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Ministry of Economic Affairs and Employment

STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA) REPORT FOR THE NATIONAL PROGRAMME FOR THE MANAGEMENT OF SPENT FUEL AND RADIOACTIVE WASTE IN FINLAND (RESULTS)

RAMBØLL Bright ideas. Sustainable change.

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Contact information

Ministry:	Ministry of Economic Affairs and Employment
Postal address	P.O. Box 32, FI-00023 GOVERMENT
Telefone	0295 060125
Contact person	Linda Kumpula
Email address	firstname.surname@gov.fi

Työ- ja elinkeinoministeriö
Arbets- och näringsministeriet

Consultant:	Ramboll Finland Oy
Postal address	P.O. Box 25, 02601 ESPOO
Telefone	020 755 611
Contact person	Antti Lepola
Email address	firstname.surname@ramboll.fi

1. IMPLEMENTING THE IMPACT ASSESSMENT

1.1 Starting points

The Act on the Assessment of the Effects of Certain Plans and Programmes on the Environment (200/2005, SEA Act) and the Government Decree supplementing it (347/2005, SEA Decree) contain a provision on the general obligation to adequately assess the environmental impact in the preparation of plans and programmes. They also contain provisions on the environmental assessment of certain plans and programmes. The SEA Act and Decree have largely implemented the Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programmes on the environment. Similarly, they have implemented the substantive provisions necessary for the adoption of the Kiev Protocol on Strategic Environmental Assessment to the United Nations Economic Commission for Europe (UN/ECE) Convention on the Environmental Impact Assessment in a Transboundary Context of May 2003 (Finnish Treaty Series 69/2010).

Under the SEA Act, if the implementation of the plan or programme could have significant effects on the environment, the authority responsible for the plan or programme must ensure that the environmental impact of the plan or programme is adequately investigated and assessed during the preparation. According to the SEA Act, environmental assessment refers to the environmental impact assessment of a plan or programme, including the preparation of an environmental report, the organisation of consultations, the incorporation of the environmental report and the results of consultations into decision-making as well as the communication of the decision.

The previous national programme for the management of spent fuel and radioactive waste, drawn up in 2015, was not subject to an environmental impact assessment in accordance with the SEA Act. The updated national programme will replace the abovementioned 2015 national programme and will become more prescriptive, creating a framework for decisions on project licensing and approval. The European Commission has required that large national programmes be subject to an environmental impact assessment in accordance with the SEA Act, thus increasing the availability of information to stakeholders. Therefore, it has, been decided that the national programme being updated requires an environmental impact assessment in accordance with the SEA Act (200/2005).

1.2 Objectives

The purpose of the SEA Act, which governs the environmental assessment of the national programme for the management of spent fuel and radioactive waste, is to promote environmental impact assessment and integration in the preparation and adoption of the authorities' plans and programmes, to improve public access to information and to promote sustainable development.

The objectives of the environmental assessment of the national programme are to, inter alia:

1. identify and assess the likely significant environmental impacts (secondary and cumulative impacts, interactions and short, medium and long-term effects, both positive and negative) related to the implementation of the content, objectives and key solutions of the national programme to be updated;
2. identify and compare the environmental impacts of possible options related to the programme in the short and long term;
3. collect substantiated information on the environmental impacts to support the development of the programme and present substantiated proposals for the integration of environmental impacts into the content of the programme;

4. propose measures to prevent or reduce potential adverse environmental impacts and increase positive impacts;
5. describe the measures planned to monitor the environmental impact of the programme;
6. identify and describe the environmental objectives relevant to the programme and the way these objectives and their environmental aspects are taken into account in the preparation;
7. provide information and increase access to information on environmental impacts to the various authorities involved in the national programme and other stakeholders;
8. establish a SEA working group of industry and experts to participate in the impact assessment process and to monitor the development of the programme and the progress and results of the assessment work.

1.3 Phases

Preparations for the update of the national programme for the management of spent fuel and radioactive waste started at the end of 2020. The environmental impact assessment in accordance with the SEA Act was launched at the same time. The update and assessment work proceeded in stages as follows:

Preparation phase
In the first phase of preparation, a plan was drawn up for updating the national programme for the management of spent fuel and radioactive waste and for carrying out an environmental impact assessment. The plan included the starting points, goals and description of the update work.

First consultation phase
The plan was announced on 9 February 2021 and was available for viewing on the websites of the Ministry of Economic Affairs and Employment, the Radiation and Nuclear Safety Authority (STUK) and the Ministry of Social Affairs and Health from 9 February to 19 March 2021. During the consultation process, the authorities, operators and associations in the sector were asked for their opinions and views on the scope and level of detail of the planned national programme and environmental report. In addition, citizens and organisations were given the opportunity to give opinions and state views.

The first consultation phase received 19 opinions from the following actors: the Ministry of Social Affairs and Health, the Faculty of Science of the University of Helsinki, the Geological Survey of Finland (GTK), the Advisory Committee on Nuclear Safety, the Government of Åland, the Municipality of Eurajoki, the Town of Loviisa, the Finnish Heritage Agency, the Regional Council of Satakunta, the Association of Finnish Municipalities, Finnish Energy, the Central Organisation of Finnish Trade Unions (SAK), the Finnish Confederation of Technical Employees' Unions (STTK), the Ecomodernist Society of Finland, the Finnish Association for Nature Conservation, Fortum Power and Heat Oy, MJT Consulting, Posiva Oy, Societal Security Solutions Oy, VTT Technical Research Centre of Finland Ltd and Teollisuuden Voima Oyj. In addition, seven actors (Fennovoima Ltd, the Ministry for Foreign Affairs, the Ministry of the Interior, the Ministry of Transport and Communications, the Ministry of Defence, the Advisory Committee on Radiation Safety and the Finnish Safety and Chemicals Agency Tukes) stated that they had no comments to make.

Several different actors expressed satisfaction with the management of spent fuel and radioactive waste in Finland. The regular updating of the national programme for spent fuel and radioactive waste management, the environmental impact assessment and the related consultations were seen as important.

Impact assessment phase
The preparation of the environmental report related to the environmental impact assessment was carried out in parallel with the updating of the national programme. The environmental impact assessment was directed by a working group of public officials, which included representatives from the Ministry of Economic Affairs and Employment and STUK. For the purpose of the assessment work, the group met approximately twice a month during the preparation of the report. In addition, the assessment work took into account the opinions and opinions received as well as the issues raised by the SEA working group.

The SEA working group was set up for the assessment process and its guidance, inviting representatives from the following actors: Fennovoima Ltd, Fortum Power and Heat Oy, Teollisuuden Voima Oyj, VTT Technical Research Centre of Finland, Posiva Oy and the University of Helsinki.

The SEA working group met for the first time on 18 February 2021 and discussed, among other things, the starting points of the environmental impact assessment, the content of the assessment report, the timetable and the objectives of the working group's activities. A second meeting of the SEA working group took place on 19 April 2021. At the meeting, the participants were able to comment on the draft report and the descriptions of their own activities. The working group met for the third time on 21 June 2021 when the preliminary results of the environmental impact assessment were ready. The meeting covered, inter alia, the results, scope and adequacy of the assessment.

The assessment report was then finalised for consultation.

Second consultation phase
The completion of the draft national programme for the management of spent fuel and radioactive waste and its environmental impact assessment report was announced on 5 August 2021. The documents were made available for viewing from 5 August to 10 September 2021 on the websites of the Ministry of Economic Affairs and Employment, the Ministry of Social Affairs and Health and STUK. The second consultation phase was largely carried out in the same way as the first.

In addition, the programme and the environmental report were presented at different events. The aim was to increase access to information and to support the interactive preparation of the programme in its handling and implementation.

Finalising phase
The received opinions and views were taken into account when finalising the national programme and its environmental impact assessment report. The following were added to the national programme:

- a reasoned opinion on how the environmental report and the opinions and view received during the consultation phases were taken into account;
- a description of how the environmental report and the opinions and views received during the consultation phases as well as environmental considerations, influenced the content of the plan or programme and the choice of options;
- a description of the (environmental) monitoring referred to in section 12.

Approval and implementation phase
The national programme for the management of spent fuel and radioactive waste will later proceed to the approval phase. Approval will be communicated separately.

Thereafter, the programme will be implemented and the environmental impact will be monitored by means of selected indicators. The need to update the programme and its environmental impact assessment will be regularly assessed as part of developments in the sector and in various working groups, such as the National Nuclear Waste Management Cooperation Group, and in the context of self-assessments and international reviews.

1.4 Options to be assessed

The starting points of the environmental impact assessment of the national programme for spent fuel and radioactive waste management are the objectives set out in the national programme (Table). The impact of the implementation and non-implementation of the objectives and their development targets (Chapter **Virhe. Viitteen lähdettä ei löytynyt.**) are considered as alternatives to be assessed.

Table 6. The main objectives under review in the impact assessment.

Objective
1. The Ministry of Economic Affairs and Employment will continue measures and background studies aimed at reforming the Nuclear Energy Act.
2. A safe and cost-effective disposal solution will be developed for all spent fuel and radioactive waste generated in Finland.
3. The licensing procedures for closure, technical requirements and operational responsibilities, including the transfer of responsibilities, will be defined about a decade before the closure of the first disposal facility.
4. It will be investigated as to how the incineration of maintenance waste released from regulatory control in Finland can be smoothly carried out in waste incineration plants in the future.
5. National waste recording procedures will be developed to meet the obligations arising from international legislation and agreements.
6. National expertise will be maintained and developed to meet the needs of both operators and public authorities by organising training and ensuring the preservation of research funding for spent fuel and radioactive waste management research.

1.5 Assessment methods

The environmental impact assessment of the national programme for the management of spent fuel and radioactive waste focused in particular on examining the environmental impact of the objectives and development targets set out in the national programme. The focus of the assessment was on the changes brought about by the possible implementation of the objectives in the operating environment. Non-implementation of the objectives was also taken into account in the comparison.

The effects of the implementation of the objectives of the national programme were examined in accordance with section 2 of the SEA Act. According to the Act, environmental impact means the impact of a programme on:

a) human health, living conditions and comfort (= living environment);
b) the soil, waters, air, climate, vegetation, animals and natural diversity (= natural environment);
c) community structure, the built environment, landscapes, cityscapes and cultural heritage (= community structure);

d) exploitation of natural resources (= natural resources).

The impact assessment focused on the impact of the implementation or non-implementation of the objectives of the national programme, particularly at the societal level. For some impacts, the scope of the assessment extends to impacts on the environment of operators. The impact assessment used the national programme and its background material as well as previous environmental impact assessments and other separate clarifications and studies carried out by operators.

The impact was assessed against the following criteria: + positive impact, - negative impact, 0 neutral impact, +/- both positive and negative impacts. On the basis of the criteria, a summary of the main identified effects was compiled in the table in Section 6.1.

The impact assessment was carried out in an expert working group consisting of experts from the Ministry of Economic Affairs and Employment, STUK and Ramboll Finland Ltd. In addition, representatives of the SEA working group (Fennovoima Ltd, Fortum Power and Heat Oy, Teollisuuden Voima Oyj, VTT Technical Research Centre of Finland, Posiva Oy and the University of Helsinki) participated in the assessment work.

2. ENVIRONMENTAL IMPACT

2.1 Assessment results

Table 7. Summary of the main identified impacts in relation to the objectives of the national programme.

Objective	Impact of implementation	Impact of non-implementation
The Ministry of Economic Affairs and Employment will continue measures and background studies aimed at reforming the Nuclear Energy Act.	In legislation, the focus of dealing with matters will become increasingly risk-based and resources will be allocated more appropriately. (+) The Radiation Act and the Nuclear Energy Act will be harmonised and their overlap reduced. (+) The terminology of the law will be clarified. (+) The requirements for operators will be clarified. (+) The administrative burden for operators and public authorities will decrease. (+) The introduction of new technologies will become possible. (+) Modern legislation will promote the implementation of climate policy objectives. (+)	Regulation will remain as before. (0) The policy and the national framework will remain the same, even if the operating environment changes. (-) The application of the legislation will become increasingly difficult due to the changing operating environment, and the administrative burden will increase. (-) The legislation will not serve the changed operating environment. (-)
A safe and cost-effective disposal solution will be developed for all spent fuel and radioactive waste generated in Finland.	**1. In the future, the management of spent fuel and radioactive waste should allow for better market-based cooperation between the operators in the sector. Achieving this objective requires, among other things, that licences for existing nuclear facilities allow for the treatment, storage and disposal of waste generated by others.**	
	The safe treatment, storage and disposal of radioactive waste can be achieved by exploiting the existing systems and knowledge of nuclear facilities. (+) The allocation of waste management measures to nuclear sites ensures that radioactive waste will not be pointlessly stored for long periods in different locations around Finland. (+) Nuclear sites have existing controlled facilities, so their use will increase the overall safety of national waste management. (+) The amount of radioactive waste received by nuclear facilities from elsewhere in Finland is small in relation to the amount of waste generated by the nuclear facility itself. Therefore, the reception of waste does not significantly increase the environmental impact at the plant site. (0)	The storage of radioactive waste in operators' temporary storage facilities throughout Finland, which has been ongoing for decades, will pose challenges to overall safety supervision. (-) The licensing procedures and supervision of temporary storage facilities will increase the administrative burden for operators and public authorities (-). There are no licences required by the Nuclear Energy Act for the treatment, storage and disposal of waste generated in unforeseen circumstances not at nuclear power plants; instead, the necessary licensing procedures only start after the generation of the waste (-).

Objective	Impact of implementation	Impact of non-implementation
	The transport of radioactive waste will increase slightly. (-) By concentrating the management of radioactive waste on existing nuclear facilities, exposure situations can be better managed and the health impact reduced. (+) All nuclear operators are guaranteed equal access to waste management services for waste treatment and disposal. (+) A targeted radioactive waste management solution is more cost-effective nationally. (+) A targeted management solution for radioactive waste can also adequately prepare for waste batches generated under unforeseen circumstances. (+)	
	2. A disposal solution for high-activity sealed sources will be developed under the leadership of the State. In practice, the aim is to develop a disposal solution by making use of existing or planned infrastructure.	
	For high-activity sealed sources that cannot be returned to the country of origin, a disposal solution will be found in Finland. In this case, they will no longer be kept in temporary storage for long periods but can be disposed of in accordance with the legal requirements. (+) The handling of sealed sources may require systems that may not be available to all operators. Centralised activities are a better solution in terms of costs, safety and radiation protection. (+) Existing knowledge and systems that ensure the safety of operations will be utilised. (+) By concentrating waste management, exposure situations can be better managed and the health impact reduced. (+) The use of existing infrastructure for the disposal of sealed sources requires that sealed sources are taken into account in long-term safety analyses and, possibly, that new types of disposal containers are designed. (0) Exploitation of existing or planned infrastructure is cost-effective. The cost of constructing a completely separate repository for sealed sources would be significantly higher in relation to the number of sealed sources to be disposed of. (+)	Currently, sealed sources awaiting disposal are stored in the repository for low and intermediate-level radioactive waste in Olkiluoto. Continued storage will not significantly increase the environmental impact. (0) Decades of interim storage is not a sustainable solution. At some point, new storage facilities will be needed when the old facilities are full. (-) Long-term storage is not in line with Finland's national policy. In addition, international conventions oblige that sealed sources must have a disposal solution rather than storage. If a solution is not developed, continued storage is contrary to Finland's national policy and international conventions. (-) The operator will not have a disposal site for its old radiation source within the transitional period specified in the Radiation Act. (-)

Objective	Impact of implementation	Impact of non-implementation
	3. The treatment, storage and disposal of radioactive waste resulting from unforeseen events (such as accidents, damage) will be prepared for in an adequate manner by making use of existing or planned infrastructure.	
	With preparedness, radioactive waste can be treated in accordance with the requirements and safely transported to further processing and storage in a suitable location. (+) A disposal location can be more easily found for waste arising from unexpected sources when it has been treated in a way that enables disposal. (+) Preparedness will help better manage exposure situations and reduce health risks. (+) Preparedness will facilitate and speed up operations in an unexpected event, when there are agreed practices between different parties. (+) Information on the measures to be taken with radioactive waste generated in unforeseen circumstances will be widely available to all those in need of information. (+) Preparedness will reduce the administrative burden when preliminary plans are drawn up for unforeseen situations. (+) Exploitation of existing or planned infrastructure is cost-effective. (+)	Waste from unexpected sources will be temporarily stored pending instructions for treatment and investigation of storage and disposal possibilities. (-) No provision has been made for unexpected situations. The volume of waste generated in unexpected situations may be very large and the properties of the waste different from those of the waste generated in normal operations. (-) Exposure situations may involve very low health risks. (-) There will be an administrative burden, over-regulation and unnecessary costs. (-)
	4. The disposal of spent fuel by TVO and Fortum will begin in Olkiluoto, Eurajoki during this decade. The start of operations will require an operating licence, which Posiva plans to apply for in the early 2020s.	
	Once the Government has granted the operating licence and the disposal of spent fuel in Finland begins, no undue burden will be shifted to future generations from the management of spent fuel. (+) The dose limit for releases of radioactive material caused by normal conditions at the spent fuel encapsulation plant and disposal facility is 0.01 mSv for a member of the public in the immediate vicinity of the plant site. The dose limit is not exceeded at the encapsulation plant and disposal facility; therefore, the dose caused by the releases is insignificant. (0) Disposal must not have a health or environmental effect in any assessment period that exceeds a maximum level that is considered accepta-	Spent fuel will still be stored in the interim storage facilities at power plant sites. The power plants are already prepared to store the spent fuel generated in operation, so there will be no new specific environmental impacts. (0) In the event of a significant delay in the start of disposal, the interim fuel storage capacity should be increased at some point at the plant sites. (-) The interim storage of spent fuel requires continuous maintenance and monitoring. (-)

Objective	Impact of implementation	Impact of non-implementation
	ble at the time of the disposal. In the foreseeable period after the closure of the disposal facility, the maximum annual radiation dose from disposal to the most exposed person is set at 0.1 millisieverts (mSv). (0) The approved and viable disposal concept is also applicable to other disposal facilities, where appropriate. (+) The knowledge and expertise gained from the operations can be utilised in Finland and elsewhere in the world. (+) The costs of spent fuel management have been prepared for in the National Nuclear Waste Management Fund. (+/-) With disposal operations, transports from the Loviisa power plant to Olkiluoto in Eurajoki will begin. In road transport, the radiation dose received by the most exposed member of the public during normal transport for one year will be 0.0009 mSv, assuming they stay at a distance of 10 metres from the container for a total of two hours. Radiation exposure to the public from maritime transport is lower. The radiation dose will be considerably lower than the average annual radiation dose received by Finns (5.9 mSv). (0) The supervision of the safety of a closed disposal facility will not require active action. (+)	
	5. The authorities will monitor the progress of future nuclear power plant projects, and their future decisions will require the promotion of spent fuel disposal solution planning so that a disposal solution or a credible plan for the implementation of a disposal solution is in place. The disposal solution can involve cooperation with other companies with waste management obligations or a private disposal facility.	
	Progress of the development of a safe disposal solution will be ensured. (+) The total cost of the management of spent fuel and radioactive waste can be reliably estimated and adequately prepared for. (+) If the solution is cooperation with other companies with waste management obligations, the existing expertise, technology and infrastructure can be fully utilised. This will require, for example, safety assessments, licensing procedures and environmental impact assessments. The environmental impact on the site would increase slightly, but the impact would be concentrated on one site in Finland. (+/-) If the solution is a private disposal facility, a multi-year development project will start to ensure the suitability and safety of the site. Part of	If the disposal solution is left open, public acceptance of the use of nuclear energy may be undermined. (-) Prolongation of interim storage in the existing interim storage for spent fuel on the plant site will not significantly increase the environmental impact. (0) Long-term interim storage without a disposal solution is not in line with Finland's policy and waste management principles. (-)

Objective	Impact of implementation	Impact of non-implementation
	the experience already gained from Posiva's disposal project can be utilised, which would probably make the process faster. The project will require studies, planning, licensing procedures and environmental impact assessments. The environmental impacts of disposal would focus on different plant sites in Finland. However, the impacts are likely to be similar depending on the characteristics of the new site chosen. (+/-) The choice of a new disposal site can create challenges for the public acceptance of the use of nuclear energy. (-)	
The licensing procedures for closure, technical requirements and operational responsibilities, including the transfer of responsibilities, will be defined about a decade before the closure of the first disposal facility.	When the substantive requirements for the closure plan are specified, the operator can proactively plan its activities to meet the requirements. In this case, more detailed studies can also be proactively targeted at the most significant environmental impacts and their prevention or reduction. (+) Instead of preparing for different scenarios, operators can optimise measures and target them at the right actions, which will reduce costs. (+) The further development of the regulatory requirements for the technical implementation of the closure phase based on experience from disposal will specify the requirements for the right measures and for the prevention or reduction of environmental impacts. (+) Once the responsibilities and procedures for transferring the responsibility for the disposal facility to the State and the activities that are left to the State are more clearly established and defined, the State can anticipate these. (+) The development of appropriate procedures for the permanent storage of disposal data in view of the need to store data for up to centuries will ensure that the plan notations, land-use restrictions and other documentation for disposal facilities are preserved for future generations. This will also ensure safety in the future. (+)	The requirements for the closure of a disposal facility are not precise, which may lead to uncertainty for the operator as to the adequacy and timing of the plans. (-) As regards the closure phase, the procedures and conditions for the transfer of responsibility for the waste to the State are left unspecified. (-) The absence of more precise technical requirements for closure will leave uncertainty for the operator in terms of planning and preparation, which entails additional costs. (-)
It will be investigated as to how the incineration of maintenance	The treatment of organic waste released from regulatory control in incineration plants supports the principle of waste legislation according to	Organic waste released from regulatory control will be disposed of in landfills under exemptions, as is currently the case. (-)

Objective	Impact of implementation	Impact of non-implementation
waste released from regulatory control in Finland can be smoothly carried out in waste incineration plants in the future.	which the recovery of waste as energy is preferable to its disposal at a landfill. (+) The incineration of organic waste released from regulatory control will reduce the amount of waste going to landfills and thus reduce the environmental impact of landfills on, for example, the natural environment and groundwater. (+) Radioactive waste can be released from regulatory control if its activity is below the limit values set by the authorities (section 27c of Act 990/1987, Guide YVL D.4, STUK Regulation SY/1/2018) and further processed like conventional industrial waste. The treatment of organic waste released from regulatory control in an incineration plant will, therefore, not differ from treatment of other industrial waste. (0) The activity of organic maintenance waste released from regulatory control may place restrictions on the recovery of bottom dross from the incineration plant at certain sites. (-) Treatment of waste released from regulatory control or bottom dross from its incineration may result in external radiation doses to treatment personnel. Due to the uncertainties associated with the incineration process, the annual radiation dose will be difficult to estimate. (-) The flue gases of the incineration plant will also release small amounts of pollutants into the air. In principle, radioactive materials in maintenance waste released from regulatory control could be released into the atmosphere as a result of incineration. The behaviour of radionuclides in the incineration of waste will depend on the chemical state of the radionuclides and the combustion conditions. (-) The annual radiation dose to workers and the public resulting from the treatment of waste released from regulatory control must not exceed the dose limit set in Guide YVL D.4. (0) Waste released from regulatory control has been wrongly considered as radioactive waste by incineration plants. Increasing knowledge and training for operators in the field will help to correct this misperception. (+) The need for exemptions for landfilling of organic waste will cease. (+) The treatment of waste released from regulatory control in the incineration process may increase concerns about, for example, the safety of incineration. (-)	The amount of waste released from regulatory control and disposed of in landfills will increase and thus the environmental impact of landfills on, for example, the natural environment and groundwater will increase. (-) Exemptions will continue to be sought for landfilling of waste released from regulatory control. They will be limited in time and must be applied for repeatedly by operators. (-) Obtaining an exemption is not a matter of course, so it may be necessary to dispose of some of the waste eligible for release from regulatory control in the power plant's own disposal facility. This will unnecessarily take up disposal space intended for radioactive waste and will be expensive. The additional cost will be reflected in the cost of nuclear waste management and can thus indirectly affect the price of electricity. (-)

Objective	Impact of implementation	Impact of non-implementation
National waste recording procedures will be developed to meet the obligations arising from international legislation and agreements.	The authorities' overall picture of all the quantities of radioactive waste stored in Finland will be improved and refined. (+) The information can be used as a basis for disposal plans, thereby optimising measures. (+) Waste management measures can be targeted at the right issues and measures can be prepared for in time. (+) The reporting by public authorities required by international obligations will be facilitated when there exists a national waste database and data on different parties are stored in a commensurate format in the database. (+)	The authority will not have a sufficiently comprehensive overview of the amount of radioactive waste and the amounts of waste to be prepared for in future disposal plans. (-) On the basis of incomplete data, it will not be possible to prepare for future space requirements, for example in terms of storage and disposal. (-)
National expertise will be maintained and developed to meet the needs of both operators and public authorities by organising training and ensuring the preservation of research funding for spent fuel and radioactive waste management research.	It will be ensured that new professionals in the field are trained for the needs of licence holders and authorities. (+) Training will improve the conditions for verifying and reducing environmental impacts. (+) Preservation of research expertise in the field in Finland will be ensured. (+) With increasing research expertise, technological advances will emerge. This will lead to the development of waste management procedures and the creation of new, more efficient waste management solutions, which can also prevent or reduce the environmental impacts. (+) Expertise and best practices in this field can also be exported to other countries. (+) Leading the way, especially in the disposal of spent fuel, will create a global demand for the expertise. (+)	If measures aimed at maintaining expertise are abandoned, this may make it more difficult to recruit new people to the sector. The sector will develop a shortage of resources, which will start to affect the safety of operations. (-) The self-sufficiency of resources cannot be guaranteed and recruiting from elsewhere may be challenging because there will also be demand for waste management professionals elsewhere in Europe as decommissioning projects progress in several countries. (-) National funding will remain the same as it has been up to now or will increase, but for operators (such as Posiva), funding for research will decrease as preparations for operation begin and research needs decrease. (-) Preservation of critical expertise in Finland will be compromised. (-)

2.2 Summary of the main impacts and the likely evolution of the current situation

The main impacts of the implementation and non-implementation of the objectives of the national programme are summarised below.

The Ministry of Economic Affairs and Employment will continue measures and background studies aimed at reforming the Nuclear Energy Act.

The reform of the Nuclear Energy Act will not have a direct impact on the living environment, natural environment, community structure or natural resources. The impact will be more administrative as the legislation is developed. Making the legislation more risk-based will reduce the administrative burden on public authorities. Legislation will have a steering effect on operators' activities, and in this case the legislative reform will also have an impact on the operating environment in the sector. The predictability brought to operators by the legislative reform, in particular, will create an opportunity to develop operations in a proactive manner to be more efficient and safer, which is likely to have a positive impact on the environmental impact of the operations in the long term. Similarly, enabling the introduction of new technologies in a more flexible or efficient way will further reduce the environmental impact in the future.

Failure to reform the legislation is not considered realistic, since it must respond to a changed operating environment and needs. The need for amendments to the nuclear energy legislation has been investigated in several working groups and has been required by parliamentary committees. The conclusion has been that there is a need to reform the nuclear legislation as a whole.

A safe and cost-effective disposal solution will be developed for all spent fuel and radioactive waste generated in Finland.

1. In the future, the management of spent fuel and radioactive waste should allow for better market-based cooperation between the operators in the sector on. Achieving this objective requires, among other things, that the licences for existing nuclear facilities allow for the treatment and disposal of waste generated by others.

The utilisation of existing nuclear facilities for the treatment and disposal of radioactive waste generated by others in Finland is considered to be a socially sustainable, safe and cost-effective solution. This is estimated to have a positive impact on the living environment, since waste management is targeted at specific plant sites and radioactive waste is not treated in several different locations. In this way, exposure situations can be better managed and the adverse health impact reduced. In addition, there is existing expertise in the treatment, storage and disposal of radioactive waste at power plants. The amount of radioactive waste received by nuclear facilities from elsewhere in Finland is small in relation to the amount of waste generated by the nuclear facility itself. Therefore, the reception of waste does not significantly increase the impact on the natural or living environment of the sites.

The current operating licences do not allow for the full treatment, storage and disposal of radioactive waste generated by others. Modification of operating licences would increase the options for the storage and disposal of waste not generated at nuclear facilities. Companies' operating licences

must enable market-based cooperation in the management of radioactive waste, including waste which is not their own.

If the operating licences do not allow cooperation, radioactive waste resulting from the use of nuclear energy can only be treated, stored and disposed of on the operator's own site. In this case, there is, in practice, only one route for the management of radioactive waste in Finland. It must be delivered to the State's storage facility for small user waste in Olkiluoto, from where they will be transferred to disposal in the repository for operational waste of the Olkiluoto power plant. Operators may also store the radioactive waste they hold for long periods of time in temporary storage facilities all over Finland.

2. A disposal solution for high-activity sealed sources will be developed under the leadership of the State. In practice, the aim is to develop a disposal solution by making use of existing or planned infrastructure.

Exploitation of the infrastructure of existing or planned nuclear facilities will provide a cost-effective and sustainable way of resolving the disposal of sealed sources that cannot be returned to their country of origin. In addition, appropriate disposal is a better solution in terms of safety and radiation protection than prolonged storage. The disposal of sealed sources requires that sealed sources are taken into account in long-term safety analyses and, possibly, that new types of disposal containers are designed in order to avoid environmental impacts. Exploitation of the infrastructure of existing or planned nuclear facilities, also for the disposal of sealed sources, is not expected to lead to significant changes in the environmental impact of the facilities, since the quantities of sealed sources are minor in relation to the total amount of radioactive waste handled and disposed of on the site.

Overall, the disposal solution for sealed sources is not expected to have a significant impact on the living environment, natural environment, community structure or natural resources when the disposal utilises existing or planned infrastructure where the installations' own waste management activities would take place despite receiving sealed sources.

If a disposal solution is not developed, continuing long-term storage is contrary to Finland's national policy and international conventions.

3. The treatment, storage and disposal of radioactive waste resulting from unforeseen events (such as accidents, damage) will be prepared for in an adequate manner by making use of existing or planned infrastructure.

When the management of radioactive waste is reasonably prepared for any new situations that may occur and the resulting radioactive waste, the waste can be handled efficiently and safely in the event of an incident. This will reduce potential exposure situations and health risks. Disposal taking advantage of existing or planned infrastructure is cost-effective. On the whole, preparedness helps avoid additional impacts on the natural and living environment. There is no impact on the community structure or natural resources when existing or planned infrastructure is used for the treatment and disposal of waste.

Recommendation for the national programme: Within the framework of the national programme, general guidance and guidelines should be drawn up in the event of unforeseen situations. This requires the cooperation of all actors (in particular the receiving parties, licensing authorities).

4. The disposal of spent fuel by TVO and Fortum will begin in Olkiluoto, Eurajoki during this decade. The start of operations will require an operating licence, which Posiva plans to apply for in the early 2020s.

If the Government grants the operating licence and the disposal of spent fuel in Finland begins, no undue burden will be shifted to future generations for the management of spent fuel, which is in the general interest of society.

The start of the operation of the spent fuel disposal facility will start the transport of spent fuel from the Loviisa power plant to Olkiluoto in Eurajoki. The transports will not have a significant impact on the natural and living environment near the transport routes, as the radiation dose will be considerably lower than the average annual radiation dose of a Finnish citizen. Releases of radioactive material from the encapsulation and disposal of spent fuel under normal circumstances will be very low and do not have a significant impact on the natural or living environment outside the plant site. Disposal must not have a health or environmental effect in any assessment period that exceeds a maximum level that is considered acceptable at the time of the disposal.

A possible delay of a few years in the commissioning of the disposal facility will not increase the environmental impact, as in any case the nuclear power plants in operation are prepared for the interim storage of spent fuel on their sites. It is highly unlikely that the start of the disposal of spent fuel will be delayed for decades. However, should this happen, the interim fuel storage capacity at the plant sites would need to be increased at some point. This would slightly increase the impact of the plant on the natural and living environment mainly through construction activities (for example, temporary noise, increased traffic).

5. The authorities will monitor the progress of future nuclear power plant projects, and their future decisions will require the promotion of spent fuel disposal solution planning so that a disposal solution or a credible plan for the implementation of a disposal solution is in place. The disposal solution can involve cooperation with other companies with waste management obligations or a private disposal facility.

The disposal solution for spent fuel must be in the general interest of society and safe, and the total costs of waste management must be prepared for.

The environmental impacts depend on whether the disposal solution is cooperation with other companies with nuclear waste management obligations or the construction of a private disposal facility. Depending on the solution, the environmental impacts will be focused on the chosen site. In both cases, the project requires, for example, licensing procedures and environmental impact assessment, which specify in more detail the environmental impact of the chosen disposal solution on the living environment, natural environment, community structure or natural resources.

Long-term interim storage without a disposal solution is not in line with Finland’s policy and waste management principles.

The licensing procedures for closure, technical requirements and operational responsibilities, including the transfer of responsibilities, will be defined about a decade before the closure of the first disposal facility.

Existing legislation already requires the permanent closure of the disposal facility. Clarification of the requirements and responsibilities for the closure will allow the operator to better prepare for the future and thus to design the measures in a way to prevent or reduce the impacts on the natural and living environment. Clarification of the safety requirements for the closure will provide the operator with the necessary information on the design requirements for the closure of the disposal facility. The community structure will be subject to minor impacts through the plan notations and land-use restrictions required by the disposal facilities even after the permanent closure of the disposal facilities.

It will be investigated as to how the incineration of waste released from regulatory control in Finland can be smoothly carried out in waste incineration plants in the future.

The use of radiation and nuclear energy generate waste which, on the basis of its low activity or activity concentration, can be released from regulatory control in accordance with the Radiation Act and the Nuclear Energy Act. In this case, the waste can be treated as non-hazardous industrial waste. The treatment of waste released from regulatory control in incineration plants will support the principle of the Waste Act according to which the recovery of waste as energy is preferable to its disposal in landfills. This will also reduce the amount of waste going to landfills and thus reduce the environmental impact of landfills on, for example, the natural environment and groundwater.

The treatment of maintenance waste released from regulatory control in waste incineration plants may have an impact on the natural and living environment, so more careful consideration must be given to the environmental impact of the behaviour of waste with a low level of activity or activity concentration in the incineration process and to the technical and radiation protection solutions to be taken into account. Incineration of waste may have a particular impact on the treatment, use and disposal of bottom dross. Environmental impacts will be examined in the environmental impact assessment and/or environmental permit procedures for the waste incineration plants concerned.

Recommendation for the national programme: A report should be drawn up on the suitability of waste released from regulatory control for treatment at an incineration plant, its possible environmental impact and possible means of mitigating harm. The licensing procedure for incineration plants should also be examined in more detail with regard to the treatment of waste released from regulatory control. If the incineration of maintenance waste released from regulatory control is not possible, the exemption practice must continue to be possible in order to maintain a cost-effective and environmentally sound waste management route for the waste released from regulatory control.

National waste recording procedures will be developed to meet the obligations arising from international legislation and agreements.

The development of the waste recording procedures will not have a direct impact on the living environment, natural environment, community structure or natural resources. The impact is more administrative. However, the development of the recording procedure will facilitate the authorities' overall view of the quantities of radioactive waste stored in Finland, which can be utilised, for example, in the optimisation of disposal plans and measures. This will also help to anticipate and minimise the environmental impact of waste management.

If recording procedures are not developed, it will not be possible to prepare for future space requirements on the basis of incomplete data.

National expertise will be maintained and developed to meet the needs of both operators and public authorities by organising training and ensuring the preservation of research funding for spent fuel and radioactive waste management research.

The maintenance of national expertise and training will not have a direct environmental impact on the living environment, natural environment, community structure or natural resources. However, training can be used to improve the skills of operators and public authorities. Increasing research expertise will lead to technological developments, which may create the conditions to prevent or reduce environmental impacts.

If measures aimed at maintaining expertise are abandoned, the sector may develop a shortage of resources, which in the long term will start to affect the safety of operations.

2.3 Transboundary impacts

The assessment of transboundary environmental impacts is agreed in the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention). States that are parties to the agreement have the right to participate in an environmental impact assessment procedure under way in another state when a planned project in a particular state (Party of origin) is assessed as likely to have transboundary impacts on the environment in the territory of the other state (affected Party).

The SEA Act (200/2005, section 10) obliges that if the implementation of a plan or programme is likely to have significant transboundary environmental impacts on the territory of another party to an international agreement or a member state of the European Union, the information and negotiation tasks related to the environmental assessment of the plan or programme must be carried out with the state in question. The Ministry of the Environment acts as the responsible authority.

The main objectives of the national programme for the management of spent fuel and radioactive waste have not been assessed to have environmental effects that could extend beyond the borders of Finland if the objectives were to be achieved. If implemented, the programme will have an administrative steering effect on operators. The environmental impact assessment of the implementation of the programme is the responsibility of the operators and has been carried out for the existing projects. On the basis of these assessments, it has been concluded that the projects do not have significant transboundary impacts and that the national programme does not create new impacts.

Below is a summary of the transboundary impacts of Posiva Oy's spent fuel encapsulation plant and disposal facility described in the environmental impact assessment procedure (Posiva Oy 2012).

Operation of the encapsulation plant and disposal facility
Posiva has estimated that the spent fuel disposal project does not have significant adverse transboundary environmental impacts. Posiva has assessed the normal operational situation and various incidental and accidental conditions and estimated the possible radionuclide emissions resulting from them.

The worst accident is estimated to be a situation in which the lid of a transport cask falls in the handling cell, breaking fuel elements in the transport cask and releasing a discharge through the filtration. The discharge would cause a dose of up to 0.9 mSv to a member of the most exposed group over the course of a year. The doses caused by postulated accidents are, therefore, lower than the required limit value of 1 mSv per year. The highest dose comes right next to the plant site, assuming theoretically that it would be inhabited by permanent residents who practised agriculture and mainly ate their own produce. The majority of the dose is accumulated through food chains from radionuclides that have fallen to the ground.

In the short term, however, the dose levels remain so low that there is no risk of immediate health effects. The risk of late effects also remains low. In neighbouring countries, the doses would still be several orders of magnitude lower than the effects in the vicinity of the disposal facility, as the distance from Olkiluoto to the Swedish mainland, for example, is more than 200 kilometres, and the doses and the environmental impact resulting from them are, therefore, not significant.

Transport of spent fuel from the Loviisa nuclear power plant by sea, road or rail
Posiva has estimated that the radiation dose received by the public in connection with the transport of spent fuel from the Loviisa nuclear power plant by sea, road and rail will be considerably lower than that caused by normal natural background radiation during the same period. The most serious road accidents could result in radioactive discharges of noble gas and other volatile substances, which would result in an accumulated dose for an individual of only about one thousandth of a per cent compared to natural background radiation. STUK has assessed an event related to the transport of spent fuel, which would result in a release such as the one described above. According to the estimate of STUK, the impact would be local and would reach up to a few hundred metres from the site at most. Therefore, the possible doses and transboundary environmental effects of the transport of spent fuel cannot be considered significant. This is in line with internationally reported transport information.

2.4 Mitigation of adverse effects

The national programme for the management of spent fuel and radioactive waste is an overall plan that aims to ensure that all spent fuel and radioactive waste generated in Finland is safely managed and that all waste management measures from the generation of waste to its disposal are implemented without undue delay.

The national programme contains a description of the national policies and the national framework, which are governed by laws and regulations. Licensing authorities, therefore, have a key role to play in preventing adverse environmental impacts. In addition, the research, study and planning of radioactive waste management focuses on the prevention and mitigation of adverse impacts.

2.5 Uncertainty factors

The assessment is based on the main objectives of the national programme, which are of a general nature with respect to the identification of environmental impacts. The report assesses the identified and most likely impacts of the developments in line with the objectives of the national programme, and the assessment is, therefore, uncertain. The potentially significant impacts of the programme are mainly generated through legislative guidance cumulatively over the long term and probably over several programming periods through various chains of impact.

2.6 Monitoring and ex-post evaluation

The possible environmental impacts of the achievement or non-achievement of the objectives of the national programme for the management of spent fuel and radioactive waste are monitored, for example, by national self-assessment and international peer review.

A national self-assessment must be carried out and an international peer review must be requested every ten years. According to the Nuclear Energy Act, the national programme must be updated based on the results of the self-assessments and peer reviews. The first international peer review and the related national self-assessment are planned for late 2022. The peer review will take the form of an ARTEMIS review of the IAEA. The results of the peer reviews will be communicated to the Commission and the other Member States and made available to the public, in so far as they do not involve classified information.

The next review of the policy, the national framework and the national programme will be based on the results of the abovementioned ARTEMIS evaluation. On the basis of the review, it can be identified whether the national programme for the management of spent fuel and radioactive waste is in need of immediate updates. If the needs for immediate updates are not identified on the basis of the results of the peer review, the programme will next be updated before the next peer review, which will take place in the 2030s. The update will be made earlier if there are significant changes in the operating environment that need to be taken into account in the national policy, national framework and national programme for the management of radioactive waste and spent fuel.

The identified environmental impact of the national programme will be further examined in the context of the implementation of the objectives of the national programme and in any separate environmental impact assessment procedures of the operators. The environmental impact assessment reports for operators' sites set out a range of impact monitoring measures to be implemented by operators in accordance with their plans and licence conditions.

3. SUMMARY

In connection with the preparation of the national programme for management of spent fuel and radioactive waste, an environmental impact assessment of the programme was carried out in accordance with the Act on the Assessmant of the Effects of Certain Plans and Programmes on the Environment (200/2005).

The environmental impact assessment focused in particular on the environmental impact of the objectives and development targets of the national programme. The focus of the impact assessment was on the impacts of achieving or not achieving the objectives, particularly at the societal level. For some impacts, the scope of the assessment extends to impacts on the environment of operators.

The reform of the Nuclear Energy Act proposed in the national programme has no direct impact on the living environment, the natural environment, community structure or natural resources. The impact of the reform is mainly administrative. However, the predictability brought to operators by the legislative reform will create an opportunity to develop operations in a proactive manner to be more efficient and safer, which is likely to have a positive impact on the environmental impact of the operations in the long term.

Similarly, the clarification of the requirements and responsibilities for the closure of disposal facilities proposed in the national programme will allow the operator to better prepare for the future and thus design the necessary measures to prevent or reduce impacts on the natural and living environment. Similarly, the proposed development of the waste regording will also not have a direct impact on the living environment, the natural environment, community structure or natural resources, but will have an administrative impact.

The impact assessment considered the utilisation of existing or planned nuclear facilities to be a socially sustainable, safe and cost-effective solution for the treatment and disposal of radioactive waste generated elsewhere in Finland. The amount of radioactive waste received by nuclear facilities from other sources is small in relation to the amount of waste generated by the nuclear facility itself. Therefore, the reception of waste does not significantly increase the impact on the natural or living environment of the sites.

A more detailed environmental impact assessment of the proposed treatment of waste released from regulatory control in waste incineration plants is required. In particular, consideration must be given to the behaviour of waste released from regulatory control in the incineration process and to the technical and radiation protection solutions to be taken into account. The treatment of waste released from regulatory control in incineration plants would support the principle of the Waste Act that the recovery of waste as energy is preferable to its disposal in landfills. This would also reduce the amount of waste going to landfills and thus reduce the environmental impact of landfills on, for example, the natural environment and groundwater. In the course of the assessment, it was therefore recommended that a report be drawn up on the suitability of the waste to be released from regulatory control for treatment at an incineration plant, its possible environmental impact and the means of mitigating any harm. It was also suggested that the licensing procedure for incineration plants should be examined in more detail with regard to the treatment of waste released from regulatory control.

The maintenance of national expertise and training were not found to have a direct impact on the living environment, natural environment, community structure or natural resources. However, training can be used to improve the skills of operators and authorities. Increasing expertise may

lead to technological developments, which may further create the conditions to prevent or reduce environmental impacts.

The identified environmental impact of the national programme will be further examined in the context of the implementation of the objectives of the national programme and in any separate environmental impact assessment procedures of the operators.