



## ANSWERS TO QUESTIONS PRESENTED BY ENVIRONMENTAL AGENCY AUSTRIA TO LOVIISA NUCLEAR POWER PLANT ENVIRONMENTAL IMPACT ASSESSMENT

Below are the answers to questions presented in chapter 8 of statement "NPP LOVIISA 1&2 LIFE-TIME EXTENSION ENVIRONMENTAL IMPACT ASSESSMENT" (REPORT REP-0790, VIENNA 2021) using the same chapter numbering as was in the statement.

### 8.1 Procedure and alternatives

#### 8.1.1 Questions

Q1. How should the wording of the envisaged life-time extension "a maximum of approximately 20 years" be interpreted: Could the life-time extension be also longer than 20 years?

The EIA procedure covered the option of extending the power plant's operation until 2050, that corresponds to 20 years extension for Loviisa 2 and 23 years extension for Loviisa 1. Current licences are valid until the end of 2027/Loviisa unit 1 and 2030/Loviisa unit 2. There are no plans to continue the operation of Loviisa nuclear power plant beyond 2050.

Q2. When will the decision on one of the options be taken by Fortum?

Fortum has not set a date when the decision will be made, but most likely it will be made in 2022.

Q3. What are the results from the international hearing on 7 October 2021?

The Ministry of Economic Affairs and Employment (MEAE) organized a public event on 7 October 2021 locally in Loviisa. The event was streamed online and remote participation was thus possible. In addition to the organizers, five persons were present at the event and a maximum of 63 persons followed it on the Internet. The event consisted of expert presentations and a discussion section during which the public

could ask questions. The questions could also have been asked in English. The presentations were in Finnish, Swedish and, in essential parts, in English.

The purpose of the event was to share information with a focus on the local perspective, such as impacts on surface water, regional economic impacts and the results of resident surveys. Citizens asked questions e.g. about nuclear waste management, the impacts of cooling water, the carbon neutrality of nuclear power, radiation safety and security of energy supply. The participants did not ask questions in English.

The EIA process is still ongoing and MEAE takes all opinions and statements into consideration in the coordinating authority's informed conclusion.

## 8.2 Spent fuel and radioactive waste

### 8.2.1 Questions

Q4. What is the timetable for the planned increase of the interim storage capacity for spent fuel?

The storage capacity is increased gradually as new capacity is needed. Existing fuel racks have already been replaced with new dense fuel racks increasing the storage capacity and this will also be done in the future. In late 2030's some other actions, like utilizing old spent fuel storage, building new pools (extension of existing new interim storage or new storage) or start final disposal that will free storage capacity, are needed.

Q5. Can you please describe the options for capacity increase of the spent fuel interim storage by high-density storage in more detail?

In spent fuel storage 2 fuel can be stored in a denser configuration than in the old racks, due to the structure and materials (boron steel) of the new fuel racks. This has already been done for some pools. In spent fuel storage 1 the fuel is stored in transfer casks and there is possibility to have more of these casks in the pools. Technical studies are ongoing.

Q6. Why will the storage system used for spent fuel interim storage not be switched to a state-of-the-art dry storage system?

Pool storage is a safe way to store the fuel and there is no need to change the concept.

Q7. Which alternative options are planned for the case that the interim and the final disposal facilities for spent fuel are not available in time?

Fortum currently plans to aim for capacity increase of the interim storage at the site. There is enough time to plan and implement the needed actions for this. For the Posiva final disposal facility the handling of the first operating license has started in January 2022 and the spent fuels from Fortum Loviisa units are planned in this license application.

Q8. Will the KBS-3 method be used despite of problematic results of copper corrosion research? How will the copper corrosion problems be dealt with?

KBS-3 method will be used by Posiva company. All the relevant research results are thoroughly analyzed and discussed in the long-term safety case to be issued by Posiva in connection with their application for the operating license. Posiva has now submitted their operating licence application to Ministry of Economic Affairs and Employment (Dec. 2021).

### 8.3 Long-term operation of reactor type VVER-440

#### 8.3.1 Questions

Q9. Does the aging management program now comply with the new requirements from 2019 and 2020?

Yes, in Periodic Safety Review to STUK this kind of assessment was done.

Q10. When will the STUK regulation implement the updated 2020 WENRA reference level for existing reactors?

STUK has not scheduled implementation of the 2020 WENRA Safety Reference Levels (SRLs). Also, WENRA has not set a target date for their implementation in national regulatory systems yet. They will be considered in the upcoming activity to reform the Finnish regulations. However, STUK has actively participated in developing of the SRLs and has not identified major gaps between the new SRLs and existing Finnish requirements, although a detailed gap analysis has not been carried out so far. STUK also participates in the peer review of the implementation of the SRLs in national regulations within WENRA as part of the activities in WENRA's Reactor Harmonisation Working Group (RHWG) when it takes place in future. At the moment, STUK sees no significant effects from implementation of the 2020 SRLs on the Finnish safety requirements and on regulatory oversight of the NPPs in Finland.

Q11. Has the STUK ageing management expert group made recent observations/conclusions?

STUK will finalize the review of periodic safety review probably in spring 2022.

Q12. When will the two remaining issues from the national action plan relating to the Topical Peer Review (TPR) "Ageing Management" under the Nuclear Safety Directive 2014/87/EURATOM be completed?

Overall Ageing Management Program (OAMP) of Loviisa NPP has been updated and implemented during 2019-2021 using IAEA SSG-48 as a guiding document. The issue related to extended shutdown is still open.

Q13. Which measures will be performed concerning the very important safety issue of the reactor pressure vessels (RPVs) ageing (embrittlement)? Is re-annealing of the RPV of Loviisa 2 envisaged? What are the remaining safety margins?

The reactor pressure vessel safety margins are followed constantly and in case of current lifetime, no actions are needed. For extended lifetime some actions are needed and currently Fortum is planning to add additional shield elements on the outer periphery of the reactor core, which lowers the neutron doses in reactor pressure vessel weld that is limiting for lifetime. First shield elements were added in the beginning of plant operation in 1980's. The shield elements have similar geometry than fuel elements, but contain steel instead of nuclear fuel. Re-annealing is one possibility in the future. This and other possibilities will be studied further before any decision and there is no urgent need for these actions.

Q14. What are the recent results of the inspections of all nozzles of the RPV? Are there any measures envisaged?

Inspections have been performed and periodic inspections will be carried out also in the future. There are no additional measures envisaged as the nozzles fulfill the requirements and they are safe to operate.

Q15. Are the results of the evaluation of the conditions of the RPV internals and head penetrations (including trends of events, and envisaged exchange measures) already available?

According to inspections and analyses the requirements are fulfilled. Periodic inspections will be carried out and the margins are followed constantly.

Q16. Are there any problems with aging of the ice condensers (as mentioned by the Loviisa Deputy Director in August 2020)?

Fortum has a continuous surveillance programme as part of the ageing management to follow the condition of the ice condensers. The functionality of the ice-condenser doors is tested by periodic testing. During annual outages Fortum also carries out inspections to the ice baskets and structures of the ice condensers.

There have not been identified any significant ageing related issues regarding the ice condensers.

Q17. Is information about the conditions of components of the primary circuit and the electrical installations (including trends of events, and envisaged exchange measures) already available?

There are systematic monitoring and ageing management procedures. Components are replaced or additional qualifications done, when necessary.

Q18. What are the findings of the OSART follow up mission 2020? Have any recommendations or suggestions not yet been resolved?

There were two findings from the OSART mission considering LTO-area (long term operation) in follow-up mission in 2020. They were related to scoping and screening list and monitoring/inspection programmes. Progress regarding both findings was considered satisfactory during OSART follow-up mission and since then all findings have been fully resolved.

Q19. Has the cause for the noise of the Loviisa 1 reactor pressure tank's foreign material monitoring system already been clarified?

The reason for the noise is known and it is caused by tolerances in some components. There have not been any damages and there is no safety concern related to this.

Q20. Which technically possible improvements to meet modern safety requirements have been considered not "reasonably practicable" for the Loviisa NPP?

There are some requirements that are not "reasonably practicable". Some of the issues are related to details in application of redundancy, separation and diversity principles. These have been analyzed using probabilistic methods (PRA) and have low safety impact. Seismic evaluations are ongoing and there will be some modifications in the future, like changes in component supports.

Q21. Which safety systems/components and Severe Accident Management (SAM) systems/equipment are shared between Loviisa 1 and 2?

The main principle is that both plant units have independent main safety systems. There are some diverse and additional systems that are common to plant units. Shared systems in figure 7- 6 of EIA report are:

11. Power supply from hydro power station

13. Diesel generator plant

15. Auxiliary emergency feedwater system has two subsystems, one for each unit. Cross connection is possible.

Severe accident management systems are partly shared between plant units. Sea water circuit of containment external spray system (16 in figure 7-6 of EIA report), severe accident management electrical systems and some severe accident I&C systems are shared. It should be noted that there are two redundancies thus single failure was considered.

Q22. Which design changes are planned in the context of the envisaged lifetime extension?

The main principle is to constantly upgrade the plant as it has been explained in more detail in chapter 7.8 of EIA report. Loviisa power plant has implemented several projects that improve nuclear safety. Safety related modifications due to lifetime extension are related to seismic events.

Due to ageing, modernizations have been done and this will continue in the future as well. In recent years, extensive renewals have been carried out on the automation of the power plant, and ageing systems and equipment have been modernized. In 2014–2018, Loviisa power plant implemented the most extensive modernization programme in the plant's history, in which Fortum invested approximately EUR 500 million.

Q23. Which existing buildings should be renovated or new constructed in framework of the lifetime extension?

In the EIA, Fortum has stated the following and there has not been any update since: *"In the possible case of life time extension, additional new buildings could be built in the power plant area. Such new buildings could include a cafeteria building in the vicinity of the office building, an*

*inspection or reception warehouse, a wastewater treatment plant and a storage hall for waste as well as a welding hall".*

Renovation is related to majority of buildings at site.

Q24. Which documents of WENRA will be taken into account for the lifetime extension in a binding form?

Fortum has not evaluated fulfillment of WENRA requirements. See also answers to Q10 and Q25.

Q25. Are the results from comparing the design features and measures of the Loviisa NPP with all requirements of SRL F already available?

Fortum has done comparison to national requirements, not to WENRA reference levels. As mentioned in answer to Q10, there are no large gaps between national requirements and WENRA SRL's. Issue F of WENRA's SRLs have been implemented in Finnish safety requirements.

Q26. Have measures been planned to meet the safety objective O2 (accident without core melt) for lifetime extension?

In EIA report chapters 9.21 and 9.22 several different releases are analyzed. Probabilistic risk assessment (PRA) and core damage frequency is discussed in EIA report chapter 7.8. Also external events are considered in the PRA.

The goal is to operate the plant safely. The work is continuous and several modifications have been done in the past. The safety objective is achieved.

Q27. Will lifetime extension measures been planned to come as close as reasonably practicable to meet the safety objective O3 (accidents with core melt)?

The goal is to decrease the level 2 PRA numerical value. Currently there are some quite conservative assumptions and more detailed studies are ongoing. The goal is to have best estimate assumptions. There will also be some changes in the guidance. There are currently no specific plans for plant changes except some seismic modification can be relevant also for severe accident management systems as well. Plant changes will be done if needed.

Q28. Has STUK already finished the review of the submitted PSR? What results did the PRS deliver? Will all requirements stemming from the results be applied as preconditions for the lifetime extension approval?

STUK has not yet finalized the review for the power plant, but the decision is expected in the spring of 2022. Results of PSR will naturally be taken into account in connection to possible operating license application.

For the low and intermediate level waste repository, STUK issued its decision in December 2022. STUK states in its decision that the operating safety and long-term safety are at a good level in the final disposal facility for low- and intermediate-level waste, and the licensee has the necessary procedures and resources in place to continue safe operation.

## 8.4 Accident Analysis

### 8.4.1 Questions

Q29. Questions Are the results from the PSA analyses (levels 2) including source terms and frequencies for severe accidents with (early) large releases (LRF or LERF) already available?

Fortum has performed level 1 and 2 PRA and these are updated every year. In level 2 PRA also large early release is evaluated.

Q30. How much is contributed by internal and external events to CDF, LRF and LERF?

External events contribute 13 % of CDF, 20 % of LRF and 5 % of LERF. The rest is contributed by internal events.

Q31. Has been performed a probabilistic safety analyses (PSA) level 3?

Several dose calculations have been performed but level 3 PRA has not been performed.

Q32. In which manner have the safety issues of the in-vessel retention concept which could endanger the containment integrity (containment bypass scenarios, cliff-edge effects in shutdown states) been solved?

There are procedures for this kind of events. For shutdown state new guidance was implemented in 2017. Success is evaluated using PRA.

Q33. What are the results of current studies on earthquakes, floods and extreme weather conditions? When have these studies been performed?

Studies for extreme weather conditions had already been done before Fukushima and they are included in PRA. After Fukushima some re-evaluations were done and these have been finalized. For example, the flood frequencies were re-evaluated in 2015 and plant modifications were implemented during 2015-2020. Alternate heat sink (air cooling by cooling towers) was finalized in 2015. Seismic plant walkdowns were performed in 2018 and more detailed studies are ongoing. Preliminary results indicate that the importance of seismic events in PRA could increase, but they would not become dominant.

Main results are presented in connection to Q30. The external event frequency is only a small fraction of core damage frequency.

Q34. Which external events have been considered in the recent PSR?

In PRA following events have been considered:

- Hydrological and oceanographic phenomena: Sea water level, frazil ice, low and high sea water temperature.

- Meteorological phenomena: High and low air temperature, wind, tornados, freezing rain, snow fall, lightning. In some cases also climate change has been considered.
- Geological phenomena: Seismic events.
- Biological impurities in water, like algae.
- Non-weather related phenomena: Ship and oil accidents, explosions.

Same events were considered also in PSR.

Q35. Which combinations of external events have been considered in the last PSR?

Events are combined in the following way:

- High wind with one of following:
  - Biological impurities in water,
  - frazil ice,
  - Low air temperature or
  - icing conditions (this poses alone no risk to plant and is considered only in combination with wind)
- High wind, frazil ice and clogging conditions for certain air intakes due to icing or snowing combined
- High wind, biological impurities in water and clogging conditions for certain air intakes due to icing or snowing combined
- Low sea water level and biological impurities in water combined with all initiating events including internal events

Same events were considered also in PSR.

Q36. Which safety margins, cliff-edge effects and envisaged improvement measures are applied for the lifetime extension concerning seismic hazard, flooding hazards and extreme weather events?

According to YVL B.7 background memo the events with frequency  $10^{-7}$  need to be considered and this has been done for events other than seismic events.

There will be seismic modifications. As seismic evaluations are still ongoing, the exact value cannot be given yet.

## 8.5 Accidents with involvement of third parties

### 8.5.1 Questions

Q37. Are there any studies about the consequences of a commercial airplane crash against the Loviisa NPP available?

Extensive risk analysis and measures to mitigate possible risks is of course part responsible nuclear operations. The requested information is part of the power plant's security arrangements, thus confidential (Covered also in the law for publicity for authorities 1999/621 §24). Therefore more detailed information on this topic cannot be shared.

## 8.6 Trans-boundary impacts

### 8.6.1 Questions

Q38. Please provide data of the largest source term identified in the probabilistic safety analyses (PSA) (regardless of its probability)?

Finnish legislation and requirements set 100 TBq target for Cs-137 and this has been accepted by competent authority (Ministry of Economic Affairs and Employment of Finland) to be used for evaluations in EIA.

Q39. Please provide the results of the dispersion calculation for this source term. It would be welcomed if these results were also presented for Austrian territory. It would be welcome if the results of the dispersion calculation were comparable with the Austrian catalogue of countermeasures (see also table 3: Values for agricultural countermeasures A07 (BMLFUW 2014), and with the Austrian national emergency plan (BMK 2020)

Document for international hearing represents the dose evaluation up to 1000 km without any protective measures related to population. The doses are not evaluated considering local conditions but this approach is considered conservative for central Europe. Table 6-2 of international hearing document represents the deposition of most important nuclides up to 1000 km. Local organizations may evaluate the impact of the countermeasures using these values.