

ENVIRONMENTAL REPORT
Government Decree on Nuclear Facilities
Limiting radiation exposure and releases of radioactive substances (chapter 1)
Ministry of Economic Affairs and Employment

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1 Introduction

Finland's nuclear energy legislation is being comprehensively reformed. The new nuclear energy act will replace the current Nuclear Energy Act (990/1987), while the decree-level provisions issued under the act will be revised and reorganised. The current Nuclear Energy Decree (161/1988) will be repealed and its provisions will be revised and incorporated in government decrees to be issued under the new act. The new nuclear energy act and the related acts and decrees are intended to enter into force on 1 January 2027.

The government decree on nuclear facilities lays down provisions on the radiation safety of nuclear facilities and transport, on the decision-in-principle of a nuclear facility project, on licensing matters concerning nuclear facilities and nuclear material recovery facilities, on licences for the handling and storage of nuclear waste and on advisory committees in the nuclear sector. Chapter 1 is the key part of the decree in terms of environmental impacts, as it limits the public radiation exposure and releases of radioactive substances resulting from the operation of facilities. The chapter also lays down provisions on preventing a large or early release, on radiation exposure following the closure of a disposal facility and on release from regulatory control.

The environmental assessment of chapter 1 of the decree is based on the Act on the Assessment of the Effects of Certain Plans and Programmes on the Environment (200/2005, SOVA Act), as the decree provides a framework for licence and approval decisions of projects in the energy supply sector. This environmental report contains an assessment of the likely direct and indirect environmental impacts of the decree, as well as information on the terms and uncertainties of the assessment, on consultation, on measures to prevent and reduce adverse impacts and on impact monitoring.

The decree is national in scope and applies to both existing and potential new facilities. As the location, size and other characteristics of new facilities are not known, impacts are assessed at a general level. Impacts specific to each facility and site are assessed as part of project-specific planning and licensing procedures, which include an environmental impact assessment procedure where necessary. The environmental assessment includes a national and a transboundary consultation process.

2 Regulatory provisions to be assessed and key changes

The assessment covers the provisions of chapter 1 of the decree and any changes that they introduce compared with the current regulatory framework.

The comparison is based on the corresponding provisions of the current Nuclear Energy Decree (161/1988). Provisions on limiting radiation exposure and releases of radioactive substances are mainly set out in chapter 3a of the Nuclear Energy Decree. The provisions concerning release from regulatory control are set out in section 10c of the decree. Table 1 sets out the topics to be assessed and indicates which aspects of the proposed regulatory framework are equivalent to the current framework and which will be changed or specified in greater detail. The environmental impacts of the changes are assessed in chapter 7.

Topic	Nuclear Energy Decree (161/1988)	Government Decree on Nuclear Facilities, chapter 1
Normal operation	The dose constraint for nuclear facilities operated by a single licence holder is 0.1 millisieverts per year.	The dose constraint will remain at 0.1 millisieverts per year.
Decommissioning	The dose constraint for the planned decommissioning of a	The dose constraint for decommissioning is 0.1 millisieverts per year.

Topic	Nuclear Energy Decree (161/1988)	Government Decree on Nuclear Facilities, chapter 1
	nuclear facility is 0.01 millisieverts per year.	
Facilities operated by several licence holders in the same area	There is no combined dose constraint laid down at decree level for facilities operated by different licence holders in the same area.	The combined dose constraint for facilities operated by different licence holders is 0.3 millisieverts per year.
Discharge of radioactive substances into a wastewater sewer	There is no separate dose constraint laid down at decree level for radioactive substances discharged into a wastewater sewer.	The dose constraint for public exposure from radioactive substances discharged into a wastewater sewer is 0.01 millisieverts per year.
Anticipated operational occurrences	The limit for potential exposure from an anticipated operational occurrence is 0.1 millisieverts per year.	The limit for potential exposure will remain at 0.1 millisieverts per year.
Class 1 postulated accident	The limit for potential exposure in the event of a Class 1 postulated accident is 1 millisievert per year.	The limit for potential exposure will remain at 1 millisievert per year.
Class 2 postulated accident	The limit for potential exposure in the event of a Class 2 postulated accident is 5 millisieverts per year.	The limit for potential exposure will remain at 5 millisieverts per year.
Design extension condition	The limit for potential exposure from a design extension condition is 20 millisieverts per year.	The limit for potential exposure will remain at 20 millisieverts per year.
Prevention of a large release	In the event of a severe accident at a nuclear power plant, the release limit for caesium-137 discharged to the atmosphere is 100 terabecquerels.	Outside the precautionary action zone, the surface activity concentration of caesium-137 shall not exceed 400 kilobecquerels per square metre.
Prevention of an early release	The likelihood of an early release requiring civil protection measures shall be extremely low. No minimum time is specified for carrying out protective measures.	At least five hours shall be available to take civil protection measures.
Nuclear material recovery facility	The dose constraint for normal operation and decommissioning, and limits on	The dose constraint and the limits on potential exposure will remain largely at their current levels. The combined dose constraint for different licence holders will also

Topic	Nuclear Energy Decree (161/1988)	Government Decree on Nuclear Facilities, chapter 1
	potential exposure from abnormal events.	be extended to cover nuclear material recovery facilities.
Radiation exposure following the closure of a disposal facility	The limit on potential exposure, and radionuclide-specific release limits covering very long periods.	An assessment based on potential exposure in the evolution scenarios forming the basis for the design, together with an assessment of the consequences of evolution scenarios outside the design bases and inadvertent human intrusion.
Release from regulatory control	Exposure criteria for releasing waste-related activities as well as materials, buildings and areas from regulatory control.	The basic regulatory approach will remain unchanged. Exposure during the intended use of a building or a part of a site shall not exceed 0.1 millisieverts per year.

3 Relationship with other regulation and objectives

3.1 Relationship with other regulation

Under the current Nuclear Energy Act, the Nuclear Energy Decree lays down provisions on limiting public exposure to radiation and on the key principles for preparedness for accidents at nuclear facilities. When the new nuclear energy act enters into force, the current Nuclear Energy Decree will be repealed and its provisions will be reorganised in government decrees to be issued under the new act. In addition to the government decree that will be issued on nuclear facilities, decree-level provisions will be laid down on matters including nuclear waste management and nuclear safeguards. The new nuclear energy act lays down provisions on the general conditions, responsibilities, licences and supervision relating to the use of nuclear energy. Chapter 1 of the government decree that will be issued on nuclear facilities contains more detailed provisions on limiting public exposure to radiation and on releases of radioactive substances, and on preparedness for operational occurrences and accidents.

The provisions of the decree relate to the Radiation Act (859/2018) and the Government Decree on Ionizing Radiation (1034/2018) issued under it, which lay down provisions on protecting human health from the harmful effects of ionising radiation. The national regulatory framework is underpinned by the Basic Safety Standards Directive (2013/59/Euratom), the Nuclear Safety Directive (2009/71/Euratom, as amended by Directive 2014/87/Euratom) and Directive 2011/70/Euratom on the management of spent fuel and radioactive waste. Finland is also bound by the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

3.2 Relationship with other plans and programmes

The National Climate Change Adaptation Plan 2030 sets objectives for anticipating and managing climate risks. The link between the plan and the decree currently under review is indirect. Flooding, changes in sea level, drought, forest fires, water temperature and the availability of cooling water may affect the safety of nuclear facilities and the potential consequences of accidents. Sections 2–5 of the decree lay down provisions on limiting public exposure resulting from operational occurrences and accidents and on preventing a large or early release. However, other nuclear facility safety provisions govern the detailed

assessment of and preparedness for external hazards associated with climate change, and they set requirements for each facility.

The National Programme for the Management of Spent Nuclear Fuel and Radioactive Waste addresses the safe management of spent nuclear fuel and radioactive waste generated in Finland. Sections 1, 7 and 8 of the decree are linked to the programme, as they concern the dose constraint for decommissioning, radiation exposure following the closure of a disposal facility and release from regulatory control.

3.3 Environmental protection objectives relevant to the decree

Protection of the public and the environment from the harmful effects of ionising radiation

The Convention on Nuclear Safety aims to maintain effective protection against potential radiological hazards at nuclear facilities, prevent accidents with radiological consequences and mitigate the consequences of any such accidents. The Nuclear Safety Directive 2009/71/Euratom, as amended, requires a high level of nuclear safety and the protection of the general public from the dangers of ionising radiation. The Basic Safety Standards Directive 2013/59/Euratom lays down basic safety standards for protecting the health of members of the public and workers. These objectives relate to chapter 1 of the decree as a whole and, in particular, to sections 2–5 on operational occurrences and accidents.

The International Commission on Radiological Protection (ICRP) issues recommendations on protection against ionising radiation. The general principles of the ICRP system of radiological protection are set out in ICRP Publication 103, published in 2007 (the 2007 Recommendations). Among other matters, the Recommendations address the justification of practices, optimisation of protection, the application of dose limits and dose constraints, and different exposure situations. In addition, individual subject areas covered by the decree are subject to the ICRP's topic-specific recommendations. The International Atomic Energy Agency (IAEA) publishes safety principles, requirements and safety guides concerning nuclear and radiation safety. Their fundamental aim is to protect people and the environment from the harmful effects of ionising radiation, both now and in the future. In the decree, these objectives are reflected in dose constraints, in provisions on preparedness for operational occurrences and accidents and in requirements for preventing a large or early release.

Safety of nuclear waste management and the protection of future generations

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management aims to protect people, society and the environment from radiation risks now and in the future. The aim of the directive on the management of spent fuel and radioactive waste (2011/70/Euratom) is to ensure responsible and safe management of spent fuel and radioactive waste while avoiding undue burdens on future generations. These objectives are taken into account in the decree in sections 1, 7 and 8, which concern decommissioning, radiation exposure following the closure of a disposal facility and release from regulatory control.

Protection of waters, the marine environment and biodiversity

The aim of water management plans is to ensure that surface waters and groundwater achieve at least good status and to prevent any deterioration in their status. The aim of Finland's Marine Strategy is to achieve and maintain good environmental status in the marine environment. The decree is indirectly linked to these objectives, as its provisions limit releases of radioactive substances and the consequences of potential accidents.

Safe and functional urban structure and land use

According to the national land use objectives, land use planning shall make provision for the needs of comprehensive security in society and prevent harm and risks to health and safety. The consequence-

based restrictions in section 5 of the decree are linked to these objectives, as the characteristics of the facility, the settlements surrounding the facility and other societal functions shall be reconciled with one another so as to limit the possibility of a large or early release and the resulting need for protective measures.

Taking environmental protection objectives into account

The environmental protection objectives described above have been taken into account in the decree primarily through provisions limiting public exposure and releases of radioactive substances, preventing accidents and limiting their consequences, ensuring the long-term safety of nuclear waste management and governing release from regulatory control. The decree is linked to objectives concerning energy, climate, water, nature, the circular economy and land use, although some of these links are indirect. Their achievement also depends on other regulation, planning and project-specific decision-making.

4 Current state of the environment and its likely development in the absence of the decree

The decree is national in scope and does not designate sites for nuclear facilities. It applies to nuclear power plants, nuclear technical facilities, disposal facilities and, insofar as specifically provided for in the decree, nuclear material recovery facilities. In Finland, activities are currently carried out in Loviisa, Olkiluoto and Sotkamo. The decree also applies to potential new facilities whose locations and characteristics are not yet known. For this reason, the current state of the environment, the characteristics of the likely affected areas or regional environmental problems cannot be described in a single coherent overview.

In the baseline scenario, the state of the environment would develop in line with the current regulatory framework and facility licences and would be shaped by the operation and decommissioning of facilities and by nuclear waste management. Accommodating new technologies and facility complexes involving multiple operators within the current regulatory framework could require case-by-case interpretation.

The characteristics of the areas concerned, local environmental issues and any potential impacts on Natura 2000 sites will be assessed in procedures specific to each facility and site.

5 Environmental assessment and consultation

The environmental impacts of the decree have been assessed as part of the decree drafting process. Statements on the environmental assessment plan were requested from authorities, and the public was given an opportunity to submit opinions. The feedback received has been taken into account insofar as it relates to chapter 1 of the decree under review and is relevant to the assessment.

The consultation process on the assessment of transboundary environmental impacts was initiated by notifying the states in whose territories implementation of the decree could have significant environmental impacts of the environmental assessment. Sweden and Norway announced that they would take part in the consultation on the decree and the environmental report. Estonia, Latvia, Lithuania and Romania requested that they be provided with information on the results of the assessment or on the adopted decree.

On the basis of the feedback, the following, in particular, were specified: the comparison of the current and the proposed regulatory frameworks; the assessment of the key substantive solutions and cumulative impacts; indirect impacts; climate change adaptation; impacts on the natural environment, and transboundary impacts; and the prevention and monitoring of adverse impacts.

6 Basis of the assessment, and the method of assessment

The assessment is based on a comparison of the substantive solutions of chapter 1 of the decree with the current regulatory framework. For each substantive solution, the assessment examines the changes it makes to the regulatory framework and the chain of effects through which those changes may affect people or the environment.

The significance of the impacts is assessed verbally, taking into account the likelihood, magnitude, duration, geographical extent and reversibility of the impact. Assessments of potential exposure consider separately the likelihood of an event and the magnitude of potential exposure.

The main uncertainty in the assessment stems from the fact that the impacts of the decree arise mainly indirectly through the design, operation, decommissioning and disposal of nuclear facilities. The actual impacts depend on facility-specific and site-specific solutions that are not known when the decree is adopted.

The assessment is qualitative and based on expert judgement. It examines the direct and indirect, positive and negative, short-term and long-term impacts arising from the substantive solutions of the decree. The assessment also takes account of the cumulative impacts and the possibility that impacts may extend beyond Finnish territory. The assessment is based on a comprehensive evaluation of the decree and its explanatory memorandum, the current regulatory framework, the material received during the consultation and other available information.

7 Impacts of the substantive solutions of the decree

This chapter assesses the impacts of the substantive solutions of chapter 1 of the decree compared with the current regulatory framework. The assessment distinguishes between provisions that remain unchanged, new restrictions and changes in the way provisions are presented that are not expected to substantially alter the level of protection. The impacts are mainly indirect, arising through the design and operation of nuclear facilities, the management of releases, decommissioning, disposal and release from regulatory control.

7.1 Normal operation, decommissioning, facilities operated by multiple licence holders and discharges into a wastewater sewer (section 1)

7.1.1 Normal operation

The dose constraint for the normal operation of a single licence holder's nuclear facilities and related activities located within the same area where movement and stay are restricted will remain at 0.1 millisieverts per year. In future, the same dose constraint will apply consistently to all nuclear facilities. The change clarifies the regulation of different types of facility but does not change the maximum permitted exposure during normal operation and is not in itself expected to change actual releases or public exposure.

The dose constraint ensures that exposure to an individual member of the public from the activities remains low compared with exposure from natural radiation sources or other human activities and well below the dose limit for members of the public. The dose constraint is not a target level of exposure, but rather a maximum level that sets limits on design and the control of releases. Exposure shall continue to be kept as low as reasonably achievable.

7.1.2 Decommissioning

The dose constraint for decommissioning will increase from 0.01 to 0.1 millisieverts per year, bringing it to the same level as for normal operation. The change increases the maximum exposure permitted by the regulatory framework during decommissioning and therefore has a negative impact in this respect.

However, the new dose constraint is considered sufficiently low to ensure that harmful health effects resulting from radiation remain unlikely and that exposure remains low compared with exposure from other radiation sources.

The current dose constraint of 0.01 millisieverts has been considered unnecessarily low for decommissioning because it could lead to safety arrangements disproportionate to the risk posed by the activity. Due to the dismantling and decontamination work carried out during decommissioning, materials containing radioactive substances are handled on a larger scale than during normal operation, and the nature of the releases may differ. However, an increase in the dose constraint does not in itself imply a corresponding increase in actual releases or health effects. The dismantling phase of decommissioning is also considerably shorter than the period of normal operation, which limits the impact of the change on the overall risk associated with the activity. Exposure shall continue to be kept as low as reasonably achievable.

7.1.3 Cumulative impacts of multiple licence holders

If nuclear facilities operated by more than one licence holder are located within the same area where movement and stay are restricted, the combined dose constraint for the normal operation and decommissioning of the nuclear facilities and related activities in that area is 0.3 millisieverts per year. The provision addresses a new kind of situation in which several licence holders operate in the same area, and it sets a combined maximum level for public exposure resulting from the cumulative impact of their operations. This allows to ensure that exposure will remain low and well below the dose limit for members of the public. Furthermore, the combined dose constraint also leaves room for any possible exposure that may result from other licensed activities.

The combined constraint has a particular impact on the design of a new facility in an area where another licence holder is already operating. The dose constraint for a new facility may need to be set below 0.1 millisieverts to ensure that the combined constraint for the area is not exceeded. Coordinating the constraints may also require cooperation between licence holders operating in the area.

7.1.4 Discharge of radioactive substances into a wastewater sewer

A new annual dose constraint of 0.01 millisieverts is introduced for public exposure from radioactive substances discharged into a wastewater sewer referred to in the Water Services Act. The separate constraint brings this release pathway, which may be used in new nuclear facility designs, within the regulatory framework. The constraint is one tenth of the dose constraint otherwise set for normal operation and keeps exposure from this release pathway low.

The person most exposed to a discharge into a wastewater sewer may not be the same as the person most exposed through the other release pathways of the nuclear facility. Exposure may be affected by the accumulation of long-lived radionuclides, for example in pipework or in wastewater treatment sludge. Application of the provision requires that, where necessary, a nuclear facility have the capacity to treat water before discharging it into a wastewater sewer so that the dose constraint is not exceeded. In some facility designs, the use of this release pathway may constitute best available techniques.

7.2 Operational occurrences and postulated accidents (sections 2–4)

The limits on potential exposure for anticipated operational occurrences, Class 1 and Class 2 postulated accidents and design extension conditions will remain at their current levels. The decree therefore does not change the level of radiological consequences permitted for these events. The graduated restrictions preserve the principle that the more likely an event is, the lower the exposure or potential exposure shall be.

The restrictions guide the design of a nuclear facility and its preparedness arrangements so that the facility has available adequate means to limit the consequences of operational occurrences and

accidents. If an operational occurrence or accident were to occur, the consequences would depend on the amount and composition of the release, and on the facility, the site, weather and water conditions and the protective measures taken. As the event categories and restriction levels remain equivalent to those in the current regulatory framework, their effect in preventing and limiting harmful radiological consequences also remains unchanged.

7.3 Prevention of a large or early release (section 5)

The current caesium-137 release limit of 100 terabecquerels for a severe accident at a nuclear power plant will be replaced by consequence-based provisions applying to all nuclear facilities. The surface activity concentration of caesium-137 in fallout outside the precautionary action zone shall not exceed 400 kilobecquerels per square metre. In addition, at least five hours shall be available to take protective measures to limit the harmful effects of radiation on the public, and the likelihood that these conditions are not met shall be extremely low.

The surface activity concentration limit is intended to prevent long-term fallout that could lead to extensive and long-lasting restrictions on the use of land and water areas. The five-hour requirement, in turn, reduces the possibility of an early release requiring protective measures for the public during the early stages of an accident. The provisions guide facility design so as to limit both the consequences of a release and the likelihood of situations in which the conditions would not be met.

Consequence-based regulation enables the siting of a nuclear facility to be assessed in relation to the population surrounding the facility and to other societal functions in a manner commensurate with the risk significance of the facility. The closer a facility is to residential areas or other societal functions, the more limited in scope the protective measures and use restrictions resulting from a potential release shall be. This may make it possible to site facilities with smaller quantities of radioactive substances or having advanced safety characteristics closer to residential areas than existing nuclear facilities, provided that their safety is otherwise adequately ensured. However, the risk associated with the siting of the facility shall be kept sufficiently low regardless of the type of facility.

Caesium-137 serves as an indicator of long-term impacts because limiting its release also limits releases of other long-lived substances that are significant in terms of environmental impacts. However, the other components of an actual release shall be taken into account to the extent that they affect public exposure and the need for protective measures. For existing nuclear facilities, the surface activity concentration limit is expected to be broadly equivalent to the current caesium-137 release limit. The change therefore primarily concerns the regulatory approach rather than a reduction in the targeted level of protection.

7.4 Nuclear material recovery facilities (section 6)

The dose constraint for the normal operation and decommissioning of a nuclear material recovery facility remains 0.1 millisieverts per year. The constraint is assessed to be sufficiently low to ensure that harmful health effects from radiation remain unlikely and that exposure from the activity remains low compared with exposure from other radiation sources.

The design of a nuclear material recovery facility shall provide for abnormal events. If a single event can be expected to occur more than once every 10 years, the limit on potential public exposure resulting from that event is 0.1 millisieverts. For other single events, potential public exposure shall not exceed 1 millisievert, except in the case of an extremely unlikely event or sequence of events whose probability of occurrence cannot be reduced by reasonably achievable measures. The limits are largely in line with the current regulatory framework. The 1 millisievert limit corresponds to the limit set for nuclear facilities in Class 1 postulated accidents.

What is new is that the combined dose constraint laid down in section 1, subsection 2, applies to exposure resulting from the cumulative impact of different licence holders' nuclear material recovery facilities and nuclear facilities located within the same area where movement and stay are restricted. This

clarifies how the cumulative impacts of activities located in the same area are managed. The decree does not alter the regulatory framework governing other environmental impacts of mining and metal production activities.

7.5 Radiation exposure following the closure of a disposal facility (section 7)

The assessment of radiation exposure following the permanent closure of a disposal facility shifts from radionuclide-specific release limits covering very long periods to an exposure-based approach. In the design-basis evolution scenarios, the limit on potential exposure is 0.1 millisieverts per year over a period of at least several thousand years during which post-closure radiation exposure to people in the area can be assessed with sufficient reliability. After this period, the aim remains to keep the maximum level of annual potential exposure at 0.1 millisieverts and no higher than at the level of radiation exposure from naturally occurring radioactive substances in the ground.

An exposure-based approach combines potential exposure to members of the public resulting from different radionuclides and migration pathways into a single assessment and focuses the safety assessment on potential consequences. Advances in modelling capabilities mean that radionuclide-specific release limits covering very long periods are no longer needed. The change also allows minor operational changes to be dealt with more flexibly than at present. This does not mean that radioactive substances are assumed to be released from a disposal facility into the environment. Instead, the decree sets acceptability criteria for the evolution scenarios considered in the safety case.

The design-basis evolution scenarios include changes in climate and in other environmental conditions and phenomena arising from interactions within the disposal system. Because of the uncertainties associated with very long periods, the results of exposure assessments serve as safety indicators and cannot be interpreted in the same way as projections dealing with the present day. The ICRP's Recommendations support the use of exposure-based or probability-based criteria in this assessment.

The consequences of non-design-basis evolution scenarios and inadvertent human intrusion are assessed separately. The objective is to ensure that these situations do not cause regionally widespread radiological impacts on the environment arising from disposed radioactive substances. The same dose limit that applies to the design-basis evolution scenarios does not apply to these situations. Overall, the change relates to the method of demonstrating long-term safety and does not lower the targeted level of protection.

7.6 Release from regulatory control (section 8)

An activity relating to waste does not cause harm to health if exposure of an individual member of the public is no more than approximately 0.01 millisieverts per year. In addition, an activity is inherently safe if workers do not need to be classified as radiation workers and the potential exposure to an individual member of the public as a result of an accident, another unlikely event or a comparable exceptional situation does not exceed 1 millisievert per year.

A nuclear facility building, its part or a part of the site may be released from regulatory control if the estimated exposure resulting from them to an individual member of the public is no more than approximately 0.01 millisieverts per year. A building or its part may also be released from regulatory control on the basis of its intended use if the estimated exposure does not exceed 0.1 millisieverts per year. Release that is based on intended use may require use restrictions. The regulatory framework largely corresponds to the regulation currently in force.

Where the conditions are met, release from regulatory control allows materials to be recycled, buildings to be reused and areas to be put to other uses while keeping exposure low. This may reduce the amount of material treated as radioactive waste and disposed of. The magnitude of the impact depends on the scale and characteristics of the materials, buildings and areas released and on their intended use and any possible use restrictions. The same provisions also apply, as laid down in the decree, to waste,

buildings and parts of the site containing naturally occurring radioactive substances at a nuclear material recovery facility.

8 Impacts by environmental factor

This chapter describes the impacts of the substantive solutions assessed above, broken down by environmental factor. The assessment considers the changes introduced by the decree compared with the current regulatory framework and how those changes affect the protection of people and the environment. The consequences of accidents are addressed only to the extent necessary to assess the impacts of the decree.

8.1 Population, human health, living conditions and amenity

The main impacts of the decree on human health relate to limiting public radiation exposure. The limit levels for normal operation, operational occurrences and postulated accidents remain largely unchanged, so the level of protection of the public does not change in this respect. Increasing the dose constraint for decommissioning raises the maximum permitted exposure but does not mean that actual exposure will rise to the same level. The combined dose constraint for different licence holders and the dose constraint for radioactive substances discharged into a wastewater sewer provide more specific controls on total exposure and on a separate exposure pathway. When assessing impacts on the public, the number of people exposed and the likelihood of exposure are relevant in addition to the magnitude of the dose.

The regulation on operational occurrences and accidents prevents and limits public exposure. Any health effects resulting from a release depend on the amount and composition of the release, and on the exposure pathways, the location of the population, and protective measures. The five-hour time limit for preventing an early release reduces the possibility of a situation that would require protective measures for the public during the early stages of an accident.

Impacts on living conditions and amenity relate particularly to protective measures that may be required in the event of an accident and to restrictions on the use of foodstuffs, water or areas. Such measures and restrictions could affect people's daily lives, their livelihoods and their access to services. The dose constraints in the decree and the provisions on preventing a large or early release reduce the likelihood of these impacts and limit their extent.

8.2 Soil, surface waters and groundwater

The impacts of the decree on soil, surface waters and groundwater relate to limiting releases of radioactive substances and the resulting exposure. Keeping the dose constraint for normal operation unchanged does not alter the current level of protection. The new dose constraint for radioactive substances discharged into a wastewater sewer provides more specific control of the exposure pathway arising through wastewater treatment and the receiving water body. At facilities using this release pathway, the change may require more specific arrangements for treating water discharged into the sewer and controlling releases. The environmental behaviour of radioactive substances, including migration in water and accumulation in pipework or in fractions generated during wastewater treatment, affects the exposure arising through this release pathway.

The surface activity concentration limit for caesium-137 reduces the possibility of long-term radioactive fallout that could lead to extensive and long-lasting restrictions on the use of land and water areas. The limit therefore protects soil and waters and safeguards their use. Caesium-137 serves as an indicator of the key consequences of long-term fallout because limiting its release also limits releases of other long-lived substances that are significant in terms of environmental impacts. The other components of a release are taken into account to the extent that they affect public exposure and the need for protective measures.

The safety assessment following the permanent closure of a disposal facility examines the potential release of radioactive substances from the repository and their migration through bedrock, groundwater, soil, surface waters and other pathways. The limits on potential exposure require the disposal system to be designed to limit releases and migration so that potential public exposure does not exceed the specified limits.

8.3 Biodiversity, biota and vegetation

The decree sets dose constraints for an individual member of the public but does not lay down dose limits for biota or other assessment criteria. For this reason, there is uncertainty in assessing the impacts of the decree on biodiversity, biota and vegetation, and compliance with the dose constraints for the public does not in all circumstances directly demonstrate that all species and habitats are adequately protected. However, preventing and limiting releases of radioactive substances also reduces the likelihood of exposure of biota. Exposure of biota is influenced by the quantity and properties of substances, their transport through the air, water and soil and their accumulation in organisms and food webs.

The limit levels for normal operation, operational occurrences and postulated accidents remain largely unchanged, so the protective effect on the natural environment does not change in this respect. The higher dose constraint for decommissioning increases the maximum permitted exposure, making control of releases to the environment particularly important during dismantling and decontamination. The surface activity concentration limit for preventing a large release reduces the possibility of long-term radioactive fallout outside the precautionary action zone and thus helps prevent radiological impacts on habitats, biota and vegetation.

The decree does not designate any sites for facilities; therefore, the impacts on individual protected areas, species or habitat types cannot be assessed on the basis of the decree. These impacts will be assessed in procedures specific to each facility and site. The provisions of the decree that limit releases and exposure prevent and limit radiological harm to the natural environment.

8.4 Urban structure, land use, the built environment and material assets

The impacts of the decree on urban structure and land use relate particularly to dose constraints and provisions on preventing a large or early release. The safety characteristics of a nuclear facility, the surrounding population, other societal functions in the area and the feasibility of protective measures for the public shall be reconciled with one another. The decree does not designate any sites or determine whether an individual project will be implemented, but its safety provisions affect what type of a facility can be built in a particular type of urban structure.

The fact that the restrictions for normal operation, operational occurrences and postulated accidents remain largely unchanged does not alter the basis on which these factors are reconciled. Consequence-based regulation enables the siting of a nuclear facility to be assessed in relation to surrounding population and other societal functions in a manner commensurate with the risk significance of the facility. A facility with a smaller quantity of radioactive substances or advanced safety characteristics may potentially be sited closer to residential areas and other societal functions than existing nuclear facilities, provided that safety is otherwise adequately ensured and the risk associated with siting remains sufficiently low. The regulatory framework may therefore also make it possible to site facilities in built environments that differ from those of existing nuclear facilities. In such cases, projects may have greater impacts on urban structure, land use, the built environment and material assets than would be the case at existing facility sites. The occurrence and significance of these impacts depend on the location and implementation of the facility and are assessed in facility-specific and site-specific procedures. At the same time, limiting a large or early release and long-term fallout reduces the possibility that restrictions

would need to be imposed on residential use, economic activity, recreational use or other land use in the event of an accident.

Regulation on decommissioning and on release from regulatory control affects the subsequent use of buildings, structures, materials and areas. Release from regulatory control allows them to be used without being subject to control under the Nuclear Energy Act when the exposure criteria set out in the decree are met. If release from regulatory control is based on a specified intended use, subsequent use may at the same time need to be restricted to be consistent with that use.

8.5 Natural resources use, waste and the circular economy

The impacts of the decree on waste and the circular economy relate primarily to release from regulatory control. If the criteria for release from regulatory control are met, materials may be reused, recycled or managed through conventional waste management instead of being treated and disposed of as radioactive waste. This may reduce the amount of material treated as radioactive waste and disposed of. The impact depends on the amount of material released from regulatory control and the purposes for which it may be used.

The change in the dose constraint for decommissioning does not determine the amount of radioactive waste generated during decommissioning. The amount of waste depends particularly on the dismantling and decontamination methods used, the radioactivity of the materials and the possibility of releasing materials from regulatory control. Arrangements for controlling releases during decommissioning and for the subsequent use of materials shall be planned so that both the restrictions on public exposure and the requirements for release from regulatory control are met.

In an accident, radioactive fallout reaching the environment could restrict the use of agricultural land, forests, fisheries, game, surface waters and groundwater. The regulation on preventing a large release and limiting long-term fallout reduces the possibility of such natural resources use restrictions.

8.6 Air

The impacts of the decree on air relate to limiting public exposure from airborne releases of radioactive substances. The dose constraint of 0.1 millisieverts for normal operation remains unchanged, so the level of maximum exposure from airborne releases does not change in this respect.

Limits on potential exposure for operational occurrences and postulated accidents also limit exposure from radioactive substances dispersed through the air. The regulation on preventing a large or early release reduces the possibility of an airborne release and long-term fallout and limits their consequences. The regional extent of the consequences would depend on the amount and composition of the release and on weather conditions.

8.7 Climate

The decree has no direct impact on the climate because it does not decide on the amount of energy production, the method of production or the implementation of nuclear facility projects. Nor does the decree contain technical provisions on climate change adaptation. However, changing environmental conditions may affect how compliance with the dose constraints and the provisions on preventing a large or early release is demonstrated for an individual project. In the long-term evolution scenarios for a disposal facility, changes in environmental conditions form part of the assessment of post-closure radiation exposure.

8.8 Landscape, townscape and cultural heritage

The decree does not decide the location of nuclear facilities, the size or appearance of buildings, the construction method or changes to the cultural environment. The decree is therefore not expected to have direct impacts on landscape, townscape or cultural heritage. Consequence-based regulation may, however, allow a nuclear facility project to be considered in a setting different from that of existing nuclear facilities. Any impacts on landscape, townscape and cultural heritage resulting from this depend on the location and implementation of each project and are assessed in project-specific procedures.

8.9 Interactions between environmental factors

The substantive solutions of the decree affect several environmental factors through the same release and exposure pathways. Limiting releases of radioactive substances to air, water and soil also reduces exposure of the public and biota and the possibility of restrictions on the use of land and water areas. Limiting a large or early release and long-term fallout protects the public and also helps prevent impacts on urban structure, livelihoods, natural resources and land use.

In the context of decommissioning and release from regulatory control, the impacts relate not only to public exposure but also to the subsequent use of buildings, areas and materials and to the amount of radioactive waste. Releasing materials and other items from regulatory control may allow them to be reused and reduce the amount of waste requiring disposal if the exposure criteria are met. Increasing the dose constraint for decommissioning has the opposite effect in this respect, as it increases the maximum exposure permitted at that stage.

9 Transboundary environmental impacts

The dose constraint for normal operation and the limits on potential exposure for operational occurrences and postulated accidents remain unchanged. In these respects, the decree does not substantially alter the potential for transboundary environmental impacts compared with the current regulatory framework.

The regulation on preventing a large or early release will become consequence-based. The regulation also prevents and limits potential transboundary impacts. The change is not expected to substantially alter the current level of protection.

10 Significance of impacts

The overall impacts of the decree on the environment and human health are assessed as minor. Most of the restrictions remain at their current levels, so the impacts are largely neutral. Increasing the dose constraint for decommissioning has a negative but minor impact. The combined dose constraint for different licence holders and the dose constraint for radioactive substances discharged to a wastewater sewer have minor positive impacts.

The change in the regulation on preventing a large or early release does not substantially alter the level of protection at existing facilities. Consequence-based regulation may affect the siting of new facilities and thus indirectly affect urban structure, land use, the built environment and material assets. The significance of these impacts cannot be assessed in general terms without facility-specific and site-specific solutions. The change concerning disposal is neutral in terms of the level of protection, while the impacts of release from regulatory control are minor and, in terms of the circular economy, positive.

By individual environmental factor, the impacts on public health, soil and waters, biodiversity, air and the use of natural resources are mainly minor and, from a protection perspective, either neutral or positive. However, there is some uncertainty in assessing impacts on biodiversity, biota and vegetation. The

decree has no direct impact on the climate. Any indirect impacts on landscape, townscape and cultural heritage depend on project-specific solutions. The significance of transboundary impacts will not change substantially compared with the current situation.

11 Prevention, reduction and monitoring of adverse environmental impacts

The decree prevents and reduces adverse environmental impacts by limiting public radiation exposure and releases of radioactive substances. Limits on potential exposure for operational occurrences and postulated accidents and the regulation on preventing a large or early release guide the design of nuclear facilities so as to prevent releases of radioactive substances and limit their potential consequences. The regulation on decommissioning, radiation exposure following the closure of a disposal facility and release from regulatory control limit adverse impacts in the later stages of a facility's lifecycle.

As the purpose of the decree is to prevent and reduce adverse environmental impacts, the assessment has not identified a need for separate supplementary measures.

Monitoring of the effectiveness of the regulatory framework also covers the application and environmental impacts of the decree. Monitoring draws particularly on information gathered through the oversight activities of the Radiation and Nuclear Safety Authority and on the experience gained from the application of the decree. The monitoring data will be used to assess the impacts of the decree and any need for amendments and will also inform subsequent legislative drafting.

12 Conclusions

This environmental report assesses the environmental impacts of chapter 1 of the Government Decree on Nuclear Facilities compared with the current regulatory framework. The chapter limits public radiation exposure from the operation of nuclear facilities and nuclear material recovery facilities and lays down provisions on preventing a large or early release, on radiation exposure following the permanent closure of a disposal facility and on release from regulatory control. The overall impacts of the decree on the environment and human health are assessed as minor because most of the restrictions will remain at their current levels.

The key changes concern the dose constraint for decommissioning, the combined dose constraint for facilities of different licence holders, radioactive substances discharged to a wastewater sewer and the prevention of a large or early release. Raising the dose constraint for decommissioning increases the maximum permitted exposure, but the impact is considered minor. The combined dose constraint and the dose constraint for discharges to a wastewater sewer provide more specific controls on exposure. The change concerning disposal primarily affects how long-term safety is demonstrated, while the provisions on release from regulatory control may promote the reuse of materials, buildings and areas.

The consequence-based regulation on preventing a large or early release reduces the possibility of long-term fallout and ensures that time is available for protective measures for the public. The regulation may also enable the siting of a nuclear facility to be assessed in relation to the surrounding population and other societal functions in a manner commensurate with the risk significance of the facility. The impacts of the decree on the public, soil and waters, biodiversity, air, the use of natural resources, urban structure and land use arise mainly through the limiting of exposure, releases and long-term fallout and through impacts influencing facility design and the subsequent use of materials. The decree has no direct impact on the climate, and the significance of transboundary impacts will not be affected in any substantial degree compared with the current situation.

The key uncertainty in the assessment is that the specific distribution and significance of the impacts depend on the characteristics of the facilities and on facility-specific and site-specific solutions, which are not known at the time the decree is adopted. Furthermore, there is some uncertainty in assessing impacts on biodiversity, biota and vegetation. Adverse impacts are prevented and reduced through the dose constraints laid down in the decree and through provisions limiting releases of radioactive

substances and their consequences. Monitoring of the effectiveness of the regulatory framework also covers the application and environmental impacts of the decree.

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