STUK

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CLEARANCE OF NUCLEAR WASTE AND DECOMMISSIONED NUCLEAR FACILITIES

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Authorisation

By virtue of the below acts and regulations, the Radiation and Nuclear Safety Authority (STUK) issues detailed regulations that apply to the safe use of nuclear energy and to physical protection, emergency preparedness and safeguards:

- Section 55 of the Nuclear Energy Act (990/1987)
- Section 29 of the Government Decision (395/1991) on the Safety of Nuclear Power Plants
- Section 13 of the Government Decision (396/1991) on the Physical Protection of Nuclear Power Plants
- Section 11 of the Government Decision (397/1991) on the Emergency Preparedness of Nuclear Power Plants
- Section 8 of the Government Decision (398/1991) on the Safety of a Disposal Facility for Reactor Waste
- Section 30 of the Government Decision (478/1999) on the Safety of Disposal of Spent Nuclear Fuel.

Rules for application

The publication of a YVL Guide does not, as such, alter any previous decisions made by STUK. After having heard those concerned, STUK makes a separate decision on how a new or revised YVL Guide applies to operating nuclear power plants, or to those under construction, and to licensees' operational activities. The guides apply as such to new nuclear facilities.

When considering how new safety requirements presented in YVL Guides apply to operating nuclear power plants, or to those under construction, STUK takes into account Section 27 of the Government Decision (395/1991), which prescribes that *for further safety enhancement, action shall be taken which can be regarded as justified considering operating experience and the results of safety research as well as the advancement of science and technology.*

If deviations are made from the requirements of the YVL Guides, STUK shall be presented with some other acceptable procedure or solution by which the safety level set forth in the YVL Guides is achieved.

Translation. Original text in Finnish.

1 Introduction

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 3 of the Nuclear Energy Act defines nuclear waste as 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. In accordance with the definition, such waste or other material from the controlled area of a nuclear facility, the activity of which is found to be low, can be classified as non-nuclear waste. Futhermore, a batch of nuclear waste may, on the basis of provisions in Section 10 of the Nuclear Energy Decree, be excluded from the scope of the Act. In this Guide, these procedures are called as clearance of nuclear waste.

This Guide is applied to waste, including recyclable materials, arising from the operation and decommissioning of a nuclear facility, as well as to non-dismantled buildings and surrounding sites being subject to regulatory control. The Guide gives the radiation protection principles to be followed in the planning and implementation of clearances. The Guide also covers the clearance procedures and the activity monitoring and record-keeping of materials to be cleared.

This Guide does not address radioactive waste or contaminated sites arising as a consequence of the utilization of natural resources. The guidance for such activities is given in Section 13 of the Radiation Act, Section 6 of the Radiation Decree and in STUK's Guides ST 6.2, ST 12.1 ja ST 12.2.

2 General safety principles

2.1 Waste

The clearance procedure for waste may be general or case-specific. In the general procedure, the destination of the materials removed from the nuclear facility need not to be defined or only its main features are defined, and the activity constraints to be applied are fixed. In the case-specifc clearance procedure, the recipient of the material and the treatment process need to be defined and the activity constraints will be fixed on the basis of case-by-case consideration.

The basic radiation protection requirement for both clearance procedures is that the annual dose[1] to any member of the public or worker processing the material, shall not exceed 10 µSv and that also otherwise the radiation exposure arising from the cleared material is as low as reasonably achievable. The dose constraint applies to the cleared materials from the operation or decommissioning one nuclear power plant or other nuclear facility.

The activity content in material to be cleared shall be below the exemption levels given in STUK's Guide ST 1.5. The material to be cleared shall not contain specific nuclear material referred to in Section 3, paragraph 2 of the Nuclear Energy Act or other nuclear material referred to in Section 1, paragraph 8 of the Nuclear Energy Decree.

2.2 Decommissioned buildings and sites

The expiry of waste management obligation, addressed in Section 32 of the Nuclear Energy Act, requires that the decommissioning of a nuclear facility has been implemented in an approved manner. A prerequisite for this is that the buildings possibly remaining at the nuclear site and the site itself can be cleared. The clearance procedure for waste may be general or case-specific. In the case-specifc clearance procedure, the future use of the site and buildings need to be defined.

The basic radiation protection requirement for the clearance of the buildings and the site of a nuclear facility is that the annual individual dose as a consequence of the use of the cleared buildings and site is not more than 10 µSv. In the case-specific procedure, however, individual doses up to 100 µSv may be permitted [1, 2]. The dose shall be assessed for the representative member of the most exposed group taking into account the future us of the site and buildings.

1 The sum of annual external dose and effective dose commitment from intake of radioactive substances within one year.

Table I. The nuclide group specific activity concentration and contamination constraints to be applied for clearance of waste (annually 100 tonnes at most for each nuclear facility).

Nuclide group	Activity concentration	Surface contamination
Alpha emitters	0,1 Bq/g	0,4 Bq/cm^2
Significant beta and gamma emitters *	1 Bq/g	4 Bq/cm^2
Weak beta and gamma emitters **	10 Bq/g	40 Bq/cm^2

* Eg. ^{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

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

Only the radioactive substances originating from the use of the nuclear facility shall be taken into account.

3 Constraints for waste

3.1 General clearance

If waste is to be cleared without any limitations, the nuclide specific activity levels given in Appendix shall be followed [3]. Alternatively, if the amount of waste to be cleared annually does not exceed 100 tonnes for one nuclear power plant or other nuclear facility, the activity levels given below may be applied when disposing of waste in a landfill or dispatching recyclable metal for melting.

If waste is to be cleared for disposal in a conventional landfill, the activity concentration constraints given in Table I shall be applied so that the activity concentration of any nuclide, averaged over 500 kg of waste at most, shall not exceed the constraint. Additionally, in no single item or waste package with mass less than 30 kg, the activity of any nuclide shall not exceed the level obtained by multiplying the respective activity concentration constraint by 30 000 g.

If recyclable metal is to be cleared for melting, the surface contamination constraints given in Table I shall be applied so that the activity contamination of any nuclide, averaged over 0,1 m^2 of accessible areas at most, shall not exceed the constraint. The surface contamination includes fixed and non-fixed contamination. The share of non-fixed contamination can be estimated to be 10% of the total contamination.

Whenever the constraints given in Table I is to be applied for more than nuclide, the sum of the ratios between the nuclide specific activity concentrations and the respective constraints shall be less than one. The same rule applies for the surface contaminations and the respective constraints.

3.2 Case-specific clearance

In case-specific clearance, activity constaraints approved by STUK for each case shall be complied with. However, these shall not exceed the following constraints included in Section 10 of the Nuclear Energy Decree:

1. The average activity concentration in a waste batch to be cleared shall be less than 10 kBq/kg.
2. The total activity of the nuclear waste in the possession of the transferee is less than 1 GBq and the alpha activity less than 10 MBq.

4 Constraints for sites and decommissioned buildings

4.1 General clearance

Building not to be dismantled may be cleared according to the general procedure and without restrictions, if occupancy of the buildings will not cause an annual dose exceeding 10 µSv to a representative member of the most exposed group. This condition will be met with high certainty if the average activity contamination on the walls, floors and ceilings of the buildings is less than 0,4 Bq/cm^2 (4 000 Bq/m^2). In addition, the activity contamination on any surface with area of one square metre shall be less than 10 000 Bq. The surface contamination constraints given above can be applied for nuclide compositions typically occurring at nuclear power plants.

4.2 Case-specific clearance

For case-specific clearance, the future use with assumed restrictions of the site and buildings not to be dismantled shall be defined and the resulting radiation doses shall be assessed. The annual individual dose may be 100 µSv at most, if a lower dose cannot be achieved by practicable means. Furthermore, the assessments shall demonstrate that even if the assumed restrictions of use would fail, the annual dose arising from use of the buildings and occupancy of the site will remain below 1 mSv with high certainty.

5 Clearance procedure

5.1 Waste

5.1.1 General clarance

The general clearance procedure is applicable for waste generated in the context of the operation or decommissioning of a nuclear facility. The procedures to be used shall be submitted for STUK's approval prior to commencing the clearance practice. The application shall include a description of the origin, characteristics and accumulation rate of waste as well as the methods to be used for activity monitoring. Subsequent to the approval by STUK of the application, waste can be removed from the controlled area of the nuclear facility as soon as it arises during the operation or decommissioning of the facility.

The general clearance procedure is not applicable to waste that is volatile or flammable or can otherwise cause particularly easily radiation exposure. STUK pays special attention to these issues when considering an application for general clearance of waste.

5.1.2 Case-specific clearance

For case-specific clearance of waste, a licence for the transfer of waste, as referred to in Section 48 of the Nuclear Energy Decree, is required, if waste will be transferred to another holder. The application for the transfer of waste shall include, besides the information stipulated in Section 48 of the Nuclear Energy Decree, a description of the origin and characteristics of the waste, methods used to monitor its activity, method to be used for disposal, recycling or reuse of the waste and the radiation exposure arising due to clearance of the waste. When the material that is released according to the case-specific procedure has been used as predetermined, no further control is warranted.

Even if the waste holder would not change, the application for the case-specific clearance shall be submitted to STUK and shall include the same information as the application referred to above.

STUK's decision on clearance either applies to a single batch of waste or is continually valid in case such waste arises repeatedly and its disposal, recycling or reuse practice remains unchanged. STUK supervises by inspections that the waste is disposed of, recycled or reused in accordance with the approved application.

5.2 Decommissioned buildings and sites

When the decommissioning of a nuclear facility has been completed and all waste has been removed from the site, the licensee shall submit to STUK an application where the future use of the remaining buildings and surrounding site is defined. The application shall also include an safety document demonstrating that the surface contamination constraints given in Section 4.1 are complied with or that dose constraints given in Section 4.2 are not exceeded in the future use of the area. The documentation shall address all relevant radiation exposure routes taking into account the future use of the area.

6 Activity monitoring and recordkeeping

The activity of waste, structures or sites shall be determined or estimated reliably. The methods shall be such that the upper bounds for the activities of the most significant nuclides can be determined with high certainty. To provide against instrument failures or human errors, redundant methods shall be used.

The methods used for the determination of the activity and the extent of the measurements shall be selected considering the origin and char-

acteristics of waste and its activity distribution. The following issues shall be considered in evaluating the suitability of various methods:

- Dose rate and surface contamination measurements are suitable for use as redundant methods. They can be used as principal methods when the nuclide composition in the material is known with adequate accuracy.
- Gammaspectrometric measurements are particularly relevant to materials with an uneven activity distribution. The activities of nuclides with weak or no gamma emission shall in this case be estimated by indirect methods.
- Sampling and analysis of the samples applies to materials in which the radioactive substances are sufficiently evenly distributed or the activity distribution is known beforehand. The method can also be used for the determination of the proportionality coefficients for nuclides with weak or no gamma emission.

In planning the measurement procedures, the influence of monitoring geometry, self-absorption, monitoring point density and other relevant factors on the representativeness of the measurements shall be considered. The measuring instruments shall be calibrated with sufficient frequency by means of radiation sources which adequately represent the energy range to be measured.

The activity monitoring related to clearance shall be recorded in a database so that the activity content data of each cleared batch can be verified as necessary. This database can also be utilized for the annual summary of clearances.

7 Regulatory control

Pursuant to Section 116 of the Nuclear Energy Decree, STUK sees to it that the measures belonging to nuclear waste management and their preparation (including decommissioning of nuclear facilities) are carried out in accordance with the pertinent rules and regulations and the decisions issued by virtue of section 28 of the Nuclear Energy Act. In addition, STUK must confirm how the licence-holder with a waste management obligation should keep accounts of the nuclear waste generated as a result of operation or decommissioning of nuclear facilities.

Pursuant to Section 32 of the Nuclear Energy Act, the Ministry of Employment and the Economy makes a decision on the expiry of waste management or decommissioning obligation on the basis of an application submitted by the pertinent licensee in accordance with Section 84 of the Nuclear Energy Decree.

The application procedures for clearance are described in Section 5 of this Guide.

The procedures, lines of responsibility, record-keeping and quality assurance measures related to clearances shall be described in detail in pertinent instructions which shall be submitted to STUK for information. The methods and equipments used for activity measurements of the materials to be cleared shall be approved by STUK for that function. STUK reviews the descriptions of measurement systems and equipment as part of the review of the safety analysis report of the nuclear facility.

STUK controls the pre-operational and commissioning testing of the activity measurement systems and equipment as provided in Guide YVL 7.11. The Guide explains which documentation relating to various equipment shall be submitted to STUK. A pre-operational inspection shall be requested for systems or suitable equipment entireties. STUK controls any additions and modifications to the activity measurement systems and equipments in the same extent as it controls the initial commissioning.

STUK carries out the inspection of the removal of control from waste according to its operational inspection programme and trough special inspections, if needed.

A summary report on annually cleared wastes shall be submitted to STUK pursuant to Guide YVL 1.5.

8 References

1. IAEA Safety Guide WS-G-5.1, Release of Sites from Regulatory Control on Termination of Practices, 2006.
2. IAEA Safety Requirements, WS-R-5, Decommissioning of Facilities Using Radioactive Material, 2006.
3. IAEA Safety Guide RS-G-1.7, Application of the Concepts of Exclusion, Exemption and Clearance, 2004.

Appendix Nuclide specific activity concentrations applied for general clearance procedures in case of unlimited amounts of material to be cleared

Radio-nuclide	Activity con-centration (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

Radio-nuclide	Activity con-centration (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

Radio-nuclide	Activity con-centration (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

* refers to nuclices with half-life less than one day

Radio-nuclide	Activity con-centration (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

Radio-nuclide	Activity con-centration (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

Radio-nuclide	Activity con-centration (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