Operational Limits and Conditions for Danish Decommissioning

BfDA prepared by the Nuclear Regulatory Authorities

2020

Table of Contents

1 Legal and Regulatory Framework

1.1 Operational Limits and Conditions for Danish Decommissioning, BfDA

1.1.1 Operational Limits and Conditions (BfDA) for Danish Decommissioning (DD) is issued pursuant to Act No. 170 of May 16, 1962 on Nuclear Installations (The Nuclear Installations Act), cf. letter of April 8, 2003 from the Ministry of Health to DD.

1.1.2 The BfDA for DD is issued by the Nuclear Regulatory Authorities (Danish Health Authority, Radiation Protection (SIS) and Nuclear Emergency Management Agency, Nuclear Division), cf. Act No. 244 of May 12, 1976 on Safety and Environmental Arrangements at Nuclear Facilities, etc. (Nuclear Facilities Act).

1.1.3 The BfDA for DD includes DD's evacuation zone, cf. 3.2.2, and the following nuclear facilities with associated status:

- DR 3, under decommissioning
- Fuel Fabrication Facility, under decommissioning
- Hot Cell Facility, under decommissioning
- Waste Management Plant, in operation

1.1.4 Similar Operational Limits and Conditions (BfD) are issued by the Nuclear Regulatory Authorities for DTU Risø Campus.

2 Overall conditions

2.1 Responsibility

2.1.1 DD, with the Director (DD's management) has the responsibility for ensuring that operation and decommissioning of the nuclear facilities at the Risø site are in accordance with all relevant legislation and:

- The Operational Limits and Conditions for DD (BfDA) and
- Laws and orders regarding radiation protection and nuclear security.

2.1.2 The management of DD must comply with all corrective actions or measures issued by the Nuclear Regulatory Authorities to ensure safety.

2.1.3 The management of DD must permit the Nuclear Regulatory Authorities full access at any time to the Risø Site in order to ensure that inspections may be conducted in relation to the daily operations, ongoing decommissioning operations, personnel, facilities and documentation under DD's control.

2.2 Overall plan

The overall framework and requirements for the decommissioning must be described in an overall plan for decommissioning of the nuclear facilities at the Risø site. The overall plan must be approved by the Nuclear Regulatory Authorities. The plan must be updated if significant changes are planned for the decommissioning of the nuclear facilities at the Risø Site, and resubmitted to the Nuclear Regulatory Authorities for approval. It is DD’s obligation to prepare the overall plan and to submit it to the Nuclear Regulatory Authorities for approval.

2.3 Project descriptions

Prior to decommissioning of a facility, a project description must be prepared and submitted to the Nuclear Regulatory Authorities for approval. Experiences from previous decommissioning projects must be included in the preparation of a new project description.

The project descriptions should be developed on the basis of the IAEA General Safety Requirement, GSR Part 6, Decommissioning of Facilities together with the IAEA Safety Guide SSG-47, Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities. Each project description must include or at least refer to the overall decommissioning plan or the description in the safety case of the following topics:

- Description of facilities and surroundings

- Summary of the operating history of the facilities
- Legal framework and regulatory requirements
- Radiation protection requirements during decommissioning
- Main decommissioning tasks and argumentation for decommissioning actions, including the expected number of sub-project descriptions
- Safety assessment documenting that the radiation protection during decommissioning is optimized. The safety assessment should be made in accordance with the IAEA General Safety Requirement GSR part 4 (Rev. 1) Safety Assessment for Facilities and Activities and the Safety Guide WS-G-5.2, Safety Assessment for the Decommissioning of Facilities Using Radioactive Material, adapted to the nature, scope and complexity of the decommissioning project.
- Environmental monitoring program
- Project organization, including requirement in relation to staffing and training
- Assessment of the needs for specialized contractors and specialized equipment
- Description of the quality assurance management system
- Radiological characterization of the facility and the methods applied
- Waste management
- Description of technical / administrative matters
- Clearance of buildings and land
- Budget and the timeframe for the decommissioning project
- The completion of the decommissioning project, including a radiological assessments after the completion of the decommissioning and a description of the content of the final decommissioning report
- References

2.4 Subproject description

A subproject description must be developed in same manner as a project description (see section 2.3), however adapted to the nature, scope and complexity of the subproject

2.5 Detailed work plans

For each identified decommissioning action, in an individual project or subproject, the project management must ensure that detailed work plans are developed. For decommissioning actions, the following must be considered:

- Possible radiological risks

- Required tools and other equipment
- Personal protection equipment
- Other precautions
- Expected dose rate at the work area
- Expected time required for each task
- Expected doses to the workers
- Personal dose meters to be used
- Waste containers to be used
- Description and expected number of waste containers to be used radioactive waste
- Expected amount of non-radioactive waste
- Expected amount of radioactive waste
- Are there requirements in the BfDA or other relevant regulations that should be taken account for?
- Control carried out by the Section for Radiation Protection and Nuclear Safety
- Quality assurance

2.6 Management system

2.6.1 DD must maintain a complete set of documentation (set of records) regarding nuclear safety and radiation protection with regards to the operation and decommissioning of the nuclear facilities.

2.6.2 The overall documentation should be based on the relevant parts of IAEA's Specific Safety Guide, SSG-20 Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report and SSG-47, Decommissioning of Nuclear Power Plants and Research Reactors and Other nuclear Fuel Cycle Facilities in addition to the General Safety Guide GSG-3, the Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste. The safety documentation is a part of the overall documentation.

2.6.3 The documentation must be updated if significant changes are made to the overall decommissioning plan or a project descriptions for the individual facilities that are relevant to the content of the documentation. The documentation must at least be updated every 5 years, first time before the end of 2006.

2.6.4 For each nuclear facility, two archives must be set up, which are physically separated and secured. Both archives must store technical descriptions including relevant drawings for the decommissioning of the nuclear facility, and in one of the archives,

protocols and correspondence, as well as original drawings of the each facility, must be kept.

2.6.5 A system of instructions on ensuring nuclear safety and radiation protection must be established and maintained during normal operation, during decommissioning and in response to emergency measures.

2.7 Quality assurance management

A quality assurance management system must be established and maintained to support the operation and decommissioning of the nuclear facilities in accordance with the requirement set by the Nuclear Regulatory Authorities. The quality assurance management system must also facilitate the registration and documentation of all essential information relating to the safe operation and decommissioning of the nuclear facilities. The quality assurance management system must be certified according to DS/EN ISO 9001.

3 Buildings and areas

3.1 Property ownership

The Risø site consists of the following land registries (Figure 1):

- land register no. 17 f Veddelev
- land register no. 4 a Veddelev
- land register no. 4 d Veddelev
- land register no. 61 a Veddelev
- land register no. 16 s Veddelev

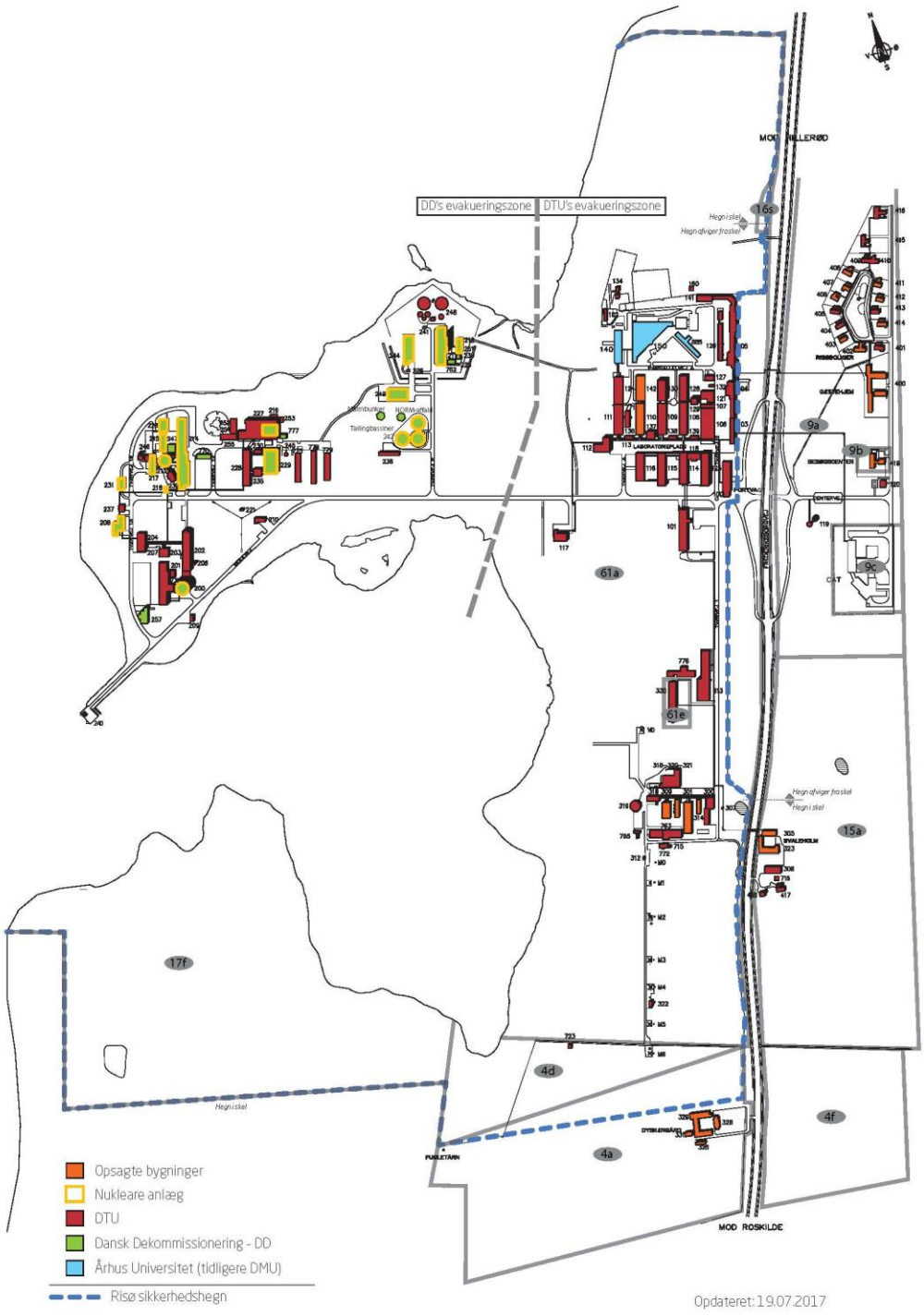
3.2 The land area of the Risø site

3.2.1 The Risø site must be fenced as shown in Figure 1 and marked with signs along the coast. DTU Risø Campus is responsible for maintaining fences and signs. DD must notify DTU Risø Campus if DD finds that fencing and signs are not intact.

3.2.2 The Risø area is divided into respectively the DTU Risø Campus' evacuation zone and the DD's evacuation zone as shown in Figure 1. Within these zones, respectively DTU Risø Campus and DD has the sovereignty over all buildings, land and technical facilities as well as the responsibility associated with the nuclear facilities. By sovereignty is understood that one can act in the same way as the owner. DD's evacuation zone is part of land register no. 61 a.

3.2.3 Written agreements may be prepared stating that one party signs over the right of use of a building, land area or technical installation to the other party. The agreement may also lay down conditions or restrictions on the particular use of a building, land area or technical installation. Copy of the agreements including an overview of the buildings, areas or technical installations, such as DTU Risø Campus or DD has been granted the use of, must be submitted to the Nuclear Regulatory Authority by the party, which have been assigned the right of use.

Figure 1: Overview map of the Risø area, indicating land and building numbers. The Risø area is divided into DTU Risø Campus and DD's evacuation zones. Table 1 shows building numbers, building names and users.



Tabel 1: Oversigt over bygningsnumre, bygningsnavne og brugere. Bygningernes placering fremgår af Figur 1.

Building	Name	User
100	Main entrance with security guards 24/7	DTU
200	DR 2 Reactor Containment Hall	DD
201	DTU	DTU
202	DTU, Isotope laboratory	DTU
203	Annex, DTU	DTU
204	Annex DTU	DTU
206	DTU, Cyclotron	DTU
207	Annex, DTU	DTU
208	Radiological Characterization Laboratory Storage of furniture	DD DTU
209	Former foundation of DR 2 cooling tower, warehouse	DTU
210	Meteorology Station	DTU
211	Waste Management Plant (main building)	DD
212	Drum Storage (including drum press)	DD
213	DR 3 Reactor Containment Hall	DD
214	Office building and DR 3 Active Handling	DD
215	DR 3 (auxiliary building)	DD
217	DR 3 (auxiliary building)	DD
218	DR3, duty office	DD
219	Engine house	DTU
221	Equipment for meteorology mast	DTU
224	Storage of Radioactive Liquids	DD
226	DR 3, storage and workshop	DD
227	Hot Cell Facility	DD and DTU
228	DTU Wind Energy	DTU
229	Fuel Fabrication Facility	DD and DTU
230	DTU Wind Energy	DTU
231	Centralvej Storage	DD
232	DTU Wind Energy	DTU
235	Annex, DTU Wind Energy	DTU
236	Crushing facility	DTU
237	Heating Room	DTU
239	Chemical waste	DD
240	DTU, Storage	DTU
241	Storage of chemical waste (radioactive, flammable)	DD
242	Tailings Pools and ore heaps	DD
244	Low Level Waste Storage	DD

Building	Name	User
245	Cooling Machine House	DTU
246	Heat and power plant	DTU
247	Offices	DD
248	Equipment for wastewater treatment plant	DTU, used by DD
249	Intermediate Storage	DD
250	Isotope Laboratory	DTU
251	Pressure Bottle Housing	DD
252	DTU Energy Conversion, Laboratory	DTU
253	DTU Energy Conversion, Heating	DTU
254	DTU Energy Conversion, Laboratory	DTU
255	DTU Energy Conversion, Laboratory	DTU
257	Clearance Laboratory	DD
730	Office Pavilion	DTU
762	Office Pavilion	DD
770	Office Pavilion	DD
775	Office Pavilion	DTU
777	Office Pavilion Project HOT CELL	DD
778	Office Pavilion	DTU
779	Office Pavilion	DTU

Table 1: Continued

3.3 Access to the Risø site

3.3.1 Access to the Risø site is subject to inspection and access to the site is via the DTU Risø Campus' guarded Main Entrance.

3.3.2 Public access along the coast of Risø Peninsula is prohibited. Boats are not allowed to dock the pier or to enter the bay area on the south of the Risø peninsula without the permission from DD and DTU Risø Campus.

3.3.3 In collaboration with DTU Risø Campus, DD shall enforce the above provisions.

4 Organization

4.1 Organization

4.1.1 The DD organization and its functions are described in the overall plan for decommissioning of nuclear facilities in the Risø site, cf. section 2.2. Changes with significant safety implications must in advance be approved by the Nuclear Regulatory Authorities.

4.1.2 DD must be organized in such a way, that the Section for Radiation and Nuclear Safety can carry out internally independent inspection of the work being carried out by the other DD sections.

4.1.3 The administrative and safety functions must be mutually independent, such that questions regarding nuclear safety and radiation protection may be handled separately.

4.1.4 Each safety functions refer directly to the director with regards to essential and fundamental questions/ issues regarding nuclear safety and radiation protection.

4.2 Human resources and qualifications

4.2.1 DD must possess the necessary qualitative and quantitative qualifications and resources to ensure the operation and decommissioning in a safe and secure manner.

4.2.2 The director must at least have one assigned adviser, who can assist with expert knowledge of nuclear facilities (nuclear expert).

4.2.3 The staff at each organizational level working with nuclear safety and radiation protection must have adequate qualifications in the form of relevant education, training and access to continued training, in accordance with the functions and responsibilities associated with the position.

4.2.4 Before hiring a director, section managers and project leaders, the Nuclear Regulatory Authorities must be provided with a set records reflecting the qualifications of the candidate. This documents must be presented to the Nuclear Regulatory Authorities before the candidate is assigned the responsibilities and authority associated with the position.

4.2.5 Training and continuing education in radiation protection must be provided for staff involved in the operation and decommissioning of the nuclear facilities.

4.2.6 DD must in advance ensure that external consultants, entrepreneurs and others, who participate in the decommissioning of the nuclear facilities, have the level of education, hence to ensure that they can complete the job in a safe manner with respect to nuclear safety and radiation protection.

4.2.7 DD must ensure that external consultants, entrepreneurs and others, who work decommissioning of the nuclear facilities, are correctly informed and instructed before each individual assignment.

4.3 Criticality assistance

DD must have a criticality expert within its organization or have an arrangement with an external criticality expert for assistance regarding criticality. Nuclear Regulatory Authorities. An overview of the qualifications of the assigned criticality expert must be presented to the Nuclear Regulatory Authorities, before he or she is assigned the responsibilities and authority associated with the function.

5 Radiation protection

5.1 Legislation and planning of a radiation protection program

Danish Health Authority´s Order No. 669 of 1st of July 2019 on ionising radiation and radiation protection[1] and Order No. 670 of 1st of July 2019 on use of radioactive substances must be included in the planning of the radiation protection[2]. The radiation protection program must be an integrated part of the overall decommissioning plan, project descriptions, subproject descriptions and detailed work plans associated with the operation and decommissioning of the nuclear facilities. The radiation protection program must ensure that the radiation protection is optimized, and that neither the dose limits for occupational exposure nor the dose constraint for members of the public are exceeded.

5.2 Radiological monitoring

Both DD staff and external consultants, entrepreneurs and others working in radiation protection areas classified as blue and red must carry personal dose meters and, if necessary, additional dose meters. The measuring period of the dose meters is one month.

In order to evaluate the doses from internal exposure the workers working in blue and red classified areas are obliged to give routine urine samples each month. Extra urine samples may be requested if operations may have resulted in internal exposure.

Area monitoring by dose meters must be applied according to a plan that ensures a representative coverage of the location. The measuring period of such dose meters is set to three months.

5.3 Radiological monitoring systems in general

An adequate number of suitable instruments (contamination monitors, dose rate meters) must be available for measuring surface contamination and ionizing radiation from the presence of all relevant radionuclides, that may give rise to potential radiological health risks during the operation and decommissioning of a nuclear facility.

All instruments must be calibrated and the functionality of each instrument must be checked on a regular basis.

[1] Hereafter Order 669/2019

[2] Hereafter Order 670/2019

5.4 Radiological monitoring programs

5.4.1 Continuous monitoring of the level of ionizing radiation, surface and air contamination levels must be in place at the nuclear facilities. Specific trigger levels must be implemented to ensure activation of already established mitigation plans.

5.4.2 Monitoring programs must be an integrated part of the detailed project descriptions and subproject descriptions for the decommissioning of the individual nuclear facilities.

5.4.3 The detailed work plans for the decommissioning of the individual facilities must be evaluated on the basis of the radiological survey of the ionising radiation levels.

5.4.4 The discharge of radioactive substances into the environment during decommissioning of the nuclear facilities must be controlled either directly by monitoring the discharge to the air or indirectly by monitoring the level of air contamination in work areas and subsequent calculations.

5.4.5 A monitoring program of the nearby environment of the Risø site must be implemented according to requirements of Table 2.

5.4.6 Grass samples must be collected quarterly in the surroundings of the Risø site up to a distance of 16 km. The individual sample sites are marked on the overview map in section 4.2.4 *Omegnsmonitering* in DD's safety documentation. The samples must be stored for measurements using modern high-resolution equipment for γ-spectrometry if there is an observed discharge from DD.

5.4.7 Before materials, originating from classified areas (blue or red ionizing radiation areas), leave the evacuation zone of DD, they must be controlled for contents and contamination of radioactive materials.

Quantity	Type	Place	Frequency	Measurement
1	Air sample	The Risø site	Weekly	γ-spectrometry
1	Precipitation sample	The Risø site	Monthly	γ-spectrometry
1	Precipitation sample	The Risø site	Monthly	Tritium
1	Sediment sample	Roskilde Fjord the area between of Risø site and Bolund	Annual	γ-spectrometry
1	Water sample	Roskilde Fjord by the Risæ site pier	Quarterly	Tritium
1	Water sample	Roskilde Fjord by the Risø site pier	Annual	^{137}Cs
1	Grass sample	The Risø site	Monthly	γ-spectrometry
9	Grass sample	At a distance of 16 km to the Risø site	Quarterly	γ-spectrometry
1	Sea plant sample	Roskilde Fjord the area between the Risø site and Bolund	Annual	γ-spectrometry
1	Waste water sample	Waste Management Plant	Weekly	Total β-activity
25	External radiation	The Risø site	Annual	Scintillation counter and TL dosimeters

Table 2: Monitoring program of the environment at the Risø site and its nearby surroundings (Risø District). The results of the monitoring program are presented in the half-yearly- monitoring report, cf. section 14.1.4.

6 Regulatory control levels of discharge of radioactive substances

6.1 Annual control levels

6.1.1 The discharge of radioactive substances into the environment from the operation and decommissioning of nuclear facilities at the Risø site must be optimized, i.e. kept as low as reasonably achievable.

6.1.2 The control levels for the discharge of radioactive substances from the operation and decommissioning of the nuclear facilities are based on the dose constraint for a member of the public living in the neighbouring community to the Risø site. The dose constraint is thus of 0.05 mSv/year for each nuclear facility and 0.1 mSv/year for DD considered as one facility.

6.1.3 The annual control levels of discharge of radioactive substances to the atmosphere from a single nuclear facility is given in Table 3.

Radionuclide	**Annual discharge limit to the atmosphere (GBq/year)**
^{3}H	1,000,000
^{14}C	1,000
^{60}Co	1,000
^{90}Sr	200
^{137}Cs	700
$^{152+154}Eu$	700
Actinides	1

Table 3: Annual control levels of discharge to the atmosphere.

6.1.4 The annual control levels of discharges to Roskilde Fjord from a single nuclear facility, is given in Table 4.

Radionuclide	**Annual discharge limit to Roskilde Fjord (GBq/year)**
^{3}H	1,000,000
^{137}Cs	400

Table 4: Annual control levels of discharge to Roskilde Fjord.

6.1.5 The control levels of discharges to the atmosphere and to Roskilde Fjord are independent of each other, due to the conservative assumptions in the calculations on which they are based.

6.1.6 If the discharge, for one or more nuclear facility, to the atmosphere or Roskilde fjord, contains radionuclide mixtures, an index value expressed as an operational sum formula must be applied to ensure that the control levels are not exceeded.

6.1.7 If discharges of radionuclides, which are not included in Table 3 and 4, occur or are planned, then the Nuclear Regulatory Authorities must be informed. Along with the notification of discharges, DD must submit a proposal for control levels for these radionuclides. See also Section 14.2 Reporting of unexpected events.

7 Clearance of materials, buildings, installations and land areas

7.1 Legislation and planning

7.1.1 Order 669/2019 and Order 670/2019 establish the principles on which materials, buildings, installations, objects, including equipment containing radioactive substances may be granted clearance.

7.1.2 Clearance values are expressed as radionuclide-specific and are either defined as mass-specific or surface-specific activity levels below which materials, buildings, installations, objects etc. originating from the operation and decommissioning of the nuclear facilities may be granted clearance.

7.1.3 Cleared materials, buildings, installations, objects etc. are free-released and not subjected to regulatory control. Hence, these materials, buildings, installations, objects etc. are considered non-radioactive.

7.1.4 The clearance must be based on DS / EN ISO / IEC 17025, and take following elements into account: the physical surroundings and environment aspects, sampling and calibration methods, method validation, equipment, traceability of the measurements, handling of samples and calibration objects.

7.1.5 Radioactive Materials must not be diluted in in the interest of gaining activity concentrations below the clearance levels.

7.1.6 Clearance of areas are subject to the approval of the Nuclear Regulatory Authorities on case-by-case basis. The dose constraint associated with the free release of the land areas at the Risø area are set to 10 µSv/year by the Nuclear Regulatory Authorities.

7.2 Clearance values

7.2.1 Mass-specific clearance values to be applied for clearance of solid materials intended for disposal, reuse, or recycling are listed in Table 5. The values are derived from appendix 4 in Order 670/2019 supplemented with values from Tables 1 and 2 in IAEA's Safety Guide RS-G-1.7, Application of the Concepts of Exclusion, Exemption and Clearance. Mass-specific clearance values for radionuclides not mentioned in Table 5 may be derived from the previous mentioned documents.

Clearance values for materials	
Radionuclide	(Bq/g)
^{3}H	100
^{14}C	1
^{60}Co	0.1
^{90}Sr	1
^{137}Cs	0.1
$^{152+154}Eu$	0.1
$^{234+235+238}U$	1
^{236}U	10
^{241}Pu	10
Other actinides	0.1

Table 5: Clearance values of materials

7.2.2 For amounts of materials less than or equal to 1,000 kg, the activity concentration may be obtained as the means value. Sub-volumes of the material with identified activity concentrations greater than the clearance values must be removed if reasonably achievable.

7.2.3 The surface-specific clearance values for the clearance of buildings for reuse are given in Appendix 5 in Order 670/2019 supplemented with values from Table 1 of the European Commission on Radiation Protection 113, Recommended Radiological Protection Criteria for the clearance of buildings and building rubble from the Dismantling of Nuclear Installations, 2000. These clearance values also apply for removal, reuse and recycling of objects. Values for the most relevant radionuclides are listed in Table 6.

Clearance values for building and surfaces	
Radionuclide	(Bq/cm^2)
^{3}H	10,000
^{14}C	1,000
^{60}Co	1
^{90}Sr	100
^{137}Cs	1
$^{152+154}Eu$	1
$^{234+235+238}U$	1
^{236}U	1
^{241}Pu	10
Actinides	0.1

Table 6: Clearance values of buildings and surfaces

7.2.4 The surface specific clearance values must be applied for the total non-removable activity on and below the surface divided by the surface area.

7.2.5 Surface Activities for objects and buildings up to 1 m^2 may be averaged and compared with surface specific clearance values.

7.2.6 Where surfaces of materials, objects or building contain multiple radionuclides, the determined nuclide-specific clearance values must be expressed in an operational sum formula to ensure that the clearance values are not exceeded.

8 Management of Criticality

8.1 Guidelines and instructions

There must be general guidelines for handling, storing and transporting of fissile materials in order to prevent criticality accidents. These guidelines must be implemented in a set of criticality instructions.

8.2 Responsibility

The head of section in charge of staff handling, storing and transporting fissile material is responsible for compliance with the criticality instructions. The head of section must also ensure that all necessary knowledge concerning criticality management and safety measures are implemented in the criticality instruction by consulting a criticality expert.

8.3 Updating of criticality instructions

New and revised criticality instructions must be submitted to the nuclear expert for review and assessment, before implementation hereof. Outdated criticality instructions must be revoked as soon as the revised criticality instructions are approved and in act.

8.4 Independent control

The inspection of the criticality instructions (in place and are up to date) is carried out by an independent criticality expert, who is not part of the sections handling, transporting and storing fissile material.

The criticality controller ensures that the criticality rules comply with the current operation. The criticality controller belongs to the section that handles the fissile material.

8.5 Basis of criticality calculations

No handling of fissile material or configuration may lead to criticality. When assessing the possibility of criticality, all factors that could lead to unintentional criticality must be taken into account. For example, the possibility of the presence of water and other neutron moderating and reflecting substances must be taken into account.

8.6 Storage

When designing criticality instruction for radioactive waste, it must be taken into account, based on today's knowledge of final disposal that the final disposal can be made without extensive special precautions.

8.7 Records

Detailed records of fissile materials must be complied and kept (safeguard).

9 Managing unexpected events

9.1 Exceeding of discharge levels

If the control levels of discharge set in Chapter 6 are exceeded or if it is expected that these will be exceeded , work taking place in the nuclear facility in question must immediately be stopped, The facility must be brought to a state where the discharge is stopped or minimized. Work at the nuclear facility must not resume until authorized by the Nuclear Regulatory Authorities. Prior to this a detailed report on the incident and on the measures taken to prevent recurrence must be submitted to the Nuclear Regulatory Authorities, cf. section 14.2.1.

9.2 Violation of the Operational Limits and Conditions

If non-compliance with BfDA occurs, DD must ensure that the nuclear facility in question as soon as possible is brought back into compliance with BfDA. No-compliances must be reported to the Nuclear Regulatory Authorities as an unexpected event, cf. section 14.2.3.

9.3 Alarming and alerting of the Nuclear Regulatory Authorities

In accordance with special BRS instructions on alerting of the Danish Emergency Preparedness Management Agency (DEMA), Nuclear Division via the Danish Police's contact point, DD must ensure:

- that all incidents on DD where unexpected release has occurred or where there is a risk of such releases, that DEMA's Emergency Management duty officer and the Danish Health Authority's 24/7 expert service are notified by DD (VHF/FDC) or the main entrance security guard as soon as possible and without undue delay.
- that all incidents on DD, where external emergency agencies are alerted, as well as all situations where the air siren is activated (except for the planed tests), that DEMA's Emergency Management duty officer and the Danish Health Authority's 24/7 expert service are notified by DD (VHF/FDC) or the main entrance security guard as soon as possible and without undue delay.
- the reporting of incidents should be done according to section 14.2.

9.4 Notification of the Danish Health Authority, Radiation Protection (SIS)

In the event of theft or loss of control of radioactive substances, DD must ensure that the Danish Health Authority's 24/7 expert service (telephone 4494 3773) is notified immediately and without undue delay.

10 On-site emergency preparedness and response

10.1 In general

10.1.1 An on-site emergency response must be in place at the nuclear facilities. The on-site emergency response must ensure measures to mitigate fires, flooding, personal injury and accidents involving radioactive substances and nuclear materials. The on-site emergency response must be coordinated with emergency response of DTU Risø Campus and the external emergency agencies including fire brigades, hospitals and the national nuclear emergency management. The on-site emergency response must be able to make a coordinated response adapted to the nature and complexity of the accident.

10.1.2 Emergency response plans and commandments must be in place to ensuring the deployment of on-site emergency response and the alerting of external emergency agencies. Also emergency instructions including tasks and responsibilities of the on-site emergency responders must be in place.

10.1.3 Tasks and responsibilities associated with the maintenance of the emergency response plan, including duty and on call duty arrangements, management and maintenance of equipment, education and updating hereof and planning and conducting emergency training, must be assigned to explicit staff members within the DDs organization.

10.1.4 Equipment of importance for the on-site emergency response, including air siren and intercom systems, must be tested at appropriate intervals.

10.1.5 There must be instructions in place that describe how the Nuclear Regulatory Authorities must be contacted if the air siren is used, cf. section 9.3.

10.1.6 Annual emergency training including the participation of both DTU Risø Campus and DD must be conducted. The Nuclear Regulatory Authorities must be notified in advance about the timing of these events.

10.1.7 Agreements must be in place between DD and other companies that have employees working within DD's evacuation zone, including DTU Risø Campus, stating that everyone is obligated to follow the instructions of DD in the event of an emergency situation within the DD's evacuation zone.

10.2 DD's emergency response organization

Confidential

10.3 Security Guard at the main entrance

Confidential

10.4 Duty organisation

Confidential

Confidential

Confidential

10.5 Emergency alerting infrastructure at the Risø site

Confidential

10.6 Technical emergency responses

Confidential

Confidential

11 Fire prevention and response

11.1 Automatic smoke detectors and alarm systems

11.1.1 Automatic fire detection and alarm systems (ABA) must in place in all areas where fire may compromise the safety of the nuclear facilities. This includes areas within the nuclear facilities where fire will increase the risk of spreading of radioactive materials. Note: DD has together with an expert in fire management reached the conclusion that the Drum Storage (building 212) is exempted from the requirement regarding fire detectors, due to limited fire risk. Likewise, the Centralvej Storage (building 231) and the Low-level Waste Storage (building 244) are exempted due to the limited fire risk in these buildings.

11.1.2 The ABA must be in compliance with, inspected and maintained in accordance with guidelines on ABA of the Danish Institute of Fire and Security Technology.

11.1.3 The ABA must ensure direct alarming of both the local emergency team as well as the security guards at the main entrance. The alarm must be coupled with information about its origin, hence which building the alarm comes from. The Fuel Fabrication Facility is exempted from the requirement of direct alarming of the local emergency services.

11.1.4 Before disconnecting the ABA the local emergency agency must be notified, and there must be an agreement in place to ensure this.

11.2 Firefighting equipment

The necessary firefighting equipment must be available at the nuclear facilities. The firefighting equipment must be inspected and tested in accordance with the relevant regulations by an authorized company.

11.3 Immediate firefighting

Upon arrival of the fire brigade to areas of the nuclear facilities where ABA are installed (cf. 11.1), radiological guidance related to the location of the alarm must be given by TV or VHA. Where deemed appropriate, the duty officer (i.e. TV or VHA) may initiate simple measures to reduce the spread and development of fire.

11.4 Fire protection inspection

11.4.1 At least within two-year intervals DD must ensure inspections of the nuclear facilities by certified fire safety consultant approved by the local emergency services. As part of the inspection, the current fire prevention level is reviewed and suggestions of improvement hereof (c.f. firefighting equipment and fire sectioning) are given.

11.4.2 DD must ensure to notify and invite the local emergency services and the Nuclear Regulatory Authorities for the inspection.

11.4.3 The resulting inspection reports must be submitted to the local emergency services and the Nuclear Regulatory Authorities for information.

11.5 Changes to the facilities

DD must involve a certified fire safety expertise in planning and implementing changes to the nuclear facillities or installations, which may have an effect on the fire safety, e.g. changes in the number of installed ABA and AVS (automatic water sprinkler systems).

11.6 Guidance of the emergency services

Within DD's evacuation zone TV and VHA do provide relevant information to the emergency services regarding the location situation.

11.7 Firefighting education and training

11.7.1 All DD personnel must be trained in elemental firefighting. The training must be maintained and updated, and it is mandatory to participate in training exercise every other year.

11.7.2 Changes in the content or extent of the training required in section 11.7.1 must be submitted to the local emergency services for approval.

12 Waste Management Plant for radioactive waste

12.1 Buildings, facilities and installations

The Waste Management Plant includes the following facilities, buildings and installations for handling and storage of radioactive waste:

- Centralvej Storage (231)
- Low Level Waste Storage (244)
- Intermediate Storage (249)
- The Drum Storage (part of 212)
- Storage container for liquid radioactive waste (next to 212)
- Flammable radioactive waste (shed next to 212)
- Radiological Characterization Laboratory (208)
- DR 2 Reactor Containment Hall (200)
- Drum dryer (basement of building 200)
- Decommissioning facility (in building 200)
- Distillatory and tanks for radioactive water (in building 217)
- Decontamination cabin (in building 217)
- Active laundry (in building 217)
- Tanks for radioactive water (building 246)
- Handling and compression facility for low level solid waste (in building 212)
- Evaporation drum (in building 212)
- Handling box (in building 212)
- Concrete foundry facility (in building 212)
- Tailing Pools (242)
- Uranium ore heap (next to 242)

12.2 General principles of waste management and waste storage

Handling and storage of radioactive waste must be in compliance with IAEA's General Safety Requirement GSR Part 5, Predisposal Management of Radioactive Waste.

Radioactive waste, including decommissioning waste, must be stored in the storage facilities of the Waste Management Plant. Prior to storing all waste must be registered and all samples for characterisation must be taken.

Storage of radioactive waste may only take place in the designated storage facilities, tailings pools or storage areas described in BfDA for DD and approved by the Nuclear Regulatory Authorities. However, to the extend necessary for handling, characterisation, packing etc. short-term storage of low-level waste in containers can accepted after notification of and acceptance of the Nuclear Regulatory Authorities.

All radioactive waste to be handled and stored must be categorized, treated and subdivided in such a way that the volume of the radioactive waste is minimized.

12.3 Overall classification of radioactive waste

The waste categorization should be based on IAEA's General Safety Guide GSG-1 Classification of Radioactive Waste. However, the use of the "Very Low Level Waste" (VLLW) waste category may only be used after the approval by the Nuclear Regulatory Authorities.

12.4 Radioactive waste management guidelines

Instructions must be available to ensure that all waste received at the Waste Management Plant is correctly categorized and managed within the waste management system. The instruction must include the following considerations:

12.4.1 Special conditions

Certain waste types may be associated with special consideration that must be evaluated and taken into account before the waste is managed within the waste management system for liquid and solid waste respectively.

12.4.2 Liquid waste.

Liquid waste must be collected and transferred to the distillation plant for treatment. The distilled water is discharged to Roskilde Fjord via the water treatment plant. The distillation residue requires further treatment e.g. volume reduction by evaporation and incineration.

- The waste must be registered and controlled, cf. section 12.5.
- The waste must be transferred to appropriate storage facility.

12.4.3 Solid Waste

Solid waste must be minimized. As part of waste handling process it must be assessed whether it is possible to minimize the amount of waste, cf. section 12.2.Solid waste from external users must be sorted, compacted and packed in drums in the handling/compression-facility at the Waste Management Plant. Decommissioning waste and secondary waste is packed in appropriate containers at the facility under decommissioning. Disused high active sealed sources may be transferred directly to the Centralvej Storage if packed according to section 12.8.1.

- The waste must be registered and controlled, cf. section 12.5.
- The waste must be transferred to appropriate storage facility.

12.5 Registration and administrative control

Registration and administrative control of waste received at the Waste Management Plant.

12.5.1 Waste packages and waste units must be assigned with a permanent identification number that links to the waste management system (database). The database must at least ensure the recording of the data below, including the traceability of waste package (the location of it in which waste storage facility):

- Identification number/bar code
- Revival date
- Container type: Material, conditioning and shielding
- Weight: waste versus container weight
- Radionuclides
- Activity and activity concentrations, including the origin of the available information.
- List of risks associated with the physical and chemical form of the waste
- Dosage rate at the surface of the waste package and at a distance of 1 meter, including date of measurement.
- The nature of waste, approximate weight content of e.g. metals, biodegradable material, combustible material and environmentally hazardous substances (Pb, Cd, Be, etc.).
- Available subsamples of the waste in the sample archive
- Origin of the waste, including information on supplier
- Identity of staff member registering the waste package
- Labeling of new waste packages must in addition comply with the requirements of § 66 i Order 670/2019.

12.5.2 Historical waste must, if possible, be recorded in the database with information as specified in 12.5.1. Labeling compliance with § 66 in Order 670/2019 must be ensured at the latest when the waste packages are transferred to the new storage facility.

12.5.3 Operational waste must, if possible, be recorded in the database of information as specified in 12.5.1. Labeling in compliance with § 66 in Order 670/2019 must be ensured at the latest when the waste packages are transferred to the new storage facility.

12.5.4 There must be instructions for external suppliers of waste.

12.5.5 The recorded data must be stored electronically with backup in a form that allows both data to be imported into the most commonly used databases. The data must be in a format that may be used for statistical studies.

12.5.6 The recorded data, both the original record and a backup record, must be stored at two physically separate locations, and both set of records must be secured against physical overload.

12.6 Waste container designs

The following container types may be used for storage of radioactive waste at the Waste facilities of the Waste Management Plant:

a1. Concrete shielded, galvanized 210 L steel drum:

- Outer diameter x height: 59 cm x 88 cm ± 5%
- Material: Galvanized steel drum lined with at least 5 cm concrete
- Inner lining: Steel drum or custom-made container

a2. Concrete Shielded, black-painted 210 L steel drum:

- Outer diameter x height: 59 cm x 88 cm ± 5%
- Material: Black painted steel drum lined with at least 5 cm concrete
- Inner lining: Steel drum

b. Concrete shielded 280 L steel drum for re-packaging of a1 or a2:

- Outer diameter x height: 63 cm x 93 cm ± 5%
- Material: Lacquered steel drum lined with 2.0 cm concrete

c. Unlined 210 L steel drum:

- Outer diameter x height: 59 cm x 88 cm ± 5%
- Material: Lacquered steel drum without lining

c-1. Unlined 280 L steel drum:

- Outer diameter x height: 63 cm x 93 cm ± 5%
- Material: Lacquered steel drum without lining

d. Stainless steel bucket:

- Outer diameter x height: 22 cm x 87 cm ± 5%
- Material: Stainless steel, minimum thickness of 0,1 cm

e. Storage container for filters:

- Steel box (height x length x width): 72 cm x 100 cm x 100 cm ± 5%
- Material: Stainless steel box lined with at least 15 cm concrete
- Inside lining: Steel sheets.

f. Stainless container for CCA blades:

- Outer diameter x height: 32 cm x 210 cm ± 5%
- Material: Stainless steel, minimum thickness 0.1 cm
- Minimum 19 cm steel lining of the lid
- Arrangement ensuring the possibility of emptying off water

g. ISO containers (temporarily approved for Intermediate Storage):

- Length x width x height: 299 cm x 244 cm x 259 cm ("10-foot container")
- Material: 1.5 mm steel (front, roof and side panels)
- Openings: Front and roof. Mounted with rubber gasket to ensure withstand of water and dust. Reinforced top rails to ensure the strength when container is open.

g-1. ISO containers, "10-foot container, half height":

- Length x width x height: 299 cm x 244 cm x 130 cm
- Material: Steel (front, roof and side panels)
- Opening: Top opening mounted with rubber gasket to ensure withstand of water and dust.
- The designed must ensure the stacking of up to 4 layers of filled containers with a maximum weight 21 tons

h. Steel containers (type 1)

- Length x width x height (outside dimensions): 205 cm x 140 cm x 115 cm
- Material: 10 mm steel (front, roof and side panels)
- Top opening: Steel plate strapped to the container using metal band clamps.

- Reinforcing profiles in the sides and bottom allowing for a 4-layer stacking with a maximum weight for a filled container of up to 13 tons.

i. Steel containers (type 2)

- Length x width x height (outside dimensions): 212 cm x 147 cm x 139 cm
- Material: 10 mm steel (front, roof and side panels)
- Top opening: Steel plate strapped to the container using metal band clamps.
- Reinforcing profiles in the sides and bottom. The container designed must ensure stacking in 4 layers with a maximum weight for a filled container of up to 13 tons.

j. Jumbo Containers

- Length x width x height (outside dimensions): 313 cm x 313 cm x 213 cm
- Material: 65 mm steel (front, roof and side panels)
- Opening: Top or side. Steel plate that is welded to the container after filling
- Maximum weight of a filled container is 100 tons
- Due to the heavy weight of the containers, they must only be stacked in the Intermediate Storage if they are empty.

12.7 General requirements for storage conditions, waste containers and waste packages

12.7.1 General Requirements

- The storage conditions must ensure the necessary radiation protection.
- The level of radiation outside a storage facility must be as low as possible at any time. This is ensured by arranging the waste package in such a way the waste package given rise to higher dose rates should be shielded by waste packages given rise to lower doses. The radiation level in working areas and hallways must be as low as possible.
- The storage conditions must protect radioactive waste and the waste packages against fire.
- The storage must be dry and protected against water and moisture.
- The waste packages must be well organised, ensuring the identification of each waste packages.
- The storage of unused waste containers must ensure protection against weathering.

- Radioactive waste must be stored in suitable waste containers.
- The waste containers must be kept closed.
- Stored waste packages must be arranged in a stable formation.
- Stored waste packages must not contain liquids.
- It must be ensured that pressure that might damage the waste containers does not building up inside the waste packages.

12.8 Centralvej Storage (231): Storage facility for ILW

12.8.1 Requirements relating to storage conditions

- Storage holes and storage pits must be closed when no work operations are taking place.
- Automatic ventilation of the storage holes must be in place, and the discharge must be filtered.
- Equipment must be available to ensure negative pressure when storage holes are opened.
- The waste containers listed in 12.6. section a, d and f, may be placed in the storage holes. Also packed and unpackaged items, which can be arranged in a stable configuration, which may be removed and that do not contaminate may be placed in the storage holes.
- The waste containers listed in 12.6. section e as well as packaged or unpackaged items, which can be arranged in a stable configuration, which may be reused and that do not contaminate may be placed in the storage pits.
- The upper limits for the amount of fissile material must be stated in the criticality instructions.
- The maximum allowed dose rate on the outside of the storage facility is 20 µSv/h,

12.9 Drum Storage (212): Storage facility for ILW

12.9.1 Special requirements for storage

- Ventilation of the building must be possible via a filtered vent. The building must be protected against temperatures below zero.
- 210 L standard drums must be used for storage of radioactive waste, as described in section 12.6 of part a1 and a2. The dose rate measured at 1

meter distance from the surface of the waste package must be less than 30 mSv/h.

12.9.2 Special requirements for waste storage and waste containers in the Drum Storage

- The drums may contain up to 10 g of ^{235}U plus 2 g of transuranic elements, or up to 30 g of ^{235}U plus 2 g of transuranic elements, if the uranium is present as natural or depleted uranium.

12.10 Low-level Waste Storage (244): Storage facility for LLW

12.10.1 Special requirements for storage

- It must be possible to conduct visual inspection of the floor to identify possible water or water seepage into the storage. Also, it should be possible to detect possible leakage origination from the stored waste packages.
- Waste packages may not be placed directly on the floor.
- The waste containers described in section 12.6 a-c, may be used for storage of radioactive waste, however the dose rate measured at 1 m distance must be less than 5 mSv/h.
- The level of exposure outside a storage facility must be as low as possible at any time. This is ensured by arranging the waste package in such a way the waste package given rise to higher dose rates should be shielded by waste packages given rise to lower doses. The exposure to workers in working areas and along hallways must be as low as possible.
- No materials may be stored in the building other than what is necessary for daily work in the storage.
- If the storage is flooded it must be ensure that the waste packages will not float.
- Sampling containers for passive waster sampling in case of flooding of the storage must be in place to ensure sampling of water at various levels.

12.10.2 Special requirements for storage and waste packages

- The waste packages may contain up to 10 g of ^{235}U plus 2 g of transuranic elements, or up to 30 g of ^{235}U plus 2 g of transuranic elements when the uranium is present as natural or depleted uranium.

12.11 Intermediate Storage (249)

12.11.1 Special requirements for storage

- The dose rate on the outside of the storage must not exceed 20 µSv/h.
- Waste must be stored in the waste containers described in section 12.6 a2, e, g, g-1, h, i and j. The dose rate measured at a distance of 1 m must be less than 1.5 mSv/h, or less than 3 mSv/h at a distance of 1 m, if the waste packages are surrounded by other shielding waste packages. In addition waste container described in Section 12.6 e, must be sealed airtight, and every quarter a sample must be taken from its surfaces as well as form the surfaces around the waste package to ensure that the waste is not leaking.
- When storing several waste units, it must be ensured that the dose rate in working areas and hallways in the Intermediate Storage and the Bufferlageret is kept as low as possible, e.g. by shielding with high dose rates with waste packages with low dose rates.
- Waste containers of the of the bottom layer must only have top openings and the sides and base of the waste container must be waterproof.
- If the storage is flooded it must be ensure that the waste packages will not float.

12.12 Handling box for solid low level waste in building 212

12.12.1 Protection against spreading

- The box must be equipped with an automatic fire extinguishing system and filtered extraction via a ventilation system.
- The pressure drop in the filter must be less than 6 cm water column.

12.13 Monitoring, testing and inspection of the storage facilities

12.13.1 Overall assessment

- At least once a year, an overall assessment must be carried out for each storage facility with the focus on the general storage conditions for waste packages, including radiological conditions.

12.13.2 Individual facilities

- The operating state of the ventilation system of the Drum Storage, must be checked every week. The ventilation system for the Centralvej Storage and the Intermediate Storage must be tested at least once every six months.
- At least once every six months, first time in the early spring, the storage pits in the Centralvej Storage must be inspected for the presence of moisture or water seepage.

- The collection-wells and inspection-wells at Centralvej Storage, Intermediate Storage and Low Level Waste Storage must be inspected at least once a year.
- The swamps in the Low Level Waste Storage must be inspected at least every quarter. If moisture is detected, mitigating measures must be implemented. If the swamps are dry, wipe samples of the internal surfaces must be taken.

12.14 Storage tanks for radioactive water

12.14.1 Protection against overflow

- Tanks for collecting radioactive water (active tanks) from the individual facilities and the laboratory (see notes) must be protected against overflow
- The tanks must be equipped with two-stage level alarms as well as alarms for overflow to the collecting tray and the floor.
- The alarms must be transmitted to the Waste Management Plant; the two-stage level alarm and the floor overflow alarm as well as to the 24/7 duty office. This also applies to active tanks of DR 3.
- For cooling water tanks of DR 3, level alarms and overflow alarms must only be transmitted to DR 3 duty office.

Notes:

- The required monitoring does not apply to tanks in the tank pits 122 and 315 that have been taken out of service and decoupled and plugged.
- In case of error and/or maintenance, the electronic tank monitoring must be out of service for a shorter period (up to 7 days). The Nuclear Regulatory Authorities must be notified about the error as soon as possible by e-mail (nuc@brs.dk and sis@sis.dk). The Nuclear Regulatory Authorities must also be informed about the cause of the error as well as an estimate of when the electronic tank monitoring will be back in normal operation.
- If one or more tanks are left without electronic monitoring, manual inspection must be initiated, under which: 1) the department concerned must be requested not to fill extraordinary volumes in the tanks; 2) the tanks must be inspected daily where water levels are read visually or by means of measuring stick, and 3) half-filled tanks must be emptied.

12.14.2 Emptying of tanks

- The contents of active tanks must be transferred to the distillation of the Waste Management Plant.

- The contents of cooling water tanks can be discharged to the sewer system of DTU Risø Campus, if the concentration of β activity in the water is less than 0.15 Bq/ml and if the total discharge complies with the requirements of Chapter 7. Otherwise, the contents of the cooling water tanks must be transferred to a distillation.

12.14.3 Monitoring, testing and inspection

- Tanks (active tanks and cooling water tanks) must be cleaned and inspected in accordance with established inspection programs.
- The systems for all level and overflow alarms must be tested once a year. The test must be done physically in the tank pits, cf. relevant instructions.
- The correct alarm signal from all level alarms must be tested once a year by electrical stimulation of the level alarms.

12.15 The distillation

12.15.1 Protection against malfunction and overload

- The distillation must be provided with overheating protection, which turn off the distillation if the temperature of the heater exceeds 125°C.
- The distillation must be equipped with a safety valve that is activated if the pressure exceeds 400 mBar.

12.15.2 Discharge of distillate

- Discharge of distillate into the water treatment plant may only take place after a control measurement showing that the beta activity is less than 1.5 Bq/ml and if the total discharge complies with the requirements of Chapter 7.

12.15.3 Monitoring of working environment

- During operation of the distillation, the air in the room must be continuously monitored for particulate beta activity with associated alarm. Monitoring may be out of order for a shorter period during troubleshooting and servicing.

12.15.4 Monitoring of discharge

- Outlet from the distillation must be via the chimney. The ventilation air in the chimney must be continuously monitored for particulate beta activity. Monitoring may be out of order for a shorter period during troubleshooting and servicing.

- The discharge of particulate beta activity via the chimney must be determined by measurement on the filter of the air monitor in the chimney. The filter is replaced approx. every 14 days.
- The content of uranium and other alpha activity as well as tritium must be determined by measuring quarterly samples of the distillate from the distillation.

12.16 The Tailing Pools: Storage of leaching residue

12.16.1 Control of drain water

Waste water must be lead to the pump station's collection tanks (trap tanks) to ensure that drain water from pools containing leach residue is collected for radioactivity control measurement before further treatment. These tanks may only be emptied after controlling for β-activity in the water, cf. 12.16.3.

12.16.2 Protection against overflow

- The collection tanks must be provided with level control with signal to the Waste Management Plant and with automatic overflow to empty tank. The level control must be set at 4/5 full tank.
- The bottom tank of the pumping station must be equipped with level control with alarm for high water level at the Waste Management Plant.
- Simultaneous signal for two 4/5 filled collection tanks as well as the alarm for high water level at the pumping station must be sent to a 24/7 duty office.
- In case of failure and/or maintenance, the electronic tank monitoring may be out of service for a shorter period (up to 7 days). The Nuclear Regulatory Authorities must be informed of the error as soon as possible via e-mail: nuc@brs.dk and sis@sis.dk. The Nuclear Regulatory Authorities must also be informed about the cause of the error as well as an estimate of when the electronic tank monitoring will be back in normal operation.
- Manual inspection must be initiated if one or more tanks are to be left without electronic monitoring. In the case of manual monitoring, the following must be carried out: 1) the tanks must be inspected daily, where water levels are read visually or by measuring stick and 2) half-filled tanks must be emptied.

12.16.3 Minimizing the contribution of drain water to radioactivity in the environment

If the activity of drain water exceeds 0.4 Bq/ml measured as β activity, the discharge water must be taken to the Waste Management Plant´s for radioactive wastewater. This must be done to ensure that contribution of drain water to naturally occurring radioactivity in the environment, is kept as low as reasonably achievable and to ensure

that the activity at the point of discharge does not exceed the activity limits for radioactivity in drinking water. Otherwise, discharge can be effected via the inactive wastewater treatment system of the Waste Management Plant. (However, a greater concentration may be allowed if, in the individual case after analysis of the radioactivity content, it can be shown that no greater amounts of radioactivity are measured in terms of their health effect, than assigned by the general limit of 0.4 Bq/ml β-activity).

12.16.4 Monitoring, testing and inspection

The pump station must be inspected once a week.

12.17 The biological water treatment plant

12.17.1 Discharges to recipient (Roskilde Fjord) of treated water must be checked. Every working day (i.e. all working days except May 1st, the Friday after Ascension Day of Christ and Constitution Day) water samples must be taken from the sand trap and just before the outlet to Roskilde Fjord. Between Christmas and New Year, water samples must be taken to an extent, with a maximum of 5 days between each sampling. The samples must be measured for β-activity content. If the concentration of β activity in the water samples exceeds 0.15 Bq/ml, the water discharge must be stopped and further investigation initiated.

12.17.2 Once every working day (i.e. all weekdays except May 1st, the Friday after Ascension Day of Christ and Constitution Day), a representative water sample must be taken from the outlet basin for a pooled sample. Between Christmas and New Year, water samples must be taken to an extent, with a maximum of 5 days between each sampling. The biannual samples must be measured for radioactive content, including uranium by γ spectrometry and gross-β.

12.17.3 Sludge from the water treatment plant must either be released if it meets the clearance criteria or handled according to the relevant waste category if clearance values are exceeded. In addition to the analyses on the half-yearly pooled samples, random samples of the sludge are taken and analysed before being sent to an external receiver.

12.17.4 The content of ɣ and β activity in sludge from the water treatment plant must be determined based on representative half-yearly pooled samples of the sludge. 200 ml of sludge must be sampled each time. The whole sample must be transferred to the pooled sample. The full volume of the pooled sample is evaporated immediately. The amount of sludge represented by each 200 ml sample is noted.

12.18 Security of buildings, facilities and vehicles

Confidential

12.19 DR 2 Reactor Containment Hall (building 200)

12.19.1 Low fire load must be maintained in the hall.

12.19.2 The hall must be equipped with approved ABA system.

12.19.3 Areas must have relevant radiological classification.

12.19.4 The hallway air must be subject to continuous radiological monitoring.

12.19.5 The ventilation system must be equipped with HEPA filters, which are tested annually with aerosols for filtration efficiency.

12.19.6 All water from the hall must be lead to an active water tank for further treatment at the Waste Management Plant.

12.19.7 The hall may only be used for packing of radioactive waste in suitable waste containers. Physical manipulation of radioactive components must only take place inside the decommissioning facility.

12.19.8 The decommissioning facility in the hall

- Must only be used for physical manipulation and packing of contaminated components. The following methods and their likes that do not affect the safety of the facility in operation may be used: plasma cutting, flame cutting, nibbling, sawing, cutting, grinding and welding.

- The decommissioning facility must not be used as a storage, which means that only contaminated units, equipment and waste containers to be used during the current job may be found.
- Sub-pressure must be maintained in the decommissioning facility compared to the hall. Acoustic and visual alarm must give alerts in case of equalizing of pressures.
- The Sub-pressure must be ensured by a ventilation system at all times, including two ventilators to facilitate redundancy during change of filters.
- Fresh air inflow is ensured by passive in flow to the surrounding hall.
- Discharge to the atmosphere must be via a HEPA-13 filter.
- Air contamination within the decommissioning facility must be monitored via ICAM, and during dust producing work procedures the monitoring will be done in the ventilation.
- The decommissioning facility must be cleaned continuously, and when not in use it may be classified as the rest of the hall and the ventilation may be turned off.

12.20 Installations out of service (awaiting decommissioning)

The Waste Management Plant includes several installations that have been taken out of service and are awaiting decommissioning. These are:

- The evaporator and asphalt plant, including associated tanks for water located in Building 211
- The active laundry located in Building 211
- Isotope laboratory located in building 211

The provisions for these installations are:

- Each installation must be kept in a safe maintenance state in compliance with the future decommissioning plan.
- The safety of each installation must not decline will awaiting decommissioning.

-

13 Additional requirements for facilities under decommissioning and facilities prepared for decommissioning

13.1 Facilities under decommissioning and facilities prepared for decommissioning

Facilities under decommissioning and facilities prepared for decommissioning include the following nuclear facilities in the Risø site:

- DR 3, consisting of: the reactor hall, heavy water room, AH hall service tunnels, engine houses, pump houses and engineering corridors
- Fuel Fabrication Facility
- The Hot Cell Facility consists of: concrete cells, as well as lock building, areas in front of and behind the hot cells and the spaces directly above the hot cells

13.2 Security and access control

Facilities under decommission and facilities prepared for decommission must be locked or under surveillance. There is only access to a facility prepared for decommission if permission from the management of that facility have been obtained. However, this does not apply to the Fuel Fabrication Facility. However, it is required that contaminated objects and areas are covered and properly classified and labelled with warnings signs for ionising radiation supplemented with a reference to the responsible person within DD's organisation.

13.3 Fire load

The fire load in facilities during decommissioning and facilities prepared for decommissioning must be kept as low as possible. Thus, storage of waste in facilities during decommissioning and facilities prepared for decommissioning must be done with special consideration for minimizing the fire load. See also Chapter 11.

13.4 Specific requirements of the Hot Cell Facility

13.4.1 The external boundary of the facility facing the DTU Risø Campus (drywall, roof over the space on the cell top, the interfaces to the two duct penetrations, as well as the original concrete deck) must be clearly marked and must not contain openings.

13.4.2 The integrity of external boundary of the facility and signage must be inspected once every quarter.

13.4.3 Once the decommissioning has commenced workers must only access to the area via the lock building at the eastern end (building D), either via the person lock or via the carriage gate.

13.4.4 Different pressures must always be maintained in the different areas, so that the lowest pressure is found in the most contaminated areas ensuring that the pressures in DD's areas are always lower than in the surrounding buildings.

13.4.5 The discharge from the ventilation system must pass a HEPA filter and the airflow after the filter must be checked for content of radioactive nuclides.

13.4.6 Workers doses, including operation specific doses and results of urine test analysis, must be reported according to an agreement with the Nuclear Regulatory Authorities. The reporting must also include information on relevant dose rates and contamination levels.

13.5 Specific requirements related to DR 3

Containment

13.5.1 Containment and its sealing systems must be maintained.

13.5.2 The pressure limits in containment to be maintained are:

- High pressure: 44.130 kPa (0.45 kp/cm^2),
- Low pressure: -6.865 kPa (-0.07 kp/cm^2).

Note: The above corresponds to the design basis for a Pluto-type reactor hall, thus DR 3.

13.5.3 When the ventilation system is in operation, there must also be a low pressure in containment of at least 10 mm water column (Vs) relative to the atmospheric pressure, in order to ensure that major leaks are detected, and that the airflow from DR 3 always is transmitted through the absolute filters,

13.5.4 If there is a need for breaking the containment during work or service campaign, it must be ensured that the containment is reestablished by the end of the workday. Prior to the breaking the containment the Nuclear Regulatory Authorities must be informed via e-mail: nuc@brs.dk and sis@sis.dk.

Control and reserve systems

13.5.5 A control system for automatic sealing of containment must be in place. This must be in operation unless the containment is sealed. Sprinkler system and elevator sump drain must be sealed off. Drainage systems and water locks must be intact or sealed off.

13.5.6 In order to ensure sealing of the containment, in the event of failure of normal compressed air supply, a system of spare air reservoirs with a sufficient volume of air to redirect valves C1, C2, T10, T11, and T12 (Building seal valve) must be in place, except when these are located in the Building seal position.

Note: Normal and reserve compressed air supply gives an alarm if the pressure is lower than respectively 4.6 bar and 2.8 bar. The Pneumatic tube system must be sealed off and do not need compressed air in conjunction with Building seal.

13.5.7 In order to secure electricity supply for safety-related equipment in the event of failure of the public power supply, the following supply units must be in operation or available:

- UPS reactor hall
- UPS duty room
- UPS AH hall
- UPS building 217 (lc)

All UPS systems must be at least 2 KVA/1500 W and must have accumulator capacity for at least 2 hours of operation at maximum local load. In addition, a compatible backup unit with accumulator batteries must be available.

On weekdays in the time period from 7.00 to 16.30, the above mentioned backup UPS must be put in operating within half an hour after the failure of one of the units. On all other days as well as weekdays in the time period from 16:30 to 7:00, the above mentioned backup UPS must be put in operation within an 1 hour and 15 minutes after the failure of one of the units.

In case of break down of an UPS unit, the Nuclear Regulatory Authorities must be notified within 5 days of when a reserve unit will be available again.

Note: BfDA is not exceeded by simultaneous network failure and failure of a UPS unit if it is out in operation within respectively:

- half an hour on weekdays in the time period from 7.00 to 16.30.
- 1 hour and 15 minutes on all other days as well as weekdays in the time period from 16.30 to 7.00.

Monitoring

13.5.8 The existing monitoring of discharge from DR 3 must be continued at the current level, i.e.:

- Operational activity measuring equipment must be available for determination of tritiated water vapor (^3H) discharge to the atmosphere.

- Gamma monitors must be available on the upper deck of the reactor by the elevator shaft. In general, the gamma monitors must measure the radiation level and ensure that the containment is sealed if an elevated radiation level occurs on the reactor top. The limit of Building seal I is set at: 10^{-2} Sv/h.

13.5.9 Gamma monitors must be placed in the ventilation chimney, and these are used to prevent the discharge of unacceptable amounts of activity to the surroundings if elevated discharges occure. The limit of Building seal I is set at 40 µSv/h.

Note: At the Building seal limit, only an activity of an order of $2 \cdot 10^9$ Bq can be released to the surroundings. The resulting dose to a person who is at a distance of 1 km from DR 3 is about 0.1 - 1 µSv under adverse weather conditions.

13.5.10 Regarding radiation monitoring equipment:

- At least one gamma monitor in the basement and at least two gamma monitors on the first deck must be in operation.
- The two gamma monitors at the cutting pool must be in operation when cutting operations are performed or other handling of radioactive units.
- The 3 continuously running air activity monitors on the reactor top, in the reactor basement and in the AH hall must all always in operation during operations that involve the risk of increased air pollution.
- At least one of the two continuously running tritium monitors in the reactor hall must always be in operation.
- The continuously running tritium monitor in the AH hall should normally in operation. It may be out of operation if there is no equipment or materials in the AH hall that may release measurable amounts of Tritium to surroundings.

Air Cleaning Systems

13.5.11 In order to clean the air in the reactor hall for radioactive substances, one of the fans V6 / V7 in the active ventilation recirculation branches must be available (except during maintenance). The pressure drop across an absolute filter (F2, F3, F6, F7) must not exceed 1.18 kPa (120 mm Vs). These filters must be tested once a year.

Fire protection

13.5.12 Automatic fire alarm systems (ABA systems) must be installed in all areas where fire can have an impact on nuclear safety, especially in types 1 and 2, as specified in the Danish Fire Technology Institute's report on DR 3 of 12 January 1999:

- Reactor hall
- Service tunnel 1

- Machine house, ground floor
- Machine house, basement
- Service tunnel 2
- Pumpe station
- Engineering corridors

Checking, testing and maintenance

13.5.13 Following rules apply for inspection, testing and maintenance:

- A maintenance and inspection plan must be in place for active and passive components of the DR 3 plant, which must be in operation during the during decommissioning and which have an effect on the safety.
- Inspection testing and maintenance of these components must be in accordance with the maintenance plan and must be recorded.
- The maintenance campaigns must be set at intervals to ensure that the components can function and performance at the required precision to ensuring safety, until the next scheduled maintenance campaign.
- Inspection, testing and maintenance must be carried out by qualified personnel using appropriate methods and equipment. Technical-administrative instructions for these inspection, testing and maintenance campaigns must be available.

13.5.14 The following plants must be tested on a monthly basis:

- Ventilation system
- Person Control System
- Air locks for access to reactor hall
- Emergency lights
- Swamp pumps in non-active drainage system: by activating the swamp signaling device

13.5.15 The following installations must be tested and reported semi- or annually:

- Accumulator battery capacity: UPS facilities must be tested once a year with a load (controlled by measurement) of ~ 750 W during discharge.
- Firefighting equipment: Hand operated extinguishers, smoke detectors, fire extinguisher system and pipelines for agent for the fire extinguishers must be checked in accordance with the regulations of the emergency services.

- The filters in the containment: (F2, F3, F6 and F7) must be tested with aerosols once a year.

13.5.16 The following facilities must be routinely monitored:

- Building seal I, weekly. In order to detect and correct any abnormal conditions all facility parts in the reactor hall and adjoining buildings must be monitored in the time period from 07:00 - 16:30 during regular inspection rounds.

13.6 Specific conditions regarding the Fuel Fabrication Facility

No radioactive materials must be added to the Fuel Fabrication Facility.

14 Reporting

14.1 Periodic reporting

14.1.1 Annual report to the Ministry of Higher Education and Science

DD must send a copy of the annual report to the Nuclear Regulatory Authorities, no later than 1st of May in the following year.

14.1.2 Operations and decommissioning report

Once a year, a report on the nuclear safety at the nuclear facilities must be prepared. The report must include:

- An overview of the quantities and categories of all radioactive waste received from external users in the previous year, or generated during the decommissioning of the each nuclear facility at the Risø site. The report must indicate which quantities, by type, weight and activity of radioactive waste are placed at each storage facility for radioactive waste at the Risø Site.
- The results of analysis of drain water samples from Tailings pools.
- The amount of sludge, pumped to the sludge bed, as well as information on whether or not the sludge bed has been emptied and where the sludge has been transferred.
- An updated map of the evacuation zones, with an overview of all DD's the buildings and technical facilities, and a 3-year overview of expected, significant building and personnel developments within the DD's evacuation zone.

14.1.3 Discharge report

Once every six months, a report on the discharge of radioactive substances from DD's nuclear facilities must be prepared and submitted for review, cf. 5.4.4.

14.1.4 Monitoring report

Once every six months, a report on the results of the monitoring of radioactivity in the Risø district must be prepared and submitted for review, cf. 5.4.5.

14.1.5 Health physical report

Once every six months, a report must be prepared on the results of measurements of radiation levels, surface contaminations and air pollution at the nuclear facilities must be prepared and submitted for review, cf. 5.4.1.

14.2 Reporting of unexpected events

14.2.1 If discharge of radionuclides not included in Chapter 6 occur

If detecting or expecting discharge of radionuclide not included in Tables 4 and 5, the Nuclear Regulatory Authorities must be notified as soon as possible, or at the latest at the beginning of the first coming normal working day. After consultation with the Nuclear Regulatory Authorities the notification must be followed up with a detailed report. However, alerting and notification of the Nuclear Regulatory Authorities under Section 9.3 must still be done as soon as possible.

14.2.2 If exceeding the limits of discharges of radioactive substances

If the limits of discharges establish in Chapter 6 is exceeded or it are expected to be exceeded, the Nuclear Regulatory Authorities must be notified as soon as possible, or at the latest at the beginning of the first coming normal working day. After consultation with the Nuclear Regulatory Authorities the notification must be followed up with a detailed report.

14.2.3 If exceeding the dose limits for occupational exposure

SIS and the Danish Working Environment Authority must be notified immediately with subsequent written notification to these authorities and the Danish Emergency Management Agency, Nuclear Preparedness, if a worker at DD has received or is expected to receive a dose which will exceed the dose limit established in the Order No. 669 of 1st July 2019 Ionising Radiation and Radiation Protection. No later than 3 weeks after the exposure a written reports on the investigations and the implemented safety measures to prevent recurrences must be submitted.

14.2.4 If other limits are exceeded

Any violation of the BfDA or the occurrence of an unsafe condition must be reported to the Nuclear Regulatory Authorities as soon as possible, or at the latest at the beginning of the first coming normal working day.

Within one week thereafter, a report must be submitted describing the course of events that led to the incident and the measures immediately implemented to prevent recurrence.

No later than 3 months after the incident, a report must be submitted containing a description of the investigations conducted in order to clarify and assess the safety aspects of the incident, the assessment itself and a description of the mitigating measures implemented to prevent recurrence.

14.2.5 If the reporting levels for discharge of radioactive substances are exceeded

Increases in routine discharges of radioactive substances must be reported to the Nuclear Regulatory Authorities within 14 days if its occurrence, if it is detected that the discharges per month or the expected discharges per month will exceeding the values given in Tables 8 and 9:

Radionuklide	Reporting level for discharges to the atmosphere from one nuclear facility [GBq/month]
^{3}H*	1.000
^{14}C	1
^{60}Co	1
^{90}Sr	0,2
^{137}Cs	0,5
$^{152+154}Eu$	0,5
Aktinider	0,001

Table 8: Reporting levels for discharge to the atmosphere. * Discharge of Tritium into the atmosphere is only reported for DR 3.

Radionuclide	Reporting level for discharge to Roskilde Fjord from the Waste Management Plant [GBq/month]
^{3}H	1000
^{137}Cs	0.5

Tabel 9: Reporting levels for discharges to Roskilde Fjord.

If there for one or more nuclear facilities are discharges of several radionuclides simultaneously to the atmosphere or Roskilde fjord, respectively, the established nuclide-specific reporting limits must be expressed in an operational sum formula.

The reporting must include a statement of the reason for the increased discharges and a description of planned or implemented measures to limit such discharges.

14.3 Final reporting on decommissioning and clearance

The decommissioning of a nuclear facility is finally documented in a final decommissioning report (cf. 14.3.1). Final clearance of buildings and adjacent land for other use is based on the clearance report (cf. 14.3.2). Final land clearance follows BfDA 7.1.6.

The final decommissioning report shows that the goal of the decommissioning has been achieved together with the radiological status of any residual facility parts, buildings and any adjacent land, constitutes the basis to assess whether they are ready to undergo a clearance process.

If the goal of decommissioning to "the green field" cannot be documented, the clearance of the facility, buildings or adjacent land areas cannot be made until the remaining decommissioning tasks have been completed. Documentation for this can be provided either as a supplement to the existing decommissioning report or in the form of a new decommissioning report.

The final clearance report summarizes the results of the clearance measurements made in connection with the completion of the decommissioning work, if necessary supplemented by additional measurements, to the extent that the Nuclear Regulatory Authorities finds it necessary.

For other buildings and adjacent land areas at the Risø site that are not part of a nuclear facility, radiological measurements or other documentation must be used to assess the need for decommissioning/clean up before a clearance process can be initiated.

Decommissioning reports should follow the outline of relevant sections of the IAEA Safety Reports Series No. 45, Standard Format and Content for Safety Related Decommissioning Documents, Section 4.7. The content should at least include all the points listed in this release, though preferably with cross-reference between reports for the same nuclear facility.

14.3.1 The final decommissioning report

The final decommissioning report provides the final documentation showing that the decommissioning of a nuclear facility has been completed in accordance with the objectives of the decommissioning plan and BfDA for Danish Decommissioning. The final decommissioning report must be readable as a standalone report and must at least include the following elements:

- General information (name, address, owner, type of facility and use)
- Accurate maps of buildings and land areas affected by the decommissioning work
- Description of the original nuclear facilities and the surroundings

- Decommissioning goals and strategy, as well as any deviations
- Radionuclides and clearance criteria for buildings, materials and objects (cf. 7.)
- Description of the decommissioning methods and activities
- Remaining facility parts (including any equipment) and surroundings
- Radiological status and description of measurement methods applied. The section must include an assessment and description of any remaining activity above the clearance levels.
- Decommissioning waste (expected vs. actual amounts of radioactive waste and clearance waste)
- Monitoring programs, measurement methods and doses
- Unexpected events
- Clearance procedures with reference to the clearance function
- ”Lessons learned”. This section provides documentation of the experience gained, which may be used to improve and optimize radiation protection as well as conventional safety during future decommissioning projects. The section may include information related to decommissioning, such as: Organization, cooperation, quality assurance, requirements, instructions, training, decommissioning techniques, waste management, etc.

14.3.2 Clearance report

The clearance report is the final documentation showing that the facility including possible remaining equipment, as well as adjacent land areas may be released from regulatory control. The clearance report must at least include/describe the following elements:

- General information (name, address, owner, type of facility and use)
- Accurate mapping of buildings and bounded adjoining areas to released from regulatory control. This may include buildings and land areas not directly covered by the decommissioning project.
- Description of measurement program rooted in e.g. MARSSIM, IAEA publications or other relevant references, and description of the use of non-accredited methods in these programs.
- Description of measurement methods with reference to the clearance function quality manual for accredited measurement methods, while non-accredited measurement methods must be described.
- Identified background levels

- Identified radionuclides
- Results of the clearance measurements and their associated assessments, calculations (including calculation of uncertainties) are described, evaluated and compared with the clearance levels set by the Nuclear Regulatory Authorities (cf. chapter 7).
- Clearance reports for individual parts of facilities and individual sub-projects in the decommissioning project can be enclosed in an annex.