SEA assessment report

Radiation and Nuclear Safety Authority regulation on the technical safety requirements for nuclear power plants

STUK 27/0007/2025

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1 Introduction

A comprehensive reform of the regulations and regulatory guides issued by the Radiation and Nuclear Safety Authority (STUK) is being implemented as a result of the legislative reform concerning the Nuclear Energy Act (TEM032:00/2023). The purpose of the comprehensive reform of regulations is to update legislation and lower-level regulations to meet regulatory needs arising from other legislation, technological developments and changes in the operating environment.

The primary objective of the reform is to ensure that the use of nuclear energy is in the overall interest of society, to ensure the safety of operations and the appropriate management of nuclear waste and other radioactive waste in Finland, and to comply with international and Euratom obligations relating to nuclear safety and nuclear material control. At the same time, the aim is to speed up the implementation of nuclear facility projects and otherwise create conditions for improving the cost-effectiveness of nuclear energy production.

2 Basis for the SEA assessment

The Radiation and Nuclear Safety Authority's regulations are being revised as part of an overall reform to bring them into line with current legislation on regulatory requirements and guidelines issued by the authorities. The reform of the regulations includes 24 Radiation and Nuclear Safety Authority regulations on technical details related to various topics. Of these regulations, 22 have been deemed to be relevant to the Act on the Assessment of the Effects of Certain Plans and Programmes on the Environment (200/2005, hereinafter referred to as the SEA Act) in the sense that they would contribute to creating a framework for project licensing or approval decisions.

The regulations issued by the Radiation and Nuclear Safety Authority do not in themselves form the basis for the licensing or approval decisions referred to in the Nuclear Energy Act, but together with the new Nuclear Energy Act and Government Decrees, they form a whole in which, in particular, the details relating to the technical approval and safety-related acceptability of nuclear facility projects are based in many respects on the STUK regulations in various areas of safety. From the perspective of environmental impact assessment, the STUK regulations that set requirements for nuclear power plants, nuclear technical facilities, disposal facilities and nuclear material recovery facilities are relevant.

With regard to the environmental assessment related to the regulations, it should be noted that individual regulations do not in themselves form a framework for licensing or approval decisions, but in this respect the regulations must be understood as a whole, covering different areas of safety. However, since a separate decision is made on each of the Radiation and Nuclear Safety Authority's regulations and the regulations are not approved as a whole, each of them constitutes a separate decision within the meaning of the SEA Act. For this reason, the Radiation and Nuclear Safety Authority has attached its own environmental report to each regulation, taking into account the environmental impacts of the specific regulation, but also the broader impacts of the regulations as a whole. Depending on the regulation, there is considerable variation in the extent to which the regulation can be assessed as having environmental impacts as such, but they are nevertheless considered to be part of the whole.

It is typical for nuclear facility projects that they always involve an environmental impact assessment procedure (EIA procedure) in accordance with the Act on Environmental Impact Assessment Procedure (252/2017, hereinafter referred to as the EIA Act), which in practice always assesses the case-specific environmental

impacts of the projects. The regulations issued by the Radiation and Nuclear Safety Authority create a framework for these projects, but in many respects the concrete impacts can only be assessed in project-specific EIA procedures. This is mainly because the impacts depend on:

- the site location, its characteristics, the natural environment and the built environment in the surrounding area;
- the type of facility, i.e. whether it is a power plant, a facility used for the processing or storage of nuclear waste, a disposal facility or a nuclear material recovery facility;
- the chosen plant technology;
- the nature of the nuclear waste generated.

The primary objective of the Radiation and Nuclear Safety Authority's regulations is to ensure the safety of nuclear facilities and to prevent the harmful effects of radiation. In other words, the requirements aim to prevent harmful effects caused by radiation on people and the environment. The regulations therefore mainly focus on radiological effects. For this reason, the environmental assessment is approached particularly from the perspective of what effects the requirements are intended to prevent and what effects may arise in exceptional situations where the obligations have not been complied with, could not be complied with or, for example, an accident has occurred.

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3 Alternatives and the chosen solution

Requirements corresponding to the proposed STUK regulations are currently presented in five regulations and in the YVL guides issued by STUK. The proposed regulations cover the same areas as the current regulations and YVL guides, but are less detailed in nature.

As a result of the comprehensive reform of the Nuclear Energy Act it is necessary in practice to amend the regulations issued by the Radiation and Nuclear Safety Authority in relation to the current regulatory framework. When the old Act is repealed, the regulations and legal norms issued under it will also be repealed, unless otherwise specified. For this reason, maintaining the current situation with regard to the standards issued by the Radiation and Nuclear Safety Authority, i.e. the so-called zero-alternative, cannot be considered a realistic alternative to the proposed solution. In terms of impact, however, such a zero-alternative would not significantly change the overall environmental impact of the regulations, as there are no plans to tighten or relax the requirements compared to the current regulations.

In theory, one option could be that no regulations would be issued by the Radiation and Nuclear Safety Authority under the new Act, in which case the regulation of activities would be based solely on the Act and the decrees issued under it. However, this option cannot be considered favourable in terms of environmental impact, as a significant amount of activities with environmental impact take place at a detailed level. In the absence of requirements, there would be a risk that safety-related aspects would not be taken into account comprehensively in all necessary areas, which would increase the risk of harmful environmental impacts.

Various options have been assessed with regard to the requirements of the regulations, particularly in terms of regulatory precision. The general starting point in the preparation has been goal-oriented and technology-neutral regulation. An alternative to this approach is technology-specific and, on the other hand, very detailed regulation. Such an alternative may, to some extent, lead to more uniform procedures for operational solutions, but it leaves less room for manoeuvre to implement solutions in the most appropriate way for the facility and its organisation. The downside of detailed regulation is generally seen as regulatory rigidity and the fact that it is not always possible to identify all situations in advance. This creates a

risk of regulatory gaps, which can also lead to undesirable outcomes from an environmental perspective.

The proposed obligations in the regulations have been selected in such a way that they correspond to the recommendations and guidelines set by the International Atomic Energy Agency (IAEA) and the Western European Nuclear Regulators Association (WENRA) for the safe operation of nuclear facilities in various areas of activity. The use of these recommendations and guidelines as the basis for nuclear regulation is an internationally established practice that has also been followed in Finland for a long time. In addition, the regulatory framework is also based on EU legislation on nuclear facilities and radiation safety, which must be implemented nationally.

4 Background, objectives and key proposals of the regulation

4.1 Background

Requirements concerning the technical safety of nuclear power plants are currently included in the Radiation and Nuclear Safety Authority's regulation on the safety of a nuclear power plant (STUK Y/1/2018) and, in particular, in the Radiation and Nuclear Safety Authority's guides YVL B.1, YVL B.2, YVL B.4, YVL B.5 and, in part, in guides YVL A.7, YVL B.3, YVL B.7 and YVL B.8. The entry into force of the new Act requires the requirements to be brought into line with it, and in this context, it has been found necessary to take into account changes in nuclear power plant technology in the requirements and to improve compatibility with international requirements.

The key international requirements concerning the safety design of nuclear power plants are the WENRA Statement on Safety Objectives for New Nuclear Power Plants, 2010, and the WENRA Safety Reference Levels for Existing Reactors, 2020. The IAEA's key requirements are presented in Safety of Nuclear Power Plants: Design SSR-2/1, Rev. 1.

4.2 Objectives and key proposals

The objective of the regulation is to provide technical safety requirements for nuclear power plants at the regulatory level based on the new Nuclear Energy Act. Another objective is to take into account developments in the design solutions of nuclear power plants. In preparing the regulation, the level of requirements has also been reviewed in relation to international requirements, mainly with regard to the references mentioned in the previous chapter.

The regulation amends or clarifies several requirements in relation to those currently in force, the most significant changes being listed below. In addition, the total number of requirements will be significantly reduced compared to the current level through generalisation, consolidation or removal, but it is also necessary to add certain requirements, such as those concerning remote control rooms. The aim of the changes is to maintain the overall safety level of nuclear power plants at the same level as before, but to increase flexibility in design solutions.

The fault tolerance requirements for systems needed to manage postulated accidents are relaxed. A separate subsystem for maintenance or repair preparedness is no longer required; instead, there is a more general requirement for preparedness for maintenance and repairs.

The requirement for single-fault tolerance of systems necessary for managing extensions of postulated accidents involving common cause failures and for managing severe reactor accidents will be made less stringent. Furthermore, in these situations, provision for single failures may in future be implemented for individual components or parts of systems instead of for the entire subsystem, if this can be justified on safety grounds.

Temporary reactor re-criticality in rare accident situations is permitted if it cannot be reasonably prevented by practical measures and does not compromise safety.

Systems for passive removal of decay heat are not required to have a backup system that implements the principle of diversity under the conditions specified in the regulation.

The application of the principles of Break Preclusion and Leak Before Break is not the only option for preparing for a sudden, axial break in the reactor cooling system and the steam pipe of a pressurised water reactor plant. The safety classification criteria for the reactor cooling system and the steam pipe of a plant equipped with a pressurised water reactor shall be amended to reflect the change mentioned above.

The self-sufficiency time requirement for the material reserves required at a nuclear power plant site is extended to prepare for increasing extreme weather events and other disturbances. The current requirements concerning the self-sufficiency time of individual systems are removed and replaced with a requirement to present a justified time for them, which increases the flexibility of the internal design solutions of nuclear power plants.

A frequency limit is set for releases occurring in the early stages of an accident. The frequency limit for large releases remains unchanged, but it is raised from the YVL guides to a regulation.

A target state and acceptance criteria are set for design basis earthquakes. Detailed requirements for seismic classification are removed, and the classification is based on the functions necessary to achieve the target state.

Monitoring and control of nuclear power plants will be enabled from a remote control room located outside the plant site, and requirements for remote control room will be added.

The concepts and requirements related to the containment and distributed systems will be amended to allow for modular nuclear power plant units containing several reactors.

Numerical criteria for physical quantities related to nuclear fuel are removed to enable different technologies.

In the safety classification, class EYT/STUK is replaced by safety class 4, which also applies to components, but no specific requirements are set for components. The aim of the amendment is to enable clearer identification of systems and components that perform safety functions.

Requirements concerning fire protection and similar internal events at nuclear power plants are no longer presented in detail but as a general principle.

5 Environmental assessment

5.1 Current state of the environment

The current state of the environment in the target areas covered by the regulation cannot be defined unequivocally. The requirements of the regulation apply to existing nuclear power plants and their areas in Loviisa and Olkiluoto, as well as to related nuclear technical facilities. In addition, the requirements apply to the disposal facilities for nuclear waste in Olkiluoto and Loviisa and the nuclear material recovery facility in Sotkamo. The regulations also apply to possible new nuclear facilities and their sites. These potential new plant sites are not known, and their environmental impacts will be assessed in project-specific environmental impact assessment procedures.

The current state of the environment at existing plant sites and the impacts of the latest changes are described in the following environmental impact assessment procedures:

- Teollisuuden Voima: Extending the service life of the Olkiluoto 1 and Olkiluoto 2 plant units and uprating their thermal power. Environmental impact assessment report.[1]
- Fortum: Loviisa Nuclear Power Plant, Environmental impact assessment report.[2]
- Posiva: Expansion of the disposal facility for spent nuclear fuel. Environmental impact assessment report.[3]

Based on the information presented in the environmental reports, the current state of the environment in the nuclear power plant areas is stable, and the power plants have not caused significant radiation exposure in the area. The most significant environmental impact of the plants is related to the thermal load caused by the cooling water, which causes the sea water to warm up in the areas surrounding the plants.

The current state of the environment cannot be assessed as such for new plant sites, but in the case of small and modular reactors (SMRs) in particular, their locations may vary from industrial environments to urban areas for district heating

[1] URL: Extending the service life of the Olkiluoto 1 and Olkiluoto 2 plant unitse and uprating their thermal power, EIA-report
[2] URL:https://www.fortum.com/sites/default/files/documents/environmental_impact_assessment_report_2021
[3] URL: Posiva_EIA 08_environmentalimpactassessmentreport.pdf

production or to other locations suitable for electricity production. As a result, their location may depend on the operating principles of the plant, i.e. in particular how close to the point of consumption the plant needs to be located. For example, in heat production, it is likely that the plant will need to be located closer to the point of consumption than, for example, an electricity-producing plant, which, like current plants, can be located in more remote locations. Local environmental conditions also depend largely on the characteristics required of the plant type at the plant site, but this cannot be assessed unequivocally.

5.2 Environmental protection objectives related to operations

Nuclear facilities are subject to international nuclear obligations that set targets and limits for the environmental impact of their operations. These are included in international nuclear agreements and EU legislation, as well as in international obligations concerning environmental protection. The following is a brief description of the environmental protection objectives arising from the various obligations.

Convention on Nuclear Safety (Finnish Treaty Series 74/1996)

In the Convention on Nuclear Safety, the contracting parties have committed themselves to ensuring that the use of nuclear energy is safe and environmentally sound. The main objective of the Convention is to organise and maintain effective protection against potential radiation hazards in nuclear facilities in order to protect individuals, society and the environment from the harmful effects of ionising radiation originating from these facilities. Another objective is to prevent accidents with radiological consequences and to mitigate any such consequences.

Council Directive establishing a Community framework for the nuclear safety of nuclear installations (2009/71/EURATOM)

The EU Council Directive on the safety of nuclear installations sets out objectives for promoting nuclear safety and ensuring that appropriate national arrangements are in place to protect workers and the general public from the dangers arising from radiation. In practice, the protection of the public also includes preventing ionising radiation from escaping from facilities into the environment.

Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Finnish Treaty Series 36/2001)

The objective of the Convention on the Safety of Spent Fuel Management and Radioactive Waste Management is to ensure that effective safety measures are in

place for all stages of spent fuel and radioactive waste management against possible hazards, so that individuals, society and the environment are protected from the harmful effects of ionising radiation both now and in the future. In addition, the aim is to prevent accidents with radiation effects and to mitigate their consequences. The Contracting Parties shall take appropriate measures to ensure that individuals, society and the environment are adequately protected against radiation hazards. Environmental considerations should be taken into account in the siting, design, construction and decommissioning of installations covered by the Agreement.

Directive on the responsible and safe management of spent fuel and radioactive waste (2011/70/EURATOM*)*

The aim of the Directive on the responsible and safe management of spent fuel and radioactive waste is to avoid imposing an unreasonable burden on future generations. This is achieved by ensuring a high level of safety in the management of spent nuclear fuel and radioactive waste, so that workers and the general public are protected from the dangers of ionising radiation.

Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) (Finnish Treaty Series 51/1998)

The OSPAR Convention sets out specific objectives for the protection of the marine environment of the North Atlantic. The general requirements of the Convention include the obligation to prevent and control pollution of the marine environment from human activities, thereby safeguarding human health and the marine ecosystem and restoring the environment in marine areas that have been significantly endangered. The Convention also applies to the control of releases from nuclear facilities.

EU environmental objectives

The EU's environmental objectives are set out in the European Climate Law (Regulation (EU) 2021/1119 of the European Parliament and of the Council on establishing a framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999), which sets a legally binding target for climate neutrality by 2050 and an interim target of reducing emissions by 55% by 2030.

Government programme

Petteri Orpo's government programme also includes several environmental objectives related to strengthening biodiversity, climate policy, clean energy, a sustainable economy and intergenerational justice. The reform of the Nuclear

Energy Act is considered to be particularly relevant to the implementation of the government programme's clean energy target.

One of the tasks of the Radiation and Nuclear Safety Authority's regulations is to act as a national regulatory body implementing various international obligations insofar as such regulation does not fall within the scope of laws or decrees. In this respect, it can be said that the objectives of these international instruments have been taken into account in the preparation of regulations. It should be noted, however, that other possible international obligations setting environmental objectives are implemented through regulations other than those of the Radiation and Nuclear Safety Authority, such as the Environmental Protection Act. In addition, the implementation of political environmental objectives is also carried out extensively by means other than the reform of the regulations related to the Nuclear Energy Act, but it also contributes to the achievement of these objectives.

5.3 Characteristics of the environment in areas likely to be significantly affected

The characteristics of the locations of nuclear facility projects depend on the facilities to be located there. With new technologies, it is no longer necessarily possible to identify certain uniform characteristics for the plant site, as was the case with previous large plant complexes, but rather the site is determined more on the basis of the intended use of the plant. The principles for the siting of nuclear facilities and the criteria for civil defence are laid down in the Nuclear Energy Act and Government Decrees. STUK's regulations set out more detailed requirements for the siting of nuclear facilities.

Until now, nuclear power plants have typically been located far from residential areas and close to water bodies, which serve as cooling water sinks for the plants. In addition, a typical feature of nuclear power plant locations is geological stability, so that the structures of the plant are not endangered, particularly by earthquakes. Another typical feature of plant sites is that they must have good transport links and the possibility of connecting to the electricity grid. In addition, plants are located in areas where there are no significant nature conservation or cultural heritage sites that could be endangered.

However, in the case of new types of power plants, the above does not necessarily apply, and the proposed Nuclear Energy Act and the draft government decrees allow nuclear facilities to be located closer to residential areas or other industries, especially if the power plant is intended to produce district heating or energy for

industrial needs. Compared to large plants, proximity to waterways is not necessarily required for all types of plants.

There are fewer safety requirements for the location of nuclear technical facilities, and other factors, such as the logistics of nuclear waste management, have a significant impact on their location. In Finland, nuclear material recovery facilities would probably be located in connection with mines or other metal recovery facilities.

Disposal facilities for nuclear waste must be geologically suitable and have stable soil and bedrock, which is a prerequisite for the safe long-term isolation of nuclear waste. The environmental conditions at disposal facilities must also be favourable in that the site naturally has sufficient conditions to prevent the spread of radioactive substances, taking into account, for example, groundwater conditions and fracture structures in the bedrock.

5.4 Significant environmental problems and impact on environmental and nature conservation

5.4.1 General

The main objective of STUK's regulations is to prevent harmful environmental impacts caused by radiation associated with the operation of facilities. The regulations issued by the Radiation and Nuclear Safety Authority are a key instrument in limiting emissions during normal operation, preventing accidents and limiting their harmful effects. The regulations impose a wide range of requirements on operators to prevent accidents and ensure that their consequences do not cause harmful effects in the surrounding areas or more widely, for example across borders.

STUK's regulations specify the requirements related to the technical implementation of nuclear facilities, compliance with which ensures that the requirements of the Act and Decree are met. The requirements of the Act and Decree concerning the limitation of radiation exposure are set in accordance with international guidelines and in such a way that normal operation has no significance for the population or the environment in terms of radiation effects. The acceptance criteria for accidents are defined at the level of a Government decree, in respect of which an assessment in accordance with the SEA Act is carried out by the Ministry of Economic Affairs and Employment.

5.4.2 Environmental impacts of activities covered by the regulation

The objectives set for the environmental effects of radiation and dose constraints are laid down in the Nuclear Energy Act and the Government Decree on Nuclear Facilities (xxxx). This regulation sets limits on the frequency of occurrences of releases at nuclear power plants that require extensive protective measures of the population, or for releases that have a widespread and long-term impact on land and water areas, as well as for releases that cause the population to take protective measures in the early stages of a nuclear facility accident. The occurrence frequency limits correspond to those currently set directly or indirectly in the YVL guides, so there will be no significant change to the current situation. In other respects, the purpose of the technical safety requirements for nuclear power plants is to limit the release of radioactive substances from the normal operation of nuclear power plants and from disturbances and accident situations in order to achieve the objectives and dose constraints specified in the Nuclear Energy Act and the Government Decree. As these high-level objectives will remain at their current level or approximately equivalent, the safety level required of nuclear power plants will remain unchanged in practice due to the above-mentioned relaxations of the detailed requirements.

The requirements concerning design solutions for the safety of nuclear power plants will change in line with general international requirements, and the requirements of the regulation will also include more provisions enabling different types of plants. However, international requirements are developing slowly, are more general in nature, and there is no uniform level of requirements for all the requirements included in the regulation. Nevertheless, it can be estimated that the regulation will enable more uniform plant solutions than before.

The impact of the changes on nuclear power plants currently in operation is expected to be minor, as some of the current requirements will continue to apply to them to the extent that this is justified in accordance with the principle of continuous improvement of safety, taking into account their design solutions. On the other hand, the relaxation of requirements concerning, for example, failure criteria may make the operation and maintenance of the plant more flexible. The change in the requirement concerning the self-sufficiency time of a nuclear power plant may, on the other hand, necessitate an increase in the plant's material reserves. Changes in classifications and the requirements as a whole will cause an administrative burden for licensees during the transition phase.

5.4.3 Environmental impacts of activities in general

Normal releases during operation

Radiation may cause environmental impacts during the normal use of a nuclear facility or nuclear material. Specific limit values approved by the Radiation and Nuclear Safety Authority are set for radioactive releases, which must not be exceeded during operation. These are set so that radioactive releases are so low in nature that they do not cause any particular environmental impact on the environment or people.[4] In addition to limiting releases, they must also be continuously monitored both by emission measurements and by environmental radiation monitoring to ensure that no harmful effects occur.

Accidents

The environmental impacts of radiation must also be considered in terms of potential accident situations. The regulations issued by the Radiation and Nuclear Safety Authority set criteria that are more specific than the law, stipulating that the more frequent an event is, the less serious its consequences may be.

Depending on the accident, residents in the vicinity of a nuclear facility could be subject to temporary protective measures, such as sheltering indoors or evacuation. In the event of an accident with serious environmental consequences, restrictions on use could be imposed on areas around the nuclear power plant, such as restrictions on staying in the area or restrictions on the use of agricultural products, and the decontamination of radioactive materials would result in waste containing radioactive materials.

According to the regulations, the probability of accidents with serious environmental impacts must be extremely low. Frequency limits are set for early and large releases, which are less frequent than 1/10,000,000 per year for early releases and 5/10,000,000 per year for large releases. An early release refers to events in which the release would occur at such an early stage of the accident that there would be no time to implement measures to protect the population. A major release refers to events that could result in widespread or long-term restrictions on the use of land and water areas.

The environmental impacts of radioactive releases from accidents may affect ecosystems in addition to the quality of the air, soil and water bodies. In addition, the impacts may affect human health, fauna and flora. The impacts may be short-

[4] See Radiation and Nuclear Safety Authority (2025) Monitoring of radioactivity in the environment of Finnish nuclear power plants: Annual report 2024. URL: https://urn.fi/URN:ISBN:978-952-309-625-7

term or long-term in nature, such as various restrictions on land use or residence in the area affected by the accident.

The effects of an accident depend on several factors, which makes it difficult to assess the overall and unambiguous environmental impact of an accident at a nuclear facility. The following factors in particular affect the nature and extent of harmful environmental impacts:

- The type and characteristics of the facility, such as protective structures and other safety features. An accident at a nuclear power plant may have more significant impacts than, for example, an accident at a facility intended for the processing of nuclear waste.
- The type and quantity of radioactive substances present at the facility.
- The nature of the accident means that the effects of a minor leak are significantly less serious than those of an accident involving the melting of the reactor core.
- The geographical location of the plant, the population density of the area, and the water conditions in the area.
- Local weather conditions, such as wind direction and speed during the accident, precipitation and temperature.
- Local soil and water conditions that may affect how radioactive substances bind to the soil and spread over a wider area.
- The effectiveness of emergency arrangements, accident management and population protection measures.

Post-accident clean-up measures are regulated by, among other things, the Radiation Act. Radiation protection limits for doses caused by radioactive releases are set out in a Government Decree. STUK's regulations set out technical requirements for the implementation and operation of nuclear facilities, with the aim of preventing the aforementioned effects of accidents from occurring or limiting them effectively.

Nuclear waste

Nuclear waste is a key environmental impact of nuclear facility operations, which can be divided into impacts during operation and impacts after disposal. The environmental impacts of nuclear waste depend on the waste fraction in question, its activity and the radionuclides it contains. Nuclear waste is always long-lived waste, and its long-term safety must be ensured even after it has been disposed of. The time it takes for nuclear waste to become harmless varies from hundreds of years to several hundred thousand years.

The treatment of spent nuclear fuel involves significantly different risks in terms of environmental impact and safety than the treatment of very low-level waste. As a result, the methods used for their treatment and disposal also differ, but the safety target level for them is the same, i.e. radiation exposure to the population must remain within the set limits.

During use, the environmental impacts of nuclear waste are related to the handling and storage of waste and the resulting radiation exposure and possible spread of radioactive substances. In this respect, however, it is more a question of limiting the radiation exposure of workers and preventing accidents related to processing. During normal operation, the environmental impact is very minor.

With regard to the disposal of nuclear waste, there are specific long-term safety requirements to mitigate environmental impacts, which must take into account factors arising from both internal and external threats that may cause radiation exposure or affect its occurrence after the closure of the disposal facility. In principle, the disposal of nuclear waste must not cause any specific environmental impacts due to radioactivity, and the various factors that may cause such impacts must be taken into account in the planning of operations. However, it is likely that land use restrictions will be imposed on the area of the disposal facility after its closure to ensure that human activity does not jeopardise the long-term safety of the disposal. The restrictions would apply, for example, to drilling or the construction of heating wells and would not restrict other activities.

Other environmental impacts

In addition to the effects caused by radiation, the construction and operation of nuclear facilities cause other environmental impacts outside STUK's area of responsibility, and these must always be assessed on a project-by-project basis, for example as part of the EIA process. STUK regulations have not been identified as having any direct impact on these effects, but the requirements do have an indirect impact on them. STUK's regulations affect, for example, the choice of location for a nuclear facility, the management of residual heat from a nuclear facility, i.e. cooling, and accident management measures.

The most significant activity causing environmental impacts, which corresponds to the current level of requirements, is the cooling of nuclear power plants. However, the impacts depend on a case-by-case basis on how the cooling of the plant in question is organised. For existing plants, the water bodies located next to the plant serve as heat sinks. Their environmental impacts have been assessed in connection with the environmental impact assessment procedures for power plant

projects.[5] The choice of location for a nuclear facility has an impact on the built environment in the surrounding area. In addition, the construction and operation of a nuclear facility may have an impact on the immediate surroundings of the site. However, the regulations do not directly specify the type of location where a facility may be built, but rather the safety objectives that the area must meet in relation to the planned facility.

A more comprehensive assessment of the environmental impact of nuclear facility projects and their significance in terms of environmental protection or nature conservation is always carried out in project-specific assessments. In practice, the most significant environmental impacts of nuclear facilities or nuclear material recovery facilities other than those caused by radiation are dealt with in accordance with environmental legislation and procedures under the Land Use Act. Apart from limiting radiation exposure, STUK's regulations have only minor indirect impacts.

5.4.4 Transboundary environmental impacts

With regard to the cross-border impacts of nuclear facilities, various accident situations, which have been discussed in more detail in the previous section, are generally relevant. In the worst case, accident situations can have cross-border environmental impacts through the spread of radioactive releases. Furthermore, depending on the location of the plant, if it is located close to a national border and the plants share, for example, waterways used for cooling the plant, this may have a cross-border impact. The environmental impacts of emissions in cross-border situations may be similar to those described above for accidents.

As described above, STUK's regulations set requirements aimed at preventing accidents and limiting their consequences. Extensive impacts, including those that cross borders, are managed in particular through regulations related to the safety design of nuclear facilities, by taking into account the characteristics of the site in the design, and by preparing for accidents through emergency preparedness.

According to the proposed Nuclear Energy Act, accidents that could potentially have transboundary effects must be considered highly unlikely. The transboundary effects of such an accident depend not only on the accident at the nuclear facility but also on the site of the facility and the weather conditions at the time of the accident. In the event of a very serious accident at a nuclear power plant that would exceed the accident management requirements set out in the Nuclear Energy Act, the radiation protection impacts of radioactive releases could extend to several tens

[5] See footnotes 1 and 2.

of kilometres under very unfavourable conditions. However, such events must be considered extremely rare. At other nuclear facilities or nuclear material recovery facilities, the impact area is considerably smaller.

5.4.5 General environmental impacts of the regulations and means of reducing harmful effects

With regard to the regulations of the Radiation and Nuclear Safety Authority, it can be generally stated that the regulations or measures based on them are expected to have primarily indirect effects on the environment. The measures presented in the regulations are essentially aimed at ensuring safe operation, safe handling of nuclear waste, accident prevention and the control and limitation of releases from operations in all situations. The regulations approach safety from different perspectives, from the design principles of the facility and the demonstration of safety to the limitation of releases and the monitoring of the state of the environment related to operations. The obligations relating to operation, organisation and emergency preparedness are all aimed at ensuring that, regardless of the situation, no harmful effects on people or the environment arise. No changes have been identified in the regulations that would significantly affect the implementation of this principle in the short or long term.

In general, it can be said that, with the exception of the regulatory requirements related to the cooling of nuclear power plants, the impact of the regulations on the environment is indirect, particularly because they are aimed at preventing harmful environmental impacts. The monitoring of releases and environmental radioactivity aims to ensure that no harmful short- or long-term effects occur to the population or the environment.

The environmental impacts of plant cooling depend on the size and purpose of the plant and the technology used for cooling. In practice, therefore, the environmental impacts of projects to which the new regulations apply must always be assessed on a case-by-case basis in a project-specific environmental impact assessment procedure.

5.4.6 Conducting environmental assessments and monitoring impacts

The environmental assessment has been carried out as part of the Radiation and Nuclear Safety Authority's regulatory preparation work. STUK has an internal guided process for regulatory preparation, in which regulations, their rationale and impact assessments are prepared in four stages. The expert responsible for the

regulation prepares it in cooperation with other STUK experts. Each stage involves an internal assessment by STUK, in which a wider group of experts and management assess the comprehensiveness of the regulation and its rationale. During the preparation phase, prior to the public consultation phase, STUK has involved key stakeholders.

In the reform of the regulation, the environmental assessment of the change will be carried out as part of the impact assessment. The criteria used to guide the impact assessment are the criteria for legislative drafting, and the criteria for environmental assessment of plans and programmes have also been used for the environmental assessment. The assessment has identified that, in practice, the potential environmental impacts of compliance with the regulatory requirements are specified on a project-by-project basis and through the planning and location solutions made in individual projects, in which case it is essential to carry out an environmental impact assessment procedure for the projects in order to assess their environmental impacts.

The monitoring of the radiation impacts caused by the use of nuclear energy and the operation of nuclear facilities is carried out regularly as part of the Radiation and Nuclear Safety Authority's oversight activities in accordance with the Nuclear Energy Act. In addition, licensees monitor the environmental impacts of their own activities. STUK regularly assesses the relevance of the regulations, utilising new information obtained from oversight, safety research, domestic and international operating experience of nuclear facilities, and developments in science and technology.

6 Conclusions

The regulations of the Radiation and Nuclear Safety Authority form a technical regulatory framework whose primary objective is to prevent the harmful effects of radiation on people and the environment. The regulations alone do not form the basis for licensing or approval decisions, but together with the Nuclear Energy Act and decrees, they create a framework for the safe implementation of nuclear facility projects. From the perspective of environmental impacts, the effects of the regulations are mainly indirect and are specified in project-specific EIA procedures.

The environmental impacts of the regulations are particularly related to the radiological effects that may be caused by releases from the normal operation of nuclear facilities and by radioactive substances released into the environment in the event of accidents. The regulations do not directly regulate the site of a nuclear facility or the technology to be selected for it, but rather set criteria for these from the perspective of nuclear and radiation safety. The environmental impact of the regulations is mainly indirect, and the regulations aim to prevent harmful effects on the environment.

Based on the environmental assessment, no changes have been identified in the regulations that would cause significant adverse effects on the environment. The Radiation and Nuclear Safety Authority will monitor the impact of the regulations as part of its oversight activities and update the regulations as necessary based on new information and experience.