STUK

GUIDE **YVL D.4** / 15 NOVEMBER 2013

PREDISPOSAL MANAGEMENT OF LOW AND INTERMEDIATE LEVEL NUCLEAR WASTE AND DECOMMISSIONING OF A NUCLEAR FACILITY

continues

With regard to new nuclear facilities, this Guide shall apply as of 1 December 2013 until further notice. With regard to operating nuclear facilities and those under construction, this Guide shall be enforced through a separate decision to be taken by STUK. This Guide replaces Guides YVL 8.2 and YVL 8.3.

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Authorisation

According to Section 7 r of the Nuclear Energy Act (990/1987), *the Radiation and Nuclear Safety Authority (STUK) shall specify detailed safety requirements for the implementation of the safety level in accordance with the Nuclear Energy Act.*

Rules for application

The publication of a YVL Guide shall not, as such, alter any previous decisions made by STUK. After having heard the parties concerned STUK will issue a separate decision as to how a new or revised YVL Guide is to be applied to operating nuclear facilities or those under construction, and to licensees' operational activities. The Guide shall apply as it stands to new nuclear facilities.

When considering how the new safety requirements presented in the YVL Guides shall be applied to the operating nuclear facilities, or to those under construction, STUK will take due account of the principles laid down in Section 7 a of the Nuclear Energy Act (990/1987): *The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience, safety research and advances in science and technology.*

According to Section 7 r(3) of the Nuclear Energy Act, *the safety requirements of the Radiation and Nuclear Safety Authority (STUK) are binding on the licensee, while preserving the licensee's right to propose an alternative procedure or solution to that provided for in the regulations. If the licensee can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with this Act, the Radiation and Nuclear Safety Authority (STUK) may approve a procedure or solution by which the safety level set forth is achieved.*

Translation. Original text in Finnish.

1 Introduction

101. Low and intermediate level waste is generated at nuclear facilities, notably nuclear power plants, when radioactive liquids and gases are processed and repair and maintenance work is carried out in the controlled area, among other things. In the present Guide, this type of waste is referred to as *operational waste*. Most of operational waste contains radioactive materials to such an extent that it must be processed, stored and disposed of in compliance with radiation protection requirements.

102. 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 also involves the processing, storage and disposal of the low and intermediate level waste arising from the dismantling of the facility (*decommissioning waste*). Under Section 3 of the Nuclear Energy Act, all measures related to the decommissioning of a nuclear facility are regarded as part of nuclear waste management.

103. Any waste generated inside the controlled area of a nuclear facility, including the structures and components of a permanently closed nuclear facility, is by definition nuclear waste. According to Section 3(1)(3b) of the Nuclear Energy Act, nuclear waste means *materials, objects and structures which, having become radioactive in connection with or as a result of the use of nuclear energy and having been removed from use, require special measures because of the danger arising from their radioactivity.* Hence, any nuclear waste determined as being of low activity can be classified as non-nuclear waste and treated as ordinary waste. Furthermore, subject to the preconditions set forth in Section 10 of the Nuclear Energy Decree, a batch of nuclear waste may be exempted from the scope of the Act. For the purposes of the present Guide, these measures are referred to as clearance of nuclear waste.

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

105. This Guide addresses the facilities and activities referred to above. Chapters 3 through 6 of the Guide contain requirements pertaining to the processing and storage of operational waste and the decommissioning of a nuclear facility, as well as obligations concerning a licence applicant or licensee. Chapter 7 describes the regulatory oversight exercised by the Radiation and Nuclear Safety Authority and other regulatory control.

106. The basic requirements concerning the safe use of nuclear energy are set out in the Nuclear Energy Act. Section 7 h of the Act provides general safety requirements for nuclear waste management, and Section 7 g for the decommissioning of a nuclear facility, respectively. The general principles for radiation protection and provisions concerning radiation work are set out in the Radiation Act (592/1991).

107. The Government Decree on the Safety of Nuclear Power Plants (717/2013) applies to the processing and storage of operational waste and to the decommissioning of a nuclear facility. The Government Decrees on the Security in the Use of Nuclear Energy (734/2008) and Emergency Arrangements at Nuclear Power Plants (716/2013) also apply to the processing and storage of operational waste and the decommissioning of a nuclear facility where applicable.

108. According to Section 6(7b) of the Government Decree on the Environmental Impact Assessment Procedure (713/2006), nuclear power plants and other nuclear reactors, including the dismantling and decommissioning of such plants and reactors, are projects that are subject to an assessment procedure under Section 4(1) of the Act on Environmental Impact Assessment Procedure (468/1994).

109. The disposal of nuclear waste is addressed in Guide YVL D.5, Disposal of nuclear waste. Several other YVL Guides issued by STUK are applicable to the processing and storage of operational waste and to the decommissioning of nuclear facilities. This Guide contains references to the applicable Guides; the relevant paragraphs are specified where practicable.

2 Scope of application

201. This Guide sets out the requirements that shall be complied with when planning and implementing the sorting, processing, storage, activity determination and record-keeping of low and intermediate level waste arising from the operation of nuclear facilities (hereinafter the *processing and storage of operational waste*).

202. The Guide sets out the basic requirements for planning and implementing the decommissioning of a nuclear facility and for the sorting, processing, storage, activity determinations and record-keeping of the waste arising from decommissioning (hereinafter the *processing and storage of decommissioning waste*).

203. The Guide also addresses the clearance of nuclear waste, including recyclable material, arising from the operation and decommissioning of a nuclear facility, as well as the clearance of a decommissioned nuclear facility. The Guide discusses the clearance procedures and the activity determination and record-keeping of the materials to be cleared.

204. 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 under Section 24 b of the Radiation Decree (1512/1991).

3 Nuclear and radiation safety

3.1 Operation and decommissioning of a nuclear facility

301. The design basis for the processing and storage of operational waste at a nuclear power plant is the annual dose constraint of 0.1 mSv to an individual of the population arising from the normal operation of the nuclear power plant (Government Decree 717/2013, Section 8).

302. Pursuant to Section 8 of Government Decree 717/2013 and the optimisation principle of Section 2 of the Radiation Act, the processing and storage of operational waste shall be so designed that the average annual dose to the most exposed individuals of the population, arising from the processing and storage of operational waste as designed, does not exceed the 0.01 mSv constraint.

303. The annual dose to the most exposed individuals of the population arising as a result of an operational occurrence or accident shall remain below the values indicated below (Government Decree 717/2013, Sections 9 and 10):

a. 0.1 mSv as a result of an anticipated operational occurrence;
b. 1 mSv in the event of a Class 1 postulated accident; and
c. 5 mSv in the event of a Class 2 postulated accident.

304. The decommissioning of a nuclear power plant shall be designed based on the objective referred to in para. 302 concerning planned activities, according to which the annual dose constraint of 0.01 mSv shall not be exceeded, and on the dose constraints for operational occurrences and accidents specified in para. 303.

305. The anticipated operational occurrences to be considered shall be defined as events that have a high probability to occur during the lifetime of the facility (on average at least once over a span of one hundred operating years).

306. The postulated accidents to be considered shall be defined and classified based on their estimated frequency so that a Class 1 accident may occur more frequently and a Class 2 accident less frequently than once over a span of one thousand years.

307. The dispersion analyses of radioactive releases to the environment and the analyses of the radiation doses arising from the releases shall be conducted in compliance with Guide YVL C.4, Assessment of radiation doses to the public in the vicinity of a nuclear facility, where applicable. This applies to normal operation, operational occurrences and accidents.

3.2 Clearance

308. The basic radiation protection requirement for the clearance of nuclear waste is that the annual dose to any member of the public or worker handling the waste does not exceed the constraint of 0.01 mSv, and that the radiation exposure arising from the cleared waste is otherwise kept as low as reasonably achievable. This dose constraint applies to the clearance of materials arising from the operation or dismantling of a single nuclear power plant or other nuclear facility.

309. The basic radiation protection requirement for the clearance of the buildings and the site of a nuclear facility is that the typical annual dose to the most exposed individual arising from the use of the cleared site and buildings is not more than 0.01 mSv. In a case-specific clearance procedure where the future use of the site and the buildings is restricted, an annual dose of an individual up to 0.1 mSv may be permitted based on radiation protection optimisation. Furthermore, it must be demonstrated by means of analyses that even if the restrictions imposed on the use of the site were to fail, the annual dose arising from use of the buildings and occupancy at the site would remain below 1 mSv with high certainty.

4 Design requirements

4.1 General safety principles

Processing and storage of operational waste

401. According to Section 7(h)(1) of the Nuclear Energy Act, *the nuclear facility shall have the facilities, equipment, and other arrangements required to ensure the safe handling and storage of [...] any nuclear waste generated during operation*.

402. The planning and implementation of the processing and storage of operational waste shall be carried out with due consideration given to potential dependencies between different waste management stages. Account shall be taken of the following safety principles in particular:

a. The generation of waste that needs to be stored or disposed of shall, among other things, be limited by means of repair work and maintenance planning, and decontamination and volume reduction.
b. Waste shall be appropriately sorted and classified in view of its further treatment, clearance, storage and disposal.
c. Waste that can be disposed of in a repository shall be conditioned and packed in accordance with the disposal requirements.
d. Waste that cannot yet be disposed of in a repository shall be safely processed and stored until disposal.
e. The radiation exposure of workers arising from waste management actions shall be limited, the spreading of radioactive materials inside the facility and into the environment shall be prevented, and preparedness for operational occurrences and accident conditions shall be maintained.
f. The radioactivity and other properties of waste shall be determined and recorded such as to ensure the availability of the necessary information concerning the waste packages that are to be disposed of, or any waste that is to be stored for a prolonged period of time.

Decommissioning of a nuclear facility

403. According to Section 7g(1) of the Nuclear Energy Act, *the design of a nuclear facility shall provide for the facility's decommissioning.* According to subsection 2, *when the operation of a nuclear facility has been terminated, the facility shall be decommissioned in accordance with a plan approved by the Radiation and Nuclear Safety Authority (STUK). Dismantling the facility and other measures taken for the decommissioning of the facility may not be postponed without due cause.*

404. In the design stage of a nuclear facility, a decommissioning strategy shall be established that at least defines the implementation stages with timetables, an outline of the dismantling and waste management solutions adopted, and the end state of the facility site. If the strategy involves a prolonged period of monitored storage prior to the dismantling of the facility, this shall be justified by considerations such as radiation protection optimisation, co-implementation of the decommissioning with other nuclear facilities, or the availability of disposal facilities.

405. Since its commissioning, a nuclear facility shall have a sufficiently detailed decommissioning plan commensurate with the type and state of the facility in place that is based on the adopted decommissioning strategy. During the operation of the facility, the strategy and plan shall be regularly reviewed and updated where necessary to ensure that they can be used as the basis for the final decommissioning plan drafted after the permanent shutdown of the facility.

406. According to Section 20 of Government Decree (717/2013), *the design of a nuclear power plant shall take account of the decommissioning of plant units so as to limit the volume of waste destined for final disposal, accumulating during their dismantling, and the radiation exposure of workers due to the dismantling of the plant, and to prevent radioactive materials from spreading into the environment during decommissioning and when the waste is processed.* These principles shall also apply to the design of other nuclear facilities.

407. Account shall be taken of the safety principles included in paras. 401 and 402 when the processing and storage of the waste arising from the decommissioning of a nuclear facility is planned and implemented.

408. During the design, construction, operation and particularly in connection with final shutdown of a nuclear facility, information concerning the facility that is of use when the decommissioning plan of the facility is kept up to date and when the facility is decommissioned shall be sought out, collected and recorded.

Clearance

409. Nuclear waste may be cleared from regulatory control following a general or case-specific procedure.

a. *In a general clearance procedure, the destination of the materials released from the facility need not be designated, or is only designated in its outline, and the activity levels to be applied are fixed.*
b. *In a case-specific clearance procedure, the recipient of the material and the maintenance process must be defined; the activity levels will be imposed based on case-by-case consideration.*

410. The general clearance procedure is not applicable to waste that is volatile or flammable or is otherwise particularly prone to cause radiation exposure.

411. In the event that waste is cleared following the general procedure without any limitations, the nuclide-specific activity levels specified in Annex A shall be complied with. Alternatively, if the annual amount of waste to be cleared does not exceed 100 tonnes for one nuclear power plant or other nuclear facility, the activity levels specified in Annex B may be applied for waste that is disposed of in a public landfill or dispatched to be melted as recyclable metal. When the levels specified in the annexes are applied to several nuclides, the sum of the ratios between nuclide-specific activities and the respective activity levels shall be less than one. When necessary, an assessment of the nuclide composition and activities of the waste may be used.

412. In a case-specific clearance, the activity levels approved by STUK for each case shall be complied with, the determination of which shall take due account of the provisions contained in Section 10(1) of the Nuclear Energy Decree:

a. *The total activity of nuclear waste in the possession of the transferee shall be lower than 1 GBq and the alpha activity lower than 10 MBq.*
b. *The annual dose caused by the transferred nuclear waste shall not exceed 0.01 mSv.*
c. *The radiation exposure caused by the transferred nuclear waste shall be as low as reasonably achievable.*

413. The activity concentrations of the waste or other material to be cleared shall be below the exemption levels given in Guide ST 1.5, Exemption of the use of radiation from the safety licence. The material to be cleared may not contain any nuclear material within the meaning of Section 3(1)(2) of the Nuclear Energy Act or nuclear use items within the meaning of Section 1(1)(8) of the Nuclear Energy Decree.

414. The site of a decommissioned nuclear facility and any buildings therein left undismantled may be cleared from regulatory control following the general or case-specific procedure. In the case-specific procedure, the future use of the site and buildings need to be defined.

415. Buildings left undismantled may be cleared following the general procedure and without restrictions if the average surface activity contamination on the walls, floors and ceilings inside the buildings is less than 0.4 Bq/cm^2 (4,000 Bq/m^2). Furthermore, surface activity contamination on any area of one square metre shall be less than 10,000 Bq. These surface contamination levels may be applied to nuclide compositions typically occurring at nuclear power plants.

416. For a case-specific clearance, the future use of the nuclear facility site and any buildings therein left undismantled shall be defined with the necessary restrictions, and the resulting radiation doses to the representatives of the most exposed group shall be assessed.

4.2 Radiation safety

417. A nuclear facility where operational waste is processed and stored or that is being decommissioned shall have radiation protection procedures in place. In the design of the facility and its operations, due account shall be taken of the following considerations:

a. The facility shall have in place a division into radiation protection areas and zones as provided in Guide YVL C.2, Radiation protection and exposure monitoring of nuclear facility workers.
b. The layout design and the design of systems and components shall comply with the requirements of Guide YVL C.1, Structural radiation safety at a nuclear facility.
c. The facility shall have a radiation monitoring system in place as specified in Guide YVL C.6, Radiation monitoring at a nuclear facility.
d. The limitation and monitoring of potential radioactive releases shall be conducted in compliance with the requirements of Guide YVL C.3, Limitation and monitoring of radioactive releases from a nuclear facility.

4.3. Activity determinations and record-keeping

418. According to Section 116(2) of the Nuclear Energy Decree, *in addition, STUK must confirm how the licensee with a waste management obligation should keep accounts of the nuclear waste generated as a result of nuclear energy use.*

Processing and storage of operational waste

419. At least the following shall be specified and recorded with regard any to unconditioned waste that is stored for several years:

a. waste type and origin;
b. amount (expressed in, for example, cubic metres, kilograms, linear metres or as number of items);
c. activity inventory data using appropriate determination methods;
d. special characteristics, such as exceptional nuclide composition, flammability or classification as nuclear use item; and
e. location in different storage rooms.

420. The activities of dominant nuclides in packed waste shall be determined before the waste packages are transferred for prolonged storage or disposal. The activities can be determined by applying the methods described in Annex C.

421. It shall be possible to identify individual waste packages and link them to the respective accounting records based on their markings. At least the following shall be recorded with regard to waste packages transferred into a storage:

a. waste type and the amount of waste;
b. treatment and conditioning method and year;
c. waste package identifier and storage location;
d. activities of dominant nuclides, potential surface contamination, and the date of activity determination;
e. classification as nuclear use item or other exceptional composition;
f. origin and owner of the waste; and
g. any other information required for wastes to be disposed of.

422. The information concerning stored waste shall be kept up-to-date and reported as required in Guide YVL A.9, Regular reporting on the operation of a nuclear facility.

Decommissioning of a nuclear facility

423. At a nuclear facility under construction, the material characteristics of the structures that will be subject to significant neutron activation shall be determined to allow the assessment of the activity concentrations in these structures due to activation.

424. At an operating nuclear facility, activity and surface contamination measurements shall be carried out and the results recorded on a regular basis to provide baseline data for planning and designing the decommissioning of the facility.

425. At a permanently closed nuclear facility, a comprehensive activity and contamination level survey and recording programme shall be implemented to update the activity data used as the baseline in the final decommissioning plan. The activity and contamination level data shall be updated as the decommissioning proceeds whenever significant changes to them can be assumed to have occurred.

426. The activity monitoring of the decommissioning waste of a nuclear facility as well as the recording and reporting of the results shall be carried out following the same procedure as with operational waste (paras. 419 through 422).

427. When the decommissioning of a nuclear facility has been completed, a survey of activity and contamination levels shall be carried out to demonstrate that the quantities of radioactive materials remaining in the buildings and soil at the facility site comply with the clearance requirements (paras. 309 and 415).

Clearance

428. The activity in materials, structures or sites to be cleared shall be reliably determined or estimated. Instrument failures and human errors shall be taken into account by using redundant methods.

429. Account shall be taken of the origin, type and nuclide composition of waste and the homogeneity of the activity distribution when the methods and the extent of the measurements used in activity determinations are selected. The guidelines provided in Annex C shall be observed when the suitability of various methods is assessed.

430. Records shall be taken of the activity determinations related to clearance that can be used for determining the activity data of each cleared batch and for compiling and reporting the annual summary as set out in Guide YVL A.9, Regular reporting on the operation of a nuclear facility.

4.4 Design of systems, structures and functions

Classifications

431. Systems, structures and components important for the occupational radiation protection or the prevention of radioactive releases shall be classified in terms of the safety of the processing and storage of operational waste or the decommissioning of a nuclear facility. At a minimum,

the relevant functions include shielding from external exposure, the containment of radioactive materials, transfers of loads containing radioactive materials, radiation monitoring, and fire protection in rooms accommodating radioactive materials. Safety classification is addressed in more detail in Guide YVL B.2, Classification of systems, structures and components of a nuclear facility.

432. As the decommissioning of the nuclear facility proceeds, the safety classification document shall be updated to reflect the current state of the facility.

433. The structures and components of a processing and storage facility for operational waste shall be classified based on the requirements concerning seismic and environmental conditions according to Guide YVL B.2, Classification of systems, structures and components of a nuclear facility, where applicable. Similar classifications shall also be made for structures and components important to the safety of the nuclear facility being decommissioned.

Design of systems, structures and components

434. The systems, structures and components of a processing and storage facility for operational waste shall be designed with due consideration given to their foreseen service life and environmental conditions. The design of systems, structures and components shall take account of operational occurrences and postulated accidents. It shall be possible to repair or replace structures and components susceptible to wear or damage.

435. The design of a processing and storage facility for operational waste or the decommissioning of a nuclear facility shall give priority to concepts where high temperatures, elevated pressures or other operational conditions that increase the accident potential are not necessary. Priority shall also be given to concepts that are based on inherently safe systems and components.

436. One of the design objectives of a nuclear facility shall be the facilitation of its eventual decommissioning. In the design of the facility, due account shall be taken of the following considerations in particular:

a. Materials shall be so selected as to minimise the generation and spreading of radioactive materials and to facilitate the cleaning of surfaces.
b. The removal of large components, the handling of activated components and the decontamination of systems shall be possible.
c. Use can be made of the structures and systems of the facility when the facility is being decommissioned.

437. When the decontamination, dismantling, transfer, cutting and packing techniques used in the decommissioning of a nuclear facility are selected, an important selection criterion shall be that the radiation exposure of workers, the releases of radioactive materials and the waste volumes generated are kept as low as reasonably achievable. The risk for potential accidents shall be assessed, and to accommodate them, priority shall be given to methods that are proven or otherwise deemed appropriate.

438. The safety of a permanently closed nuclear facility that has been brought to a state of monitored storage shall, to the extent practicable, be independent of active systems and operational actions. The condition of the facility shall not decline during storage to such an extent that it complicates subsequent dismantling.

439. The design of the structures of a processing and storage facility for operational waste shall, where applicable, comply with the requirements set out in Guide YVL E.6, Buildings and structures of a nuclear facility.

440. The design of systems and components shall comply with the general requirements included in Guide YVL B.1, Safety design of a nuclear power plant, and, where applicable, the requirements included in:

a. Guide YVL E.7, Electrical and I&C equipment of a nuclear facility, discussing electrical and I&C equipment; and
b. section 5.5 of Guide YVL B.1, Safety design of a nuclear power plant, discussing air conditioning and ventilation systems.

441. The design of hoisting and transfer equipment shall comply with the requirements set out in Guide YVL E.11, Hoisting and transfer equipment of a nuclear facility.

442. The design of new structures and systems to be installed, or those to be refurbished, for the decommissioning a nuclear facility, as well as the design of hoisting and transfer equipment, shall be conducted in compliance with the Guides specified in paras. 439 through 441 where applicable.

Sorting, treatment and packing of waste

443. The amounts of waste generated as a result of maintenance and repair work at a nuclear facility shall be limited. The bringing of any unnecessary objects and materials into the controlled area shall be avoided. Where possible, the working methods shall be so selected that the amount of waste generated remains small and the further processing of the waste generated is facilitated.

444. In the event that liquid wastes are markedly different from other types of waste in terms of their chemical composition, activity concentration or nuclide composition and their amounts are substantial, they shall, as a rule, be processed separately. In the event that a certain type of waste is only generated in small amounts, it can be mixed with other waste, provided that this does not complicate its further treatment or essentially degrade the properties of the end product.

445. When the treatment and conditioning methods for liquid waste are selected, due consideration shall be given to the requirements imposed by operational safety and final disposal. Such waste can be immobilised, i.e. mixed with a binding agent to form uniform strong or ductile products. Alternatively, liquid waste can be closed in a durable container after drying or absorbing in a suitable medium.

446. The containers intended for the temporary storage of contaminated oils, chemicals and other similar fluids or sludges shall be resistant to corrosion and fit for the purpose in other regards as well. Non-immobilised waste of this kind may only be stored for long time periods in exceptional cases, such as when ageing them for clearance from regulatory control.

447. For the purpose of interim storage or disposal, solid waste shall be packed into containers that facilitate their transfer, prevent the spreading of radioactive contamination and reduce the fire risk associated with the waste. Efforts shall be made to reduce the volume of waste by means of sorting, compaction or cutting, for example.

448. Highly radioactive waste shall be stored in water pools or in other storages providing sufficient radiation shielding prior to packing for disposal. During the cutting and packing of such waste, due consideration shall be given to ensuring the radiation protection of workers and preventing the spreading of radioactive materials.

449. Contaminated metal waste shall be decontaminated of easily removable radioactive materials whenever the decontamination does not cause any significant occupational exposure, and whenever this may significantly reduce the risk of the spreading of radioactive materials or enable the clearance of the waste from regulatory control.

Transfers and storage of waste

450. A nuclear facility shall have adequate storage space for both unconditioned and packed waste. The design shall take account of the need for repairs of the storage containers and rooms as well as potential failures and disruptions in the processing equipment and disposal activities.

451. Intermediate level waste packages shall, as a rule, be transferred to a storage facility by remote control. In a low level waste storage, transfer operations close to the waste packages are also possible. In the design of the transfer equipment, due account shall be taken of the prevention of handling accidents and it shall be possible to maintain and repair the equipment in a radiation-shielded manner.

452. The storage conditions shall be such that the condition of the waste packages will not degrade during the planned storage period. Air humidity

and temperature variations in the storage shall be limited where necessary. The condition of waste packages that are stored for a prolonged period of time shall be systematically monitored, and it shall be possible to remove degraded waste packages from the storage.

4.5 Prevention of occurrences and accidents

453. To make provision for the occurrence of a single failure, steps shall be taken to ensure the availability of any functions related to the processing and storage of operational waste or the decommissioning of a nuclear facility, the failure of which might cause an accident resulting in a significant release of radioactive materials or radiation exposure of the facility's personnel. In ensuring the functions, the principles of separation and diversity shall be applied whenever practicable. The functions to be ensured shall be determined based on their safety classification.

454. When liquid waste is stored, provision shall be made for phenomena adverse to safety, such as:

a. the corrosion of containers;
b. sedimentation or crystallisation that complicates the further treatment of the waste; and
c. the generation of volatile or combustible compounds in containers.

Arrangements shall be in place for the detection and recovery of container leaks.

455. The prevention and containment of fires and explosions shall primarily be based on facility layout planning and fire compartmentation. Any materials or equipment that increase the fire load or pose an ignition or explosion hazard may not be unnecessarily placed within fire compartments important to safety or in their immediate vicinity. The prolonged storage of flammable waste shall be avoided. The materials used in storage facilities shall predominantly be incombustible and heat resistant.

456. A processing and storage facility for operational waste or a nuclear facility being decommissioned shall be equipped with an automatic fire alarm system by means of which any fire can be located. Where necessary, the rooms of the facility shall be equipped with a suitable fire extinguishing system and with first-response fire fighting equipment suitable for operative fire fighting. The planning and design of fire safety arrangements shall comply with Guide YVL B.8, Fire protection at a nuclear facility, where applicable.

457. In the planning and design of the processing and storage of operational waste or the decommissioning of a nuclear facility, due account shall be taken of any external events that may give rise to occurrences or accidents important to radiation safety as provided in Guide YVL B.7, Provisions for internal and external hazards at a nuclear facility.

458. Security arrangements shall be in place to protect the processing and storage of operational waste or the decommissioning of a nuclear facility against unlawful action, the extent of which shall be commensurate with the threat arising from unlawful action. The planning and design of such arrangements shall, where applicable, comply with Guide YVL A.11, Security of a nuclear facility.

5 Operation of the facility

501. The holder of an operating licence for a nuclear facility or the licensee of a nuclear facility being decommissioned shall have in its possession the documents required under Section 36 of the Nuclear Energy Decree and Sections 23–26 of Government Decree 717/2013. These documents shall be regularly updated to reflect the current structure and state of the facility.

502. The holder of an operating licence for a nuclear facility or the licensee of a nuclear facility being decommissioned shall have an operating experience feedback programme in place for collecting, analysing and reporting operating experience and events at its own facility and other similar facilities, and for keeping current with safety research. Based on the programme, the opportunities for enhancing the safety of operational waste management or the decommissioning of the nuclear facility concerned shall be considered, and any improvements deemed

justified shall be implemented. The monitoring of the feedback from operating experience shall comply with the requirements of Guide YVL A.10, Operating experience feedback of a nuclear facility.

503. A licensee who stores waste for a prolonged period of time (e.g. for more than 10 years) shall have a condition monitoring programme for stored waste packages or unpacked waste in place to ensure that the characteristics of the waste remain consistent with the requirements pertaining to their safe interim storage and eventual disposal. The programme shall comprise the inspection of stored waste to a representative extent. Where necessary, the waste shall be returned for re-conditioning or packing.

504. A licensee who processes and packs waste for storage or disposal shall determine the technical requirements pertaining to the waste packages. These requirements shall satisfy the criteria defined by the licensee of the storage or disposal facility based on the safety of interim storage or the long-term safety of disposal. The licensee responsible for processing and packing the waste shall ensure that the waste packages comply with the requirements. Any waste packages that do not satisfy the facility-specific criteria may not be transferred to the storage or disposal facility without an approval by STUK.

505. In the event that the waste transferred to a disposal facility contains components or structures of a nuclear facility that have been classified as nuclear use items other than nuclear material, the licensee shall write such components or structures off from the nuclear material accounting records. A similar procedure shall be complied with whenever waste classified as nuclear use items is cleared from regulatory control. The applicable procedures are specified in more detail in Guide YVL D.1, Regulatory control of nuclear safeguards.

506. In the event that the licensee, following the commissioning of the nuclear facility concerned, wishes to modify any system, structure, component or mode of operation related to the processing and storage of operational waste that STUK has previously approved, the modification plan shall be subjected to STUK's approval as provided in section 112 of the Nuclear Energy Decree prior to its implementation. Plant modifications shall comply with the requirements set out in Guide YVL A.1, Regulatory oversight of safety in the use of nuclear energy.

507. The licensee of a nuclear facility being decommissioned shall break down the decommissioning project into appropriate implementation stages, each of which being subject to STUK's approval pursuant to Section 112 of the Nuclear Energy Decree with due regard to the procedures set out in Guide YVL A.1, Regulatory oversight of safety in the use of nuclear energy. In this connection, the licensee shall also make the necessary changes and additions to the final decommissioning plan.

508. The amounts of radioactive materials released to the environment from a nuclear facility or a nuclear facility being decommissioned shall be monitored by means of representative measurements performed at the potential release pathways of radioactive materials. Release measurements are addressed, where applicable, in Guide YVL C.3, Limitation and monitoring of radioactive releases from a nuclear facility.

509. A radiation monitoring programme shall be implemented in the vicinity of a nuclear facility or a nuclear facility being decommissioned, the extent of which shall be determined based on the foreseen releases of radioactive materials. Environmental radiation monitoring is addressed, where applicable, in Guide YVL C.4, Assessment of radiation doses to the public in the vicinity of a nuclear facility.

510. The radiation protection and exposure monitoring of the personnel of a nuclear facility or a nuclear facility being decommissioned shall be carried out in compliance with YVL C.2, Radiation protection and exposure monitoring of nuclear facility workers.

511. A nuclear facility or a nuclear facility being decommissioned shall have emergency response arrangements in place, the extent of which shall

be commensurate with the foreseen accidents, and the design of which shall, where applicable, be based on Guide YVL C.5, Emergency arrangements of a nuclear power plant.

512. Under Section 7 k of the Nuclear Energy Act, the licensee shall appoint a responsible manager and his or her deputy for the nuclear facility. The holder of an operating licence of a nuclear facility, or a licensee of a nuclear facility being decommissioned, shall also specify the positions important to safety and define the required qualifications. The licensee shall verify the competences of the individuals in these positions prior to the commissioning of the facility or prior to the commencement of its decommissioning, and prepare training programmes for developing and maintaining the professional competence of the personnel. The organisation of a nuclear facility is addressed in Guide YVL A.4, Organisation and personnel of a nuclear facility.

6 Demonstration of compliance with safety requirements

6.1 Principles for the demonstration of safety

601. Compliance with the safety requirements pertaining to the undisturbed processing and storage of operational waste and planned decommissioning actions for the nuclear facility concerned shall be verified in connection with the commissioning testing of systems, structures and components. The performance of safety systems designed in view of operational occurrences and accidents shall be similarly verified as far as practicable.

602. In the event that the probability or consequences of an anticipated operational occurrence or a postulated accident cannot be shown to remain insignificant by reference to the design basis or safety systems, compliance with safety requirements shall be demonstrated by means of computational analyses. The representativeness of the analyses shall be ensured by considering various kinds of occurrences and accidents with the greatest safety impact that may occur in connection with the management of operational waste or decommissioning of the nuclear facility.

603. The fulfilment of the requirements concerning radiation protection of the facility's workers and the public in its vicinity shall be primarily demonstrated by means of a deterministic safety analysis. Additionally, if an accident may have severe consequences based on deterministic analyses, it shall be assessed by means of a probabilistic risk assessment where the probability of the accident and the potential radioactive releases resulting from it are assessed.

6.2 Safety analysis reports and their annexes

604. When the preliminary and final safety analysis reports pertaining to a processing and storage facility for operational waste are prepared, the requirements set out in section 6 of Guide YVL B.1, Safety design of a nuclear power plant, shall be complied with where applicable. Additionally, the safety analysis reports shall at least provide:

a. a description of the safety principles, design bases and other criteria adopted in the design of the facility;
b. a generic plan concerning the processing and storage of operational waste, with due consideration given to the general safety principles set out in paras. 401 and 402;
c. a detailed description of the site of the facility;
d. a detailed description of the planned or constructed facility;
e. a description of the processing and storage activities; an outline in the preliminary safety analysis report and a detailed description in the final safety analysis report;
f. a description of the facility's personnel and of the procedures used for verifying the competences of the persons in positions important to safety; an outline in the preliminary safety analysis report and a detailed description in the final safety analysis report;
g. a description of the waste to be processed and stored at the facility and a description of waste processing methods and the properties of the resulting waste packages; an outline in the preliminary safety analysis report and a detailed description in the final safety analysis report;

h. a description of the criteria pertaining to the properties of the waste to be processed and stored that have been derived from safety requirements; an outline in the preliminary safety analysis report and a detailed description in the final safety analysis report;
i. a description of the monitoring programmes to be implemented at the facility (quality control of waste packages, ageing management programme, operating experience feedback programme); an outline in the preliminary safety analysis report and a detailed description in the final safety analysis report; and
j. a summary of the analyses concerning the operational safety of the facility addressing the radiation exposure of workers and potential radioactive releases, and the resulting radiation doses arising from normal operation, anticipated operational occurrences and accidents.

605. The final decommissioning plan of a nuclear facility shall include a decommissioning safety analysis report that at least provides:

a. a description of the safety principles, design bases and other criteria to be observed in the decommissioning of the facility;
b. a detailed description of the facility and its site (based on the updated final safety analysis report, among other things);
c. a description of the radiation sources at the facility (activity concentration and surface activity contamination levels of structures and components, dose rates in different rooms);
d. a detailed description of the technical implementation of the decommissioning (implementation of monitored storage where relevant, the different implementation stages involved in dismantling, the required new structures and components);
e. a description of the facility's personnel and of the procedures used for verifying the competences of the persons in positions important to safety;
f. a description of the management of the waste arising from decommissioning, including disposal;
g. a description of the monitoring procedures related to decommissioning (monitoring of occupational exposure, monitoring of radiation and contamination levels at the facility, monitoring of environmental releases); and
h. a summary of the analyses concerning the safety of the decommissioning addressing the radiation exposure of workers and potential radioactive releases, and the resulting radiation doses arising from planned actions, anticipated operational occurrences and accidents.

606. The safety analysis reports shall be kept up-to-date as specified in Guide YVL A.1, Regulatory oversight of safety in the use of nuclear energy. The updates to the safety analysis reports shall take account of any changes in the properties or handling and storage conditions of waste that may have a bearing on safety.

607. The safety analysis reports shall be supplemented with topical reports, the purpose of which is to clarify on what kind of experimental studies and analyses the design and planning of the facility and its operations are based.

6.3 Periodic safety review

608. A safety review shall be periodically conducted at nuclear facilities as provided in Guide YVL A.1, Regulatory oversight of safety in the use of nuclear energy. The periodic safety review shall cover the processing and storage of operational waste.

609. The periodic safety review of a decommissioned nuclear facility shall be conducted in compliance with the licence conditions, and in any event no later than 15 years of the date when a comparable comprehensive safety review was last conducted.

610. The periodic safety review shall include assessments of the nuclear facility's safety status and its preservation, as well as potential development targets with due consideration given to the results of the monitoring programmes specified in paras. 502 and 503. Detailed requirements for the content of the periodic safety assessment are provided in Guide YVL A.1, Regulatory oversight of safety in the use of nuclear energy.

7 Regulatory oversight by the Radiation and Nuclear Safety Authority

7.1 Licensing processes

Processing and storage of operational waste

701. Waste management facilities and systems constructed in the immediate vicinity of a new nuclear power plant or other nuclear facility may be treated as parts of the plant or facility concerned. Documents pertaining to the waste management facilities or systems constructed in the immediate vicinity of an operating nuclear facility may be presented as amendments or additions to the corresponding documents pertaining to the nuclear facility concerned, if the construction of the facility or system can be carried out under the operating licence of that nuclear facility.

702. When a construction licence for a processing and storage facility for operational waste is applied for, the documents specified in YVL A.1, Regulatory oversight of safety in the use of nuclear energy, shall be submitted to STUK for approval where applicable.

STUK will review and approve the additions to the respective documents insofar as the intention is to enlarge the processing and storage facility under the terms and conditions of an existing operating licence. Additionally, a report discussing the potential impact of the foreseen enlargement work on the safety of existing nuclear facilities shall be submitted to STUK for approval.

703. When an operating licence for a processing and storage facility for operational waste is applied for, the documents specified in YVL A.1, Regulatory oversight of safety in the use of nuclear energy, shall be submitted to STUK for approval where applicable.

STUK will review and approve the additions to the respective documents insofar as the intention is to commission a major enlargement of the processing and storage facility under the terms and conditions of an existing operating licence. The commissioning of such facilities is subjected to the Radiation and Nuclear Safety Authority's approval as provided in Section 20 of the Nuclear Energy Act.

Decommissioning of a nuclear facility

704. Under Section 32 of the Nuclear Energy Decree, an application for a construction licence for a nuclear facility shall be accompanied by a description of the applicant's plans and available methods for the decommissioning of the nuclear facility and the disposal of the nuclear waste arising from it. The description shall, in particular, discuss the provisions made in the design of the facility to facilitate its eventual dismantling and to keep the amount of radiation exposure and radioactive waste arising from the dismantling as low as reasonably achievable.

705. Under Section 34 of the Nuclear Energy Decree, an application for an operating licence for a nuclear facility shall be accompanied by a description of the applicant's plans and available methods for the decommissioning of the nuclear facility and the disposal of the nuclear waste arising from it. These descriptions shall include a detailed decommissioning plan (including a waste management plan) based on which the cost calculations necessary for estimating the assessed liability referred to in Section 39 of the Nuclear Energy Act can be made. The plan shall also include preliminary reports on the radiation safety of the foreseen actions.

706. If the use of a nuclear facility or a nuclear facility complex for the purpose defined in the operating licence has been terminated in part or completely, the licensee shall ensure that the licence pursuant to Section 20 of the Nuclear Energy Act pertaining to the facility is commensurate with its state and, where applicable, apply for alteration of the licence conditions or renewal of the licence without undue delay.

7.2 Regulatory oversight of safety

Processing and storage of operational waste

707. STUK oversees the construction, commissioning and operation of the processing and storage facilities for operational waste in accordance with Guides YVL A.1, Regulatory oversight of safety in the use of nuclear energy, and YVL A.5, Construction and commissioning of a nuclear facility.

Decommissioning of a nuclear facility

708. STUK shall be notified of the permanent shutdown of a nuclear facility without delay. A plan for the measures necessary for ensuring the safety of the facility shall also be presented in this connection. If the operation of a nuclear facility complex is continued in part, the licensee shall, within a period of two years, submit to STUK for approval a plan for bringing the closed nuclear facility to a state of monitored storage.

709. The licensee shall submit to STUK for approval a final decommissioning plan no later than two years following the date when the operation of all those nuclear facilities that are intended to be decommissioned concurrently was terminated. In this connection, the licensee shall also submit to STUK for approval the safety analysis report referred to in para. 605 and updates to the documents referred to in Section 36 of the Nuclear Energy Decree, where applicable. The final decommissioning plan shall be kept up-to-date during the decommissioning of the facility.

710. STUK oversees the decommissioning of the nuclear facility by applying procedures similar to those laid down in Guide YVL A.1, oversight of the operation of a nuclear facility. The commencement of different stages of the decommissioning is subject to STUK's approval pursuant to Section 112 of the Nuclear Energy Decree following the procedures specified in Guide YVL A.1, Regulatory oversight of safety in the use of nuclear energy.

711. The licensee shall report the progress of the decommissioning to STUK on a regular basis.

712. According to Section 84(1) of the Nuclear Energy Decree, a licensee with a waste management obligation shall apply for an order on the expiry of his waste management obligation with the Ministry of Employment and the Economy when the decommissioning of the nuclear facility has been completed. According to Section 33 of the Nuclear Energy Act, a prerequisite for the expiry of the waste management obligation is that STUK has confirmed that the quantity of radioactive materials remaining in the buildings and soil of the facility site complies with the requirements specified under the Act, and that the other measures referred to in Section 32 of the Nuclear Energy Act have been duly completed.

713. When filing an application for an order on the expiry of the waste management obligation referred to in para. 712, the licensee under a waste management obligation shall submit to STUK a summary of the implementation of the decommissioning and an application for the clearance of the site and any buildings therein referred to in para. 718.

714. When the decommissioning of a nuclear facility has been brought to completion in an acceptable manner as provided in para. 712, the licensee shall notify STUK of the cessation of the use of nuclear energy in accordance with Section 120 of the Nuclear Energy Decree.

Clearance

715. The procedures to be used in the general clearance of waste shall be proposed to STUK for approval prior to the commencement of operations. The application shall include a description of the origin, characteristics and accumulation rate of waste, as well as the methods used in activity determinations. When STUK has approved the application, waste can be removed from the controlled area as it accumulates.

716. A case-specific clearance is subject to an application for the transfer of waste as provided in Section 48 of the Nuclear Energy Decree in cases where the waste will be transferred to another holder, or corresponding documents submitted to STUK in cases where the waste is not transferred to another holder. The application for the

transfer of waste shall include, in addition to the information required under Section 48 of the Nuclear Energy Decree, a description of the origin and characteristics of the waste, the methods used in activity determinations, the method used in the processing or disposal of the waste, and the radiation exposure arising as a result of the clearance of the waste.

717. STUK's decision on a case-specific clearance may pertain to a single batch of waste, or it may be valid for an indefinite term in cases where waste arises on a constant basis and its processing or disposal method remains unchanged. STUK oversees that the waste processing and disposal method is in compliance with the approved application.

718. When the decommissioning of a nuclear facility has been brought to completion and all waste has been removed from the site, the licensee under a waste management obligation shall submit to STUK for approval an application for the clearance of the site and any buildings therein so as to allow the verification referred to in Section 33(2) of the Nuclear Energy Act to be made. In case of a general procedure, the application shall state the results of the survey referred to in para. 427 demonstrating that the surface activity contamination levels specified in para. 415 are not exceeded. In case of a case-specific procedure, the application shall also include a report demonstrating that the dose constraints specified in para. 309 are not exceeded in the future use of the site and its buildings.

Definitions

Waste package

Waste package shall refer to the entity formed by waste and the container surrounding it.

Intermediate level waste

Intermediate level waste shall refer to waste that, because of its high level of activity, requires effective radiation protection arrangements when processed. The activity concentration of such waste is usually 1 MBq/kg–10 GBq/kg.

Unconditioned waste

Unconditioned waste shall refer to waste that has not been processed into its final form or packed into a waste package for storage and/or disposal.

Decommissioning

Decommissioning shall refer to the dismantling of a permanently closed nuclear facility so that no special measures are required at the facility site due to radioactive materials originating from the dismantled facility.

Decommissioning waste

Decommissioning waste shall refer to the low and intermediate level waste arising from the dismantling of a nuclear facility.

Low level waste

Low level waste shall refer to waste that, because of its low level of activity, can be processed without any special radiation protection arrangements. The activity concentration of such waste is usually not more than 1 MBq/kg.

Anticipated operational occurrence

Anticipated operational occurrence (DBC 2) shall refer to such a deviation from normal operation that can be expected to occur once or several times during any period of a hundred operating years. (Government Decree 717/2013)

Postulated accident

Postulated accident shall refer to a deviation from normal operation which is assumed to occur less frequently than once over a span of one hundred operating years, excluding design extension conditions; and which the nuclear power plant is required to withstand without sustaining severe fuel failure, even if individual components of systems important to safety are rendered out of operation due to servicing or faults. Postulated accidents are grouped into two classes on the basis of the frequency of their initiating events: a) Class 1 postulated accidents (DBC 3), which can be assumed to occur less frequently than once over a span of one hundred operating years, but at least once over a span of one thousand operating years; b) Class 2 postulated accidents (DBC 4), which can be assumed to occur less frequently than once during any one thousand operating years.

Packed waste

Packed waste shall refer to waste that has been conditioned into its final form for storage and/or disposal.

Clearance

Clearance shall refer to the classification of waste or other material originating from the controlled area of a nuclear facility, the activity of which is below the prescribed levels, as non-nuclear waste to be treated as ordinary waste or recycled.

Annual dose

Annual dose shall refer to the sum of the effective dose arising from external radiation within the period of one year, and of the committed effective dose from the intake of radioactive substances within the same period of time. (Government Decree 717/2013)

Operational waste

Operational waste shall refer to the low and intermediate level waste arising from the operation of nuclear facilities.

References

1. Nuclear Energy Act (990/1987).
2. Nuclear Energy Decree (161/1988).
3. Radiation Act (592/1991).
4. Radiation Decree (1512/1991).
5. Government Decree on the Safety of Nuclear Power Plants (717/2013).
6. Government Decree on the Security in the Use of Nuclear Energy (734/2008).
7. Government Decree on Emergency Arrangements at Nuclear Power Plants (716/2013).
8. Predisposal Management of Radioactive Waste. General Safety Requirements Part 5. IAEA Safety Standards Series No. GSR Part 5.
9. Decommissioning of Facilities Using Radioactive Material. Safety Requirements. IAEA Safety Standards Series No. WS-R-5.
10. Radiation Protection and Safety of Radiation Sources – International Basic Safety Standards – Interim Edition. General Safety Requirements Part 3. IAEA Safety Standards Series No. GSR Part 3.

ANNEX A Levels for the general clearance of unlimited amounts of material

Radionuclide	Activity concentration (Bq/g)
H-3	100
Be-7	10
C-14	1
F-18 *	10
Na-22	0.1
Na-24*	1
Si-31	1000
P-32	1000
P-33	1000
S-35	100
Cl-36	1
Cl-38*	10
K-42	100
K-43 *	10
Ca-45	100
Ca-47	10
Sc-46	0.1
Sc-47	100
Sc-48	1
V-48	1
Cr-51	100
Mn-51*	10
Mn-52	1
Mn-52m *	10
Mn-53	100
Mn-54	0.1
Mn-56*	10
Fe-52 *	10
Fe-55	1000
Fe-59	1
Co-55 *	10
Co-56	0.1
Co-57	1
Co-58	1
Co-58m*	10000
Co-60	0.1
Co-60m*	1000
Co-61*	100
Co-62m*	10
Ni-59	100
Ni-63	100

Radionuclide	Activity concentration (Bq/g)
Ni-65*	10
Cu-64*	100
Zn-65	0.1
Zn-69*	1000
Zn-69m*	10
Ga-72*	10
Ge-71	10000
As-73	1000
As-74*	10
As-76*	10
As-77	1000
Mo-101*	10
Tc-96	1
Tc-96m*	1000
Tc-97	10
Tc-97m	100
Tc-99	1
Tc-99m*	100
Ru-97	10
Ru-103	1
Ru-105*	10
Ru-106	0.1
Rh-103m*	10000
Rh-105	100
Pd-103	1000
Pd-109	100
Ag-105	1
Ag-110m	0.1
Ag-111	100
Cd-109	1
Cd-115	10
Cd-115m	100
In-111	10
In-113m*	100
In-114m	10
In-115m*	100
Sn-113	1
Se-75	1
Br-82	1
Rb-86	100
Sr-85	1

Radionuclide	Activity concentration (Bq/g)
Sr-85m*	100
Sr-87m*	100
Sr-89	1000
Sr-90	1
Sr-91*	10
Sr-92*	10
Y-90	1000
Y-91	100
Y-91m*	100
Y-92*	100
Y-93*	100
Zr-93*	10
Zr-95	1
Zr-97*	10
Nb-93m	10
Nb-94	0.1
Nb-95	1
Nb-97*	10
Nb-98*	10
Mo-90*	10
Mo-93	10
Mo-99	10
Sn-125	10
Sb-122	10
Sb-124	1
Sb-125	0.1
Te-123m	1
Te-125m	1000
Te-127	1000
Te-127m	10
Te-129*	100
Te-129m	10
Te-131*	100
Te-131m	10
Te-132	1
Te-133*	10
Te-133m*	10
Te-134*	10
I-123	100
I-125	100
I-126	10

* indicates nuclides with half-lives less than one day

Radionuclide	Activity concentration (Bq/g)
I-129	0.01
I-130*	10
I-131	10
I-132*	10
I-133*	10
I-134*	10
I-135*	10
Cs-129	10
Cs-131	1000
Cs-132	10
Cs-134	0.1
Cs-134m*	1000
Cs-135	100
Cs-136	1
Cs-137	0.1
Cs-138*	10
Ba-131	10
Ba-140	1
La-140	1
Ce-139	1
Ce-141	100
Ce-143	10
Ce-144	10
Pr-142*	100
Pr-143	1000
Nd-147	100
Nd-149*	100
Pm-147	1000
Pm-149	1000
Sm-151	1000
Sm-153	100
Eu-152	0.1
Eu-152m*	100
Eu-154	0.1
Eu-155	1
Gd-153	10
Gd-159*	100
Tb-160	1
Dy-165*	1000
Dy-166	100
Ho-166	100
Er-169	1000
Er-171*	100
Tm-170	100
Tm-171	1000

Radionuclide	Activity concentration (Bq/g)
Yb-175	100
Lu-177	100
Hf-181	1
Ta-182	0.1
W-181	10
W-185	1000
W-187	10
Re-186	1000
Re-188*	100
Os-185	1
Os-191	100
Os-191m*	1000
Os-193	100
Ir-190	1
Ir-192	1
Ir-194*	100
Pt-191	10
Pt-193m	1000
Pt-197*	1000
Pt-197m*	100
Au-198	10
Au-199	100
Hg-197	100
Hg-197m	100
Hg-203	10
Tl-200	10
Tl-201	100
Tl-202	10
Tl-204	1
Pb-203	10
Bi-206	1
Bi-207	0.1
Po-203*	10
Po-205*	10
Po-207*	10
At-211	1000
Ra-225	10
Ra-227	100
Th-226	1000
Th-229	0.1
Pa-230	10
Pa-233	10
U-230	10
U-231	100
U-232	0.1

Radionuclide	Activity concentration (Bq/g)
U-233	1
U-236	10
U-237	100
U-239*	100
U-240*	100
Np-237	1
Np-239	100
Np-240*	10
Pu-234*	100
Pu-235*	100
Pu-236	1
Pu-237	100
Pu-238	0.1
Pu-239	0.1
Pu-240	0.1
Pu-241	10
Pu-242	0.1
Pu-243*	1000
Pu-244	0.1
Am-241	0.1
Am-242*	1000
Am-242m	0.1
Am-243	0.1
Cm-242	10
Cm-243	1
Cm-244	1
Cm-245	0.1
Cm-246	0.1
Cm-247	0.1
Cm-248	0.1
Bk-249	100
Cf-246	1000
Cf-248	1
Cf-249	0.1
Cf-250	1
Cf-251	0.1
Cf-252	1
Cf-253	100
Cf-254	1
Es-253	100
Es-254	0.1
Es-254m	10
Fm-254*	10000
Fm-255*	100

ANNEX B Levels for the general clearance of limited amounts of material

B01. The clearance of waste for disposal in a public landfill is subject to the activity concentration levels specified in the table below that may not be exceeded in respect of the activity concentration of any nuclide averaged over a maximum of 500 kg of waste. Additionally, the activity of any nuclide in any single item or waste package with a mass of less than 30 kg may not exceed the value obtained by multiplying the respective activity concentration limits by 30,000 g.

B02. The clearance of bulky metal objects for recycling is subject to the surface activity contamination levels specified in the table below that may not be exceeded in respect of the surface activity contamination of any nuclide averaged over a maximum of 0.1 m^2 of accessible surface area.

B03. When the levels specified in the table are applied to several nuclide groups, due account shall be taken of the fact that the sum of the ratios between nuclide group specific activities and the respective maximum values shall be less than one. An equivalent rule also applies to surface activity contaminations and the levels imposed on them.

Table. The nuclide group specific activity concentration and surface activity contamination levels applicable to the clearance of waste (a maximum for 100 tonnes for a single nuclear facility per year).

Nuclide group	Activity concentration	Surface activity contamination
Alpha emitters	0.1 Bq/g	0.4 Bq/cm^2
Strong gamma and beta emitters*	1 Bq/g	4 Bq/cm^2
Weak gamma and beta emitters**	10 Bq/g	40 Bq/cm^2

* For example ^{54}Mn, ^{58}Co, ^{60}Co, ^{65}Zn, ^{90}Sr, ^{106}Ru, ^{110m}Ag, ^{124}Sb, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{144}Ce and nuclides having similar radiation emission energy

** For example ^{3}H, ^{14}C, ^{51}Cr, ^{55}Fe, ^{63}Ni and nuclides having similar radiation emission energy

ANNEX C Activity determinations of waste

C01. The activity measurements of waste are carried out for the purpose of its clearance from regulatory control and for determining the activity inventory of waste packages to be stored or disposed of.

C02. The methods to be used in activity determinations depend on the characteristics and packing type of the waste concerned, as well as on the nuclide composition of the waste and the evenness of its activity distribution, among other things. The following general guidelines are provided for the activity determinations of waste.

a. Dose rate and surface activity contamination measurements are suitable as redundant methods. They can be used as the principal methods when the nuclide composition of the object being measured is known precisely enough.
b. Gamma-spectrometric measurements are particularly well-suited to objects with uneven activity distribution and varying nuclide composition (e.g. packages of maintenance waste). The activities of nuclides with weak or no gamma emissions shall, in this case, be estimated by indirect means, for example by means correlating to the activity of an appropriate gamma emitter with safety margins.
c. Sampling and sample analysis are suitable for waste, in which the distribution of radioactive materials is sufficiently even or whose activity distribution is known beforehand. The method can also be used for determining the correlation factors for nuclides with weak or no gamma emissions.
d. When the measurement procedures are planned, due account shall be taken of the influence of measurement geometry, self-absorption, sampling frequency and other relevant factors on the representativeness of the measurements. The measuring instruments shall be calibrated with sufficient frequency using radiation sources that are representative of the energy range being measured.
e. If the origin and nuclide composition of the waste remains more of less constant, the activity determination can be carried out based on a statistically representative fraction of waste packages. In that case, the nuclide-specific activities of other waste packages can be calculated based on the dose rates measured from them and the measured nuclide compositions.
f. The contamination of waste packages shall primarily be prevented by keeping the processing and storage rooms clean. In the event that significant contamination of waste packages is suspected, their surface activity contamination shall be checked by measuring a statistically representative number of the packages prior to their transfer into the storage.