

Guide YVL D.4, Predisposal management of low and intermediate level nuclear waste and decommissioning of a nuclear facility

1 Scope of application

This Guide primarily concerns nuclear power plants and research reactors, but it also pertains, where applicable, to other nuclear facilities and to the processing and storage of radioactive waste, the custody of which is permanently assigned to the Government by virtue of the Government Decree on ionising radiation (1034/2018). The interim storage for the waste, the custody of which is assigned to the Government, is located in Olkiluoto in connection with the VLJ repository.

Description 204 of the government's duty of care connected to the processing and storage of radioactive waste, the custody of which is permanently assigned to the Government, has been updated to comply with the Radiation Act (859/2018) and Government Decree (1034/2018).

2 Justifications of the requirements

The Guide addresses three topics:

- the sorting, processing, storage, activity determination and record-keeping of low and intermediate level waste generated at nuclear facilities (hereinafter processing and storage of operational waste);
- the decommissioning of nuclear facilities, including management of the waste generated (hereinafter decommissioning and the processing and storage of decommissioning waste); and
- the clearance of operational waste, decommissioning waste or clearance of a decommissioned nuclear facility site and any buildings therein left undismantled from regulatory control as referred to in the Nuclear Energy Act (hereinafter clearance).

Nuclear facilities and especially nuclear power plants generate low and intermediate level radioactive waste, for example in the treatment of radioactive liquids and gases and from repair and maintenance works in the controlled areas. Most of operational waste contains radioactive substances to such extent that it must be processed, stored and disposed of in compliance with the safety requirements.

The decommissioning of a nuclear facility means the dismantling of a permanently closed nuclear facility to an end state where no special measures are needed at the facility site due to radioactive materials originating from the dismantled facility. Decommissioning can involve the dismantling of all structures and systems (green field) or only structures and systems classed as radioactive (brown field). Depending on the strategy selected, the dismantling of nuclear facilities can be done immediately or in a delayed fashion. Immediate decommissioning means that the dismantling of the nuclear facility commences as soon as possible after the final closing of the facility. Delayed dismantling means that the nuclear facility is kept in a permanent shutdown state, typically for a long time, even decades, before commencing the

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dismantling. Decommissioning also involves the processing, storage and disposal of the low and intermediate level waste generated as a result of the dismantling of the facility. Based on the Nuclear Energy Act (990/1987), nuclear waste management is considered to include all measures pertaining to the decommissioning of a nuclear facility.

At the outset, waste generated at the controlled areas of a nuclear facility, including the structures and equipment of a shut-down nuclear facility, is regarded as nuclear waste. Section 27c(1–2) of the Nuclear Energy Act lays down procedures concerning clearance levels and the processing of nuclear waste that does not exceed the clearance level, for which STUK approval is required.

Under Section 33 of the Nuclear Energy Act, a nuclear facility is considered decommissioned when the Radiation and Nuclear Safety Authority has confirmed that the quantity of radioactive materials remaining in the buildings and soil of the facility site complies with the requirements specified by virtue of the Act. In this Guide, this procedure is referred to as clearance of the nuclear facility site and any buildings therein left undismantled.

The Guide addresses the facilities and functions referred to above as well as low and intermediate level waste originating from them. The Guide presents requirements that must be fulfilled in the design and implementation of the processing and storage of operational waste, including its sorting, activity determination and record-keeping. In addition, the Guide sets out the basic requirements for planning and implementing the decommissioning of a nuclear facility and for the sorting and storage of the waste arising from decommissioning. The Guide also addresses the clearance of nuclear waste, including recyclable material, arising from the operation or decommissioning of a nuclear facility, as well as the clearance of a decommissioned nuclear facility. The Guide does not cover releases of radioactive substances from a nuclear facility or detailed design requirements for processing equipment or storage facilities.

2.1 Justifications of the requirements by topic

Below are justifications for the changes made to Guide YVL D.4 in this revision.

2.1.1 Chapter 3 Nuclear and radiation safety

The requirements presented in Chapter 3 are connected to nuclear and radiation safety. Chapter 3.1 presents the annual dose constraints set for a member of the public for the decommissioning of nuclear facilities and the processing and storage of operational waste. The requirements presented in the chapter are, in regard to radiation protection and to preparedness for operational occurrences and accidents based on the Nuclear Energy Decree (161/1988) and in regard to clearance, the Nuclear Energy Act (990/1987).

Descriptions 301–303 and requirement 304 have been updated with regulatory references to the annual dose constraints received by a member of the public (Sections 22b and 22d of the Nuclear Energy Decree). Description 307 contains an updated reference to STUK Guide YVL C.4 “Assessment of radiation doses to the public in the vicinity of a nuclear facility”. In this context, the previously used phrase

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“limit for the annual dose” was changed to correspond with the phrase used in current legislation, “annual dose constraint”.

Chapter 3.2 addresses the annual dose constraints set for members of the public or workers handling the waste that are connected to the clearance from regulatory control of nuclear waste, buildings and the site. In accordance with Section 27d of the Nuclear Energy Act, a requirement that clearance levels be set in such a way that the exposure caused to members of the public is of minor significance was added to requirement 308.

2.1.2 Chapter 4 Design requirements

Chapter 4.1 General safety principles

Chapter 4.1 contains requirements for the processing and storage of operational waste, decommissioning of a nuclear facility and clearance of nuclear waste, the nuclear facility site and any buildings therein left undismantled. The requirements are connected to, for example, plans for the decommissioning of a nuclear facility and updates thereto and consideration of decommissioning in the design of a nuclear facility, and they are based on the Nuclear Energy Act and the Radiation and Nuclear Safety Authority Regulations STUK Y/1/2018, STUK Y/4/2018 and STUK SY/1/2018.

Description 403 concerning the decommissioning of a nuclear facility has been changed to correspond with Section 7g of the amended Nuclear Energy Act, and Subsection 4 of this Section on the licensee's obligations concerning the decommissioning of a nuclear facility has been moved to description 706.

According to requirement 411, in the event that waste is cleared following the general procedure without any limitations, the nuclide-specific activity levels specified in Annex A to Guide YVL D.4 shall be complied with in accordance with the Radiation and Nuclear Safety Authority Regulation STUK SY/1/2018. Annex B gives levels for general clearance, which are applied for limited amounts of material (100 tonnes per year). Here, nuclear power plant refers to all plant units and storage facilities within the same power plant site, and nuclear facility refers to, for example, an encapsulation or final disposal facility or a facility for the processing and/or storage of nuclear waste.

In requirement 412, the conditions presented regarding case-specific clearance (a, b and c) have been updated to correspond with the content of Section 10(1) of the Nuclear Energy Decree. A requirement regarding the withdrawal of approval under Section 27c(4) of the Nuclear Energy Act has also been added to requirement 412.

The requirement that the activity concentrations of the waste or other material to be cleared be below the exemption levels given in Guide ST 1.5 “Exemption of radiation use from safety licensing” has been removed from requirement 413. In the Radiation and Nuclear Safety Authority Regulation STUK SY/1/2018, the exemption levels and clearance levels are the same.

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Chapter 4.2 Radiation safety

Chapter 4.2 presents requirements for radiation protection arrangements for a nuclear facility where operational waste is processed and stored or that is being decommissioned. The requirements regarding radiation safety are based on the Nuclear Energy Act, Radiation Act, Nuclear Energy Decree and the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

Chapter 4.3 Activity determinations and record-keeping

Chapter 4.3 presents requirements concerning activity determination, identification of waste packages and waste record-keeping. It also contains requirements concerning the decommissioning of a nuclear facility and clearance, and they address activity and surface activity contamination measurements at different phases of a nuclear facility's lifecycle, and the activity determinations of materials, structures and sites to be cleared from regulatory control. The requirements of the chapter are based on the Nuclear Energy Act and the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

Chapter 4.4 Design of systems, structures and functions

Chapter 4.4 presents requirements concerning the classification of systems, structures and components and the maintenance of classification documents. Requirement 433 has been changed to correspond with the content of Guide YVL B.1 "Safety design of a nuclear power plant" as regards classification requirements. Chapter 4.4 also contains requirements for the design of systems, structures and components, the sorting, processing and packing of waste and the transfers and storage of waste. According to requirement 435, the design of a processing and storage facility for operational waste or the planning of the decommissioning of a nuclear facility shall give priority to concepts where high temperatures are not used. However, thermal methods can be used when their use is justified, when their safety is considered and when it is preferable, for example for long-term safety. Design-related requirements 439–442 have been clarified in that the requirements on complying with other YVL Guides have been changed to references to the requirements presented in the Guides in question. Each YVL Guide is then applied separately on a case-by-case basis for the waste processing and storage facility in regard to operation and the decommissioning of nuclear facilities. The requirements of the chapter are based on the Nuclear Energy Act and the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

Chapter 4.5 Prevention of occurrences and accidents

Chapter 4.5 presents requirements for the prevention of occurrences and accidents. The requirements are connected to functions to be secured against single failure, provision for phenomena adverse to safety in the storage of liquid waste, prevention of fires and explosions, fire protection, consideration of external events that may give rise to significant occurrences, and security arrangements. Requirements 456–458 have been clarified in that the requirements on complying with other YVL Guides have been changed to references to the requirements presented in the Guides in question. The requirements of the chapter are based on the Nuclear Energy Act and the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

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2.1.3 Chapter 5 Operation and decommissioning of the facility

Chapter 5 presents requirements for documents from the period of an operating licence or decommissioning licence and updates thereto, an operating experience feedback programme, a condition monitoring programme for waste packages stored in the long term or unpacked waste, technical requirements pertaining to the waste packages, nuclear safeguards pertaining to final disposal and changes made following the commissioning of a nuclear facility. The requirements of the chapter are based on the Nuclear Energy Act, Nuclear Energy Decree and the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

Requirement 501 concerning documents from the period of an operating licence or decommissioning licence has been updated to correspond with updated regulations and legislation: Section 36a of the Nuclear Energy Act and the Radiation and Nuclear Safety Authority Regulations STUK Y/1/2018 and STUK Y/4/2018. Requirements 502, 506, 508 and 511 have been clarified in that the requirements on complying with other YVL Guides have been changed to references to the requirements presented in the Guides in question. The appointment of a responsible manager for the decommissioning of a nuclear facility pursuant to Section 7k of the Nuclear Energy Act has been added to requirement 512, and description 513 addresses safety culture pursuant to Section 25 of the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

2.1.4 Chapter 6 Demonstration of compliance with safety requirements

The requirements of the chapter are based on the Nuclear Energy Act and the Radiation and Nuclear Safety Authority Regulation STUK Y/1/2018.

Chapter 6.1 Principles for the demonstration of safety

The requirements of Chapter 6.1 address the principles for the demonstration of safety, such as commissioning testing and different types of analyses.

Chapter 6.2 Safety analysis reports and their annexes

The requirements of Chapter 6.2 address preliminary and final safety analysis reports, which are submitted at different phases of the lifecycle of a nuclear facility, the updating thereof and the supplementation of the safety analysis reports with topical reports. Requirement 604 takes into account the decommissioning of a nuclear facility in accordance with Section 36a of the Nuclear Energy Act.

The requirements of Chapter 6.2 also include requirement 605 concerning the content of the final decommissioning plan of a nuclear facility. The requirement has been updated by removing overlaps with the safety analysis report concerning decommissioning.

Chapter 6.3 Periodic safety review

Chapter 6.3 presents requirements for conducting a periodic safety review, its updating frequency and content. The updating frequency of the periodic safety review

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of decommissioning has been changed from 15 years to 10 years to correspond with Section 7e of the Nuclear Energy Act.

2.1.5 Chapter 7 Licence procedures and documents to be submitted to the Radiation and Nuclear Safety Authority

In this Guide update, the previous Chapter 7 “Regulatory oversight by the Radiation and Nuclear Safety Authority” has been divided into two different chapters: Chapter 7 “Licence procedures and documents to be submitted to the Radiation and Nuclear Safety Authority” and Chapter 8 “Safety oversight by the Radiation and Nuclear Safety Authority”. As such, the requirements concerning the licence holder and the description of STUK’s oversight have been separated more clearly. The requirements of the chapter are based on the Nuclear Energy Act and Nuclear Energy Decree.

Chapter 7.1 Processing and storage of operational waste

The requirements of Chapter 7.1 address the licensing of nuclear waste management facilities and systems when they are constructed in the immediate vicinity of a nuclear facility or as a separate nuclear facility. Requirements 702 and 703 have been updated to comprise a requirement for the licensee instead of a description of STUK’s operations.

Chapter 7.2 Decommissioning of a nuclear facility

Chapter 7.2 presents requirements concerning the licensee’s obligations after the operation of a nuclear facility has been terminated. The requirements address an announcement of the permanent closing of a nuclear facility, application of a decommissioning licence, commencement of the different work phases of decommissioning and reporting connected to decommissioning. Chapter 7.2 also contains requirements concerning the actions connected to the ending of the duty of care and reporting procedures for terminating the use of nuclear energy. The previous requirements 704 and 705 concerning the documents to accompany the construction and operating licence applications of a nuclear facility have been removed because they are laid down in Sections 32 and 34 of the Nuclear Energy Decree. Description 706 of the licence holder’s obligations after the termination of the operation of a nuclear facility has been updated to correspond with Section 7g(3) of the Nuclear Energy Act. Requirement 707, which is connected to the oversight of a processing and storage facility for operational waste throughout their lifecycle, has been moved to Chapter 8. The update to requirement 709 takes into account the requirement of Section 36a of the Nuclear Energy Decree concerning the documents to be submitted to STUK by the licence holder. The description of STUK’s oversight has been moved from requirement 710 to Chapter 8.

Chapter 7.3 Clearance

The requirements of Chapter 7.3 are connected to the approval of procedures to be used in general clearance and the application for the transfer of nuclear waste required for case-specific clearance. Chapter 7.3 also contains a requirement concerning the application to be submitted to STUK regarding the clearance of the site and any buildings therein according to the general or case-specific procedure. The section on STUK’s oversight has been removed from description 717.

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2.1.6 Chapter 8 Safety oversight by the Radiation and Nuclear Safety Authority

Chapter 8 presents of the regulatory oversight by the Radiation and Nuclear Safety Authority.

Description 801 (formerly 707) addresses STUK's oversight concerning the design, construction, commissioning, operation and decommissioning of a processing and storage facility for operational waste.

Descriptions 802 and 803 (formerly 702 and 703) are connected to STUK's oversight when the intention is to enlarge the processing and storage facility and commission the expansion under the terms and conditions of an existing operating licence

Description 804 (formerly 717) concerns STUK's oversight concerning clearance procedures.

Description 805 concerns STUK's review and approval of the decommissioning licence application as regards documents referred to in Section 36a of the Nuclear Energy Decree.

2.1.7 Guide Annexes A–C

Annex A presents levels for the general clearance of unlimited amounts of solid material. The table corresponds with the table presented in the Radiation and Nuclear Safety Authority Regulation STUK SY/1/2018.

Annex B, "Levels for the general clearance of limited amounts of material" include levels for activity concentration and surface activity contamination, which are applied for the general clearance of nuclear waste when the amount of material to be cleared does not exceed 100 tonnes per year for a single nuclear facility. The Annex also sets forth averaging rules, which are intended to ensure that the material or surfaces to be cleared do not contain any highly radioactive points. In the table, the nuclide group specific level of weak beta and gamma emitters is disproportionate compared to Annex A, "Levels for the general clearance of unlimited amounts of material". Annex A allows some weak beta nuclides to have higher activity concentrations in unlimited clearance than in limited clearance. Therefore, the table is stricter in regard to the strong gamma and beta emitters of the corresponding table, for which 100-tonne clearance allows some nuclides to have ten times higher activity than in unlimited clearance. No changes were made to the table during this update, but it will be assessed more closely during the next Guide update. In the table in Annex B, a single nuclear facility refers to a nuclear power plant that includes all the plant units and storage facilities located in the same power plant site. Another nuclear facility refers to, for example, an encapsulation or final disposal facility or a separate waste processing and storage facility.

Annex C, "Activity determinations of waste", provides general instructions for determining the activity of waste, itemises the suitability of different measurement and analysis methods for different types of waste, and analyses factors connected to the reliability of measurements.

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3 International provisions concerning the scope of the Guide

Key IAEA standards concerning the scope of this Guide

- GSR Part 5 Predisposal Management of Radioactive Waste
- GSR Part 6 Decommissioning of Facilities
- GSR Part 3 Radiation Protection and Safety of Radiation Sources – International Basic Safety Standards – Interim Edition.

Other IAEA standards

- SSG-40 Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors
- SSG-47 Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities
- GSG-7 Occupational Radiation Protection
- WS-G-5.1 Release of Sites from Regulatory Control on Termination of Practices (not updated)
- WS-G-5.2 Safety Assessment for the Decommissioning of Facilities Using Radioactive Material (not updated)
- WS-G-6.1 Storage of Radioactive Waste (not updated)
- RS-G-1.7 Application of the Concepts of Exclusion, Exemption and Clearance (not updated).

WENRA safety reference levels:

- Waste and Spent Fuel Storage Safety Reference Levels
- Decommissioning Safety Reference Levels.

The Guide corresponds with international recommendations.

4 Impacts of the Tepco Fukushima Dai-ichi accident

Taken into account in other YVL Guides, which are referred to in this Guide.

5 Needs for changes taken into account in the revision

The needs for changes due to changes made to international and national laws/regulations and the change proposals made in connection with the preparation of the YVL Guide implementation decisions (SYLVI) together with others recorded in STUK's change proposal database have been considered when updating the requirements. In addition, the possibilities to reduce the so-called administrative burden have been considered.

The most significant change for Guide YVL D.4 was that requirements presented therein concerning the decommissioning of nuclear facilities and clearance of nuclear waste were adopted into the Nuclear Energy Act and Decree. These changes did not have a significant impact on the content of the Guide, but they clarified and reinforced the content of the Guide, since the basic requirements are now set forth in the Nuclear Energy Act and Decree.

Changes to Guide YVL D.4 were caused by, for example:

- Moving of annual dose constraints to the population and adding restrictions concerning the processing and storage of operational waste to the Nuclear Energy Decree (Sections 22b and 22d). These legislative changes required some specifications to descriptions 301–303 and requirement 304 of the Guide. In accordance with Section 27d of the Nuclear Energy Act, a requirement that clearance levels be set in such a way that the exposure caused to members of the public is of minor significance was added to requirement 308 of the Guide.
- Requirements concerning the decommissioning of a nuclear facility were updated when added to the Nuclear Energy Act and Decree. Requirements concerning decommissioning were already included in this Guide, but they have now been updated to correspond with the content of the requirements of the Nuclear Energy Act and Decree. There were minor specifications to requirements 501, 507, 512, 604 and 709 and to descriptions 403 and 706.
- A mention of the reuse, recycling and disposal of nuclear waste if the amount of radioactive substances within it does not exceed the clearance level provided by virtue of Section 7q(1)(28) of the Nuclear Energy Act was added to the Nuclear Energy Act (Section 27c). Requirements concerning clearance were already included in this Guide, but they have now been updated to correspond with the requirements of the Nuclear Energy Act and Decree. In Guide YVL D.4, this caused minor specifications to description 103 and requirement 412, to which a new reference was added regarding withdrawal of clearance approved by STUK (Section 27c(4) of the Nuclear Energy Act).
- Concerning clearance, the new the Radiation and Nuclear Safety Authority Regulation on exemption values and clearance levels (STUK SY/1/2018), which applies to the clearance of solid materials, was also taken into account in the Guide update. The Regulation did not change the requirements of Guide YVL D.4.
- Chapter 7 of the Guide was divided into Chapters 7 and 8 in such a way that Chapter 7 contains various requirements concerning licensing for the licensee, and Chapter 8 contains safety oversight by STUK.
- Description 204 of the Government's duty of care connected to the processing and storage of radioactive waste, the custody of which is permanently assigned to the Government, has been updated to comply with Section 80(3) of the Radiation Act (859/2018) and Section 32 of the Government Decree (1034/2018).
- Guide YVL D.4 contained an unusual number of requirements to comply with other YVL Guides, and these requirements have been changed to references to the Guides in question. In conjunction with this, requirement attributes were also changed from requirement to description, where necessary. In Guide YVL D.4, such paragraphs included 433, 439–442, 456–458, 502, 506, 508 and 511.
- Changes in regulations and legislation The references to regulations and legislation connected to radiation and nuclear energy legislation in descriptions 106 and 107 have been updated: Radiation Act (859/2018) and Government Decree on Ionizing Radiation (1034/2018), and the Radiation and Nuclear Safety Authority Regulations STUK Y/1/2018, STUK Y/2/2018, STUK Y/4/2018 and STUK SY/1/2018. The reference to legislation connected to the environmental impact assessment procedure presented in description 108 has also been updated. Similar updates have also been carried out elsewhere. The Guide update also takes into account changes in content due to legislation, including

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amendments to the Nuclear Energy Act 905/2017 and 862/2018 amendment to the Nuclear Energy Decree 1001/2017.