Reasoned conclusion of the coordinating authority

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Reasoned conclusion of the Ministry of Economic Affairs and Employment concerning the environmental impact assessment report for Loviisa nuclear power plant

1 Project information and the environmental impact assessment procedure

The environmental impact assessment (EIA) report deals with the extension of operations at Loviisa nuclear power plant and the alternative decommissioning options. The nuclear power plant is located on the island of Hästholmen in Loviisa.

Fortum Power and Heat Oy (Fortum) is the project owner. Ramboll Finland Oy serves as the EIA consultant to Fortum in the project.

Under section 10 of the Act on the Environmental Impact Assessment Procedure (the EIA Act, 252/2017), the Ministry of Economic Affairs and Employment serves as the coordinating authority for projects concerning nuclear power plants referred to in the Nuclear Energy Act (990/1987).

1.1 Description of the project and the different alternatives

The operating licences for the Loviisa 1 and Loviisa 2 power plant units and the associated buildings required for the management of their nuclear fuel and nuclear waste will expire in 2027 and 2030. The report also deals with the use of the final disposal facility for low- and intermediate-level nuclear waste. The report analyses three different alternatives for the extension of nuclear power plant operations.

Under Option 1 (VE1), the company will extend the operations of both power plant units by a maximum of approximately 20 years after the current licence periods. The buildings and storage facilities required for nuclear fuel and nuclear waste management, as well as the final disposal facility will continue in use and will be expanded where necessary. The nuclear power plant could also be used for the processing, interim storage and final disposal of small amounts of radioactive waste generated elsewhere in Finland.

Under Option 0 (VE0), the nuclear power plant will be decommissioned after the expiry of the current licences, that is, in 2027 and 2030. The buildings and storage facilities required for the nuclear waste management of the plant units, as well the final disposal facility will continue in use until rendered unnecessary or decommissioned.

Option 0+ (VE0+) is the same as Option VE0 in all other respects, except that it would also allow the nuclear power plant to be used for the processing, interim storage and final disposal of small amounts of radioactive waste generated elsewhere in Finland.

1.2 Environmental impact assessment procedure

Fortum submitted its environmental impact assessment report (EIA report) to the Ministry of Economic Affairs and Employment on 6 September 2021. The report follows the EIA procedure and the programme stage, which began on 13 August 2020, when the party responsible for the project submitted the environmental impact assessment programme to the Ministry of Economic Affairs and Employment. The ministry issued its opinion regarding the programme on 23 November 2020. The project falls within the

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scope of the environmental impact assessment procedure because it is a project referred to in points 7b and 7d of Appendix 1 (list of projects) of the EIA Act.

1.3 Interfaces with other projects

According to plans, the spent fuel from the Loviisa nuclear power plant will be deposited for final disposal in Posiva Oy's repository in Olkiluoto, Eurajoki. The project will affect the amount of spent fuel deposited in the final disposal facility.

The assessment procedure also examines options for using the nuclear power plant for the processing, interim storage and final disposal of small amounts of radioactive waste generated elsewhere in Finland. In this respect, the project is linked to ongoing Finnish projects that are typically conducted by the industrial sector, health care sector and research institutions and generate low- and intermediate-level waste.

The project is also linked to the decommissioning of the FiR 1 research reactor of the VTT Research Centre of Finland and the research laboratory for radioactive materials at Otakaari 3 (OK3). The assessment procedure also addresses the possibility of depositing low- and intermediate-level waste from the decommissioning projects in interim storage at Loviisa power plant and in final disposal in the L/ILW repository.

The project may be linked to various plans and programmes concerning the use of natural resources and environmental protection, including national target programmes and international commitments.

According to the report, no projects have been identified in and around the power plant area that could contribute to cumulative effects if the operations were extended or if the plant were decommissioned. In the future, the project may impact the continued use of present transmission lines and the utilisation of the thermal energy generated by the plant, but these aspects were excluded from the current assessment procedure.

1.4 Other procedures and land use planning

The operation and decommissioning of a nuclear power plant requires a licence as specified in the Nuclear Energy Act. Such licences are issued by the government. The project may also require other licences in accordance with section 21 of the Nuclear Energy Act, issued by the Radiation and Nuclear Safety Authority STUK.

The operating licences for the Loviisa power plant units will expire in 2027 (Loviisa 1) and 2030 (Loviisa 2). The licences for the buildings and storage facilities required for the units' nuclear fuel and nuclear waste management, as well as their expansions will expire in 2030. If the party responsible for the project wishes to extend the use of the nuclear power plant units, new operating licences must be applied for. If not, a decommissioning licence must be sought.

The operating licence for the final disposal facility for reactor waste (the L/ILW repository) will expire in 2055. If the party responsible for the project wishes to use the L/ILW repository for longer than this, a new operating licence must be applied for. Owing to the substantial differences in the operating times of the power plant units and the L/ILW repository, decisions on the operating licence for the L/ILW repository must be made in a separate process.

Other radiation practices at Loviisa nuclear power plant require a safety licence issued by the Radiation and Nuclear Safety Authority STUK in accordance with the Radiation Act. The safety licence is valid until further notice and must be updated in accordance with changes. Regarding the transport of nuclear waste and radioactive substances, a transport or safety licence must be applied for or a notification must be submitted to STUK. The transport licence is also handled by STUK.

Other permits discussed in the impact assessment report are those related to the Land Use and Building Act (132/1999), the environmental permit specified in the Environmental Protection Act (527/2014), the permit for water resources management and the permit for extracting domestic water specified in the Water Act (587/2011), as well as the permits specified in the Act on the Safe Handling of Dangerous Chemicals and Explosives (390/2005). These acts also contain provisions on various notification

obligations. The existing local detailed plan for the area enables the implementation of the alternatives laid out in the procedure.

The impact assessment report also discusses the project's connections to various plans and programmes concerning the use of natural resources and environmental protection. These include various climate policy targets, Finland's national climate and energy strategy and the water resources management plans and marine strategy.

2 Public participation and a summary of the statement and opinions submitted on the impact assessment report

The Ministry of Economic Affairs and Employment organised a public hearing concerning the report in accordance with the Act on the Environmental Impact Assessment Procedure and the Government Decree on the Environmental Impact Assessment Procedure (277/2017). The environmental impact assessment report was published on the Ministry's website on 6 September 2021.

An open consultation was organised from 20 September to 18 November 2021. An announcement regarding the report was published on the ministry's website on 20 September, as well as in the project's municipality and neighbouring municipalities in accordance with section 108 of the Local Government Act (410/2015). An announcement regarding the open consultation was also published in the following newspapers: Helsingin Sanomat, Hufvudstadsbladet, Kymen Sanomat, Uusimaa, Loviisan Sanomat, Östnyland, Itäväylä, and Nya Östis.

The Ministry of Economic Affairs and Employment requested statements on the assessment report from the following parties: the Ministry of the Environment, Ministry of the Interior, Ministry for Foreign Affairs, Ministry of Defence, Ministry of Agriculture and Forestry, Ministry of Transport and Communications, Ministry of Social Affairs and Health, Ministry of Finance, Radiation and Nuclear Safety Authority (STUK) and the nuclear safety committee, Regional State Administrative Agency for Southern Finland, Uusimaa Centre for Economic Development, Transport and the Environment, Helsinki-Uusimaa Regional Council, Finnish Safety and Chemicals Agency (Tukes), Finnish Environment Institute, Eastern Uusimaa Emergency Services Department, Eastern Uusimaa Police Department, City of Loviisa, Municipality of Myrskylä, Municipality of Pyhtää, City of Porvoo, Municipality of Lapinjärvi, City of Kouvola, Akava – Confederation of Unions for Professional and Managerial Staff in Finland, Confederation of Finnish Industries, Finnish Energy (ET), Geological Survey of Finland, Greenpeace, Fennovoima Ltd, Fingrid Oyj, Central Union of Agricultural Producers and Forest Owners (MTK), Porvoo Museum, Finnish Society for Nature and Environment, Posiva Oy, VTT Technical Research Centre of Finland, Teollisuuden Voima Oyj, Finnish Confederation of Professionals (STTK), Finnish Association for Nature Conservation, Federation of Finnish Enterprises, Central Organisation of Finnish Trade Unions and WWF. Other parties and citizens also had the opportunity to express their opinion about the project.

On 10 September 2021, the Ministry of Economic Affairs and Employment requested the Ministry of the Environment to organise a transboundary consultation in accordance with the Espoo Convention related to the environmental impact assessment procedure of Loviisa nuclear power plant and submit the feedback to the coordinating authority.

During the programme phase, Sweden, Estonia, Russia, Norway, Denmark, Germany, Lithuania, Austria and the Netherlands indicated their intention to participate in the assessment procedure. The Ministry of the Environment requested statements from these countries on 20 September 2021.

The announcement, the environmental impact assessment report and the statements and opinions received during the consultation period were published on the website of the Ministry of Economic Affairs and Employment at https://tem.fi/en/loviisa-eia-report. An English-language version of the report and report summary were also available on the site.

2.1 Public event

The Ministry of Economic Affairs and Employment organised a public event at Lovisaviken School on the extended operation and decommissioning of Loviisa nuclear power plant in accordance with the EIA procedure on 7 October 2021. The event was streamed online to enable remote participation. Five

participants followed the event in person and a maximum of 63 people online. Fortum handled the practical arrangements.

The event consisted of expert presentations and a discussion during which the public could ask questions and express their opinions. The presentations were given in Finnish and Swedish, and essential parts also in English. Questions could be posed in all three languages. The presentations addressed local aspects, such as the impact on surface waters, the regional economy and the results of resident surveys.

The discussions focused especially on nuclear waste management and the final disposal of nuclear waste, as well as on the impact of cooling water on nearby waterways. The carbon neutrality of nuclear power, as well as radiation safety and security of supply were also on the agenda. The minutes of the event are archived in the ministry's document management system.

2.2 Summary of the statements and opinions

A total of 22 statements and opinions related to the national hearing were submitted to the ministry. The statements mainly described the report as being comprehensive. Many Finnish respondents were in favour of continuing the nuclear power plant's operations, basing their opinion on the security of energy supply and on nuclear electricity being free of greenhouse gas emissions. Most of the comments concerned the impacts of cooling water.

In the transboundary hearing, statements were submitted from Austria, Lithuania, Sweden and Estonia and their respective authorities. The ministry also received 12 statements from European citizens and organisations. These statements mainly opposed the use of nuclear energy because of the risk of accident and concerns about the safety of the final disposal of spent nuclear fuel.

2.2.1 Authorities and municipalities

According to the **Regional State Administrative Agency for Southern Finland**, the assessment report provides an adequately detailed description of the impacts on human living environments caused by the different options, taking into account the other licences required for nuclear power plant operations. The statement was prepared by the agency's unit for environmental health care.

The Regional State Administrative Agency points out that data on the environmental health impacts of current operations are available from a long period of time, and monitoring is carried out regularly. The agency refers to the assessment report, according to which extending operations does not imply significant changes to the current impacts and monitoring, in addition to which the expansions are not expected to have significant impacts on the nearest susceptible areas.

Regarding decommissioning, the Regional State Administrative Agency notes that if the power plants are completely dismantled (according to the greenfield principle), special attention must be placed on the prevention of noise and dust disturbance in further planning and the licence processes.

The agency supports the idea, included in options 1 and 0+, of the power plant being able to receive and process, as well as accept for interim storage or final disposal, small amounts of radioactive waste generated elsewhere in Finland. The unit for environmental health care approves of the idea, seeing as the power plant has the functions and facilities suitable for the processing and final disposal of radioactive waste.

Geological Survey of Finland considers the need for additional excavation for the L/ILW repository to be significant. The potential impact that the extension may have on local groundwater conditions should be explored in greater detail.

In terms of hydrogeological impacts, the extension's surface area may be of greater significance than its volume. The current facility is located between two horizontal fragmented rock zones. The report does not indicate how the additional excavation will be carried out, but presumably the intention is to keep within the same rock segment. The network of fissures in the upper part of the rock may be water-bearing and difficult to avoid due to its wide scope. If water-bearing fissures are cut into extensively, there will be more leaks and a greater need for injection.

According to Geological Survey of Finland, this means that surveys of the rock quality must also focus on the water-bearing features of the fissures. Although the impacts are expected to be restricted to the close vicinity of the excavated area and its use, the chapter on the present state of groundwater (9.15.3) states that fluctuations in the level of groundwater are connected to the sea and the mainland. While this does not necessarily mean the flow of groundwater, lateral hydraulic connections exist over a wider area.

Disturbances at the interface between fresh and saline water during the construction of the L/ILW repository is an indication of vertical connections (9.15.3). The surge of saline water is a common observation and the result of a change in the hydraulic pressure caused by water pumping. Based on Figure 9.26, the chemical groundwater conditions have levelled out at a depth above 120 metres, but have not returned to the conditions preceding construction. The expansion of the L/ILW repository may exacerbate the disruptions, and saline water may rise closer to the repository.

Based on this, Geological Survey of Finland believes that the decision to discontinue the monitoring of the fresh-saline water interface in 2015 was unfounded. In Geological Survey of Finland's opinion, challenges related to interpretation are not a reason for discontinuing data collection. If parts of the groundwater system are not understood adequately, the situation must be rectified. Vertical connections can also offer channels for gases occurring naturally in the bedrock that have dissolved in the groundwater and are released when the pressure drops.

For these reasons, it is important to conduct groundwater monitoring over the entire lifecycle of the power plant site, engage in an integrated interpretation based on various data sources and continue to update the materials. The impacts of excavation can be influenced by addressing the bedrock structures and the hydrogeological and hydrogeochemical conditions in adequate detail in the location and implementation of the expansion.

According to the report, the rise in seawater temperature due to climate change, discussed in chapter 7.5.6, may result in power restrictions. The report does not take a stand on whether the limit for cooling water flow determined in the environmental permit needs to be raised in the future. At present, the cooling water flow is close to the limit in late summer.

In the opinion of Geological Survey of Finland, it is reasonable to continue the plant's operations in view of Finland's security of energy supply and the management of radioactive waste generated elsewhere. According to Geological Survey of Finland, the report did not raise any aspects that would require any other solution.

The Eastern Uusimaa Emergency Services Department says it provides expert statements on the construction permit procedure for the new buildings and renovations included in Option 1. The possibility included in Options 1 and 0+ to receive, process, place in interim storage and deposit in final disposal radioactive waste generated elsewhere in Finland must be taken into account, as necessary, in the external emergency plan and other safety documents. Regarding the decommissioning options, the Emergency Services Department affirms that it will maintain the external rescue plan and organise related statutory preparedness drills for as long as the site is considered to pose a special hazard as specified in section 48 of the Rescue Act.

The **Eastern Uusimaa Police Department** points out that, from a national perspective, the Loviisa nuclear power plant is a very important special power production site. Under normal conditions, the safety of the nuclear power plant is the responsibility of the licence holder's safety organisation. On the whole, operations at Loviisa nuclear power plant have been safe and free of disturbance. In its statement, the police department only addresses aspects that directly affect police operations and the planning of operations.

Option 1 does not involve changes to the present state. The impacts of maintenance work and fuel transports, for example, will remain the same. Should Option 1 be selected, the police department will continue its contingency planning and measures maintaining preparedness.

Option 0 means a reduced risk of hazard on the site. However, safety measures will still be required to ensure the safe handling of nuclear material and radiation sources, as well as to prevent their use for illegal purposes for as long as the site contains nuclear material and radiation sources. Transports of

nuclear material and radiation sources will continue to require contingency planning and safety measures In the police department's opinion, the impacts of Option 0+ are otherwise similar to those of Option 0, except that the transports of nuclear material and radiation sources will have substantially larger impacts and will raise the hazard level of the site.

The Municipality of Lapinjärvi is in favour of operations continuing at the nuclear power plant, but disapproves of the transport and storage of radioactive waste generated elsewhere. The municipality emphasises that special attention must be placed on the safety of nuclear fuel transports and the long-term safety of storage, as well as on mitigating any rise in seawater temperature.

The City of Loviisa supports Option 1. According to the statement, climate change and increased electricity consumption call for the use of nuclear energy for at least 20 years. The statement mentions the maintenance work carried out on the site, the appropriateness of area use and land planning, as well as the investments in infrastructure.

The Ministry of Social Affairs and Health expresses its satisfaction with the report, taking into account the recommendation made by the national coordination group for nuclear waste management concerning waste generated elsewhere in Finland (VE1, VE0+). In the ministry's opinion, it would benefit society at large if Fortum could offer other operators waste treatment and final disposal services of radioactive waste.

The handling of radioactive waste generated in places other than nuclear plants belongs to the administrative branch of the Ministry of Social Affairs and Health. The amount of waste is minor compared to the amount of radioactive waste generated in nuclear power plants. The ministry agrees with the report's estimate, according to which the final disposal of waste will not cause radiation-related problems for employees or residents in the area. Options 1 and 0+ require a new operating licence to be obtained for the L/ILW repository. The ministry does not have other comments on the assessment report.

In the opinion of **the City of Porvoo,** the assessment report is thorough and addresses the local executive's statement on the EIA programme. The city does not have any remarks on the report.

According to **Porvoo Museum** (with regional responsibility for Eastern Uusimaa), the extension of operations has only a minor impact on the landscape and cultural environment. Regarding new buildings, the impacts on the landscape can be minimised by leaving buffer zones in place and by paying attention to the height and colour scheme of buildings. As no relics or other archaeological cultural heritage sites are known to exist in Hästholmen, continued operations do not have direct physical or landscape impacts on the area's archaeological cultural heritage.

For decommissioning plans, a survey of the area's historical building stock and its conservation value must be carried out. The options described in the report can also be seen as having a positive impact on the landscape structure. VE0+ does not imply special impacts on the landscape or the cultural environment.

According to the **Radiation and Nuclear Safety Authority STUK**, the assessment report meets the criteria for radiation and nuclear safety specified in section 19 of the EIA Act. STUK is of the opinion that its statement on the assessment programme has been taken into account adequately. In its statement, STUK requested further details about the application of the BAT principle in efforts to reduce radioactive emissions, as well as about the impact that extending the duration of operations will have on Posiva Oy's activities.

According to STUK, Fortum's estimates on the environmental impacts of radioactive substances, radiation monitoring, measures related to ageing management, processing of radioactive waste generated elsewhere in Finland and decommissioning are adequate at this point. The accident modelling and handling of impacts is also sufficient for now. STUK will conduct a detailed assessment to determine whether safety-related requirements are met when inspecting the application for an operating licence or decommissioning licence.

The Uusimaa Centre for Economic Development, Transport and the Environment considers the assessment report to be comprehensive and appropriately drafted. In the centre's opinion, the project has significant adverse impacts on surface waters, the state of water bodies, the achievement of the goals of water resources management and marine strategy, as well as aquatic organisms and fish. The

centre emphasises the need to better plan the measures mitigating these impacts and to carry them out in full.

The centre considers the rise in temperature caused by the discharge of cooling water to be one of the most significant adverse impacts of the plant. Therefore, the intake of cooler cooling water discussed in the assessment programme and the engineering work required for this should have been examined as part of the assessment. More detailed assessments of these impacts should be carried out in further project planning.

The assessment report finds that a slight deterioration in the status of the Klobbfjärden body of water resulting from the combined impact of the thermal effect and the point source diffusion of nutrients cannot be ruled out. According to the Uusimaa Centre for Economic Development, Transport and the Environment, the impact that continued operations will have on the state of water bodies and the need to mitigate the adverse effects should have been examined in greater detail and analysed in the light of the water resources management plan. In further planning, a more detailed assessment of the project's impacts on the ecological state of the body of water and the contributing factors must be carried out to ensure feasibility.

The centre also calls for a more detailed assessment of the impacts on the marine strategy and the state of the sea, addressing the impacts on the descriptors of a good status of the marine environment and the related indicators, as well as the changes caused by the project in ecosystems and species. The centre emphasises that reducing diffuse pollution has a key impact on the state of water bodies, and Fortum can affect the state of waters in the project's area of influence by adopting measures to reduce diffuse pollution. The Uusimaa Centre for Economic Development, Transport and the Environment is prepared to cooperate with Fortum and jointly plan mitigating measures.

The impacts of continued operations on the state of surface waters should have been compared more clearly with the impacts of Option 0 over the entire planned period. According to the centre, a separate discussion of each option and comparison with the present state does not provide a clear picture of the changes in the state of waters. This merits further attention in the future.

The centre considers that the report addresses climate impacts comprehensively, except for a few minor deficiencies. The assumptions used and the content of calculations have been described clearly, but the discussion of uncertainties is partly insufficient and the analysis of mitigating measures is superficial. The direct climate impacts from operations and decommissioning in the different options could have been discussed separately from indirect climate impacts related to electricity.

The significance of climate impacts from continued operations is considered to be reasonably positive, which appears to be an accurate assessment. Thanks to developments in driving power and vehicle technology, the climate impacts from operations are expected to be minor, even if the construction of new buildings in the project area and the process-based methane and nitrous oxide emissions from the power plant's wastewater treatment plant are taken into account.

The overall evaluation of the climate impacts from decommissioning (moderately negative) is most likely fairly accurate, although the centre questions the assessment according to which emissions from decommissioning are negligible (Table 9-33). The assessment does not take into account the climate impacts from the construction sites for the demolition of the facility, as well as the expansion and closure of the L/ILW repository. Moreover, emissions from the processing of demolition waste or the required construction materials (e.g. concrete and steel) are not discussed at all.

According to the centre, research related to climate change must be followed in the future and the resulting information must be used to improve the safety of the plant, as described in the report.

As for fishery, the centre observes that the impacts from Option 1 are much the same as currently. In the case of decommissioning, the impacts on fishery are positive, as the adverse factors will cease to exist.

In the centre's opinion, the soil and bedrock have been discussed adequately in the report, and the assessment corresponds to the centre's understanding. Areas with contaminated soil must be determined well in advance before initiating construction and demolition work. Plans must be made for the handling of contaminated soil, which may be found in connection with demolition work. The sources

for soil, bedrock and groundwater models have been added appropriately to the report. Adequate seabed surveys have been conducted to determine the state of soil layers and sediments.

According to the centre, noise and vibration have been analysed in sufficient detail. The assessed significance of the impacts resulting from different options is most likely correct, assuming that the adverse effects are mitigated adequately. The centre expects noise disturbance to occur especially during demolition, making it important to mitigate noise and vibration nuisance due to the long duration of demolition and the proximity of holiday housing. Measures for mitigating adverse effects are discussed in parts in the report. In the centre's view, in addition to adopting noise control measures, the noisiest work should be scheduled outside nesting and holiday seasons.

Impacts on nature have been discussed appropriately, and the most significant impacts have been addressed. The centre emphasises the importance of monitoring the quality of seawater to follow developments related to non-native species. Condensed waters pose the risk of introduction and spread of non-native species.

The report contains a sufficient review of traffic impacts. If the power plant is decommissioned, road transport routes must be planned carefully. Sea transports of nuclear waste do not cause nearly as many adverse traffic impacts as road transports.

Concerning land use planning, the centre observes that the Helsinki-Uusimaa Land Use Plan 2050 has entered into force insofar as the appeals filed on it were dismissed by the Administrative Court. The parts of the previous regional land use plans that remain in force are the Natura 2000 sites marked in the Uusimaa regional land use plan and the phased regional land use plan 2, as well as the wind power solution, Natura 2000 sites and nature reserves marked in the phased regional land use plan 4. The regional land use plan for Östersundom also remains in force.

The Helsinki-Uusimaa Regional Council commented on the regional land use plan valid in the project area and on the region's climate goals. The council found the impact assessment to be comprehensive and did not have any remarks on the conclusions.

According to the council, the report provides an accurate description of the regional land use plan's steering role. In its previous statement, the council found that the options presented comply with the valid regional land use plans and the phased regional land use plan for Eastern Uusimaa approved by the regional council.

After the statement had been submitted, the Helsinki Administrative Court stayed the implementation of the phased land use plan based on the appeals filed, which did not, however, concern the Loviisa nuclear power plant. The plan has later entered into force on most parts. The final decision on the matter will be made by the Supreme Court. The Helsinki-Uusimaa Regional Council does not find reason to change its views expressed in the previous statement based on these events.

According to the Helsinki-Uusimaa Regional Council, of the options examined in the assessment procedure, the extension of operations would best help achieve the general provision of transitioning to a climate sustainable energy system included in the phased regional land use plan for Eastern Uusimaa. Furthermore, the Regional Council believes that continuing operations at the nuclear power plant will support the Uusimaa region achieve its goal of carbon neutrality by 2035.

The Ministry of Transport and Communications, Ministry of the Interior, Ministry for Foreign Affairs, Ministry of the Environment, Finnish Safety and Chemicals Agency and the **Finnish Environment Institute** announced they did not have any remarks on the matter.

2.2.2 Statements by other countries and authorities

Austria indicated its interest in continued consultations in accordance with Article 5 of the Espoo Convention and Article 7 of the EIA Directive. The response submitted by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology included an appendix with an expert statement from the environment agency, containing 39 questions related to the assessment procedure. The Ministry of Economic Affairs and Employment prepared answers to the questions in cooperation with the project owner and STUK. The ministry will take Austria's final statement into account in the further stages, as required.

The Lithuanian Ministry of Environment did not have any remarks on the report but requested the ministry to submit further information on some aspects. The Ministry of Economic Affairs and Employment prepared answers to the questions in cooperation with the project owner and STUK.

The Swedish Environmental Protection Agency organised consultations in accordance with the Espoo Convention, which resulted in statements from the Swedish Board of Agriculture (Jordbruksverket) and Sami Parliament (Sametinget).

The Board of Agriculture is of the opinion that transboundary impacts affecting Sweden can only occur as a result of a severe reactor accident. According to the board, the report should address a more severe accident, whose fallout and impacts on Swedish agriculture and forestry would be modelled for various weather conditions. The Sami Parliament observed that their previous statement has been taken into account in the procedure. In terms of reindeer husbandry, the plant's decommissioning poses fewer risks and is thus the best option for the future.

The Estonian Environment Agency believes that the report's accident modelling should be more conservative and that higher values should be used in it. In many drills, the emissions of the radionuclide Caesium-137 (Cs-137) are around 2%, which would lead to emissions of some 3,300 TBq in the case of Loviisa nuclear power plant. The section on transboundary impacts and their mitigation should indicate the party responsible for carrying out the measures.

The Netherlands, Norway, Germany, Denmark and **Russia** had no remarks on the report. The German state of Mecklenburg-Vorpommer referred to its statement provided during the programme stage, in which it supported the plant's decommissioning.

2.2.3 Statements by private persons, organisations and companies

Atomstopp atomkraftfrei leben!, an Austrian organisation, expressed its disappointment in the arrangements of the consultation and hearing. In the organisation's view, alternative forms of energy should have been presented in the environmental impact assessment report. Based on flexRISK calculations determining the impacts of a severe reactor accident in Europe, the organisation observes that under unfavourable weather conditions, a severe reactor accident at the Loviisa power plant would result in substantial contamination in nearly all European countries. The organisation is also of the view that the nuclear waste management solutions have not been criticised or tested in practice. Similar statements were submitted by the organisations **Anti atom komitee**, **Wiener Platform Atomkraftfrei**, **Nuclear Transparency Watch**, **Friends of the Earth Austria** and **Friends of the Earth Europe**. Organisations from the Czech Republic, Poland and Bulgaria also contributed to the statement of the last of these.

Ekoenergo Oy is in favour of extending the service life of the Loviisa power plant on the basis of the need for domestic electricity and on carbon dioxide emissions. The company proposes using waste heat from the plant for heating in Helsinki. Extending the plant's service life has a greater impact on Finnish carbon dioxide emissions than any other single measure.

Fennovoima Ltd observes that the Loviisa nuclear power plant plays a significant role in Finland's electricity production, energy self-sufficiency and low carbon goals. The company hopes to see an extension to the plant's service life and says it trusts the authorities' ability to assess the safety of operations. Fennovoima appreciates that the report discusses the option of the Loviisa power plant receiving and processing radioactive waste generated elsewhere in Finland as well as accepting such waste for interim storage or final disposal.

Fingrid Oyj observes that Finnish electricity production is changing rapidly and that it is increasingly being located in northern Finland. In view of the Finnish power system, the decommissioning of the Loviisa power plant would increase the pressure to invest in north-south power transmission links and would probably make it difficult to maintain mainland Finland as a harmonised bidding zone for electricity trading. Decommissioning would most likely have short-term adverse impacts on Finland's self-sufficiency in electricity production and the adequacy of electrical power, especially in the winter.

According to the Swedish organisation **Folkkampanjen mot Kärnkraft-Kärnvapen**, the Loviisa power plant should be closed as soon as possible. In the organisation's opinion, radioactive emissions are

hazardous to humans and other organisms. The risks of ageing continue to increase. Moreover, the L/ILW repository should be moved away from the coast to prevent radioactive substances entering the sea. According to the organisation, the final disposal of spent fuel is not safe, in addition to which nuclear energy and the use of uranium have a negative impact on the climate.

The Swedish organisation **Miljövänner for kärnkraft** considers that, based on the environmental impact assessment and other experiences, extending the operations of the Loviisa power plant units will not cause environmental impacts within Sweden's borders. International experiences show that the service life of reactors that have been well maintained and designed in compliance with Western safety standards can be extended to at least 60 years. According to the organisation, the Loviisa nuclear power plant plays an important part in the achievement of Finland's and the EU's climate goals.

According to the organisations **Naiset Atomivoimaa Vastaan & Naiset Rauhan Puolesta**, extending the plant's service life does not promote the overall benefit of citizens, but is based on nuclear power companies' pursuit of financial gains. The organisations are of the opinion that the Loviisa reactors do not comply with the standards for new reactors and their ageing poses additional risks.

Several countries in Western Europe are shutting down nuclear energy, citing the safety risks and expenses involved, which is why Fortum should also give up its plans to extend the service life of the reactors. Nuclear energy use has a negative impact on Finland's image as a country. The organisations demand that the ministry acquaints itself with, for example, the statements of German authorities and other reports dealing with nuclear energy and sustainability.

According to the organisations, the ministry should consider nuclear energy at large instead of focusing only on extending the service life of the Loviisa reactors. The ministry must not permit the extension to the service life of the reactors. Instead of nuclear energy, assets should be allocated to renewable energy production, hydrogen technology and the decommissioning of reactors. The statements also take a stand on the safety of final disposal of nuclear waste. In the organisations' view, the ministry should urge Fortum to address the ethical aspects of final disposal.

In terms of environmental impacts, the organisations point to the impacts that water consumption and cooling water have on, for example, the oxygen concentration of water bodies. Emissions of tritium are also of concern to health and safety. According to the organisations, the plans for extending the plant's service life do not take the EU's BAT principle into consideration.

Social-Ecological Union and nine other Russian non-governmental organisations have signed a statement opposing the extension of the plant's service life. The organisations point out that extending the operations of the ageing plant, whose original service life was 30 years, poses a serious threat to countries around the Baltic Sea. The organisations refer to the flexRISK study and its findings that the impacts of an accident could extend to St Petersburg.

The Finnish Confederation of Professionals (STTK) observes that the radiation exposure of employees is the most significant environmental risk from nuclear energy. Employees' health and safety must be ensured. STTK considers the assessment to be adequate and carefully prepared and the basis for supporting the extension of the plant's service life.

According to the **Uusimaa district organisation of the Finnish Association for Nature Conservation**, the environmental impact assessment report is deficient and needs to be supplemented. Under the Water Framework Directive, the project is not allowed to weaken the state of water bodies. The state of Klobbfjärden is bad. The organisation is therefore of the opinion that the plant violates the Water Framework Directive.

The report should have included options for reducing the thermal load on the sea and mitigating other impacts on the state of water bodies. The organisation provides examples of mitigation measures specified in the conditions of environmental permits for bioproduct mills, which it believes should also be required of the Loviisa nuclear power plant. According to the organisation, the best available technology should also be employed to prevent fish and other organisms from ending up in the cooling system.

A more severe accident should be included in the report's analysis, and the assessment should be expanded concerning, for example, substances released into the sea and crisis situations. The impacts of nuclear fuel procurement, the final disposal of nuclear waste and waste cleared from regulatory

control have not been discussed adequately. Chemicals released into the sea and their impacts have not been handled in the report.

According to the organisation's statement, the consultants who prepared the report are not knowledgeable about the impacts of radioactive substances. In addition, the authorities should also contribute with their expertise in the field. The lack of competence in environmental science has caused problems in the licence procedures for nuclear power plants.

VTT Technical Research Centre of Finland does not have any objections to the assessment, but it wishes to point out that VTT has a new operating licence for the FiR 1 research reactor granted by the government on 17 June 2021, which is valid until the end of 2030. Regarding waste generated elsewhere in Finland, the report takes into account the waste generated by the FiR 1 research reactor and the Otakaari 3 research laboratory, as well as waste generated during the operation and dismantling of the new VTT Centre for Nuclear Safety.

VTT reiterates the observation expressed in the earlier statement that nuclear energy is free of carbon dioxide emissions. Therefore, it is good in terms of both national and international climate goals to consider an extension to the plant's operations. VTT still considers it excellent that preparations are made to use the L/ILW repository for the final disposal of radioactive waste from other parts of Finland. This is very positive from the national perspective of radioactive waste management.

Wiener Umweltanwaltschaft, from Austria, opposes the continued use of the power plant due to the outdated technology.

A total of six statements were received from **private individuals**, one of which was signed by two people. The content of the first statement corresponded to the statement submitted by Ekoenergo Oy. The statement supported the extension of the Loviisa power plant's operations citing Finland's need for electricity and the goal of reducing carbon dioxide emissions. It also proposed using waste heat for heating in Helsinki.

Another statement proposed specifications to the state of nutrients and algal growth in the sea as well as the impacts of the condensed water cycle. This topic was discussed at the public hearing, where the statement provider pointed out that condensed water extracted from deeper down contains more nutrients compared to surface waters, which might have an impact on eutrophication on the discharge side. As stated at the hearing, the question has been examined indirectly by comparing the properties of the discharge side with adjacent sea areas. No significant differences were observed between the areas. The statement provider adds that, due to the fast flow of condensed water, the impacts show up farther away from Hästholmsfjärden. Algal growth is substantial especially northwest and north of the islands on the western side of Hudö bay. Since the emissions from the Loviisa wastewater treatment plant also have an impact on the situation in the area, this is a case of combined effects. However, the impact of condensed water on this has not been examined.

In the following statement, citizens 3 and 4 refer to the decision issued on 17 December 2020 by the Uusimaa Centre for Economic Development, Transport and the Environment, which requires Fortum to add and inspect monitoring points in areas where thermal emissions from the plant can justifiably be expected to increase eutrophication. This applies especially to the area bounded by the mainland, Kirmosund, Hästholmen, Åmusholmen and Abborrgrundsudden. According to the statement, the eutrophic impact of condensed water has not ended and continues to cause harm to real estate owners. The statement providers also refer to their statement concerning the impact assessment programme, where, among other things, they brought up the decision by the Supreme Administrative Court (508/2017) ordering Fortum to pay compensation for hindrances to recreational use to owners of beach properties in the area.

The fifth statement signed by a private individual and submitted from Germany brought up many of the same considerations as the statements of, for example, the Atomstopp atomkraftfrei leben! organisation.

Citizen number 6 from Austria opposes the extended use of the Loviisa power plant and the use of all other nuclear power plants. They discuss the impacts of the Chernobyl nuclear power plant accident (also in Finland). Citizen number 7 discusses the embrittlement of reactor pressure vessels, which they consider a systematic error in plants of the kind built in Loviisa. Overall, they consider it impossible to

extend the service life of the old power plant. According to the statement, the information provided on decommissioning is inadequate.

3 The adequacy and quality of the assessment report

As the coordinating authority for the EIA procedure, the Ministry of Economic Affairs and Employment has reviewed the adequacy and quality of the assessment report and is of the following opinion in this respect:

The report on the environmental impact assessment of the Loviisa nuclear power plant prepared by Fortum meets the content requirements specified in section 19 of the EIA Act (252/2017) and in the EIA Decree (277/2017), and it has been handled in compliance with EIA legislation. The assessment report has been drawn up with consideration to the project's assessment programme and the related statement issued by the coordinating authority. The project owner has had at its disposal adequate expertise for assessing environmental impacts and carrying out separate reviews.

The assessment report is comprehensive and has been carefully prepared. An adequate number of options have been presented for the project. The assessment of environmental impacts came up with no aspects which could not be reduced to an acceptable level and which would prevent the implementation of any of the options. Comparisons of the project's environmental impacts and the different options will be discussed in the following section.

However, based on the analysis of the Ministry of Economic Affairs and Employment and the statements and opinions received, the assessment could have been more specific in certain respects. Some of the comments presented must be taken into account in further project planning.

3.1 Impacts on surface waters

The thermal load caused by the discharge of condensed water in the nearby sea area is one of the most significant environmental impacts of the nuclear power plant's operations. The condensed water is taken from Hudöfjärden, located west of Hästholmen, and discharged into Hästholmsfjärden, east of the plant.

The assessment programme proposed hydraulic works related to the continued use of the plant, which aimed at extracting cooler water than currently. This would lower the temperature of the discharged cooling water and increase the electrical power of the plant. Hydraulic works are not discussed in the assessment report, as the project owner decided to give up the plans, citing the results of technical and financial surveys carried out by it. In its statement, the Uusimaa Centre for Economic Development, Transport and the Environment was of the opinion that the topic should have been discussed as part of the assessment and that it should be specified during further planning.

According to the Uusimaa Centre for Economic Development, Transport and the Environment, the impact that continued operations will have on the state of water bodies and the need to mitigate the adverse effects should have been examined in greater detail. The impacts of mitigation measures should have been compared to the water resources management plan. According to the centre, impacts on the state of water bodies could be mitigated by adopting measures to reduce diffuse pollution. A discussion of measures aimed at mitigating the impacts on fish and water bodies was also called for in the statement submitted by the Finnish Association for Nature Conservation. Two statements signed by private individuals raised the impact that thermal load can have on the eutrophication of water bodies.

The Centre for Economic Development, Transport and the Environment also requires specifications to the assessment of impacts on the marine strategy and the state of the sea. The impacts of the different options on the state of surface waters should have been compared more clearly over the entire planned period.

The Ministry of Economic Affairs and Employment finds that the assessment of impacts on surface waters and the discussion of the mitigating measures are adequate at this stage of project planning, but must be specified in the future.

Under EIA legislation, the project owner is required to examine reasonable options for the project and propose measures to avoid, prevent, restrict or eliminate identified substantial and adverse

environmental impacts. The project owner gave up plans for hydraulic works soon after the programme stage. In the opinion of the Ministry of Economic Affairs and Employment, although a comprehensive treatment of mitigating measures is a crucial part of the EIA procedure, the project owner cannot be required to analyse an option that it is not seriously considering. However, the project owner explores other ways of obtaining colder cooling water in connection with its normal research concerning the power plant's operations.

Hästholmsfjärden is part of the Klobbfjärden body of water, the ecological status of which has been found to be bad in the third water resources management planning period (2022–2027). Owing to the status of the body of water, the project must not degrade the status or adversely affect factors influencing it. Given that the status of the water body is bad, it is important that Fortum takes part in planning measures to improve the state of waters jointly with the Uusimaa Centre for Economic Development, Transport and the Environment and the City of Loviisa. One example of such cooperation could be the preparation of a rehabilitation plan for the body of water and participation in its implementation.

3.2 Impacts on the soil, bedrock and groundwater

The decommissioning stage encompasses the final disposal of radioactive decommissioning waste in the L/ILW repository's present facilities and any new facilities built as required. In its statement, Geological Survey of Finland remarks that the potential impact that the extension may have on local groundwater conditions should be explored in greater detail.

Based on the information presented in the assessment programme, Geological Survey of Finland believes that the monitoring of the fresh-saline water interface should not have been discontinued in 2015. It also believes it is important to ensure that the project owner has a good understanding of the area's groundwater system. However, the Uusimaa Centre for Economic Development, Transport and the Environment finds that the discussion of the soil, bedrock and groundwater is sufficient. The sources for soil, bedrock and groundwater models have been added appropriately to the report. In the opinion of the Ministry of Economic Affairs and Employment, Fortum must in its further project planning focus attention on any local groundwater impacts resulting from the extension of the L/ILW repository and take into account the role of waste in terms of safety.

3.3 Impacts on the climate

According to the assessment report, the positive impacts of continued use of the plant are reasonably significant, as nuclear power plant operations do not generate greenhouse gas emissions. In the case of decommissioning, the climate impacts were assessed to be reasonably significant, but negative. Emissions from traffic and stand-by generators have been taken into account in the assessment of direct climate impacts. The discussion of the lifecycle emissions of nuclear energy is based on international studies, and in connection with decommissioning, the replacement of nuclear energy has been discussed briefly.

According to the Uusimaa Centre for Economic Development, Transport and the Environment, the conclusions of the analysis of climate impacts appear to be accurate, although the analysis is lacking in parts. The uncertainties related to the assessment and the mitigating measures should have been discussed in greater detail. The direct climate impacts from operations and decommissioning in the different options could have been discussed separately from indirect climate impacts related to electricity. For example, the report did not contain a detailed analysis of the climate impacts from the construction of new buildings or from the dismantling of the plant. According to the centre, research related to climate change must be followed in the future and the resulting information must be used to improve the safety of the plant, as described in the report.

Many other statements highlighted the role of the Loviisa nuclear power plant in generating energy free from greenhouse gas emissions, but no additional remarks concerning the assessment were brought up. According to the organisations Naiset Atomivoimaa Vastaan and Naiset Rauhan Puolesta from Finland and Folkkampanjen mot Kärnkraft-Kärnvapen from Sweden, nuclear energy does not help curb climate change.

The Ministry of Economic Affairs and Employment agrees with the observations that the Centre for Economic Development, Transport and the Environment has made concerning the assessment of

impacts on the climate. Nevertheless, the conclusions drawn in the report are appropriate and adequate at this stage. The fact that the generated electricity is free from greenhouse gas emissions is clearly more significant than the project's direct climate impacts.

3.4 Impacts of a severe reactor accident

The Swedish Board of Agriculture, the Estonian Environment Agency, the Austrian Ministry for the Environment, several non-governmental organisations and one private individual believe that a larger source term should have been used to model a severe reactor accident. The Estonian Environment Agency also found that the section on transboundary impacts and their mitigation should have indicated the party responsible for carrying out the measures.

The Ministry of Economic Affairs and Employment states that in Finland, section 22b of the Nuclear Energy Decree (161/1988) sets the limit for a large emission at 100 TBq for Caesium-137 emissions, and this limit has generally been used as the source term for Finnish assessments of environmental impacts. In the report's accident modelling, other radionuclides are expected to be released in the same proportion assumed for Caesium-137. The area examined in the modelling extends 1,000 kilometres from the power plant. The impacts of accidents at the plant reviewed have been compared to those of the severe reactor accidents at Fukushima and Chernobyl.

At the EIA programme stage, the ministry required that a more realistic case of accident for the plant in question be included in the EIA report. As concerns the plant's extended use (VE1), the report analyses an accident involving a large run-time leak from the primary circuit to the secondary circuit. This case covers a wide range of interference and accident situations related to nuclear power plants, with impacts that are either milder than or of the same size as the case analysed.

In addition to reactor accidents, the report deals with other emergency situations, such as fires or transport-related risks, as well as conventional environmental and safety risks.

The Ministry of Economic Affairs and Employment is of the opinion that the project owner has addressed the matters required at the programme stage. The analysis is comprehensive and adequate at this stage. The Radiation and Nuclear Safety Authority STUK will assess the nuclear power plant's safety later, in connection with any application for an operating licence.

3.5 Other remarks expressed in the statements

In their statements, several international non-governmental organisations and one private individual expressed the wish that the presentations of the public event were translated into English or that another event were organised for an international audience. The statements cited the Espoo and Aarhus Conventions.

According to the Ministry of Economic Affairs and Employment, in connection with EIA procedures, it has been common practice to organise public events targeted mainly for local residents. Based on feedback from the public, the participants at the event held on 7 October 2021 were prepared to also answer English-language questions, in addition to which the slides related to the hearing process, for example, were available in English. All the information disclosed at the event was based on the EIA report, which was also available in English. The website of the Ministry of Economic Affairs and Employment is also available in English. Everyone has had an equal opportunity to participate in the hearing by means of a statement. The ministry also points out that experts respond to any questions concerning the EIA procedure by email.

The remarks expressed in the other statements and opinions received by the ministry mainly concerned further project planning, such as preparations for decommissioning or the general acceptability of nuclear energy.
Ekoenergo Oy and one private individual brought up the possibility of utilising waste heat from the plant. The

Ministry of Economic Affairs and Employment notes that the company has informed it that it is not planning this option at the moment, which is why the question has not been handled in the report.

Furthermore, several organisations offered their opinions on the extended use of nuclear energy, the safety of final disposal of nuclear waste and radioactive emissions. To this, the Ministry of Economic Affairs and Employment responds that the Radiation and Nuclear Safety Authority STUK will assess the project's safety later in connection with any application for an operating licence. The safety of the final disposal of spent nuclear waste will be assessed in connection with the operating licence for Posiva's final disposal facility.

4 The reasoned conclusion of the coordinating authority

The reasoned conclusion of the coordinating authority is based on the content requirements for the assessment report specified in section 19 of the Act on the Environmental Impact Assessment Procedure (252/2017) and section 4 of the Government Decree on the Environmental Impact Assessment Procedure (277/2017), the project description and surveys discussed in the assessment report, the survey results and their analysis, as well as the content of statements and opinions submitted.

The coordinating authority's reasoned conclusion must be included in the licence decision in accordance with section 26 of the EIA Act. The licence decision must indicate how the assessment report and the reasoned conclusion have been taken into consideration.

In the opinion of the Ministry of Economic Affairs and Employment, the options presented do not pose the kind of harmful environmental impacts that would be impossible to accept, prevent or mitigate to an acceptable level. The ministry has organised its analysis of the impacts of the different options according to the potential licences required under the Nuclear Energy Act. In all the options, the L/ILW repository calls for an operating licence separate from the power plant units, which is why the repository's impacts are discussed separately.

The report provides an adequate comparison of the different options. Overall, the environmental impacts of continued operations (VE1) are larger than those resulting from decommissioning (VE0 or VE0+), as the plant must be ultimately decommissioned even if its operations are extended for now. However, when assessing the environmental impacts of the different project options, attention must also be focused on the project's significance to the energy economy, which is considerable on a national level.

The processing, storage and final disposal of waste generated elsewhere in Finland do not pose significant environmental impacts. However, the management of such waste would have a positive impact on the national management of radioactive waste overall, as it would contribute to the sustainable and safe final disposal of radioactive waste, regardless of the source of waste. The maximum volume of such waste handled at the Loviisa power plant is estimated to be 2,000 m^3. The figure is small compared to the waste generated at the nuclear power plant.

4.1 Significant environmental impacts from extended operations (VE1)

Under this option, the use of the Loviisa nuclear power plant would be extended to around 2050. The impacts on the environment will remain mainly the same as currently.

The thermal load to the nearby sea area resulting from the discharge of cooling water is the most significant environmental impact from the facility's normal operations. Significant environmental impacts target surface waters, as well as fish and fishery, the climate, people's living conditions and comfort, community structure and tangible property. Environmental impacts may also result from accidents. The plant's extended use increases the overall volume of spent nuclear fuel and other nuclear waste.

All the environmental impacts from decommissioning must also be taken into account in this option. If the operations are extended, the plant units will be decommissioned in 2050–2060.

4.1.1 *Surface waters*

In the case of extended plant operations, the impacts on surface waters resulting from the intake and discharge of cooling water will remain much the same as currently. The condensed water is taken from Hudöfjärden, located west of Hästholmen, and discharged into Hästholmsfjärden, east of the plant. In the assessment report, the project's impact on Hästholmsfjärden has been estimated as being reasonably

significant and negative. According to the assessment, the overall impact on other parts of the sea area is minor and negative or negligible. The Ministry of Economic Affairs and Employment considers this assessment is likely to be accurate.

The discharge of cooling water has a direct impact on, for example, water temperature, stratification and ice conditions. The assessment also addresses climate change, which may contribute to a temperature increase in the surface sea water in the coming decades.

In addition to the thermal load from cooling water, the state of water bodies is also affected by the nutrient input mainly attributed to non-point source pollution carried by river waters. The sanitary wastewaters from the Loviisa power plant also carry small amounts of nutrients into the sea. As stated in the assessment report, the thermal load of cooling water has contributed to accelerated eutrophication in the area. The increase in eutrophication has been more notable in Hästholmsfjärden than at the nearby comparison station in Hudöfjärden.

Several other chains of causation have also been assessed in the procedure. Thermal load further weakens the poor oxygenation conditions of the seabed and thus affects the benthic fauna, which has declined. Phytoplankton and aquatic flora are also affected, in addition to which warmer seawater may favour non-native species such as the dark false mussel.

As observed by the Ministry of Economic Affairs and Employment, the impact of cooling water is particularly significant due to the sensitivity of the affected area. Hästholmsfjärden is part of the Klobbfjärden body of water, the ecological status of which has been found to be bad in the third water resources management planning period (2022–2027). The classification is based on the EU Water Framework Directive and the Act on the Organisation of River Basin Management and the Marine Strategy (1299/2004). The goal of legislation is to achieve a good environmental status for all water bodies. The project assessed must not weaken the ecological or chemical status of the bodies of surface water or endanger the achievement of a good status of surface waters.

The report states that a continued thermal impact may contribute to a slower achievement of a good status for the water body. The Ministry of Economic Affairs and Employment requires this to be taken into account in further project planning.

According to the report, the continued thermal impact from cooling water will continue to no later than 2050. The impact of the end to the thermal load caused by the power plant is discussed in connection with the impacts from decommissioning. Uncertainties concerning the assessment include those related to climate change and nutrient input and the complexity of interactions in the environment.

4.1.2 *Fish and fishing*

The impact of the power plant’s extended operations is assessed to be moderately negative on fish and minor and negative on fishing. Warmer sea water favours species that have adapted to it, including pike-perch and cyprinids. The round goby, a non-native species, is also likely to become more abundant. Moreover, warm water will prevent the formation of ice, hampering the reproduction of species spawning under ice, such as the burbot, and making winter fishing more difficult.

Biomass carried to the power plant with the cooling water intake consists mainly of fish. The amount of fish carried to the plant has been 10–25 tonnes annually. The collection of this biomass can be seen as having a positive impact, as it also removes nutrients from the sea.

4.1.3 *Greenhouse gas emissions and climate change*

According to the assessment, the climate impacts of extended plant operations are moderate and positive. The direct greenhouse gas emissions are small compared to the impacts of carbon-free energy production, which are significant for all of Finland. Finland has set itself the goal of carbon neutrality by 2035, which requires an increased production of emissions-free energy.

4.1.4 *People’s living conditions and comfort, community structure, tangible property*

The project owner has assessed the project’s impacts on people’s living conditions and comfort, as well as on the energy market, security of supply and regional economy. While EIA legislation does not require

the energy market, security of supply and regional economy to be assessed, the Ministry of Economic Affairs and Employment considers these as significant socio-economic impacts. The project's impacts on the energy economy were also highlighted in the statements received and during the programme stage of the procedure, when several statement providers as well as the Ministry of Economic Affairs and Employment called for a review of developments in the electricity market.

According to the assessment, the impact of extended operations on people's living conditions and comfort is minor but negative. Residents in the nearby areas feel more negative about the nuclear power plant operations than people living farther away. Among other things, the power plant is considered as having negative impacts on the landscape and recreational use of water bodies. Risks related to nuclear power plant operations may be of concern farther away. The resident survey indicated a negative attitude to the reception of waste generated elsewhere in Finland. On the other hand, potential positive impacts on the region's employment and demographics were also raised.

The extension of operations is estimated to have a large and significant impact on the Finnish energy market and security of supply. This estimate is based on the increased demand for emissions-free electricity available regardless of weather conditions. In 2020, the output from the Loviisa nuclear power plant was 7.8 TWh, while the overall demand for electricity in Finland totalled 80.9 TWh.

The impact on the regional economy is assessed to be very large and positive in the Loviisa sub-regional unit, moderately positive in Eastern Uusimaa and Kymenlaakso, and minor and positive for the entire country. The impact is based on, for example, the power plant's direct impacts on employment and the multiplicative effects of maintenance investments and procurement during operations.

4.1.5 *Radioactive waste and waste management*

Extending the power plant's service life will increase the accumulation of spent nuclear fuel and the overall volume of low and intermediate-level waste Nevertheless, the impacts of extended operations on waste management have been assessed to be minor and negative. This result is based on the number of fuel bundles expected to increase by approximately 3,700 if operations are continued for another 20 years. The accumulated volume of low-level waste is expected to total around 600 m^3 and that of intermediate-level waste around 2,400 m^3 packaged. The management of low and intermediate-level waste will continue in the same way as under the currently valid operating licences. The final disposal of accumulated spent nuclear fuel will be handled in accordance with the existing plans of Posiva Oy.

The main change resulting from the power plant's extended use comes from the increase in storage capacity for spent nuclear fuel, which would take place through an expansion of the interim stockpile or by placing nuclear fuel in intermediate storage tanks more frequently. The cooling need for spent nuclear fuel in the intermediate storage facility is not expected to increase significantly, despite the increasing amount of fuel, as the fuel thermal output is constantly decreasing during intermediate storage. However, it is possible to increase the cooling capacity if necessary.

4.1.1 *Severe reactor accident and other exceptional situations and accidents*

Although a reactor accident is highly unlikely, were such an accident to take place, it would have exceptionally wide and long-term impacts. The report contains modelling of an accident in which 100 TBq Cs-137 nuclides and other radionuclides in the same proportion are released into the atmosphere.

Such a case would most likely not cause direct radiation impacts on humans, but the area within a five-kilometre radius would have to be evacuated or people would be required to seek shelter indoors. The impact of emergency measures has not been taken into account in the estimated doses. At the local and regional level, the use of soil, water bodies and foodstuffs may be restricted due to radioactive fallout. Such an accident and its management would also have very significant impacts on the national level. Long-term impacts would affect the population's material and mental wellbeing, for example. A reactor accident of the kind modelled in the report would not lead to direct health impacts caused by radiation doses outside Finland.

In addition to a severe reactor accident, the report examines less severe incidents, which may cause radioactive emissions, as well as conventional emergency situations and accidents. Preparations for climate change have been taken into account in the assessment.

4.2 Significant environmental impacts from decommissioning (VE0, VE0+)

Decommissioning comprises several stages. After the preparatory stage, which lasts for around three years, the radioactive parts of the plant units will be dismantled, and the resulting radioactive waste will be deposited in the I/ILW repository. The required waste management functions will be made independent of the rest. Their independent use will last for 20–35 years, after which they will be dismantled.

Environmental impacts will result from the impacts of operations coming to an end, as well as from the direct impacts of decommissioning. The most significant environmental impacts are related to the elimination of the thermal load caused by cooling water. Negative impacts on the climate and energy markets will emerge at least if the power plant is decommissioned after the current operating period. The direct negative impacts of decommissioning include traffic and noise impacts and the generation of decommissioning waste.

According to the company's estimates, handling decommissioning according to the greenfield principle will have fewer long-term adverse environmental impacts on nature, the landscape and the comfort of living compared to the brownfield principle. However, decommissioning based on the greenfield principle will have more adverse impacts during dismantling.

If the power plant's operations are not extended after the currently valid licence periods, the units will be decommissioned in 2030–2040. If the operations are extended, the plant units will be decommissioned in 2050–2060.

4.2.1 *Surface waters*

Decommissioning would have a moderately positive impact on Hästholmsfjärden and a minor positive impact or negligible impact on the other nearby sea areas. Decommissioning will mean an end to the thermal load from cooling water, returning the temperature and stratification of the sea area back to normal and bringing an end to the negative impacts on water quality, phytoplankton, aquatic flora and benthic fauna. The positive impacts are surrounded by some uncertainty regarding the oxygenation conditions of deep basins. As stated in the assessment report, the rate of recovery is difficult to predict.

4.2.2 *Fish and fishing*

In the case of decommissioning, the thermal load from cooling water will end, enabling fish and fishing to recover and begin to resemble the conditions in the surrounding sea areas. In Lappomträsket lake, potential deregulation would enable the current dam structure to be replaced with a submerged weir, thus opening a migration route for fish. On the other hand, deregulation and the discontinuation of the lake's oxygenation might have a negative impact on fish. The assessment involves uncertainties in this respect. The impact is assessed to be moderately positive on fish, and minor and positive on fishing.

4.2.3 *Greenhouse gas emissions and climate change*

According to the assessment, decommissioning that takes place after the current operating period will have a moderately negative impact on the climate. The assessment is based on the need to replace the electricity production in Loviisa with other forms of production, the emissions of which depend on the method of production. Alternative production methods are discussed at a general level. Decommissioning also generates greenhouse gas emissions, such as those due to increased traffic, but these are insignificant compared to the potential impact of electricity production.

4.2.4 *People's living conditions and comfort, community structure, tangible property*

The project owner has assessed the project's impacts on people's living conditions and comfort, as well as on the energy market, security of supply and regional economy. During demolition, decommissioning is expected to have moderately negative impacts on people's living conditions and comfort due to, for example, increased noise, vibration and traffic. In the long term, however, the impacts are expected to be minor and positive following the potential recovery of the water bodies and landscaping. Respondents to the resident survey had a negative attitude to the reception of waste generated elsewhere in Finland.

According to the assessment, decommissioning has significant negative impacts on the energy market and security of supply. Electricity generated at the nuclear power plant must be replaced with new production, in addition to which more north-south transmission links will be needed.

The positive impact of final decommissioning on the regional economy is assessed to be large in the Loviisa sub-regional unit. In Eastern Uusimaa, Kymenlaakso and at the level of all of Finland, the impact on the economy is minor and positive. This impact results from, for example, an increase in the demand for material recycling and dismantling services. However, the economic impacts generated during operations will end.

4.2.1 *Landscape and cultural environment*

The impacts of decommissioning on the landscape and cultural environment depend on whether the deregulated buildings are left in place or whether they are dismantled. If the buildings are not fully dismantled, the impact is minor and positive. The dismantling of high buildings will also mitigate landscape impacts in dismantling carried out on the basis of the brownfield principle. Dismantling based on the greenfield principle will leave the area as close as possible to its natural state, which will eliminate all long-term landscape impacts. In this case, the impact is assessed to be moderately positive. Before the buildings are dismantled, a historic building survey must be carried out on the area's building stock.

4.2.2 *Traffic*

Traffic will increase especially during the dismantling work related to decommissioning, and these impacts are assessed to be moderately negative. The smooth flow of traffic may occasionally suffer on Atomitie and Saaristotie, and the increase in traffic will raise the risk to traffic safety.

4.2.3 *Noise*

Noise disturbance may be felt especially during the dismantling phase. If the plant is decommissioned according to the greenfield principle, noise will be caused especially by conventional dismantling work. The occasional concrete crushing will make the loudest noise, which may be carried to the holiday homes on the nearby islands and the mainland. According to the assessment, the impact of noise disturbance is minor and negative. It is important to reduce disturbance from noise, for example, by timing the noisiest work appropriately.

4.2.4 *Radioactive waste and waste management*

The dismantling phase of decommissioning is expected to generate 3,300 m^3 activated waste and 19,000 m^3 of contaminated waste. An estimated 700 m^3 of maintenance waste and other waste packaged in barrels, as well as 2,260 m^3 of solidified liquid waste will be generated. According to the project owner's assessment, the impacts of decommissioning on waste and waste treatment are minor and negative.

The Ministry of Economic Affairs and Employment observes that the dismantling of the power plant will generate a considerable amount of radioactive waste. The final disposal of radioactive waste calls for a considerable extension of the L/ILW repository. Soil contamination must also be assessed in connection with dismantling and conventional waste must be treated appropriately.

4.2.5 *Severe reactor accident and other exceptional situations and accidents*

The nuclear power plant's risk level will drop considerably when it is decommissioned. However, the risks related to the treatment, storage and transport of spent nuclear fuel and other radioactive substances will continue until all the waste has been deposited in final disposal. Dismantling also involves risks of radiation exposure. In addition, decommissioning involves risks of conventional accidents. The Radiation and Nuclear Safety Authority STUK will assess the safety of decommissioning later, when the company applies for a licence to decommission the nuclear power plant.

4.3 Significant environmental impacts from the expansion of the L/ILW repository (VE1, VE0, VE0+)

The L/ILW repository will be used for the final disposal of low and intermediate-level nuclear waste generated during the nuclear power plant's operations and decommissioning. According to estimates, the repository's present capacity can also accommodate the low and intermediate-level waste generated during extended power plant operations, should this option be chosen. According to plans, the L/ILW repository will be expanded to accommodate decommissioning waste. The expansion is included in every option presented in the assessment report.

If the operations of the power plant units are extended, the L/ILW repository will be closed by 2090. If the plants are decommissioned after the end of the current operating licence period, the repository will be closed by 2065. Prior to this, the L/ILW repository and the necessary auxiliary functions will be made independent along with other waste management functions.

The most significant environmental impacts of the L/ILW repository's expansion arise from the impacts of excavation on the bedrock and groundwater, as well as from the blasted rock and the noise caused by its crushing. The amount of waste generated elsewhere in Finland is small compared to the waste generated at the nuclear power plant, and the final disposal of such waste will not have a significant impact on the operations of the L/ILW repository.

4.3.1 *Soil and bedrock*

According to the assessment, the impact of the expansion of the L/ILW repository is minor and negative. However, the need for additional excavation is large in terms of volume. The volume of the expansion to the L/ILW repository, located at a depth of approximately 100 metres, is estimated at 71,000 m^3. The overall volume will thus be approximately 188,000 m^3. As stated in the assessment report, the expansion of the L/ILW repository will be planned to avoid disturbance to existing final disposal facilities.

4.3.2 *Groundwater*

The expansion of the L/ILW repository will temporarily increase the volume of seepage water. The explosives used during excavation may affect the quality of groundwater locally. According to the assessment, the impact on groundwater is minor and negative. The Ministry of Economic Affairs and Employment emphasises the importance of further project planning addressing any local impacts on groundwater caused by the expansion, also paying attention to the importance of the safety of waste.

4.3.3 *Noise*

The excavation of the L/ILW repository, the crushing of blasted rock and transports are sources of noise disturbance. The loudest noise is caused by any crushing of blasted rock above ground. Such noise may carry to the holiday homes on nearby islands and the mainland. According to the report, the impacts of noise are minor and negative. Taking into account the duration of the expansion, which will last for several years, and the location of holiday homes, it is important to reduce the noise disturbance from the expansion of the L/ILW repository. The noisiest work should be timed appropriately to mitigate the impacts.

4.3.4 *Use of natural resources*

According to plans, the blasted rock from the expansion of the L/ILW repository will be primarily used to fill the L/ILW repository. It can also be used for landscaping after the dismantling stage or possibly for earthworks outside the power plant site. According to estimates, the work will result in around 100,000 m^3 of blasted rock. Its utilisation is considered to promote the circular economy, which is why the impact is assessed as being minor and positive. In the opinion of the Ministry of Economic Affairs and Employment, the amount of blasted rock is large and it is therefore important to carefully plan its use.

4.4 Other impacts

The assessment report also discusses other impacts of the project options. These have been assessed as being of minor or no significance. The Ministry of Economic Affairs and Employment considers this estimate to be accurate, provided that the mitigating measures described in the report are carried out.

According to Fortum's estimates, extended use would cause minor negative impacts on land use, land use planning and the built environment, the landscape and cultural environment, traffic, emissions of radioactive substances and radiation exposure. Minor positive impacts would affect the fauna. No significant impacts have been identified concerning noise, vibration, air quality, use of natural resources, soil and bedrock, groundwater, conservation areas and the health of people.

The plant's decommissioning is assessed to carry minor negative impacts in terms of vibration, air quality, emissions of radioactive substances and radiation exposure, surface water (Lappomträsket lake) and fauna. Minor positive impacts have been identified regarding land use, land use planning and the built environment. According to the assessment, the health of people will not be affected.

The expansion of the L/ILW repository has a minor negative impact on the quality of surface water, vibration, air quality, traffic, waste and waste treatment, as well as the comfort and living conditions of people. The expansion is not considered to cause any other environmental impacts.

4.5 Up-to-dateness of the reasoned conclusion

When making decisions on licences, the licensing authority must ensure that the reasoned conclusion is up-to-date. If requested by the licensing authority, the coordinating authority must state whether the reasoned conclusion is up-to-date. The project owner can also request the coordinating authority's view on the up-to-dateness of its reasoned conclusion before the licence application becomes pending. If required, the assessment procedure can be supplemented in accordance with section 27 of the EIA Act.

5 Announcement of the coordinating authority's reasoned conclusion

The Ministry of Economic Affairs and Employment issues a public notice concerning its reasoned conclusion. Information about the notice is also published on the electronic noticeboards of the municipalities affected by the project.

The ministry submits the reasoned conclusion and the statements and opinions received to the project owner. The reasoned conclusion is submitted to the authorities handling the project, to the municipalities affected by the project, as well as to the regional council and other relevant authorities. Moreover, the ministry must submit the reasoned conclusion and translations of the essential parts of it to the Ministry of the Environment, which submits them to the states that have participated in the environmental assessment procedure.

The reasoned conclusion and the statements and opinions received are also available on the website of the Ministry of Economic Affairs and Employment at https://tem.fi/en/loviisa-eia-report.

6 Service fee, grounds for determining the fee and instructions for requesting an administrative review

Service fee EUR 47,630

The fee is based on the Act on Criteria for Charges Payable to the State (150/1992) and the Decree of the Ministry of Economic Affairs and Employment on the chargeable services of the Ministry of Economic Affairs and Employment related to the environmental impact assessment procedure for nuclear power plants (139/2021). As provided in the Decree, the fee charged for the coordinating authority's reasoned conclusion in a demanding project (exceeding 30 person-days) is EUR 16,540 to which an hourly fee of EUR 90 is added for working hours exceeding 30 working days. However, the maximum total is EUR 47,630.

An administrative review of this payment decision can be requested from the Ministry of Economic Affairs and Employment. A review must be requested within six months of the payment decision as laid down in the Administrative Procedure Act (434/2003). Instructions for requesting an administrative review are appended to the decision.

A decision on the request for an administrative review may be appealed as laid down in the Administrative Judicial Procedure Act (808/2019).

	Minister for Economic Affairs	Mika Lintilä
	Senior Specialist	Jaakko Louvanto

Appendices	Instructions for requesting an administrative review
Distribution	Fortum Power and Heat Oy
For information	Recipients of request for statement