the NPP could be built because these locations have a minimum surface area of 15 ha. K1 is owned by EPC and adjoins the site of the existing NPP and the coal fired plant. The other locations are owned by the Zealand Seaports which has reserved 25 ha for a possible location for the new NPP. Some of the potential sites are also of interest for other enterprises.

Out of the 7 sites only K5 is unsuitable for the NPP because of its layout.

K1, K2 and K7 are close to the mouth of the harbor and thus through-flow cooling is a realistic option. K3 and K6 will be investigated only if through-flow cooling proves impossible at the other sites. The first sites to be investigated are K1, K2, K4 and K7. (NL-GOV 2011)

4 EXTERNAL HAZARDS

4.1 Flooding

Only sites K1 and K3 are situated within the Westerschelde dike. The other five sites are located outside the dikes.

However all sites are inside the port area. Thus flooding is the most important external hazard for the new NPP. The flooding hazard for every location considered for siting needs to be assessed. The lessons learned from the Fukushima disaster and the European stress-test on operating NPPs specific design requirements to prevent fuel meltdown accidents in the new NPP caused by floods should be applied when assessing the different locations.

There are many operational records of experience of external flood induced accidents in which the functionality of safety related equipment has been impaired. Much evidence has been recorded recently on in-leakage, essentially through poor sealing in structural joints or cable conduits and inspection openings. The provisions for such events are mainly design related, but attention should be paid to the possibility of the groundwater table rising as a consequence of a flood, as its maximum level is a true design basis for the plant. (IAEA 2003a)

Dikes, walls and penetration closures are not to be considered as site protection as such. (IAEA 2003a) Dikes can be considered as one barrier, but the plant itself must have an absolutely reliable emergency cooling system working also in case of a beyond design flood event.

The cladding of many dikes along the Oosterschelde and Westerschelde is not strong enough. Projectbureau Zeeweringen was commissioned to reinforce the dikes of Zeeland. In case of a so-called super-storm, some stones and concrete could break away although the stone cladding should be strong enough to safely stem the waves of a super-storm. Reinforcement is necessary to protect Zeeland and other parts of the Netherlands against flooding. The Flood Defense Act regulates the sturdiness of dikes and stone cladding. The standard depends on the damage a storm can cause in a specific area. In Zeeland the safety standard is 1:4,000. This means that a dike should be able to withstand a super-storm which occurs once in 4,000 years. After the Fukushima accident, Minister Verhagen reported that the dike directly protecting Borssele has weakened and is at risk of breaking during a heavy storm with an incidence of once every 4,000 years (TWEEDE KAMER 2011b). For most European NPPs the design flood is determined as the maximum flood level with an incident once every 10,000 years. (Uncertainties can be substantial over this long time period.)

The IAEA emphasizes that the flood hazard may change over time as a result of various causes:

- Changes in the physical geography of a drainage basin, including the estuaries;
- Changes to the offshore bathymetry, coastal profile and catchment areas;
- Changes induced by changes in climate.

Climate change leads to more extreme weather conditions such as storminess and higher precipitation. This will be of major importance for new NPPs, because of their planned lifetime of 60 years plus another 30 years for decommissioning and dismantling the plant. (IAEA 2003b)

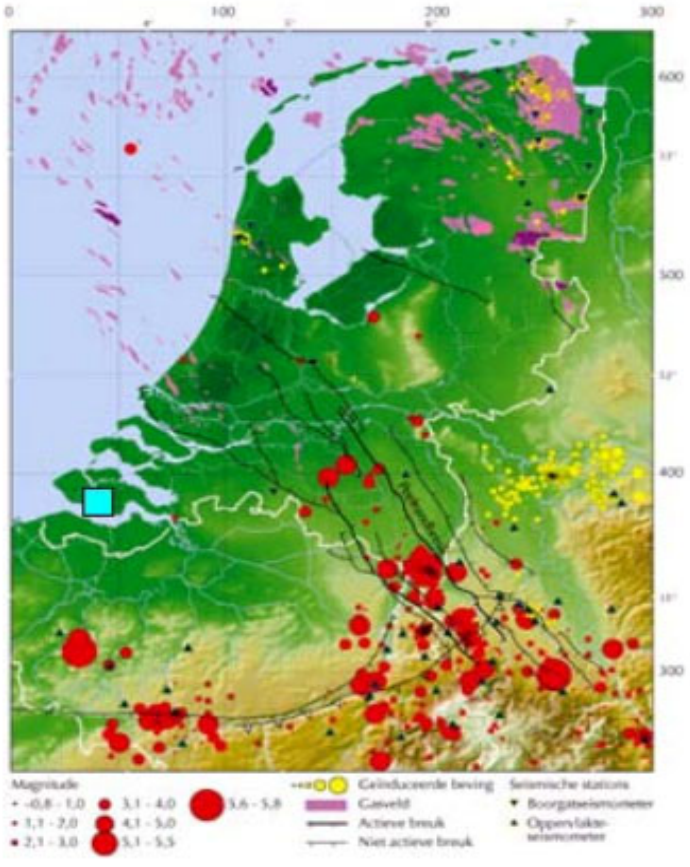
The plant design should have sufficient margins to cover effects of climate change as well as the uncertainties of the estimation of the maximum flood level.

4.2 Earthquake

The Guidelines for the EIR (Annex II of the Memorandum) demand to include a description of the geotechnical and geophysical risks within the study area. These risks consist of soil setting, landslides and earthquake.

The preliminary memorandum of Delta and the Notification of ERH does not even mention the earthquake hazard. In general the region´s earthquake hazard is perceived as being small. The earthquake map below confirms this assumption. The largest recorded quake in the Netherlands occurred in Roermond in 1992 and measured 5.4 on the Richter scale; this corresponds to MSK 7 and in terms of peak horizontal acceleration (PGA) this is about 0.15 g. The region has a risk of an earthquake with a magnitude of 5 in the Richter scale of once in 500 years (PGA = 0.1 g). It is unlikely that such an earthquake would seriously damage a new NPP.

Historical earthquakes in the Netherlands



Red circles indicate 'natural' earthquakes, yellow circles indicate 'induced' earthquakes (e.g. by gas extraction). The blue square indicates the location of the Borssele power plant.

Source: VU 2011

umweltbundesamt

Figure 5: Historical earthquakes in the Netherlands.

For the design basis earthquake two levels of ground motion hazard should be evaluated for each plant sited in a seismic area. Both hazard levels should generate a number of design basis earthquakes grouped into two series, seismic level 1 (SL-1) and seismic level 2 (SL-2). SL-2 level is the term for a safe shutdown earthquake. SL-1 corresponds to a less severe, more probable earthquake level, where the plant can still be operable.

A seismic level 2 (SL-2) earthquake corresponds directly to ultimate safety requirements. The level of ground motion associated with such an earthquake is required to have a very low probability of being exceeded over the plant lifetime. It represents the maximum level of ground motion to be assumed for design purposes. (IAEA 2003c)

In highly active areas, where both earthquake data and geological data consistently reveal short earthquake recurrence intervals, periods of the order of tens of thousands of years may be appropriate for the assessment of capable faults.

In less active areas, it is likely that much longer periods may be required. A structural relationship with a known capable fault has been demonstrated such that movement of the one may cause movement of the other at or near the surface. (IAEA 2004)

In some states, SL-2 corresponds to an earthquake level with a probability of exceeding the ten-millennial earthquake (≥ 10^{-4}/year). (IAEA 2003c)

For German NPPs basic design safety is proven for an earthquake ≤ 10-5 /year. Following the assessment of German NPP's according to the German stress test the plant should have safety reserves to resist a quake of 1 or 2 higher levels of intensity. (RSK 2011)

The size of the relevant region may vary, depending on the geological and tectonic setting, and its shape may be asymmetric in order to include distant significant seismic sources of earthquakes. Its radial extent is typically 300 km. If it can be demonstrated easily that there are major tectonic structures closer to the site than the radius indicated, then studies should concentrate on this part of the region. (IAEA 2010)

The site investigation needs to reassess the earthquake risk in the Sloe area with state of the art methods for a large area surrounding the potential NPP site.

In addition to the earthquake risk a geotechnical evaluation of each location assessing the stability of the geological set-up is very important for the base of the reactor building.

4.3 Explosions, fires and chemical accidents

All sites considered for the new NPP are located in the industrial and port area. Therefore man-made external impacts have to be analyzed regarding the risk of industrial accidents in the vicinity of the NPP location. Transports in the port and industrial area could cause explosions, fires and the release of chemicals.

Other external events as aircraft crash and sabotage are mentioned in the SEA memorandum as risks which have to be analyzed as Beyond Design Basis Accidents (BDBA) in the Probabilistic Safety Assessment (PSA).

Some sites are next to industrial complexes, which could pose explosion or fire hazards for the new NPP, such as the refinery adjoining K3 and other chemical enterprises, as well as the transport of chemicals in the neighborhood. A ranking of the considered sites according to the hazards mentioned would be an important piece of information.

5 ACCIDENTS & TRANS-BOUNDARY EMISSIONS

5.1 Beyond design basis accidents

Beyond Design Basis Accidents (BDBA) are treated in the Guidelines (under the heading “Nuclear safety and radiation.” (NL-GOV 2011, Annex II)

BDBAs are characterized as highly improbable accidents when the reactor can no longer be properly cooled and passive safety facilities (like the building that acts as a containment system) must limit the effects on the surroundings of the NPP. The probabilistic safety analysis (PSA) method needs to be used to indicate the effects of beyond-design accidents. A PSA is a safety analysis that examines the probabilities, the course and consequences of serious accidents. (NL-GOV 2011, Annex II)

The Austrian interest can be defined by quoting the following key demands in line with the safety target O3 of the WENRA statement of November 2010 (WENRA 2010):

- Core melt-accidents, which can lead to early or large releases, must be practically eliminated. According to the IAEA definition a situation is „practically eliminated“, if it is either physically impossible to occur, or if the conditions can be considered with a high degree of confidence to be extremely unlikely to arise (IAEA 2004). The discussion about the physical impossibility has to be continued as far as possible. Otherwise – in the case of „high degree of confidence, extremely unlikely” a safety claim solely based on probabilistic considerations is not acceptable. Insecurities are to be taken into account and quantified as far as possible. Sensitivity studies are necessary to avoid “cliff-edge“ effects.
- For core melt-accidents, which cannot be practically eliminated, the design needs to have in place such measures, that only protective measures limited in time and space are necessary for the population (no permanent resettlement, evacuation only in the immediate surroundings of the plant etc.) and that enough time is left to implement those measures.

The Guidelines (NL-GOV 2011, Annex II) demand the EIR to analyze the consequences of BDBA external events such as aircraft crash, earthquake, sabotage etc. and also consequences of other external events (“calamities”) as explosions and an accident in the operating Borssele NPP-1.

For an assessment of accident impacts on a trans-boundary level, the EIR should give an overview on the analyzed design base accident (DBA) and beyond design base accident (BDBA) scenarios.

- For the assessment of trans-boundary impacts a complete description of the core inventory, accident sequences, frequency of occurrence and release rates (source terms) for the proposed NPP should be presented in the EIR.
- The requirements for the safety systems should be described in detail; the requirements regarding the proof of the functioning of the provisions for preventing breach of containment 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). Analogue requirements for other external impacts (flood, earthquake, explosions etc.) should also be specified.

- Interim storage of spent nuclear fuel should be described (technical, inventory, accident prevention and protection from external impacts).

5.2 Emergency planning

The Guidelines treat this issue under the heading “Risk control and response to calamities” by stating:

“Identify the risk contours during normal operation, in the event DBA and BDBA as well as external calamities and incidents. Describe the measures that will be taken to keep the risk contours within the operating limits to the fullest possible extent. These must be feasible, sufficiently validated, proven measures. And take into account the release of radioactive substances as well as other hazardous emissions. (NL-GOV 2011, Annex II)

Provide a transparent picture of the routing and volume of traffic in the event of a calamity in relation to the capacity of the present traffic network, taking into account traffic streams in two directions as the population will need to leave the area and the emergency services must enter the area. (NL-GOV 2011, Annex II)”

Each NPP should publish an emergency plan. The relevant EC directive recommends including the emergency plan in the EIR, the protection measures under severe accident conditions for the population working and living in the Sloe area should be explained in detail. (EC 1989)

The EIR needs to describe internal emergency measures (accident management) in general as well as assessing individual events and subsequent failures. The following issues deserve special attention:

- Accident management measures for the different stages of loss of core cooling,
- Accident management measures for preserving containment integrity after fuel damage (core or spent fuel pond),
- Accident management measures for the storage of spent fuel.

For each case the prevention of possible “cliff-edge-effects“ needs to be discussed. Issues of organization, of availability of equipment and supplies (fuel for the diesel-generators, cooling water etc.), prevention of radioactive releases (also releases of contaminated water) need to be taken into account. Attention should be devoted to possible impacts of a far-reaching destruction of the plant infrastructure, contamination of the plant site and similar effects. (ENSREG 2011)

The discussion needs to determine possible negative impacts on the implementation of accident management measures, which might arise due to severe damage at the other reactor units or fuel storages at the site. Guaranteed heat removal from the reactor core and the storage ponds needs to be proven for a long time period after the accident.

The IAEA recommends establishing an Emergency Response Center at each nuclear power plant site, which is sufficiently protected against external events and is equipped with displays for the most important safety relevant parameters, which are collected by robust instruments and transferred via robust lines. (IAEA 2011)

6 ABBREVIATIONS

ABWR ..... Advances Boiling Water Reactor

AP 1000 ..... Advanced Passive Reactor

BDBA ..... Beyond Design Basis Accident

CA ..... Competent Authority

COVRA ..... Central Organization for Radioactive Waste (in the Netherlands)

DBA ..... Design Basis Accident

DELTA ..... Delta Energy B.V.

EC ..... European Commission

EIA ..... Environmental Impact Assessment

EIR ..... Environmental Impact Report

ENSREG ..... European Nuclear Safety Regulator Group

EPR ..... European Pressurized Reactor

EPZ ..... N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland biggest Electricity Supplier in NL

ERH ..... Energy Resources Holding B.V.

IN ..... Initiator

IAEA ..... International Atomic Energy Agency

Min. EL&I ..... Minister of Economic Affairs, Agriculture and Innovation

Min. I&M ..... Minister of Infrastructure and Environment

NCEA ..... Netherlands Commission for Environmental Assessment

NPP ..... Nuclear Power Plant

PGA ..... Peak (horizontal) Ground Acceleration

PSA ..... Probabilistic Safety Assessment

SEA ..... Strategic Environmental Assessment

SEV ..... Structure Plan for Electricity Supply

SL ..... Seismic Level

WENRA ..... Western European Nuclear Regulators Association

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