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Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant, explanatory memorandum

MAIN CONTENT

The Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant is laid down by virtue of Section 7 q of the Nuclear Energy Act (990/1987), as it is in Act 676/2015. It repeals the Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (Y/1/2016) that entered into force on 1 January 2016.

The regulation is used to issue the provisions concerning the safety of a nuclear power plant that specify the provisions of the Nuclear Energy Act. The content of the new regulation largely corresponds to the regulation to be repealed. Its essential aim is to make the regulation reflect the changes to the Nuclear Energy Act and the radiation legislation.

In conjunction with the clarification of the Nuclear Energy Act, the authorisation to give orders on the structural radiation safety of the nuclear facility and the managing of the releases of radioactive substances has been added to the law. Therefore, a requirement proposal on the means of limiting radiation exposure and releases has been added to the regulation. The reform of the Radiation Act (859/2018) causes the need to define the requirements specifying the assessment and monitoring of the exposure of the workers and the members of the public (Section 7, Section 24).

Provisions concerning the decommissioning license of nuclear facilities have been added to the Nuclear Energy Act, so the implementation of decommissioning is discussed in the Act as a stage separate from operation. This causes the need to set separate requirements in the regulation for the decommissioning stage of the nuclear facility and the safety of decommissioning.

Other needs for changes relate to the clarification need for individual requirements. The regulation also clarifies the application of the requirements as a whole as concerns the nuclear facilities in the scope of the regulation.

The regulation is intended to enter into force on 15 December 2018.

General rationale

Within the European Atomic Energy Community (Euratom), Council Directive 2009/71/Euratom was issued on establishing a framework for the nuclear safety of nuclear facilities. After the Fukushima nuclear power plant accident, the Directive was made more detailed through Directive 2014/87/Euratom on the changing of the Euratom Nuclear Safety Directive (hereafter referred to as the supplement to the Nuclear Safety Directive [NSD]).

On 5 December 2013, the new Council Directive 2013/59 was issued in the EU, laying down basic safety standards for the protection against the dangers arising from ionising radiation and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/42/Euratom and 2003/122/Euratom, also called the BSS Directive (Basic Safety Standards).

The new Radiation Act (859/2018), which was issued on 9 November 2018 and entered into force on 15 December 2018, and lower-grade regulations issued under it were used to implement the EU's new BSS Directive. Requirements prescribed in the Radiation Act, also concerning the use of nuclear energy, entered into force as an annexed act to the Radiation Act, and they are also applied to operations governed by the Nuclear Energy Act. The requirements of the BSS Directive, which had to be separately implemented for the use of nuclear energy and which required changes to the Nuclear Energy Act, were included in the presentation package of the Radiation Act for reasons related to technical legislative procedure, and they entered into force as an annexed act to the Radiation Act on 15 December 2018.

The supplement to the Nuclear Safety Directive (NSD) was enforced through the amendment (14.12.2017/905) to the Nuclear Energy Act (990/1987) that entered into force on 1 January 2018. At the same time, updates were made to the Act's provisions on pressure equipment due to the new Pressure Equipment Act (1144/2016) that entered into force on 1 January 2017. In addition to these changes, the Act was clarified and supplemented, for example, as concerns the decommissioning of nuclear facilities. Specification needs have also been observed in the assessment of the requirements of the Euratom Nuclear Waste Directive, which was issued in 2011 and enforced in Finland through the amendment to the Nuclear Energy Act in 2013. These specifications have now been added to the Nuclear Energy Act.

Few new requirements at the regulatory level resulted from the Nuclear Safety Directive, because the issues had been taken into account in advance in the preparation of the requirements of the NSD directive and the IAEA and WENRA's new reference levels during the update of Government Decrees on Nuclear Power Plant Safety (733/2008) and the Emergency Response Arrangements at Nuclear Power Plants (735/2008) in 2013.

2 Current status

The principles and requirements concerning the safety of a nuclear facility are laid down in Chapter 2 a of the Nuclear Energy Act and the obligations of the licensee specifically in Section 9 of the Act. Until 31 December 2015, provisions specifying these requirements were included in the Government Decree on the Safety of Nuclear Power Plants (717/2013).

The amendment (676/2015) of the Nuclear Energy Act transferred the authority for issuing general safety provisions to the Radiation and Nuclear Safety Authority (STUK). In connection with the amendment of the Nuclear Energy Act, previous general safety provisions issued as Government Decrees were repealed. The general safety provisions of the Radiation and Nuclear Safety Authority were issued on 22 December 2015, and they entered into force on 1 January 2016. The Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant was issued as part of this reform by virtue of Section 7 q of the Nuclear Energy Act. The content of the new Radiation and Nuclear Safety Authority Regulation corresponded to the earlier Government Decree.

The Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant, which entered into force on 1 January 2016, does not include legal norms on the structural radiation safety of nuclear facilities or the assessment of the public's radiation doses.

3 Key objectives and proposals

This regulation is used to issue the provisions concerning the safety of nuclear power plants and other nuclear facilities within the scope of application (separate fuel storage facilities and research reactors) that specify the provisions of the Nuclear Energy Act. The regulation is related to the authorisation granted to STUK concerning the issuing of safety regulations for nuclear facilities by virtue of Section 7 q of the Nuclear Energy Act. This regulation specifies the regulations concerning the safety of nuclear facilities within the scope of application as regards the design, construction, operation and decommissioning of the facility.

This regulation replaces and updates the Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (Y/1/2016). The update is part of the update project of the nuclear energy industry and the radiation legislation.

Its essential aim is to make the regulation on nuclear power plant safety reflect the proposed changes to the Nuclear Energy Act. The need to change the Nuclear Energy Act is based on the national enforcement of the NSD and BSS directives, the specification to the 2013 enforcement of the Nuclear Waste Directive and the clarification of the Act implemented at the same time. This regulation is not used to implement the requirements of the NSD directive or the supplementary requirements of the Nuclear Waste Directive, because they have been implemented on the Act level.

The clarification of the Nuclear Energy Act, the reform of the Radiation Act and the Basic Safety Standards (BSS) Directive for radiation protection result in a need to define the requirements specifying the structural radiation safety of nuclear facilities and the estimation and monitoring of the exposure of the public (Section 7, Section 24). A requirement proposal on the means of limiting radiation exposure and releases has been added to the regulation.

Provisions concerning the decommissioning license of nuclear facilities were added to the Nuclear Energy Act, so the implementation of decommissioning is discussed in the Act as a stage separate from operation. This results in a need to discuss the safety of a nuclear facility also when applying for a decommissioning license and to add decommissioning to paragraphs that refer to decommissioning as well as operation.

Other needs for changes relate to the clarification need for individual requirements. The regulation also clarifies the application of the requirements as a whole as concerns the nuclear facilities in the scope of application.

Otherwise, the new regulation largely corresponds to the Radiation and Nuclear Safety Authority Regulation to be repealed.

4 Impacts of the proposal

The regulation presents certain requirements that are new in terms of their content, the impacts of which are estimated to be minor in view of the current situation.

5 Drafting of the regulation

The Regulation on the Safety of a Nuclear Power Plant was drafted at the Radiation and Nuclear Safety Authority (STUK) as standard clerical work within the framework of the project (RYSÄ) that STUK established in order to guide the drafting of the regulations, to ensure coherence between the different regulations and to manage the conformity to law and layout of STUK's regulations.

Statements concerning the regulation proposal were requested with a letter dated 1 November 2017 from the Ministry of Employment and the Economy, the Ministry of Social Affairs and Health, the Ministry of the Environment, the Ministry of the Interior, the Ministry for Foreign Affairs, Fortum Power and Heat Oy, Teollisuuden Voima Oyj, Fennovoima Oy, VTT Technical Research Centre of Finland Ltd, the Finnish Safety and Chemicals Agency, the Rescue Services of Satakunta and Eastern Uusimaa and the Police Departments of Southwest Finland and Eastern Uusimaa.

Statements were received from Fortum Power and Heat Oy, Teollisuuden Voima Oyj, Posiva Oy, Fennovoima Oy, VTT Technical Research Centre of Finland Ltd, the Rescue Services of Satakunta and the Police Department of Southwest Finland.

The following parties reported that they had no statements or comments on the draft: the Ministry of Employment and the Economy, the Ministry of Social Affairs and Health, the Ministry of the Environment, the Ministry of the Interior, the Finnish Safety and Chemicals Agency, the Rescue Services of Eastern Uusimaa and the Police Department of Eastern Uusimaa.

The statements demanded a clear line between the application of this regulation (Y/1/2018) and the Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (Y/4/2018) and the clarification of the scope of application The term *nuclear power plant* was replaced in the regulation by the term *nuclear facility*, because the regulation is also applied to other nuclear facilities. Nuclear waste or the definition of a nuclear waste facility was not included in the regulation. The use of the terms was seen as confusing. The statements commented on the consistency between the Act's new requirements on the licensee's responsibility for subcontractors and equivalent requirements already existing in the regulation. The requirements and terminology relating to the new license phase, decommissioning license, were also commented on.

On the basis of the statements, the scopes of application of regulations Y/1/2018 and Y/4/2018 were clarified in the regulations and in the explanatory memorandums. The contents of the requirements of the regulation on the licensee's responsibility for subcontractors were reviewed, and the requirements overlapping with the Act were removed. As regards terminology, the use of the terms *nuclear waste* and *decommissioning* was reviewed. In addition, the different variations of the terms *nuclear safety* and *radiation safety* were replaced by the term *safety* whenever possible. The issue is clarified in section "*Overall safety of a nuclear facility*" of the explanatory memorandum.

Statements regarding draft 4 of the regulation proposal were requested from the Advisory Committee on Nuclear Safety and the Advisory Committee on Radiation Safety with letters dated 28 February 2018. In its statement issued on 6 April 2018, the Advisory Committee on Nuclear Safety states that the draft prepared by STUK for the safety regulation regarding the safety of nuclear power plants presents a clear summary of the essential requirements concerning the safety of a nuclear power plant and the related procedures to be followed. In its statement, the Advisory Committee on Nuclear Safety highlighted two things, one of which concerned bringing the facility into a safe state after non-severe accidents and the other taking into account unlawful activities in the design as an internal threat. These comments in the statement of the Advisory Committee on Nuclear Safety have been taken into account. In addition, the appendices to the statement of the Advisory Committee on Nuclear Safety included detailed comments aimed at specifying the requirements of the regulation. In its statement issued on 9 May 2018, the Advisory Committee on Radiation Safety states that the regulation takes into account the amendment to the Nuclear Energy Act (905/2017) that entered into force on 1 January 2018 and the proposed amendments to the Radiation Act in a sufficient manner. The Advisory Committee on Radiation Safety welcomes the proposal on sections to be applied to research reactors that has been added to the section on the scope of the regulation. The Advisory Committee on Radiation Safety appreciates that the nuclear waste management collaboration pursued in the field is also evident in this regulation.

In spring 2018, the Steering Committee of the RYSÄ-project decided that the final draft of the regulation would be published on the STUK website for public comments during the summer. No comments were offered by the public, but some further comments concerning clarification of some of the requirements were received from Teollisuuden Voima Oyj, Posiva Oy, Fennovoima Oy, VTT Technical Research Centre of Finland.

6 Regulation’s entry into force

The regulation shall enter into force at the same time as the amendment to the Nuclear Energy Act (/2018) that enters into force as an annexed act to the Radiation act (/2018) on 15 December 2018.

Detailed rationale

Overall safety of a nuclear facility

The most important objective of the safety design of nuclear facilities is to prevent large releases of radioactive substances into the environment. This requires encuring the main safety functions, i.e. the management of the reactivity of nuclear fuel, residual heat removal from the nuclear fuel in the reactor or fuel storage or from the containment to the ultimate heat sink and the control and confinement of radioactive materials. Effective emergency response arrangements are used to control accident situations at the nuclear facility and to further minimise their consequences for the environment and people.

Other safety objectives relating to the use of nuclear energy include keeping nuclear facilities safe as radiation workplaces and controlling other nuclear commodities safely and appropriately in accordance with the obligations of international agreements.

The safety of the use of nuclear energy is affected by technology and also by the activities of people and organisations.

With security arrangements, licensees secure nuclear facilities and nuclear commodities against illegal activities, so the implementation of the security arrangements ensures for its part the attainment of the above-mentioned objectives.

Section 1 Scope

This regulation is intended to apply to nuclear power plants: A nuclear power plant, as defined in Section 3 of the Nuclear Energy Act, refers to a nuclear facility the purpose of which is electricity or heat production, equipped with a nuclear reactor, or a complex consisting of nuclear power plant units and other related nuclear facilities located on the same plant site.

A nuclear facility, as defined in the Nuclear Energy Act, shall refer to facilities used for the generation of nuclear energy, including research reactors, facilities implementing the large-scale final disposal of nuclear waste, and facilities used for the large-scale production, generation, use, processing or storage of nuclear material or nuclear waste.

This regulation shall also apply to the handling and interim storage of spent nuclear fuel at a nuclear power plant and the handling of other radioactive waste at a nuclear power plant. It would also apply to nuclear facilities outside of the nuclear power plant site area intended for the handling and storage of nuclear fuel in which the amount of spent nuclear fuel at any given time is more than 100 tonnes of uranium.

Moreover, the regulation shall apply, as necessary, to other nuclear facilities equipped with a nuclear reactor. This refers to low-power research reactors. A proposal on sections to be applied to small research reactors has been added to the scope.

The Radiation and Nuclear Safety Authority's Regulation on the Safety of Disposal of Nuclear Waste (Y/4/2018) applies to the disposal of spent nuclear fuel and other nuclear waste originating from the nuclear facility into facilities constructed inside bedrock and soil. Regulation Y/4/2018 also applies to the processing facilities for spent nuclear fuel and other nuclear waste that are not connected to nuclear power plants, i.e. the encapsulation plant, and to short-term storage that occurs in connection with these facilities.

In the scope, the interfaces of this regulation and regulation Y/4/2018 have been elaborated. If the amount of spent nuclear fuel stored at the nuclear waste processing facility is greater than 100 tonnes of uranium, this regulation Y/1/2018 shall be applied to it in the same manner as to interim storage facilities for spent nuclear fuel. If the amount of spent nuclear fuel is less than 100 tonnes of uranium, regulation Y/4/2018 shall be applied. Regulation Y/4/2018 shall also be applied to storage and handling facilities of low and intermediate level nuclear waste, if they are not part of the nuclear power plant. Paragraph 2 has been removed.

Section 2 Definitions

The key terms and definitions used in the regulation are presented in Section 2 of the regulation.

In the definition of normal operating situations in subparagraph 9, the term ‘nuclear power plant’ has been replaced by ‘nuclear facility’ because the definition also applies to separate fuel storage facilities. subparagraph 22, the definition of a nuclear facility, has been changed to match the definition in the Nuclear Energy Act. *‘Nuclear waste’* and *‘nuclear waste facility’* have been added to the definitions.

Section 3 Demonstration of compliance with safety requirements

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

1) demonstration of compliance with the safety requirements of a nuclear facility.

Pursuant to Section 7 e of the Nuclear Energy Act, compliance with requirements concerning the safety of a nuclear facility shall be proven reliably and the overall safety of the facility shall be assessed at regular intervals. A licence for the construction or operation of a nuclear facility may be granted if the plans concerning the facility meet the safety requirements in accordance with this Act.

Pursuant to the Nuclear Energy Act, for the further development of safety, measures shall be implemented that can be considered justified considering operating experience and safety research and advances in science and technology.

The IAEA’s general safety requirements [1] stipulate that all methods and computer software used for safety assessment must be qualified for their purpose.

The analysis methods must be verified as well as qualified. Qualification cannot be performed unless the system has first been verified. In Paragraph 4, the earlier term *‘qualified’* has been changed to *‘validated’*.

Paragraph 5 on the assessment of the safety of decommissioning has been added to the regulation on the basis of the amendment (905/2017) to the Nuclear Energy Act (990/1987). The safety of a nuclear facility shall be assessed in connection with the updates of the decommissioning plan, when applying for a decommissioning license and at Periodic Safety Reviews during decommissioning.

Section 4 Safety classification

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

2) safety classification of a nuclear facility.

A similar requirement is included in the IAEA's safety requirements [2] and [3] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

The dispersion of radioactive substances from the plant into the environment is prevented by means of dispersion barriers based on the defence-in-depth principle and safety functions designed to keep the dispersion barriers intact to mitigate the consequences of an accident.. The safety classification is divided into a structural safety classification based on the dispersion barriers for radioactive substances and a functional safety classification based on the safety functions that work to ensure the integrity of the dispersion barriers.

The fundamental safety functions are the management of the reactivity of nuclear fuel (ahutting down the reactor and keeping it subcritical or keeping fuel subcritical in the fuel storage), transferring the residual heat to the ultimate heat sink and the prevention of the dispersion of radioactive substances. In order to classify the systems, equipment and structures participating in safety functions, the functions of the nuclear facility must be identified and safety functions defined. The systems, structures and components related to the safety functions shall be divided into safety classes in a manner where their safety class corresponds to the safety significance of the function whose implementation they participate in. A safety function may be a combination of several different systems and their related support systems.

The safety class is used to define the quality requirements for the planning, manufacturing and installation of each item and the assessments, inspections and tests related to the verification of quality during the lifecycle of the nuclear facility. Furthermore, the scope of regulatory control is based on the safety classification.

Section 5 Ageing management

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

3) ageing management of a nuclear facility

Similar requirements are included in the IAEA's safety requirements [2] and [5] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

During operation, the systems, structures and components of nuclear facilities are subjected to stresses and environmental effects that may reduce their operability. Preparations for this are made at the design stage by defining the best structural design for the operating conditions and high quality requirements. Maintaining operability with the defined safety margins even during operational occurrences and accidents must be ensured by means of tests and analyses before the commissioning.

During operation, the operability of systems, structures and components must be ensured by means of periodic inspections, tests and maintenance. Most equipment is designed to be replaced during the service life of the plant before any changes affecting operability can occur. Ageing management in terms of the overall service life of the plant is important for systems, structures and components that are designed to last until the decommissioning of the plant; for them, ageing must be monitored with particular care and any problems must be anticipated well in advance before they can jeopardise the safety of the plant. Ageing management also includes the reaeach of ageing phenomena and the utilisation of operating experience received from similar equipment at other nuclear power plants.

The requirements related to systems, structures and components may also change during the service life of the nuclear facility and the available technology may develop, which will lead to the systems, structures and components no longer meeting the level of requirement. Manufacturers or other actors may also go out of business, which would make original spare parts and technical support required for any problems that arise during operation and maintenance (support functions) unavailable. This type of technological obsolescence must be managed by taking the necessary measures if any systems, structures or components are in danger of becoming obsolete.

The replacement of systems, structures and components with new or similar technology, as well as repairs and modifications, shall be carried out in a systematic manner. The design basis shall be followed and the effects on the other systems, structures and components of the nuclear facility shall be analysed.

In the section, decommissioning has been added to the life cycle of the nuclear facility to be taken into account in ageing management.

Section 6 Management of human factors relating to safety

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

4) management of human factors relating to safety at a nuclear facility

A requirement similar to the one proposed is included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

People, technology and the organisation form a socio-technical system whose operation affects the safety of the nuclear facility throughout its life cycle. The operation of the socio-technical system naturally includes variation that can be manifested in different ways, for example, in failures and errors, in milder defects and cutting corners or in unplanned activity. Through their activities, people may also compensate for the defects of other system parts or optimise parts of the operation. Good design of technical solutions and the organisation's practices takes into account the characteristics of human activity and uses management procedures for human factors to make solutions that are tolerant of error and guide people towards good operations. The management procedures for human factors aim to enable the success of human activity and avoid the impacts of the deficiencies of human activity on the safety of the nuclear facility. As concerns safety, particularly dangerous situations are those where the same errors are made in parallel subsystems of safety systems or in redundant systems. The management of human factors includes systematic procedures observed in system design, placement, use and maintenance in order to prevent common cause failures due to human action. The management of human factors is based on multidisciplinary knowledge of the operation of the socio-technical system. In addition to technical expertise, it utilises information on the actions of people and the organisation and the interaction between people and technology.

Paragraph 1 has been rephrased. In the proposed change, the concept 'human error' has been replaced by the concept 'human factor'. The impact of human action on safety can be either direct or transferred, and the concept of error gives too simple a picture of the effect mechanism. Human factors can be identified on individual and group levels and from the point of view of the organisation and culture. The operating environment, the norms of society and values also affect human factors. Human factors must also be taken into account during the planning of decommissioning and during decommission.

Section 7 Limitation of radiation exposure and releases of radioactive substances

The title of the section and Paragraph 1 do not use the term '*maximum value*' because the Radiation Act uses terms '*dose limit*' and '*dose constraint*' instead of this term.

The limitation of public and worker radiation exposure is governed by the Nuclear Energy Act, the Radiation Act and the related Nuclear Energy Decree and Government Decree on ionising radiation. In Paragraph 1 of the section, the references are to the Nuclear Energy Act, which refers to the Radiation Act and the above-mentioned decrees. A similar entity was previously discussed in two paragraphs in this section that have now been replaced by one paragraph, i.e. Paragraph 2 has been removed.

The authorisation to give orders on the structural radiation safety of the nuclear facility, radiation measurements, the managing and monitoring of the releases of radioactive substances and the estimation of the public's radiation doses has been added as subparagraph 20 to Section 7 q of the Nuclear Energy Act. Paragraph 3, which has been added to this regulation, lists the main means that can and must be used to limit public and worker radiation exposure and emissions of radioactive substances. STUK's YVL Guides present detailed requirements relating to these.

Section 8 Site safety

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

5) safety of the site of a nuclear facility

The requirements laid down in this section are also presented in the IAEA's safety requirements [6].

In the siting of a nuclear facility, the aim is to protect the plant against external threats as well as to minimise any environmental detriments and threats that might arise from it. Effects on the supply of cooling water and on electric power grid connections shall also be considered when surveying external events. Other factors to be considered include:

impact on land use, socio-economic impacts, traffic arrangements, reliable electric power transfer to the national grid and specific factors relating to the security of supply of electric power.

The normal operation of the nuclear facility or anticipated operational transients do not limit land use offsite. In the environment surrounding the nuclear power plant, however, precautions in the form of land use and public protection plans shall be taken with a view to the possibility of a postulated accident and severe reactor accident. This means, among other things, that facilities or population centres where the necessary protective measures, such as sheltering indoors or evacuation, would be difficult to implement, shall not be situated in the vicinity of the plant. Furthermore, in the nuclear facility's vicinity, no activities shall be engaged in that could pose an external hazard to the plant.

Prior to the licensing procedure proper, the environmental effects of the nuclear facility project are studied and evaluated by environmental impact assessment (EIA). The EIA procedure is governed by the Act on Environmental Impact Assessment Procedure (252/217) and Government Decree on Environmental Impact Assessment Procedure (713/2006). This also involves an international hearing of countries near Finland in accordance with the convention on the assessment of cross-border environmental impacts (Espoo convention, Finland's Statute Book No. 67/1997). The Land Use and Building Act (132/1999) and Decree (895/1999) also contain provisions regarding zoning that guide the use of land areas and construction.

Section 9 Defence-in-depth

The requirements specify the defence-in-depth DiD principle presented in Section 7 b of the Nuclear Energy Act. Furthermore, pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

6) defence in depth of a nuclear facility

The requirement concerning the functional defence-in-depth safety principle is included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident. The regulation is based on the five functional levels of defence that are used in the IAEA's safety requirements [2] concerning the design of a nuclear power plant. The IAEA's safety requirements [2] also include the requirement that the levels of defence must be as independent as practically achievable.

The section requires that the safety of the nuclear power plant be ensured by applying the functional defence-in-depth safety principle. The functional defence-in-depth safety principle refers to ensuring the safety of nuclear facilities by using consecutive, redundant functional levels that ensure the integrity of the engineered release barriers for the dispersion of radioactive substances (Section 10). The functional levels involve safety functions and systems and equipment implementing them.

The primary goal for the design of nuclear facilities is to prevent operational occurrences during normal operation. To this end, high quality requirements are applied to the design, manufacture, installation and service of equipment and the operation of the plant. The equipment is designed with high safety margins, its condition is monitored during operation and it is used and maintained following appropriate instructions. The personnel responsible for the safe operation of the nuclear facility shall be trained for their duties and the organisation shall have a high level of safety culture.

Notwithstanding the careful design and operation of the nuclear facility, operational occurrences shall be prepared for with systems designed to manage the occurrences. Nevertheless, accident situations shall still be prepared for. It is usually necessary for systems related to the reactor to start automatically, but there is typically more time in nuclear facilities to bring the accident situation under control. Manually actuated systems can also be used to control accidents, if this is justified on the grounds of safety; the requirements for fuel storage facilities are presented in Section 12.

As the final level of the defence-in-depth safety principle, preparations are made for the mitigation of the consequences of an accident by applying different accident management methods and emergency and rescue arrangements during situations where substantial amounts of radioactive substances have been released into the environment.

Paragraph 2 has been specified for the scope, and the word ‘also’ has been removed from level 3 requirement text so that, in justified situations, the management of accident situations does not require both automatic and manually actuated functions.

Section 10 Engineered barriers for preventing the dispersion of radioactive substances

The requirements specify the defence-in-depth safety principle presented in Section 7 b of the Nuclear Energy Act. Furthermore, pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

7) engineered barriers for preventing the dispersion of radioactive substances from a nuclear facility

The section requires ensuring safety by applying the principle of structural defence-in-depth, i.e. structural levels that aim to prevent the dispersion of radioactive substances. The levels based on dispersion barriers for radioactive substances are related to the reliability and leak tightness of mechanical structures and equipment. In a nuclear power plant, these barriers include the fuel cladding (item 3, subsection a), the primary circuit (item 3, subsection b) and the containment (item 3, subsection c). Ensuring the integrity of all the release barriers (a, b, c) is the safety target. Radioactive substances can only be released into the environment if all of these consecutive release barriers fail. The functional defence-in-depth safety principle (Section 9) is applied in order to ensure the integrity of the dispersion barriers.

The first release barrier for radioactive substances is the fuel. Fuel failure may occur if the fuel cooling is substantially reduced or the power of the reactor rises too high in relation to the cooling. Furthermore, the fuel cladding is subjected to stresses that may reduce the strength of the fuel during normal operation. In order to prevent fuel failures, the reactor, primary circuit, process systems, I&C and electrical systems directly connected to the primary circuit and the water chemistry shall be designed in a manner that creates a very low probability of fuel damage during normal operating conditions or anticipated operational occurrences. The number of fuel failures must be kept low also during postulated accidents in order to minimise the amount of radioactive substances that pass through the first release barrier. The fuel cooling shall not be jeopardised, since a loss of cooling may lead to severe core damage. During criticality accidents, the time available for managing the situation is so short that mitigating the consequences is not practically feasible. Therefore, the probability of their occurrence shall be very low.

Another release barrier for radioactive substances is the primary circuit including the reactor pressure vessel. The integrity of the primary circuit shall primarily be ensured with quality design, material selection and manufacturing that minimises the likelihood of detrimental structural defects and mechanisms threatening the integrity of structures remains extremely low. It shall be possible to reliably observe minor faults during the life cycle of the primary circuit, and their development shall be monitored.

It is not practically possible to mitigate the consequences of a sudden pressure vessel failure by safety functions, so it would lead to an early major release. Therefore, the probability of a sudden pressure vessel failure shall be extremely small in various operational states of the plant. The integrity of the main coolant lines of the nuclear power plant can be ensured during its life cycle by observing the leak before break principle, or the loss of integrity can be prepared for with reliable safety systems.

In order to prevent damage to the primary circuit, the loads that the primary circuit is subjected to during operational occurrences and accidents shall be taken into account with high safety margins during the design. The primary circuit is one of the structures that have not been designed to be replaced during the service life of the plant. The primary circuit is subjected to particularly strict condition monitoring that aims to anticipate any created problems well in advance before they jeopardise the safety of the plant. As regards equipment that will be replaced during operation, condition monitoring is focused on ensuring their operability by means of inspections and tests. Condition monitoring also includes the utilisation of operating experience received from similar equipment at other nuclear power plants.

One of the possible failure mechanisms of the primary circuit and the secondary circuit of a pressurised water reactor is the overpressure that these components are subjected to during different operational occurrences and accident situations. In order to prevent this failure mechanism, the primary circuit and the secondary circuit of a pressurised water reactor shall be protected by means of equipment that prevents the overpressure.

In order to ensure the timely detection of primary circuit leaks, the nuclear power plant shall be equipped with leak monitoring systems that issue timely warnings allowing the plant to be shut down in a controlled manner without jeopardising safety. In the long term, minor leaks can also have other harmful effects on the safety of a nuclear power plant. In addition to actual leak detection systems, leak detection can be performed using, for example, indirect indications and visual inspections. The requirements for the reliability of leak detection shall be justified separately for each plant.

Pool-type research reactors do not have a primary circuit that is pressurised as in nuclear power plants, but it is still necessary to ensure the integrity of the primary circuit by quality design and manufacture and good water chemistry. It shall also be possible to reliably detect leaks.

The containment is the final release barrier for the radioactive substances generated inside the nuclear power plant. A containment shall be constructed around the reactor of the nuclear power plant and its coolant circuit. A containment is not required for spent fuel storage pools or storage facilities or low-power research reactors.

The containment shall be designed, constructed and operated in a manner that ensures its leak tightness during anticipated operational occurrences and postulated accidents. Severe accidents involve several phenomena that can jeopardise the integrity of the containment. Unless they can be reliably excluded, all these phenomena shall be considered during the design in order to ensure the integrity of the containment.

Short-term high-energy phenomena may occur during severe reactor accidents. Examples include steam explosion, hydrogen explosion and the rupture of the pressure vessel at high pressure.

During severe reactor accidents, direct interaction of molten core material with the load bearing containment structure shall be prevented. This can be implemented by equipping the containment with systems that ensure the cooling and stabilisation of the molten core material in a manner where the molten core material cannot contact the load bearing containment structures. The ability to cool the molten core material is essential in restoring the plant to a safe state following a severe reactor accident.

The wording of the title of Paragraph 3(a) has been changed to better match the subparagraphs. The requirement for the probability of a fast growing crack has been added to Paragraph 3(b) as item ia. For the pressure vessel, the requirement was previously included in the Government Decision on the safety of nuclear power plants (395/1991). Otherwise, the fulfilment of the requirement in a nuclear power plant requires either preparing for the consequences of a crack or observing the leak before break principle. Item v has been changed to express the objective instead of requiring systems. The title of the Paragraph 3(c) has also been specified. In Paragraph 4, the terminology has been corrected to match the terminology used in other similar sections (for example, Section 10[3][a][iii]).

Section 11 Safety functions and provisions for ensuring them

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

8) safety functions of a nuclear facility and ensuring them

The requirements concerning redundancy, separation, the diversity principle, the safe state principle and the automatic starting of the safety functions presented in this section are included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

Notwithstanding the careful design and operation of the nuclear power plant, operational occurrences and accidents are prepared for by means of safety functions that are designed to detect disturbances and accidents and to mitigate their consequences, i.e. to ensure the integrity of the release barriers for radioactive substances. The most important safety functions are shutting down the reactor and keeping it subcritical, transferring the residual heat from the reactor to the ultimate heat sink and the prevention of the dispersion of radioactive substances. Inherent safety features shall be primarily utilised when planning the safety functions. During the design of the reactor, in particular, it shall be ensured that the combined effects of physical feedback, such as the feedback on reactor power by increase in the fuel and coolant temperature, are such that they control the increase in reactor power.

The design of the safety functions applies principles that are used to ensure that the functions important for safety are performed reliably in order to prevent accidents and to mitigate their consequences. These include the principles of redundancy, separation, diversity and safe state and the automatic starting of safety functions. Operations needed to reach and maintain a controlled state can also be performed manually when there is sufficient time for carrying out the operations.

According to the redundancy principle, the systems implementing safety functions are divided into several redundant subsystems. The nuclear power plant systems that are required in postulated accidents to bring the plant to a controlled state and to retain the plant in a controlled state shall be designed in a manner that allows the system to implement its safety functions even if any individual component of the system were to fail (single failure criterion) and if any component in the same system were to be simultaneously unavailable due to repair or maintenance, for example. The single failure criterion alone may be applied to systems implementing safety functions whose maintenance or repair requires bringing the plant to a safe state. A postulated failure, service or repair that is related to a support system necessary for the operation of a system is considered to be included in the unavailability assumptions required for the system. This failure criterion is applied to the most important safety functions, i.e. systems that shut down the reactor, maintain it in a subcritical state and remove the residual heat.

The separation principle covers physical separation and functional isolation. The aim of the separation is to prevent the failure of safety functions due to the same internal or external event. The separation also limits the fault propagation between subsystems or between systems of different levels of defence.

The same safety function can be implemented by means of systems and components based on different principles of operation. This diversity principle improves the reliability of the safety function and avoids the consequences of common cause failures that are related to the safety function in question. The diversity principle shall be applied to those systems implementing safety functions that are used to limit the consequences of anticipated operational occurrences and class 1 postulated accidents.

When assessing the safety of the plant, the potential for common cause failures caused by components, human activity and external events shall be considered.

After operational occurrences and postulated accidents, it shall be possible, if necessary, to bring the nuclear power plant from a controlled to a safe state in which the primary circuit is "non-pressurised" or near the atmospheric pressure, the reactor has been shut down and the removal of its residual heat has been secured.

A nuclear power plant shall be equipped with systems and equipment for the management and monitoring of severe reactor accidents. Since a severe reactor accident can, most commonly, only be created due to the failure of systems designed for operational states and postulated accidents, the systems and equipment designed for severe reactor accidents shall be independent of the systems designed for the normal operational states and postulated accidents of the plant. The primary task of the severe reactor accident systems is to ensure the integrity of the containment, thereby retaining any radioactive substances released during an accident inside the containment.

The accident at Fukushima Dai-ichi demonstrated the difficulties caused to a nuclear power plant by the unavailability of the electricity distribution system or the interruption of connections from the plant. Due to this reason, the section includes a requirement concerning an independent method of transferring residual heat from the reactor for three days. The planning shall take account of disturbances in the plant's internal electricity distribution systems that render the system inoperable. The requirement has also been extended to rare external events. These requirements do not necessarily need to be met by the same system. The demand for acceptable performance during rare weather phenomena may impose higher performance requirements on individual nuclear power plant systems and equipment than those otherwise imposed on the plant site. For fuel storage pools, the equivalent requirement is presented in Section 12.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary. Paragraph 4 has been specified to be applied to functions needed in postulated accidents, and it now includes tests that can also cause the inoperability of subsystems. The part concerning fuel storage facilities has been removed from Paragraph 7 and moved to Section 12 in order to clarify the requirements concerning fuel storage. The requirement for bringing the nuclear power plant to a safe state after an anticipated operational occurrence, a postulated accident or a design extension condition has been added as Paragraph 7a, because a safe state had been defined but no requirements had been presented concerning it. Paragraph 8 has been specified to be applied to reaching a controlled state of a severe reactor accident in a nuclear power plant: Absolute independence is not required for functions needed to reach a safe state. The design requirement for the management of a severe reactor accident concerns nuclear power plants. In small pool-type reactors, the probability of a severe accident shall be extremely small.

Section 12 Safety of fuel handling and storage

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

9) safety of fuel handling and storage at a nuclear facility

The requirement set forth in the section is included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

In fuel storage, the defence-in-depth principle shall be complied with where applicable. Disturbances and accidents shall be prevented, but their occurrence shall still be prepared for.

A dispersion barrier comparable to the containment of a nuclear power plant may not exist around the spent fuel storage facilities. The protective cladding of the fuel rods is the primary dispersion barrier. For this reason, the probability of a severe accident in the fuel storage shall be extremely low. This goal can be reached through reliable cooling of the fuel pools as well as structural design of fuel pools and related systems in order to prevent the pools from draining. However, reliable observation of leaks is also essential. The prevention of structural damage to fuel pools plays a key role in reducing the possibility of a severe accident.

In this respect, small pool-type research reactors are similar to fuel pools. For this reason, the possibility of a severe accident shall be extremely low in them, whether the fuel is located in a reactor or in storage.

The removal of residual heat from fuel shall be implemented in a manner that keeps the fuel cooled at all times and will not allow it to overheat in a manner that could jeopardise the integrity of the fuel rod cladding. The design of fuel storage pools and equipment and structures affecting them can prevent accidents that would compromise the cooling. When stored in water pools, the removal of residual heat from fuel shall be verified using the redundancy, separation and diversity principles. These requirements are more specifically presented in the YVL Guides.

Preventing the criticality of the fuel stored inside the fuel storage facilities shall be ensured during the handling and storage of fuel. Since the time available for managing the situation is short during criticality accidents, the probability of criticality shall be very low.

Damaging the fuel rods during processing could lead to emissions and doses, which is why such occurrences shall be reliably prevented.

Spent fuel will need to be stored for extended periods of time before the final disposal. The conditions within the storage facilities may vary during this time. During the entire storage period, it shall be ensured that the fuel storage conditions, such as water chemistry, will not change in a manner that makes fuel rod failure possible.

Paragraph 1, which mentions the defence-in-depth safety principle and the related safety principles specified in the YVL Guides, has been added to the section. Paragraphs 1a and 1b present the requirements for fuel storage that were previously included in Section 11(6) and (7). This is intended to clarify the requirements concerning fuel storage. Radiation protection has been removed from Paragraph 1, because it is covered by the proposal included in Section 24. In Paragraph 4, 'criticality accident' has been changed to 'criticality'.

Section 13 Safety of handling and storage of radioactive waste

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

10) safety of handling and storage of radioactive waste at a nuclear facility

Section 3 of the Nuclear Energy Act defines nuclear waste as materials, objects and structures that have become radioactive in connection with or as a result of the use of nuclear energy, have been removed from use and require special measures because of the danger arising from their radioactivity. The regulation further defines nuclear waste as waste generated during the operation and decommission of a nuclear facility whose activity concentration exceeds the limiting values that the Radiation and Nuclear Safety Authority has defined in its Guide.

Waste that exceeds the limiting values shall be managed as nuclear waste. The dependencies between the different stages of the generation and management of nuclear waste shall be considered. Waste shall be sorted and classified in a manner that allows their further processing in a safe and appropriate manner. The goal of further processing is to minimise the volume of waste and to bring the waste to a state that is stable in terms of storage and disposal. The most common processing methods include cutting and compressing the waste, solidifying liquid waste and packaging waste inside containers.

When the immediate disposal of the waste is not possible, it shall be stored inside a storage facility located at the nuclear facility whose conditions are appropriate in terms of safety and the preservability of the waste packages. A licensee under a waste management obligation who intends to deliver nuclear waste to a handling, storage or disposal facility of another licensee shall ensure that the waste is handled and packed taking into account the later stages of waste management.

The section takes into account the scope, replacing ‘nuclear power plant’ with ‘nuclear facility’. Paragraphs 3 and 4, whose content is the same as Section 16(4) and (5) of the waste regulation, has been added to the section.

Section 14 Protection against external hazards affecting safety

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

11) protection against external hazards affecting the safety of a nuclear facility

The requirement set forth in the section is included in the IAEA’s safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

External events at a nuclear facility may compromise the safety of the nuclear facility. They may compromise the integrity of the systems, structures and components related to safety functions, cause an operational occurrence or an accident or prevent safety functions from being executed. Such hazards include various weather phenomena (such as high or low temperatures, high winds, blizzards, lightning), earthquakes, high sea level (flooding) and other unauthorised activities compromising nuclear safety activities, including a large commercial airliner crash. These phenomena and hazards shall be taken into account during the design of the plant. This can be achieved by taking into account the loads and interactions caused by different events in the design of the systems, structures and components related to safety functions and by utilising the different means of safety design (defence-in-depth, redundancy, diversity and separation).

Access connections at the plant shall also be designed in a manner that minimises the effects of anticipated external events on the safety of the plant.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility'. External events shall also be considered in the design of fuel storage facilities. In Paragraph 1, 'safety functions' has been changed to 'safety'.

The wording regarding unlawful activities has been changed to make it more descriptive. It is necessary to extend the definition to cover unauthorised activities compromising nuclear safety, such as the licensee's internal procedure for carrying out the security arrangements and ensuring nuclear safety, the violation of which is not necessarily against the law. However, such activities may have significance in terms of the safety of the use of nuclear energy and it must also be possible to target security measures at them. For example, the licensee may have required that certain rooms must be entered by at least two people at the same time in order for admission to be granted. Any deviations from this may compromise nuclear safety, but this does not make such activities unlawful in themselves. However, the aforementioned risk may be reduced by means of security arrangements and the activities of security personnel.

Section 15 Protection against internal hazards affecting safety

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

12) protection against internal hazards affecting the safety of a nuclear facility

The requirement set forth in the section is included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

The systems related to safety functions shall be protected against internal hazards by following the same principles as presented in Section 14 regarding external hazards. Internal hazards may include fires, pipe breaks, container ruptures, explosions, drop of heavy objects and flooding. The safety functions shall be appropriately protected against the hazards listed above, at a minimum, by utilising the methods of safety design (defence-in-depth, redundancy, diversity and separation).

The section takes into account the scope, replacing ‘nuclear power plant’ with ‘nuclear facility’. In Paragraph 1, ‘safety functions’ has been changed to ‘safety’. Unlawful activities have been added to the section in a scope equal to that of external hazards.

Section 16 Safety of monitoring and control

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

13) safety of monitoring and control of a nuclear facility

The requirement set forth in the section is included in the IAEA’s safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

It shall be possible to monitor the state of a nuclear facility during normal operation, operational occurrences and accidents. This requires sufficient instrumentation. A nuclear power plant is controlled from a control room that has been designed specifically for this purpose. Within the control room, the plant operators shall have access to sufficient equipment that enables them to control the plant and provides information concerning the operational state of the nuclear power plant and any deviations from the normal operational state. This also includes equipment that the operators can use to monitor the implementation of safety functions and the progress of the accident during operational occurrences and accidents , and to take action according to emergency procedures.

During the early stages of transient and accident situations, the nuclear power plant shall be equipped with automatic systems that trigger the safety functions when necessary and control and monitor their operation. The automatic systems shall manage the safety of the plant long enough to provide the operator with sufficient time to consider and implement the correct actions on the basis of the emergency procedures.

The sufficiency of time to consider and implement the correct actions as well as other prerequisites for control actions shall also be assessed while planning the placement of control actions in the control room or locally. In preparation for situations where the main control room is not available, such as a fire, the nuclear power plant shall have a supplementary control room that is independent of the main control room as well as the necessary local control stations. The supplementary control room shall offer controls for systems that can be used to shut down the reactor and keep it subcritical, cool the fuel in the reactor, and transfer residual heat from the fuel in the nuclear reactor and the spent fuel stored at the plant into the ultimate heat sink.

The section takes into account the scope, replacing ‘nuclear power plant’ with ‘nuclear facility’. The mention of the control room has been removed from Paragraph 1, because the equipment indicating the state of the plant is not completely located in the control room. The control room has been added to Paragraph 3 as a new Subparagraph 3a, which also specifies the scope of operations carried out from the control room.

17 § Taking the safety of decommissioning into consideration in the design

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

24) taking the safety of the decommissioning of a nuclear facility into consideration in design, and the safety of the decommissioning of a nuclear facility

The requirement set forth in the section is included in the IAEA's safety requirements [2].

The design of a nuclear facility shall take account of the radiation protection requirements of the decommissioning of the facility. Many arrangements that are useful for the decommissioning are also important for radiation protection and waste management during plant operation. These include the selection of structural materials in a manner that minimises the formation of long-lived radioactive substances, minimises the formation of corrosion products and their passage inside the primary circuit, and makes surfaces easy to clean.

The activity concentrations that will be accumulated by the structures and components of a nuclear facility shall be assessed during the design stage of the facility. This allows for simplifying the design of the plant unit's decommissioning.

The nuclear facility's room arrangements are also important in terms of the facility's decommissioning and major repair projects. They should be designed in a manner that simplifies the repair and removal of large components, the appropriate handling of activated components and structures, and the decontamination of systems.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility'. In addition, 'the handling of waste' has been removed as unnecessary, because 'decommissioning' as a general term covers it to the extent intended.

Section 18 Safety of construction

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

14) safety of the construction of a nuclear facility

The requirement set forth in the section is included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

The basis for the safety of a nuclear facility is laid down during the construction stage, and any mistakes made at this time may jeopardise the safe operation of the plant and cause unnecessary problems during operational occurrences and accident situations. To this end, the key task of the holder of a construction licence for a nuclear facility shall be to ensure that safety has been appropriately considered during the construction of the nuclear facility.

The holder of the construction licence shall ensure that the nuclear facility is constructed and implemented in conformity with the safety requirements and using approved plans and procedures. The construction licence holder's personnel, at different levels of the organisation, shall be aware of the requirements related to the plant’s safety and acknowledge the safety significance of their tasks. According to the Nuclear Energy Act, the licensee shall also ensure that the other organisations participating in the construction of the nuclear facility follow the safety requirements related to nuclear safety and understand their significance. The responsibilities at the different levels of the licensee’s organisation shall be clearly defined and work shall be performed according to written instructions where safety has been appropriately considered. Furthermore, work shall be documented.

The section takes into account the scope, replacing ‘nuclear power plant’ with ‘nuclear facility’. Paragraph 2 has been removed, because the requirement was included in the Nuclear Energy Act in connection with the amendment (905/2017).

19 § Safety of commissioning

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

15) safety of the commissioning of a nuclear facility;

The requirement set forth in the section is included in the IAEA’s safety requirements [5] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

The purpose of commissioning is to demonstrate that the plant is operating according to the plans and that the operating instructions are appropriate. For the commissioning of a nuclear facility, a detailed plan is drawn up on how to demonstrate the operational compliance of the facility’s systems, structures and components. The commissioning measures shall be planned in advance so that they can be implemented in a controlled manner without endangering safety.

By means of commissioning tests, the licensee demonstrates that the entire plant and, in particular, the systems important in terms of safety are compliant with the design bases. The tests are carried out in stages; first in a cold state, then in a hot state with the normal design parameters and, finally, during the nuclear testing done after the loading of the fuel. The nuclear tests demonstrate that the entire plant, including the nuclear reactor, is operating as planned. The nuclear tests also include the validation of operating instructions during operational occurrences. The nuclear tests are performed by increasing the power gradually and assessing the possibilities of proceeding at each step.

All commissioning tests include the validation of the plant’s operating instructions under normal operating conditions.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary. Modifications to the nuclear facility have been added to Paragraph 1, because the correct function of the modified parts and their suitability for the operation of the plant shall also be ensured. The requirement concerning the organisation and personnel has been removed from Paragraph 2, because the requirements are presented in more detail in Section 25 and, according to Section 36 of the Nuclear Energy Decree, the description concerning the organisation and personnel shall be presented as part of the operating licence application. The requirement that the procedures of the commissioning shall be planned and instructions shall be provided has been added to Paragraph 1.

Section 20 Safety of operation

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

16) safety of the operation of a nuclear facility

A nuclear power plant is controlled from a control room that has been designed specifically for this purpose (Section 16). The control room of the plant shall be constantly manned by a sufficient number of operators trained for their tasks. The operators shall be assisted by equipment that provide sufficient information concerning the normal operational state of the nuclear power plant and any deviations therefrom as well as updated written procedures that allow the plant to be safely controlled and monitored. The control room shall also be furnished with equipment that the operators can use to monitor the implementation of safety functions and the progress of the accident during operational occurrences and accident situations. Furthermore, procedures for the identification and control of circumstances shall be available to assist the operators during operational occurrences and accident situations.

Repair and maintenance is carried out during plant operation in order to ensure the operating condition of the plant. For the avoidance of human errors, any service and repair work shall be based on written orders and instructions.

Operational activities take place at the nuclear facility during operation, and different events affecting safety also occur. The plant shall have in place procedures for recording a sufficient amount of information for the purposes of assessing these situations after they have occurred.

Modifications to a nuclear facility can be designed for different reasons during operation. The holder of the operating license shall ensure that these modifications are designed and implemented in conformity with the safety requirements and using approved procedures.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary. Paragraph 1 has been removed from this regulation: according to the Nuclear Energy Act, the license holder is responsible for ensuring the safe operation of the nuclear facility. In Paragraph 2 on the control room and operators, the requirement for the written procedures has been separated to form Paragraph 2a. A requirement has been added concerning modifications of a nuclear facility during operation.

Section 20 a Safety of decommissioning

Because of the addition of the provisions concerning the decommissioning license of nuclear facilities in the Nuclear Energy Act, it is necessary to set separate requirements in this regulation for the decommissioning license phase of nuclear facilities and the safety of decommissioning.

There shall be plans and procedures for decommissioning that ensure the maintaining of safety at the facility in different phases of decommissioning. During decommissioning, there shall be enough operators and other personnel at the facility in accordance with Section 25.

The title of Chapter 5 has been changed to also include decommissioning: the requirements during operation also concern decommissioning.

Section 21 Taking operating experience and safety research into consideration in order to improve safety

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

17) taking operating experience and safety research into consideration in order to improve the safety of a nuclear facility

The requirement set forth in the section is included in the IAEA's safety requirements [2] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

All safety-significant operational events shall be investigated for the purpose of identifying the root causes as well as defining and implementing the corrective measures. The safety of the nuclear power plant is ensured by systematically monitoring the condition of the plant and the operating experience gained in order to repair any defects and design errors by means of maintenance and/or modifications.

For the enhancement of safety, the licensee shall systematically monitor and assess operating experience from its own nuclear facility and from other nuclear facilities, the results of safety research and technical developments. The components and structures of a nuclear facility will age during operation, regardless of careful maintenance. Safety research also continuously provides new information. The starting point for the operational supervision of the nuclear facility is to ensure that the condition of the facility remains compliant with the design bases and that operating experience and advances in the fields of science and technology are taken into account during the further improvement of the facility's safety.

Monitoring operating experience and the results of safety research will also offer valuable information concerning events that may not have been considered during the basic design of the plant. These events will lead to safety improvements and they shall be taken into account insofar as this possible in view of the technological aspects.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary.

Section 22 Operational Limits and Conditions

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

18) Operational Limits and Conditions of a nuclear facility

The requirement set forth in the section is included in the IAEA's safety requirements [2] and [5] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

The Operational Limits and Conditions are a key document in terms of the operation and supervision of the nuclear facility. The licensee shall operate the plant in compliance with the regulations set in the Operational Limits and Conditions, and compliance with them shall be monitored and any deviations reported.

The Operational Limits and Conditions lay down the specific requirements concerning different systems and equipment that are used to ensure the operation of the plant in compliance with the design bases and safety analyses. These requirements include, for example, the requirements concerning the operability of systems and maximum allowable times for equipment repair during plant operation. In addition to this, the requirements and limiting values are set for the system process variables, such as power, pressure, temperature, flow rate and their change rates.

The Operational Limits and Conditions also present the administrative requirements concerning the minimum staffing of the control room during operation, for example. Functional tests repeated at regular intervals are used to ensure the functionality of the systems and equipment of the nuclear facility. The tests important for safety and their performance intervals have also been defined in the Operational Limits and Conditions.

The Operational Limits and Conditions are also needed in the decommissioning phase, and the phased abandonment of requirements shall be planned. The Operational Limits and Conditions shall therefore be applied as necessary in order to ensure the safety of the nuclear facility during decommissioning.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary. A new requirement (Paragraph 3) has been added concerning the Operational Limits and Conditions during decommissioning.

Section 23 Condition monitoring and maintenance to ensure the safety of the facility

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

19) condition monitoring and maintenance of a nuclear facility to ensure the safety of the facility;

The requirement set forth in the section is included in the IAEA's safety requirements [2] and [5] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

The operational reliability of the systems, structures and components is a prerequisite for the safe operation of a nuclear facility. The plant shall be designed in a manner that allows for inspecting, testing, maintaining and overhauling all the systems, structures and components that are important in terms of safety. The nuclear facility shall have in place condition monitoring and maintenance programmes and instructions that contain detailed procedures for ensuring the integrity and operability of systems, structures and components important for safety. These procedures are based on applicable standards, manufacturer recommendations and the licensee's own operating experience or experience from other nuclear facilities. A sufficient number of safety functions shall be maintained during decommissioning.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary.

Section 24 Radiation measurements and monitoring of releases of radioactive substances and estimation of radiation doses to the public and workers

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

20) structural radiation safety at a nuclear facility, radiation measurements and control and monitoring of releases of radioactive substances and estimation of radiation doses to the public;

The requirement set forth in the section is included in the IAEA's safety requirements [2], [5], [7] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

Based on the BSS directive, Paragraphs 2–4 have been added to the Section. Paragraph 1 has been divided to separately address the measurements of radiation levels and activity levels performed inside the nuclear facility (Paragraph 1) and the requirements concerning environmental monitoring (Paragraph 1a). The radiation levels of nuclear facility rooms and the activity concentrations of indoor air shall be measured in order to define the habitability of the rooms, the need to use protective equipment and similar changes in time for workers' radiation protection. In addition, these room measurements and measurements of the activity concentrations of gases and liquids in the systems provide information on the amounts of radioactive substances in the nuclear facility, the operation of processes and systems and their changes (for example, accumulation of activity, leaks, or any activity released into the environment) for measures during the normal operation of the facility and during disturbances and accidents.

The releases of radioactive substances shall be monitored and their concentrations in the environment shall be observed through measurements in order to know whether the releases are sufficiently low to be acceptable or whether measures reducing the releases or other measures are needed.

The radiation doses to the workers and the public in the surroundings caused by the operation or decommissioning of a nuclear facility shall be measured or otherwise estimated in order to know whether they are sufficiently low to be acceptable. The radiation doses to the public cannot normally be measured, primarily because of their small size, so they shall be assessed in some other way. Radiation doses are caused by external and internal radiation exposure, so they must be taken into account in the measurements and assessments.

According to the BSS directive and the international radiation protection recommendations (ICRP Publication 101 and 103[9, 10]), for the radiation doses to the public, it is necessary and sufficient to define the radiation dose for an individual who, based on his/her age, place of residence and lifestyle, represents the most exposed group but is not necessarily the most exposed individual. This individual is the so-called representative individual. In the definition of radiation exposure, the significant migration routes of radioactive substances to the body and environment of the representative person in terms of exposure shall naturally be taken into account.

The radiation doses and the releases from a nuclear facility and concentrations of radioactive substances in the environment shall be reported to the Radiation and Nuclear Safety Authority for control and related communication.

The monitoring of the amount of radioactive substances in the vicinity of the nuclear facility and the overall radiation situation is referred to as environmental radiation monitoring. According to Section 36(1) subparagraph (10) of the Nuclear Energy Decree (161/1988), the applicant shall submit to the Radiation and Nuclear Safety Authority a programme concerning the environmental radiation monitoring of the nuclear facility when applying for an operating licence. The purpose of environmental radiation monitoring is to ensure that the radiation exposure to the public caused by the nuclear facility is kept as low as reasonably achievable and that the limiting values in the regulations are not exceeded. Furthermore, monitoring can be used to observe any short- and long-term changes in the normal radiation situation in the environment. Monitoring is also a way to verify the measurements of radioactive releases at the nuclear facility and the calculation models used to estimate dispersion.

Section 25 Ensuring safety by management, organisation and personnel

Pursuant to Section 7 q of the Nuclear Energy Act (990/1987), the Radiation and Nuclear Safety Authority issues more specific provisions on the technical details of the principles and requirements stipulated in this chapter, with regard to the following aspects:

21) nuclear facility management, organisation and personnel to the extent that provisions are required to ensure the safety of the use of nuclear energy

The requirement set forth in the section is included in the IAEA's safety requirements [8] and in the reference levels [4] that WENRA updated and published due to the Fukushima accident.

Safety culture

A good safety culture shall be maintained during the design, construction and operation of a nuclear facility. The licensee and the senior management of the nuclear facility shall visibly and systematically commit to solutions promoting safety and act in a manner that ensures the safety of the facility at every level and during each procedure. Security arrangements and safeguards of nuclear materials are also essential parts of the safety culture.

The manner in which an organisation is led is one of the key factors in terms of its functionality. The activities of the personnel are guided by the focus areas defined by the management and the values and expectations manifested in the operations of the management. The structure of the organisation, the sufficiency of personnel resources and well planned work distribution form the basis for meaningful and motivating work tasks. The example set by the management plays a key role in maintaining a high level of safety culture. Those working at a nuclear facility shall have good prerequisites for the continuous development of safety.

The careful performance of tasks is absolutely necessary during the operation of the nuclear facility and the service and repair tasks. The goal is to protect the equipment against disturbances and radiation. All work shall be planned in advance and performed carefully. The personnel shall act responsibly and acknowledge the safety significance of their tasks. Training in particular shall emphasize that any discovered deficiencies or defects must be immediately rectified. The risk of financial losses shall never prevent the performance of procedures that are necessary in terms of safety.

The safety culture of nuclear facilities cannot be constructed solely on following rules. Training and practical work shall emphasise that everyone must have the necessary competence for their work and acknowledge the importance of their task in terms of the safety of the nuclear facility.

Updated, clear procedures form an important basis for safety. The personnel whose activities are regulated by the procedures shall be aware of their contents, understand them and be committed to following them. In order to meet these objectives, the users themselves shall ensure that the procedures are maintained and updated.

Safety and quality management

The management system of a nuclear facility refers to the processes and methods by means of which the organisation defines its safety and quality policies, the goals for its operations and the methods by means of which these goals are achieved. One of the goals for the management system is to develop and maintain a high level safety culture that also includes the prerequisites for advanced quality management. The organisations participating in the design, construction, commissioning and operation of a nuclear facility shall have in place a management system, and it shall be regularly assessed and continuously improved. The management system shall compile all the management requirements within the organisation and describe the planned and systematic procedures that ensure the meeting of the requirements. It shall be compatible with the goals of the organisation and promote achieving them.

The key goal for the management system is to ensure safety. The management system shall cover the entire life cycle of the plant, from the site selection to the decommissioning. It shall oblige the entire personnel as well as the contractors, suppliers and partners in co-operation who work at the nuclear facility.

One of the important tasks of the management system is to create the prerequisites for a high level of quality management. In this regard, during the entire life of the plant unit from its design to construction, operation and decommissioning, the licensee is responsible for developing and maintaining a documented management system that defines the quality requirements and safety goals for the equipment, tasks and work related to the nuclear facility that are important in terms of safety.

The quality requirements set by the management system shall cover all organisations that participate in the design, construction, operation and decommissioning of the nuclear power plant.

Lines of management, responsibilities and expertise

The manner in which an organisation is led is one of the key factors in terms of its functionality. The activities of the personnel are guided by the focus areas defined by the management and the values and expectations manifested in the operations of the management. The structure and management relationships of the organisation, the tasks and related responsibilities of the personnel, the sufficiency of personnel resources and well planned work distribution form the basis for meaningful and motivating work tasks. It is essential in terms of the functionality of the organisation that its operation or the related risks are assessed and developed in order to discover any deficiencies in a timely manner. When developing the organisation’s structure or ways of action, it shall be ensured that the modifications implemented support the achievement of safety goals and that the process of change implementation is controlled.

Tasks that are significant in terms of the safe operation of the nuclear facility shall be named. Training programmes shall be prepared for developing and maintaining of the professional qualifications of these persons, and an adequate command of the skills required for the duties must be verified. It is a prerequisite for the safety of the nuclear facility that the holder of the licence for the use of nuclear energy employs sufficient personnel with the training and professional skills required for the tasks as well as sufficient information concerning the requirements related to the safety of the facility.

The personnel shall acknowledge the safety significance of their tasks. Nuclear power plants have specific tasks whose importance in terms of safety is considered so high that they require the appointment of responsible persons whom the Radiation and Nuclear Safety Authority will approve for their tasks. These tasks include the plant's responsible manager and the persons responsible for emergency response arrangements, security arrangements, nuclear safeguards and radiation safety. Furthermore, the roles and responsibilities of the main operators located in the main control room of the nuclear power plant are so central in terms of the safe operation of the plant and the management of operational occurrences and accident situations that only persons approved by the Radiation and Nuclear Safety Authority may occupy these positions. The persons in these positions shall possess sufficient authority and possibilities for bearing the responsibility vested in them.

The licensee shall directly employ adequate and competent personnel for ensuring the safety of the nuclear facility. To accomplish this, the personnel shall, among other things, be familiar with the design bases and safety requirements of the facility and be able to ensure the conformance of the nuclear facility concerned. Furthermore, the organisation shall have access to professional expertise required for the safe operation of the plant, the maintenance of all equipment important to safety and the management of accidents. The careful and professional performance of tasks is absolutely necessary during the operation of the nuclear facility, the service and repair tasks and the management of accident situations. All work shall be planned in advance and performed carefully. The personnel employed in these tasks shall act responsibly and acknowledge the safety significance of their work. The thorough and versatile processing of matters related to safety requires that the licensee has a group of experts, independent of the other parts of the organisation, working as support for the responsible manager, said group convening on a regular basis to handle safety-related issues and to issue recommendations thereon if necessary. Herein, an expert independent of the other parts of the organisation refers to a person who is not participating in the decision-making concerning safety matters within the organisation.

The section takes into account the scope, replacing 'nuclear power plant' with 'nuclear facility' when necessary. The phrase 'during construction or operation' has been removed from Paragraph 4, because changes to approved plans shall be implemented in a systematic and controlled manner during all phases of the life cycle, including decommissioning. In Paragraph 7, the objective has been presented and excessive details removed. The wording of the section has been unified with the amendment of 1 January 2018 to the Nuclear Energy Act (990/1987).

Section 26 Entry into force

The section contains provisions on the entry into force of the regulation. It repeals the Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant Y/1/2016 issued on 22 December 2015.

The regulation is intended to enter into force on 15 December 2018.

Upon its entry into force, this regulation would be applied to any pending matters.

Section 27 Transitional provision

The safety requirements included in the regulation have been drawn up with a view towards new nuclear facilities. The goal is for the operating plant units, too, to meet these requirements after a specific transitional period, to the extent that this can be justified pursuant to Section 7 a of the Nuclear Energy Act and while considering the technical solutions in use at the nuclear facility. This section states the subsections of the regulation that the operating plants do not meet and whose meeting cannot justifiably be required.

Regardless of this, the requirements in these subsections would also apply to operating plants insofar as this can be considered justified pursuant to the principle laid down in Section 7 a of the Nuclear Energy Act.

The following shall be applicable to a nuclear power plant unit and a nuclear facility located in connection with it for which an operating licence was issued prior to 1 January 2016: Section 10(3) subparagraph (c), Sections 11 and 14 and Section 16(4), to the extent required with respect to the technical solutions of the nuclear power plant unit in question, under the principle laid down in Section 7 a of the Nuclear Energy Act.

Availability of the regulation, guidance and advice

This regulation has been published as part of the regulations issued by the Radiation and Nuclear Safety Authority that can be found on Finlex at: http://www.finlex.fi/en/viranomaiset/normi/555001/. The regulation is also available from the Radiation and Nuclear Safety Authority.

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10. The 2007 Recommendations of the International Commission on Radiological Protection, ICRP Publication 103, Annals of the ICRP 37 (1), 2007.