DANISH HEALTH AUTHORITY
Radiation Protection

2024

Council Directive 2011/70/EURATOM for the responsible and safe spent fuel and radioactive waste

Fourth report from Denmark

Health for all

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Introduction

Radioactive waste in Denmark is generated from decommissioning on the former nuclear facilities at the Risø site and to a limited degree by users of radioactive substances in research, industry and in the medical sector in Denmark. In industry, the largest amount, by mass, of radioactive waste is generated from oil and gas extractive activities. NORM waste is either managed and stored by the responsible licensees (oil and gas industry) at their sites or by Danish Decommissioning at the Risø site.

The Ministry of Higher Education and Science is the entity responsible for the implementation of the provisions provided in the National Programme for the Responsible and Safe Management of Radioactive Waste. Danish Decommissioning, a subsidiary to the Ministry of Higher Education and Science has been designated as national waste management organisation in the framework of Parliamentary Resolution B90/2018.

In this capacity, Danish Decommissioning carries out the decommissioning of the former nuclear research facilities at the Risø site, receives radioactive waste from institutional users of radioactive materials, and develops and implements plans for the long-term management of radioactive waste in Denmark. This includes construction and operation of an upgraded storage facility at the Risø site, which is to be operated until commissioning of a geological disposal facility by 2073 at the latest. Radioactive waste stored at the facilities of Danish Decommissioning complies with the criteria for classification as Low Level Waste and Intermediate Level Waste.

The Danish Health Authority regulates all use of radioactive substances, including management of radioactive waste, in Denmark. For the regulatory oversight of the nuclear installations at the Risø site, the Danish Health Authority and the Nuclear Division of the Danish Emergency Management Agency constitute the Nuclear Regulatory Authorities. The Nuclear Regulatory Authorities refer to the Minister of Interior and Health.

This report was compiled by the Danish Health Authority for the Ministry of Interior and Health. The report is structured with reference to the guidelines prepared by ENSREG Working Group 2 on Member States reporting on Article 14.1 of Council Directive 2011/70/Euratom (2018). The information presented includes contributions from the Danish Emergency Management Agency, the Ministry of Higher Education and Science and Danish Decommissioning.

1. Recent developments

Since the last reporting[1], the main efforts in implementing the National Programme for the Responsible and Safe Management of Radioactive Waste[2] (National Programme) in Denmark have centred on the continued decommissioning of the nuclear facilities at the Risø site, as specified in Parliamentary Resolution B48/2003[3] and planning and execution of the measures necessary to establish an upgraded storage facility as specified in Parliamentary Resolution B90/2018[4]. Danish Decommissioning has begun the development of a disposal facility programme, including a first draft of an implementation plan to this effect (see Annex, section 12.1). The Geological Survey of Denmark and Greenland has finalised a review of existing data in order to establish an overview of geological conditions at a depth of 500 m[5]. The review will be used as a baseline for area evaluation in the process of site selection for a disposal facility. Full scope IAEA review missions were conducted in 2021 (IRRS) and 2022 (ARTEMIS) and have resulted in adjustments of National Programme implementation.

1.1. Implementation of the National Programme

The overall programme structure is described in section 1.1 of the National Programme and is comprised by 3 technical and 3 socio-economic areas considered in Parliamentary Resolution B90/2018 and projected over a timescale ranging from the completion of the decommissioning of the nuclear facilities until commissioning of a geological disposal facility by 2073 at the latest. The timescale is divided into short-term, mid-term and long-term periods, which provides the time frame for the course and completion of the main deliveries defined in the National Programme.

The technical areas are subdivided into “Waste Management”, “Geology & Siting” and “Disposal Solution” – whereas the socio-economic areas are subdivided into “Organisational Framework”, “Stakeholder Engagement” and “Finance and Costing”. The main areas are further divided into a number of variably interdependent deliveries, which take effect in the short-term, mid-term or long-term, or extends over several terms.

Implementation of the National Programme in the reporting period has been focused on the technical areas, notably on the following short-term to mid-term objectives:

- Decommissioning of the nuclear facilities at the Risø site (Waste Management)

[1] Council Directive 2011/70/Euratom - Third report from Denmark
[2] National Programme for the Responsible and Safe Management of Radioactive Waste, Denmark (2020)
[3] Parliamentary Resolution B48/2003 on the decommissioning of the nuclear facilities at the Risø Research Facility site
[4] Parliamentary Resolution B90/2018 on a long-term solution for Denmark's radioactive waste
[5] Technical reports in English are provided on the GEUS website

- Construction of an upgraded storage facility at the Risø site and associated waste management facilities, including transfer of waste from existing storage facilities at the Risø site to the upgraded storage facility (Waste Management)
- Review and identification of potential host geologies for disposal extending to depths of 500 m (Geology and Siting)
- Identifying possible disposal concepts incl. generic feasibility and barrier system studies (Disposal Solution).

1.1.1. Decommissioning of the nuclear facilities at the Risø site

The decommissioning work at the Risø site has developed largely as anticipated for the reporting period. Work has been centred on the decommissioning of the Hot Cell Facility, Danish Reactor 3 (DR 3), and the facilities of the Waste Management Plant. The last stage of decommissioning of the Fuel Fabrication Plant was completed in 2022, followed by release from regulatory control in 2023. The current status of decommissioning work at the Risø site is that two out of six nuclear facilities have been approved for release to unrestricted use, while a third facility – the former DR 2 reactor – after decommissioning has been transformed to a Handling Hall for bigger waste items. section 2.2.1 provides more detail regarding completed as well as ongoing decommissioning works at the Risø site.

1.1.2. Construction of an upgraded storage facility

The planning phase of the storage facility project is in the final stages. Under The Nuclear Installations Act, the construction of the upgraded storage facility is subject to approval by the Minister for the Interior and Health. A draft preliminary safety report has been presented by Danish Decommissioning to the Nuclear Regulatory Authorities for comments prior submission of an application for approval of construction. Prior to the construction phase, an environmental impact assessment of the proposed project is subject to approval by the Danish Environmental Protection Agency. A local plan making provisions for the location and physical dimensions of the storage facility needs to be adopted by the City Council of Roskilde Municipality. Danish Decommissioning plans to announce the legal tender of the construction project by the end of 2024/beginning of 2025. Under the assumption that the storage facility project will meet the requirements for approval of construction, the construction phase is expected to have a duration of approximately three years, provisionally 2025-2028.

1.1.3. Review and identification of potential host geologies for disposal extending to depths of 500 m

In January 2022, Geological Survey of Denmark and Greenland published[6] a report of desk studies and modelling exercises based on a review and compilation of existing data. Characterisation and evaluation of geological properties and conditions at 500 meters depth has led the Survey to conclude that further in situ studies are required to establish detailed data on the subsurface properties and conditions at depths to 500 meters. The acquired data will be used as input to a safety case with the purpose of demonstrating whether the combined disposal concept of geological and engineered barriers can

[6] Studies of geological properties and conditions for deep disposal of radioactive waste, Denmark

provide the required level of safety and performance on both the short and long term. Further desk studies are planned to be carried out 2024-2025 with the aim of supporting the development of a disposal facility concept, cf. Subsection 1.1.4.

1.1.4. Identifying possible disposal concepts incl. generic feasibility and barrier system studies.

Danish Decommissioning has been tasked with the identification and recommendation of a generic disposal facility concept. In 2021, an overview of generic disposal concepts was presented by Danish Decommissioning along with a preliminary consideration of two relevant concepts to be further developed: 1) a deep geological facility and 2) an intermediate-depth facility in combination with a borehole. Danish Decommissioning considers the borehole concept particularly relevant for disposal of the "special waste", given the very limited volume of this fraction of the Danish inventory. In 2023, following a recommendation from the ARTEMIS review mission in 2022, Danish Decommissioning presented a draft implementation plan (see Annex, section 12.1), which is currently undergoing revision and consolidation following comments from international and national experts, from national regulatory authorities, and from the Geological Survey of Denmark and Greenland.

1.2. Legal framework

Following revision of Danish legislation for radiation protection in 2018-2019[7], additional reviews of the executive orders issued under The Radiation Protection act were initiated in 2022. The resulting updates include *inter alia* specific provisions on decommissioning, and further specifications regarding radioactive waste management. Updated executive orders are expected to enter into force in 2025.

A revised circular on the tasks of Danish Decommissioning as subsidiary to the Danish Agency for Higher Education and Science has been issued by the Danish Agency for Higher Education and Science in 2022 (Circular no. 9261/2022).

Details on the regulatory and legal framework for safe management of radioactive waste are presented in chapter 4.

1.3. IAEA review missions to Denmark in 2021 and 2022

Denmark hosted a full scope IRRS mission from 30. August to 8. September, 2021. The mission identified potential for further enhancement of the safety of radioactive waste management through the review of legislation related to future radioactive waste management facilities, in particular for disposal, and by revision of the policy and strategies for the management of radioactive waste to include all types of radioactive

[7] Danish Health Authority, Radiation Protection, Legislation

waste. The IRRS mission report[8] is publicly available through the website of the Danish Health Authority.

Further to this review, an ARTEMIS mission was conducted in Denmark from May 1 to May 9, 2022. The review mission concluded that the safety of radioactive waste management could be further enhanced by providing updates to the National Programme for the management of all types of radioactive waste, including appropriate interim targets and end states allowing for the monitoring of the programme's implementation, management of and control over all radioactive. Further recommendations addressed the need for comprehensive planning for a disposal facility, characterization of radioactive waste and development of waste acceptance criteria. The ARTEMIS mission report[9] is publicly available through the website of the Danish Health Authority.

[8] Danish Health Authority, Radiation Protection, IRRS mission 2021
[9] Danish Health Authority, Radiation Protection, ARTEMIS mission 2022

2. Scope and Inventory

Article 2 – Scope

1. This Directive shall apply to all stages of:
   (a) spent fuel management when the spent fuel results from civilian activities;
   (b) radioactive waste management, from generation to disposal, when the radioactive waste results from civilian activities.
2. This Directive shall not apply to:
   (a) waste from extractive industries which may be radioactive and which falls within the scope of Directive 2006/21/EC;
   (b) authorised releases.
3. Article 4(4) of this Directive shall not apply to:
   (a) repatriation of disused sealed sources to a supplier or manufacturer;
   (b) shipment of spent fuel of research reactors to a country where research reactor fuels are supplied or manufactured, taking into account applicable international agreements;
   (c) the waste and spent fuel of the existing Krško nuclear power plant, when it concerns shipments between Slovenia and Croatia.
4. This Directive shall not affect the right of a Member State or an undertaking in that Member State to return radioactive waste after processing to its country of origin where:
   (a) the radioactive waste is to be shipped to that Member State or undertaking for processing; or
   (b) other material is to be shipped to that Member State or undertaking with the purpose of recovering the radioactive waste.

   This Directive shall not affect the right of a Member State or an undertaking in that Member State to which spent fuel is to be shipped for treatment or reprocessing to return to its country of origin radioactive waste recovered from the treatment or reprocessing operation, or an agreed equivalent.

Article 12 – Contents of national programmes

1. The national programmes shall set out how the Member States intend to implement their national policies referred to in Article 4 for the responsible and safe management of spent fuel and radioactive waste to secure the aims of this Directive, and shall include all of the following:

(…)

   (c) an inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from decommissioning, clearly indicating the location and amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste;

Article 14 – Reporting

(…)

2. On the basis of the Member States' reports, the Commission shall submit to the European Parliament and the Council the following:

(…)

   (b) an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects.

2.1. Radioactive waste in Denmark

In accordance with Danish law, radioactive materials, including NORM (Naturally Occurring Radioactive Materials) without any foreseen use are to be considered as radioactive waste.

Radioactive waste in Denmark is presently stored by Danish Decommissioning. NORM waste resulting from the oil and gas extraction is stored by responsible licensees and by Danish Decommissioning.

Classification of radioactive waste in Denmark refers to the IAEA Safety Guide "Classification of Radioactive Waste", GSG-1, 2009. The use of the category "Very Low Level Waste" (VLLW) is subject to approval by the regulatory authorities.

2.2. Waste generating activities

The bulk of radioactive waste in Denmark originates from the decommissioning of the former research reactors and supporting facilities at the Risø site, where all Danish nuclear installations are located. Radioactive waste in quantities of 5-10 m^3/year, are transferred to Danish Decommissioning from users (research institutions, hospitals, industries etc.) of radioactive materials in Denmark. Routine maintenance and operational activities in oil and gas-extractive industries generate in the order of 50 m^3/year of NORM waste, which is stored at the sites of the licensees.

2.2.1. Decommissioning of the nuclear facilities at the Risø site

The decommissioning of the Fuel Fabrication Plant was successfully completed in 2022 and the facility was released from regulatory control in May 2023. Currently, emphasis is on the decommissioning of the one remaining research reactor - Danish Reactor 3 (DR 3) and the Hot Cell Facility. The overall decommissioning plan for the Waste Management Plant is subject to update and reapproval before dismantling can resume. The work has been on hold since the fall 2023.

Main progress in decommissioning since 2021 fall within the following areas:

1) Decommissioning of Danish Reactor 3 (DR 3),

2) Decommissioning of the Hot Cell Facility,

3) Decommissioning of the facilities of the Waste Management Plant (work to resume upon reapproval of overall decommissioning plan)

Below, the current status is briefly summarised. Further details on the decommissioning activities at the Risø site are presented in the national reports from Denmark to the Joint Convention[10].

For DR 3, demolition of the reactor block is now approximately 1/3 completed.

At the Hot Cell Facility, removal of equipment inside the cells is ongoing along with preparing for demolishing of the cells.

As for the Fuel Fabrication Facility, low levels of uranium contamination identified on a concrete floor in a crawlspace was removed in 2022 which completed the decommissioning of the Fuel Fabrication Facility. By May 1st 2023 the Fuel Fabrication was released from regulatory control.

Decommissioning plans for the facilities at the Waste Management Plant were approved by the Nuclear Regulatory Authorities in May 2019. In the approval it was specified that decommissioning of certain parts of the Waste Management Plant would require more detailed decommissioning plans. Initial decommissioning has been carried out and the first of these detailed decommissioning plans was submitted to the Nuclear Regulatory Authorities in May 2023 awaiting approval before the decommissioning may be initiated. Other parts of Waste Management Plant are not considered to be contaminated which is to be documented by radiological contamination surveys. Facilities at the Waste Management Plant, which are still essential for supporting decommissioning facilities, such as analytical laboratories and waste water treatment units, have been relocated in other buildings managed by Danish Decommissioning at the Risø site.

2.2.2. Radioactive waste from institutional users

Institutional users of radioactive materials in Denmark (i.e. hospitals, industries, research institutions etc.) are required to transfer all non-dischargeable types of radioactive waste within one year of generation of the waste. This ensures a continuous flow of transferred radioactive waste to Danish Decommissioning and prevents accumulation of radioactive waste at local sites. Institutional users of radioactive materials delivered up to 10 tons LLW and disused sealed sources per year to Danish Decommissioning. In 2021 Danish Decommissioning received from external users 4.3 tons of solid waste including 1.4 tons of smoke detectors and 258 litres of liquid waste. In 2022, 3.9 tons of solid waste (incl. 0.6 tons of smoke detectors) and 742 litres of liquid waste were received, and for 2023 the amounts received were 5.5 tons of solid waste (incl. 0.3 tons of smoke detectors) and 230 litres of liquid waste.

While generation of radioactive waste from institutional use over the past decade or so has proven relatively constant, the increase in the number of cyclotron facilities installed at medical research and treatment centres poses a potential source of radioactive waste, once the shielding of such bunker-type facilities is decommissioned. The total number of cyclotron facilities currently in operation is eight, and the number of planned facilities is

[10] National Reports from Denmark to the Joint Convention

two. Preliminary studies indicate that decommissioning may generate substantial volumes of concrete and steel with overall low activity concentrations enabling storage and decay as a possible waste management route. Also, the outcome of studies suggests a potential for significantly reducing generation of radioactive waste through careful characterization, modelling, segregation and sorting. The specific characteristics of this potential waste stream are conservatively included in projections for generation of radioactive waste, taking into consideration the expected lifespans of cyclotron facilities.

2.2.3. NORM waste

NORM waste stored at Dansk Decommissioning represents 65% (by mass) of the national inventory of NORM waste. The NORM waste stored at Danish Decommissioning consists of 1130 tons of tailings and 53 tons of materials received from external generators throughout the operational lifetime of the nuclear facilities. Of the remaining 35% of the NORM inventory, 34% originates from oil and gas extraction activities and is stored by one licensee, while NORM waste from geothermal heat extraction and contaminated materials make up only 1%. The combined amount of NORM waste at these locations is approximately 600 tons. The annual production of NORM waste from the oil and gas industry in the reporting period has been in the order of 50 tons per year.

2.3. Inventory

The currently anticipated requirement for storage space in the upgraded storage facility amounts to approximately 15.000 m^3 of radioactive waste conditioned for storage – including both institutional waste and decommissioning waste. This is based on preliminary assessments referring to current stored volumes and generic packing concepts. As such the assessed required storage space may be subject to updates, following finalization of *e.g.* waste acceptance criteria. Current planning therefore foresees a storage capacity of 15.000 m^3 and additional ~ 17% extra storage capacity for potential future waste arisings. Further expansion of the storage facility remains an option, should the need arise.

In addition, approximately 2500 m^3 of uranium ore, 600 m^3 tailings and 114 m^3 NORM material, which is currently managed by Danish Decommissioning will be accommodated in a separate storage building at the Risø site.

The inventory listed in this report is also available through the IAEA hosted “Spent Fuel and Radioactive Waste Information System” (SRIS)[11], providing information on radioactive waste inventories, national radioactive waste management programmes etc. in IAEA member states

2.3.1. Radioactive waste managed by Danish Decommissioning

The low and intermediate level radioactive waste managed by Danish Decommissioning is stored in several storage facilities at the Risø site. Inventories of radioactive waste are

[11] IAEA Spent Fuel and Radioactive Waste Information System - Denmark

given in the Table 1 and Table 2 with reference to storage facility, volume or mass and activity contents of the stored radioactive waste.

2.3.2. Special waste

There are no spent fuel management facilities in Denmark. The “special waste” comprises the liquid core from the former research reactor DR 1, as well as fragments from post-irradiation physical and mechanical testing and examination of power type fuel. The “special waste” is stored under safe and secure conditions at storage facilities for radioactive waste at Danish Decommissioning. No precautions for heat dissipation are necessary for these materials. Based on these properties and nuclide activity concentrations, the “special waste” is designated as ILW.

The activity of spent fuel from DR 1 reported here includes the fission product isotopes ^{137}Cs and ^{90}Sr and actinides ^{239}Pu and ^{240}Pu with correction for decay until 31. December 2023. The activity of experimentally produced and irradiated fuel of power reactor type was calculated using Safeguard records and burnup scaling factors with decay correction to 31. December 2023. Fission product isotopes include ^{137}Cs, ^{90}Sr, ^{151}Eu and ^{154}Eu and actinide isotopes include: ^{235}U, ^{236}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, and ^{241}Am. The calculation of actinides has been updated to take into account the transformation of ^{241}Pu to ^{241}Am.

An inventory of the stored special waste is given in Table 1.

Waste designation	**Storage facility**	**Material**	**Mass/ Volume**	**Activity**
DR 1 liquid reactor core	Risø site	Solution of 20 % enriched uranyl sulphate in light water	4.9 kg U 15.8 l	25.9 GBq fission products 0.4 GBq actinides
Experimentally produced and irradiated fuel of power reactor type	Risø site	Uranium oxide pellets mostly in zircalloy tube	233 kg U	484 TBq fission products 35 TBq actinides

Table 1. “special waste” in storage facility at the Risø site. Activity data as of 31. December 2023.

2.3.3. Other low and intermediate level radioactive waste stored at the Risø site

In addition to the “special waste”, low level radioactive waste and intermediate level radioactive waste is stored at different storage facilities at the Risø site, as indicated in Table 2.

Storage facility	Mass (tons)	Volume (m^3)	Activity (TBq)
Low Level Waste Storage	1,780 t	1,100	6
Drum Storage and Centralvej Storage	~162 t	84	489
Taillings and ore Pools	4,800 t	3,100	0.1
Intermediate Storage	2,092 t	1,425	194

Table 2. Inventory of radioactive waste stored at Danish Decommissioning as of 31. December 2023.

The inventory in the Intermediate Storage has increased from a mass of 1,775 to 2,092 tons since the last reporting in 2021. However, the activity has decreased from 217 TBq to 194 TBq. The reason for this decrease is the decay of short-lived radionuclides, especially Co-60. Additionally, a significant portion of the waste added to the Intermediate Storage since the last reporting consists of concrete used for shielding in the experimental rigs from DR 3 and concrete from the reactor block of DR 3, characterized by low activity.

Danish Decommissioning also stores a combined amount of 4,800 tons of uranium ore and tailings with a total activity of 0,1 TBq.

3. General principles and policies

Article 4 – General principles

1. Member States shall establish and maintain national policies on spent fuel and radioactive waste management. Without prejudice to Article 2(3), each Member State shall have ultimate responsibility for management of the spent fuel and radioactive waste generated in it.
2. Where radioactive waste or spent fuel is shipped for processing or reprocessing to a Member State or a third country, the ultimate responsibility for the safe and responsible disposal of those materials, including any waste as a by-product, shall remain with the Member State or third country from which the radioactive material was shipped.
3. National policies shall be based on all of the following principles:
   - (a) the generation of radioactive waste shall be kept to the minimum which is reasonably practicable, both in terms of activity and volume, by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of materials;
   - (b) the interdependencies between all steps in spent fuel and radioactive waste generation and management shall be taken into account;
   - (c) spent fuel and radioactive waste shall be safely managed, including in the long term with passive safety features;
   - (d) implementation of measures shall follow a graded approach;
   - (e) the costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;
   - (f) an evidence-based and documented decision-making process shall be applied with regard to all stages of the management of spent fuel and radioactive waste.
4. Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Directive 2006/117/Euratom, has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.

Prior to a shipment to a third country, the exporting Member State shall inform the Commission of the content of any such agreement and take reasonable measures to be assured that:

- (a) the country of destination has concluded an agreement with the Community covering spent fuel and radioactive waste management or is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ('the Joint Convention');
- (b) the country of destination has radioactive waste management and disposal programmes with objectives representing a high level of safety equivalent to those established by this Directive; and
- (c) the disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set down in the radioactive waste management and disposal programme of that country of destination.

3.1. National policy for responsible and safe management of radioactive waste.

Through the adoption of Parliamentary Resolution B48/2003 and Parliamentary Resolution B90/2018, the Government has established a national policy with initial provisions for the safe decommissioning of the nuclear facilities at the Risø site and the

safe management and disposal of the resulting radioactive waste as well as radioactive waste from institutional use of radioactive material in Denmark.

Parliamentary Resolution B48/2003 forms the basis for the current policy on decommissioning and management of radioactive waste. Herein, the Danish Parliament announces its agreement that the Government will promote the decommissioning of the nuclear facilities at Risø Research Center by the state enterprise Danish Decommissioning, in order to release the areas on the site for unrestricted use within a timeframe of up to 20 years. Pursuant to the resolution, the Danish Parliament also gave its consent that the Government, at the time of the dismantling (decommissioning), started preparing a basis for decision for a Danish final disposal facility for low- and medium-level waste.

Parliamentary Resolution B90/2018 further specifies the end goals for management and disposal of these waste streams, and defines the responsibilities of Danish Decommissioning as national waste management organisation in the framework of Parliamentary Resolution B90/2018. The resolution aims to implement a long-term solution for Denmark's radioactive waste with a view to continued safe storage until the waste may be disposed of in a disposal facility. Parliamentary Resolution B90/2018 enables the short-term improvement of safety through the construction of a new upgraded storage facility at the Risø site. The resolution facilitates - in the medium term - geological studies at depths of up to 500 meters in order to identify suitable geologies for a deep geological disposal facility in Denmark. After this, a location of the geological disposal facility can be recommended based on a number of analyses of safety, geological, physical and socio-economic conditions, in particular the option for voluntary participation by local municipalities/communities. In the long term, Parliamentary Resolution B90/2018 will enable the establishment of a geological disposal facility to be commissioned by 2073 at the latest.

Parliamentary Resolution B90/2018 also allows for the – in parallel – continued exploration of the possibilities for an international solution for the so-called “special waste”, comprising the bulk of long-lived activity in the Danish inventory of radioactive waste (cf. section 2.3.2). The “special waste” will, at the latest at the point in time where a planning act for a geological disposal facility is passed, be included in the inventory to be disposed of in Denmark, should an international solution not have been found for this waste.

Finally, according to Parliamentary Resolution B90/2018, a disposal solution could also be considered for NORM designated as waste, which is currently stored by responsible licensees until a long-term management and disposal solution is decided upon.

In 2020, the issue of management and disposal of NORM was discussed by members of the Nordic Council[12] in order to establish a baseline of NORM management in the Nordic countries and to explore possible avenues for collaboration between member states. In April 2021, the Nordic Council Committee for a Sustainable Nordic Region put forward Proposal A 1860 that the Nordic Council adopt the following recommendations to the Nordic Council of Ministers:

- that suitable sites for one or more joint Nordic disposal facilities for NORM should be identified
- that any legal and regulatory obstacles for import/export of NORM between member states should be identified and remedied
- that negotiations should be initiated to establish joint financing of one or more NORM disposal facilities
- that procedures are established to ensure the safe management and the safe handling of NORM transportation between member states.

Proposal A 1860 was adopted by the Joint Session of the Nordic Council in November 2021. The resolution was forwarded to the Nordic Council of Ministers for approval and subsequent consideration by the national parliaments of the member states. In February 2022, the Nordic Council of Ministers declined approval of Proposal A.

[12] The Nordic Council is the parliamentary arm of Nordic Co-operation, an inter-governmental regional partnership of Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and Åland, cf. https://www.norden.org/en/information/official-nordic-co-operation.

4. National framework

Article 5 – National framework

1. Member States shall establish and maintain a national legislative, regulatory and organisational framework ('national framework') for spent fuel and radioactive waste management that allocates responsibility and provides for coordination between relevant competent bodies. The national framework shall provide for all of the following:
   - (a) a national programme for the implementation of spent fuel and radioactive waste management policy;
   - (b) national arrangements for the safety of spent fuel and radioactive waste management. The determination of how those arrangements are to be adopted and through which instrument they are to be applied rests within the competence of the Member States;
   - (c) a system of licensing of spent fuel and radioactive waste management activities, facilities or both, including the prohibition of spent fuel or radioactive waste management activities, of the operation of a spent fuel or radioactive waste management facility without a licence or both and, if appropriate, prescribing conditions for further management of the activity, facility or both;
   - (d) a system of appropriate control, a management system, regulatory inspections, documentation and reporting obligations for radioactive waste and spent fuel management activities, facilities or both, including appropriate measures for the post-closure periods of disposal facilities;
   - (e) enforcement actions, including the suspension of activities and the modification, expiration or revocation of a licence together with requirements, if appropriate, for alternative solutions that lead to improved safety;
   - (f) the allocation of responsibility to the bodies involved in the different steps of spent fuel and radioactive waste management; in particular, the national framework shall give primary responsibility for the spent fuel and radioactive waste to their generators or, under specific circumstances, to a licence holder to whom this responsibility has been entrusted by competent bodies;
   - (g) national requirements for public information and participation;
   - (h) the financing scheme(s) for spent fuel and radioactive waste management in accordance with Article 9.
2. Member States shall ensure that the national framework is improved where appropriate, taking into account operating experience, insights gained from the decision-making process referred to in Article 4(3)(f), and the development of relevant technology and research.

4.1. National framework during the reporting period

The legislative, regulatory and organisational framework for safe management of radioactive waste in Denmark has remained as specified for the last reporting period, with no change in the assignment of roles and responsibilities of regulators, operators and licence holders.

Review activities of the executive orders issued under The Radiation Protection Act were initiated in 2022, also addressing some recommendations and suggestions provided during the IRRS and ARTEMIS missions. The anticipated updates include further provisions regarding decommissioning and radioactive waste management. Updated executive orders are expected to enter into force in 2025.

The Ministry for the Interior and Health made administrative updates to the circular detailing the tasks of the Danish Health Authority and the Danish Agency for Higher Education and Science regarding radioactive waste management and issued an updated Circular no. 9635 of 16 June 2022 on the tasks of the Danish Health Authority and the Danish Agency for Higher Education and Science concerning responsible and safe management of radioactive waste.

The Danish Agency for Higher Education and Science revised and issued a circular (Circular no. 9261/2022)[13] regulating tasks and responsibilities of Danish Decommissioning (licence holder), replacing previously issued circulars.

The national framework is presented in more detail in the following sections.

4.1.1. Legal Framework

The legal framework for radiation protection and safety as well as for responsible and safe management of radioactive waste in Denmark rests on The Radiation Protection Act[14], The Nuclear Installations Act[15], and their underlying executive orders and circulars.

The Radiation Protection Act is the main instrument for transposition of Council Directive 2013/59/EURATOM (The European Basic Safety Standards). In addition to the provisions of the Directive, the act implements the framework and principles of The 2007 Recommendations of the International Commission on Radiological Protection, ICRP Publication 103. In covering the ICRP “exposure situations” and “exposure categories”, the act is all-inclusive in terms of facilities and activities, applying to nuclear installations as well as all stages in the management of radioactive waste. The act empowers the Danish Health Authority with all regulatory core functions such as authorization, review and assessment, inspection and enforcement.

The Nuclear Installations Act defines the concept of nuclear installations and establishes the fundamental principles for authorization; to ensure and maintain safety during commissioning, operation and decommissioning of nuclear facilities. Pursuant to the law, the Danish Health Authority under the Ministry of Interior and Health and (by later amendments) the Danish Emergency Management Agency under the Ministry of Defence, constitute the Nuclear Regulatory Authorities. The Nuclear Regulatory Authorities are authorised to establish limits and conditions for construction, operation and decommissioning of nuclear facilities, to issue terms necessary to ensure compliance with such limits and conditions and to access nuclear facilities at any time. The Nuclear Regulatory Authorities can demand that operations shall be stopped if stipulated limits and conditions are violated, or for reasons of safety. The nuclear installations at the Risø site, including the national storage facilities for radioactive waste, are subject to oversight and inspection by the Nuclear Regulatory Authorities.

[13] Circular no.9261 of 11 March 2022, on Danish Decommissioning
[14] Act no. 23 of 15 January 2018, on Ionising Radiation and Radiation Protection (The Radiation Protection Act)
[15] Act no. 170 of 16 May 1962, on Nuclear Installations (The Nuclear Installations Act)

The nuclear facilities at the Risø site are thus subject to regulatory control by the Danish Health Authority and by the Nuclear Regulatory Authorities. Regulatory control is exercised in a coordinated manner. This also applies to the new, upgraded storage facility to be established according to the provisions of Parliamentary Resolution B90/2018. The application of The Nuclear Installations Act to the upgraded storage facility will reflect that the upgraded storage facility itself as well as the activities undertaken there, shares few similarities with nuclear installations as such.

The national legal framework comprises additional legislation in support of responsible and safe management of radioactive waste, including: The Environmental Impact Assessment Act, The Nuclear Safety Act, The Health Act, The Public Information Act and The Planning Act, including relevant underlying orders.

4.1.2. Organizational and Regulatory framework

The regulatory framework for the management of radioactive waste comprise three ministries in the main. Pursuant to the all-encompassing nature of The Radiation Protection Act, the Ministry of Interior and Health is responsible for the legal framework in relation to all facilities (also nuclear facilities) and activities involving radiation sources including management of radioactive waste. The Ministry of Interior and Health is responsible for the legal framework governing the administration of the Nuclear Regulatory Authorities. The Ministry of Higher Education and Science is administratively responsible (as operating entity) for the nuclear facilities in Denmark, which are all government property and for Danish Decommissioning, which is tasked as national implementer for the decisions regarding radioactive waste management according to Parliamentary Decision B90/2018.

The Danish Health Authority

The Danish Health Authority acts under the Ministry of Interior and Health. The main tasks include health promotion, disease treatment and prevention – the latter including radiation protection and safety. In accordance with The Radiation Protection Act, the Danish Health Authority is the national competent authority for regulating the use of radioactive substances including radioactive waste. The everyday administration of the obligations and powers of the act is delegated to the Danish Health Authority, Department for Radiation Protection. Pursuant to The Nuclear Installations Act, the Danish Health Authority and the Danish Emergency Management Agency constitute the Nuclear Regulatory Authorities – maintaining regulatory oversight of nuclear safety, including for storage facilities where these are regarded as nuclear installations. In addition to the above described regulatory functions, the Danish Health Authority has been assigned particular responsibilities in relation to the implementation of the National Programme. These responsibilities are detailed in Circular no. 9635 of 16 June 2022. The relevant legislation is:

1. The Radiation Protection Act (Act no. 23 of 15 January 2018 on Ionising Radiation and Radiation Protection) and the following underlying Executive Orders transpose the large majority of the EU-BSS provisions into Danish legislation:

1.1. Executive Order no. 669 of 1 July 2019 on Ionising Radiation and Radiation Protection.
1.2. Executive Order no. 670 of 1 July 2019 on Use of Radioactive Substances.
1.3. Executive Order no. 672 of 1 July 2019 on Transboundary Shipments of Radioactive Waste and Spent Nuclear Fuel.
1.4. Circular no. 9635 of 16 June 2022 on the tasks of the Danish Health Authority and the Danish Agency for Higher Education and Science concerning responsible and safe management of radioactive waste

2. The Nuclear Installations Act (Act no. 170 of 16 May 1962 on Nuclear Installations)
2.1. Executive Order no. 278 of 27 June 1963 on Protective Measures against Accidents at Nuclear Facilities, etc. – as changed according to Executive Order no. 502 of 10 January 1974.
2.2. Circular no. 9450 of 9 July 2020 on the regulatory control exercised by the nuclear regulatory authorities regarding the nuclear safety of nuclear installations, etc.

The Danish Agency for Higher Education and Science

The Agency has formal responsibility for institutions under the Ministry of Higher Education and Science, including Danish Decommissioning. The primary tasks of Danish Decommissioning are to: 1) dismantle the nuclear research facilities at Risø by 2023, in a safe, environmentally sound and economically optimal way, 2) receive, process and store radioactive waste from Danish users of radioactive material, and 3) participate in the process that lead to a long-term solution for the radioactive waste by 2073 - until then, storing the waste. The role and responsibilities of Danish Decommissioning are detailed in Circular no. 9261 of 11. March 2022. The Danish Agency for Higher Education and Science has been assigned particular responsibilities in relation to the implementation of the National Programme. These responsibilities are detailed in Circular no. 9635 of 16 June 2022.
The relevant legislation/governing instruments are:

1. Parliamentary Resolution B48, 2003 on the Decommissioning of the Nuclear Facilities at Research Station, Risø.
2. Parliamentary Resolution B90, 2018 on a Long-Term Solution for Denmark's Radioactive Waste.
3. Executive Order no. 1229 of 3 November 2015 on Departmental Changes between Ministers
4. Circular no. 9635 of 16 June 2022 on the tasks of the Danish Health Authority and the Danish Agency for Higher Education and Science concerning responsible and safe management of radioactive waste
5. Circular no. 9261 of 11. March 2022 on Danish Decommissioning.

The Danish Emergency Management Agency

The Danish Emergency Management Agency (DEMA) is responsible for Danish emergency preparedness and acts under the Ministry of Defence. DEMA supervises authorities and municipalities on emergency preparedness and comprise one part of the Nuclear Regulatory Authorities. Pursuant to The Nuclear Installations Act, the Danish Emergency Management Agency and the Danish Health Authority constitute the Nuclear Regulatory Authorities. The relevant legislation is:

1. The Nuclear Installations Act (Act no. 170 of 16 May 1962 on Nuclear Installations)
1.1. Executive Order no. 278 of 27 June 1963 on Protective Measures against Accidents at Nuclear Facilities, etc. – as changed according to Executive Order no. 502 of 10 January 1974.

1.2. Circular no. 9450 of 9. July 2020 on the regulatory control exercised by the nuclear regulatory authorities regarding the nuclear safety of nuclear installations, etc.

2. The Emergency Management Act, Nuclear Preparedness Chapter 7a (Consolidation Act no. 314 of 3 April 2017 on Emergency Management).
   2.1. Executive Order no. 1762 of 27 December 2016 on Security Measures for Nuclear Material and Nuclear Facilities and Drafting of Security Plans.
3. The Nuclear Safety Act (Act no. 244 of 12 May 1976 on Safety and Environmental Conditions at Nuclear Facilities, etc.) (Only § 11 and § 12 (1) is in force).

The Danish Environmental Protection Agency

The Danish Environmental Protection Agency is part of the Ministry of Environment, and it administers the legislation on environmental protection, which is to ensure clean air, (drinking-) water and soil and good living conditions for people, animals and nature. The Environmental Impact Assessment Act as well as The Planning Act (under the Ministry of Ecclesiastical Affairs) are relevant in the planning and siting of facilities such as nuclear facilities or a disposal facility for radioactive waste. The relevant legislation is:

1. The Environmental Impact Assessment Act (Consolidation Act no. 4 of 3 January 2023 on Environmental Impact Assessment of Plans and Programs and of Specific Projects (EIA).
2. The Environmental Protection Act (Consolidation Act no. 48 of 12 January 2024 on Environmental Protection)

The Danish Agency for Planning and Rural Development (Ministry of Ecclesiastical Affairs)

The Danish Agency for Planning and Rural Development administers The Planning Act on involving the public in a coherent planning that combines social interests in land use, contributes to protect nature and environment, and creates a good framework for growth and development throughout the country. The Planning Act as well as the Environmental Impact Assessment Act are relevant in the planning and siting of facilities such as nuclear facilities or a disposal facility for radioactive waste. The relevant legislation is:

1. The Planning Act (Consolidation Act no. 223 of 1 March 2024 on Planning).

5. Competent regulatory authorities

Article 6 – Competent regulatory authority

1. Each Member State shall establish and maintain a competent regulatory authority in the field of safety of spent fuel and radioactive waste management.
2. Member States shall ensure that the competent regulatory authority is functionally separate from any other body or organisation concerned with the promotion or utilisation of nuclear energy or radioactive material, including electricity production and radioisotope applications, or with the management of spent fuel and radioactive waste, in order to ensure effective independence from undue influence on its regulatory function.
3. Member States shall ensure that the competent regulatory authority is given the legal powers and human and financial resources necessary to fulfil its obligations in connection with the national framework as described in Article 5(1)(b), (c), (d) and (e).

5.1. Legal and regulatory framework for the safe management of radioactive waste

The legal framework for responsible and safe management of radioactive waste in Denmark rests on The Radiation Protection Act, The Nuclear Installations Act and their underlying executive orders and circulars.

The Radiation Protection Act is the main instrument for transposition of Council Directive 2011/70/Euratom. The act empowers the Danish Health Authority with all regulatory core functions such as authorization, review and assessment, inspection and enforcement, and ensures that the Danish Health Authority exercises its functions under the act in full professional independence.

The Nuclear Installations Act defines the concept of nuclear installations and establishes the fundamental principles for authorization to ensure safety during construction, operation and decommissioning of nuclear facilities. The act stipulates that the Danish Health Authority under the Ministry of Interior and Health and (by later amendments) the Danish Emergency Management Agency under the Ministry of Defence, constitute the Nuclear Regulatory Authorities. The Nuclear Installations Act authorizes the Nuclear Regulatory Authorities to establish limits and conditions for construction, operation and decommissioning of nuclear facilities and to issue terms necessary to ensure compliance with such conditions. The Nuclear Installations Act furthermore grants the Nuclear Regulatory Authorities the right to access nuclear facilities at any time.

The nuclear installations at the Risø site, including the national storage facilities for radioactive waste, are thus subject to oversight and inspection by the Danish Health Authority as well as the Nuclear Regulatory Authorities.

The Danish Health Authority and the Danish Emergency Management Agency remain functionally separated from organisations or bodies responsible for management of radioactive waste in Denmark through allocation of the responsibility for implementing the political decisions in Parliamentary Resolution B48/2003 and B90/2018 to the Ministry of Higher Education and Science.

Further details regarding the national framework for responsible and safe management of radioactive waste is provided in the National Programme and chapter 4 in this report.

5.2. Financial provisions

The Financial Act covers the operating costs of the Danish Health Authority and the Danish Emergency Management Agency through allocations to the respective ministries in charge i.e., the Ministry of Interior and Health and the Ministry of Defence, respectively.

The responsibility for funding the National Programme, including the activities of the Danish Health Authority and the Danish Emergency Management Agency, in order to fulfil the obligations related to article 5(1)(b), (c), (d) and (e) lies with the Danish Parliament. The adoption of the annual Financial Act, which is a requirement in the Danish constitution, confirms the obligations of Parliament to meet the costs of the National Programme and to guarantee the availability of funds at the time when they are needed.

In the event of an unforeseen budget requirement, a motion of approval is prepared by the responsible ministry to be presented to the Financial Committee of the Danish Parliament. The decision for approval rests with the Finance Committee.

6. Licence holder

Article 7 – Licence holders

1. Member States shall ensure that the prime responsibility for the safety of spent fuel and radioactive waste management facilities and/or activities rest with the licence holder. That responsibility can not be delegated.
2. Member States shall ensure that the national framework in place require licence holders, under the regulatory control of the competent regulatory authority, to regularly assess, verify and continuously improve, as far as is reasonably achievable, the safety of the radioactive waste and spent fuel management facility or activity in a systematic and verifiable manner. This shall be achieved through an appropriate safety assessment, other arguments and evidence.
3. As part of the licensing of a facility or activity the safety demonstration shall cover the development and operation of an activity and the development, operation and decommissioning of a facility or closure of a disposal facility as well as the post- closure phase of a disposal facility. The extent of the safety demonstration shall be commensurate with the complexity of the operation and the magnitude of the hazards associated with the radioactive waste and spent fuel, and the facility or activity. The licensing process shall contribute to safety in the facility or activity during normal operating conditions, anticipated operational occurrences and design basis accidents. It shall provide the required assurance of safety in the facility or activity. Measures shall be in place to prevent accidents and mitigate the consequences of accidents, including verification of physical barriers and the licence holder's administrative protection procedures that would have to fail before workers and the general public would be significantly affected by ionising radiation. That approach shall identify and reduce uncertainties.
4. Member States shall ensure that the national framework require licence holders to establish and implement integrated management systems, including quality assurance, which give due priority for overall management of spent fuel and radioactive waste to safety and are regularly verified by the competent regulatory authority.
5. Member States shall ensure that the national framework require licence holders to provide for and maintain adequate financial and human resources to fulfil their obligations with respect to the safety of spent fuel and radioactive waste management as laid down in paragraphs 1 to 4.

6.1. Obligations of the licence holder

The Radiation Protection Act assigns the responsibility for radioactive waste management facilities and/or activities with the licence holder. The Nuclear Installations Act assigns responsibility for the management of radioactive waste generated from nuclear installations with the designated owner of the facility. As such, the obligations of licence holders have remained unchanged during the reporting period. The prime responsibility for the safe management of radioactive waste rests with the licence holder.

6.1.1. Assessment and demonstration of safety

All activities related to use of radioactive materials, decommissioning of facilities for such use and associated radioactive waste management conducted by any undertaking, including Danish Decommissioning, are subject to the provisions in The Radiation Protection Act and underlying executive orders. Following these provisions, licensees are required to undertake assessments of safety, taking into account all aspects relevant to safety. Safety assessments must at all times reflect the activities undertaken by the licensee. For planned activities or facilities for the use of radioactive materials, a safety assessment must be prepared prior to the onset of activities or use of facilities. Radiation

Protection legislation requires licensees to be able to document compliance with relevant legal requirements. The Danish Health Authority may specify terms to a license, including provisions for assessment and demonstration of safety.
According to The Nuclear Installations Act, any designated owner of a nuclear facility must seek approval for construction as well as operation of a nuclear facility. Prior to construction of a nuclear facility, the Nuclear Regulatory Authorities must be presented with a preliminary safety report detailing technical properties of the facility, control and safety measures and site-specific characteristics. Prior to operation of a nuclear facility, the Nuclear Regulatory Authorities must be presented with a final safety report providing sufficient information to facilitate a full assessment of the safety of the facility. Approval to construct or operate a nuclear facility may be given on terms. The Nuclear Regulatory Authorities may at any time specify further requirements for reasons of safety, including provisions for assessment and demonstration of safety.

6.2. Mandate, tasks and responsibilities for Danish Decommissioning

The adoption of Parliamentary Resolution B90/2018 extends the tasks of Danish Decommissioning to also include contributions to establishing a long-term solution for radioactive waste. In this capacity, Danish Decommissioning will take active part in processes related to planning, localisation, construction, operation and decommissioning of the planned upgraded storage facility as well as in the development of the disposal solution to be implemented by 2073 at the latest. As presented in chapter 4, tasks and responsibilities for Danish Decommissioning have been elaborated through various Parliamentary Decisions, issuance of circulars etc.

Existing facilities

Radiation Protection legislation requires Danish Decommissioning to ensure the safety of spent fuel and radioactive waste management, to uphold documentation for safety and to implement quality assurance and management systems as appropriate. For the decommissioning of facilities at the Risø site, Danish Decommissioning is required to perform safety assessments, to elaborate plans for management of radioactive waste, and through instructions and verification processes, including radiological monitoring, to demonstrate that safety is maintained. Similar provisions are stipulated in the Operational Limits and Conditions for Danish Decommissioning.

As reported in previous national reports from Denmark, the Nuclear Regulatory Authorities have issued Operational Limits and Conditions for Danish Decommissioning, detailing how the nuclear installations at the Risø site may be safely operated and decommissioned. The Operational Limits and Conditions for Danish Decommissioning specifies that Danish Decommissioning has the responsibility for ensuring that operation and decommissioning of the nuclear facilities at the Risø site takes place in accordance with the conditions set in the Operational Limits and Conditions and laws and orders regarding radiation protection and nuclear security. The Operational Limits and Conditions set conditions regarding, *inter alia,* maintaining and improving safety of spent

fuel and radioactive waste management, documentation for safety, quality assurance and management systems. The Operational Limits and Conditions for Danish Decommissioning further specify that the collective Safety Documentation for Danish Decommissioning must be updated minimum every 5th year. Every chapter is updated separately.

As the decommissioning of the nuclear facilities at the Risø site is ongoing, the Operational Limits and Conditions are progressively updated. Latest version of the Operational Limits and Conditions is from 2022. Public versions of the Operational Limits and Conditions are available on the website of the Danish Health Authority[16].

Planned facilities

Following Parliamentary Resolution B90/2018, Danish Decommissioning is planning construction of a new upgraded storage facility for all the radioactive waste for which Danish Decommissioning bears prime responsibility. The storage facility will be in operation until no later than 2073 when a final disposal facility for the waste will be in operation.

Since the adoption of Parliamentary Resolution B90/2018 Danish Decommissioning's main focus has been on preparation and planning of the new upgraded storage facility. According to the resolution, the facility shall be located on the Risø peninsula. The more precise location on the peninsula has been decided, based on an overall safety assessment, an assessment of the location in relation to already existing facilities and an assessment of the geotechnical conditions on the preferred location. In parallel, the overall demands and specifications have been formulated, and a detailed project proposal formulated in close cooperation between Danish Decommissioning and the associated contractors. During the process there has been a close dialogue with the nuclear regulatory authorities and other stakeholders, both directly and through the established national and local contact fora.

After finalization of the detailed project proposal, the main focus has been on finalizing the safety assessment for the upgraded storage facility. In parallel, the documentation for obtaining the necessary approvals regarding environmental impacts (Act 973/2020) and spatial planning (Act 1157/2020) is under preparation. Simultaneously, a detailed budget has been elaborated and approval by the Financial Committee of the Danish Parliament has been obtained. When all necessary approvals are obtained, the construction site will be prepared and a public tender will be announced. Depending on approvals, it is estimated that the facility will be ready for operation by 2028.

When the upgraded storage facility is ready for operation, the radioactive waste will be transferred from the present storage facilities.

After establishment of the upgraded storage facility and transfer of the waste, the main activities will be waste management, including continued reception of waste from external

[16] Operational Limits and Conditions for Danish Decommissioning 2020

users of radioactive sources, inspection and necessary handling of the stored waste and preparation of the waste for final disposal, comprising account of planning and construction of new reception and handling facilities, as well as more detailed characterization and description of especially the historical waste, where the present documentation is insufficient. A more detailed long-term waste management plan will be elaborated based on experience from international practice and dialogue with Danish Decommissioning's international panel of experts.

Human and financial resources of license holder

Financial provisions for Danish Decommissioning are described in chapter 8.

Until now, the main focus of Danish Decommissioning has been decommissioning. In the future, focus will change, gradually turning the organization into an organization centred on radioactive waste management, with responsibility for safe storage of the waste, and co-responsible for the process leading to disposal. In 2021, Danish Decommissioning introduced a major organisational change in order to better prepare the organisation to the new tasks.

7. Expertise and skills

Article 8 – Expertise and skills

Member States shall ensure that the national framework require all parties to make arrangements for education and training for their staff, as well as research and development activities to cover the needs of the national programme for spent fuel and radioactive waste management in order to obtain, maintain and to further develop necessary expertise and skills.

7.1. Regulatory authorities

Circular no. 9635 on safe management of radioactive waste specifies that the Danish Health Authority as part of the implementation and maintenance of the national framework for radioactive waste management must maintain and further develop expertise and qualifications related to safe management of radioactive waste. This is to be achieved through training or other staff competence development arrangements corresponding to the needs of the National Programme.

The general fulfilment of this requirement is ensured through the staffing and human resources planning policy of the Danish Health Authority. In addition, the Danish Health Authority actively takes part in international fora regarding safe management of radioactive waste, decommissioning, radiation protection, transport safety etc.

In the reporting period, the Danish Health Authority contributed actively to the completion of the project on Decommissioning of Small Medical, Industrial and Research Facilities (MIRDEC) as part of the activities associated with participation in the IAEA´s International Decommissioning Network (IDN). In addition, consultancy services were provided to the IAEA in the field of radioactive waste management and decommissioning. Staff from the Danish Health Authority participated in IAEA mediated ARTEMIS review missions (both in the roles of national counterpart and as team leader), pursuant of the requirements in article 14.3 of Council Directive 2011/70/Euratom.

The Danish Health Authority continued to contribute to the Euratom Article 31 and 37 Groups of Experts and in the work of the European Nuclear Safety Regulators Group (ENSREG), and ENSREG Working Group 2 on radioactive waste management and decommissioning.

Pursuant of Circular no. 9450 on nuclear safety, The Nuclear Regulatory Authorities shall maintain and further develop their own qualifications and competences regarding nuclear safety and emergency preparedness through schemes for education and training, other competence development of staff and, for example, ongoing participation in international cooperation, international conferences, etc.

Danish Emergency Management ensures adequate and competent staffing and maintenance of competencies through the staff planning policy of the agency, including

schemes for training for new as well as existing staff. In addition, the Danish Emergency Management Agency actively takes part in international cooperation.

7.2. The license holder

Operating in a country with a nuclear program of limited and continuously decreasing scope, it is important for Danish Decommissioning to maintain focus on the need for expertise and qualifications in order to sustain and develop the necessary competences for safe management of the radioactive waste. Therefore, a competence strategy was developed in 2023 with the aim to give a comprehensive overview of competencies now and in the future. As a part of the work with having the right qualifications inhouse at the right time a part of the strategy is also a strengthened international collaboration through knowledge clusters across country borders.

Knowledge transfer, training, sharing of experience, mapping of tacit knowledge, and networking are important factors in maintaining the necessary expertise and skills. Danish Decommissioning participates in different fora in the waste management field, a.o. Club of Agencies, the ERDO Association (Danish Decommissioning acts as vice chairman in the association), the EURAD programme (directly involved in the Routes WP), Guidance WP, and Requirement Management activities. Danish Decommissioning also engages in highly beneficial bilateral cooperation with our neighbouring countries, Sweden and Norway. Formal collaboration has been entered with Norway in 2024.

Furthermore, Danish Decommissioning has established an international group of experts with representatives from waste management organizations in Finland, Norway, Sweden, the Netherlands, and Switzerland in order to discuss matters on waste management, including disposal.

All new staff hired at Danish Decommissioning participate in an introductory course on the fundamentals of radiation protection, which contains a brief introduction to ionizing radiation, detection of ionizing radiation, biological effects of ionizing radiation, fundamental radiation protection principles and mitigating strategies, and practical radiation protection procedures related to the specific site.

To ensure the right competences needed for waste management and the development of a disposal solution, there will be an extra focus on obtaining the right development expertise in the upcoming years, e.g. through in-house training, IAEA courses, and the aforementioned knowledge clusters.

8. Financial resources

Article 9 – Financial resources

Member States shall ensure that the national framework require that adequate financial resources be available when needed for the implementation of national programmes referred to in Article 11, especially for the management of spent fuel and radioactive waste, taking due account of the responsibility of spent fuel and radioactive waste generators.

The financial resources for the National Programme are derived from reserve fund allocations which are recorded as budget positions on The Financial Act adopted annually by Danish Parliament.

The financing system to secure the financing of the management of radioactive waste in Denmark has been established in two incremental stages:

1. The decision in 2003 to begin the decommissioning activities of Danish Decommissioning cf. Parliamentary Resolution B48/2003
2. The decision in 2018 to begin the upgrade of storage facilities of Danish Decommissioning and to begin the process towards the implementation of a disposal facility no later than 2073, cf. Parliamentary Resolution B90/2018.

In addition, financing relating to the competent national authorities and R&D activities are covered by allocations on the operating budgets of the various government agencies involved in the National Programme.

In the following section, the financing system of the National Programme will be described in relation to the areas and deliverables which are enshrined in the National Programme.

8.1. Financing system of the National Programme

The financing system covers the following areas:

Technical areas:
- Waste management
- Geology & siting
- Disposal solution

Socio-economic areas:
- Organisational framework
- Stakeholder management
- Economical & financial issues

8.1.1. Technical area: Waste management

Waste management includes the upgrade of the facilities at the Risø site, the probing for an international solution and the process moving from upgraded storage to predisposal to disposal. Danish Decommissioning is the waste management organisation responsible for operations to maintain and develop the National Programme. The operating expenses of Danish Decommissioning are covered in § 19.61.03 of The Financial Act. Decommissioning projects are covered by instalments from reserve fund § 19.11.79.70 in The Financial Act. This reserve fund was established in 2003 as a consequence of Parliamentary Resolution B48/2003.

Expenses relating to the upgrade of the storage facilities and projects relating to the predisposal and disposal phases of the National Programme are covered by instalments from reserve fund § 19.11.79.71 which was established in The Financial Act for 2019 following Parliamentary Resolution B90/2018.

8.1.2. Technical area: Geology & siting

Expenses relating to geological research and siting investigation activities are financed by an allocation from reserve fund § 19.11.79.71. The allocation is installed in the budget of The Geological Survey of Denmark and Greenland (§ 29.41.01.20 of The Financial Act) which is assigned the role as operator of geological research in the National Programme. The Geological Survey of Denmark and Greenland is a self-governing and independent research institution under the Ministry of Climate, Energy and Utilities.

8.1.3. Technical area: Disposal solution

Danish Decommissioning has been assigned the task to develop the technical conditions of a disposal facility concept. The task is enshrined in § 19.63.03 of The Financial Act and has been consolidated further in a revision of the circular outlining tasks and responsibilities of Danish Decommissioning, cf. subsection 4.1. above. Funding for this purpose will derive from the budget position in § 19.11.79.71.

8.1.4. Socio-economic area: Organisational framework

The organisational framework consisting of the waste management organisation for storage, predisposal and disposal is financed through the operating budget of Danish Decommissioning.

The Danish Agency for Higher Education and Science is acting as the principal of Danish Decommissioning and supervises management priorities through the instrument of an annual target and performance plan. The target and performance plan is revised and adjusted in an on-going dialogue between the Agency and Danish Decommissioning.

8.1.5. Socio-economic area: Stakeholder engagement

Stakeholder engagement is organized and performed in the communication infrastructure described in section 9.2. The Agency for Higher Education and Science has the responsibility for organizing and coordinating stakeholder initiatives and processes with Danish Decommissioning. The competent regulatory authorities and other entities will be

involved as per the issues and special competences to be included in stakeholder communication. Stakeholder dialogue at the local level will be designed in a participatory process to allow for local communication needs and preferences to determine the structure and activities of the dialogue. The dialogue structure will strive to achieve maximum flexibility during the entire duration of the programme. Direct expenses of stakeholder engagement are funded from the operations budget of the Danish Agency for Higher Education and Science which also contributes with services in kind, e.g., meeting logistics, administrative assistance and maintenance of the website landing page for radioactive waste on ufm.dk.

8.1.6. Socio-economic area: Economic and financial issues

In the following, the cost assessment methodology (hypothesis, inputs & boundary conditions) will be described relating to 1) decommissioning activities and 2) upgraded storage and disposal facilities.

Decommissioning activities

The cost assessment of the decommissioning of the nuclear facilities on the Risø site is performed according to a target of complete decommissioning to greenfield status over a period of twenty years (2003-2023).

Costs are assessed according to two groups of activities: a) Basic expenses relating to the operation, security and maintenance of Danish Decommissioning; b) Project expenses relating to planning, investment and execution of decommissioning projects.

Cost assessment is laid out in Parliamentary Resolution B48/2003 stating annual expenses over the 20-year decommissioning project period. Estimations of project expenses include a buffer of approx. 31 pct. of total decommissioning costs to allow for unforeseen costs. Total decommissioning costs are estimated at approx. DKK 1,120 million (2003 net present values). Decommissioning activities are expected to be completed by 2029.

Upgraded Storage facilities

The specifications of the upgraded storage facilities are described in depth in the project proposal formally approved by Danish Decommissioning in 2023.

The cost assessment of upgraded storage facilities is targeting the implementation of an upgraded storage facility at the Risø site by 2028. The assessment of construction costs includes: a) Direct construction expenses, b) Construction site management expenses and c) Supervision/counselling expenses. A buffer to cover unforeseen expenses is estimated at 15 pct. of total construction costs.

In Parliamentary Resolution B90/2018, the construction costs of upgraded storage facilities were estimated at approx. 171 million DKK (2017 net present value) which included the following cost items:

- Storage facilities

- Inspection area
- Loading/unloading space.

Existing facilities at Danish Decommissioning that will continue to be used or upgraded as part of the upgraded storage construction programme include:

- Fencing, perimeter guarding system and security gate
- Workshop and conditioning facilities
- Characterisation Laboratory and Clearance Laboratory
- Office space
- Roads and parking space
- Garages.

A visitor's centre has been under consideration and may be included in the storage facility at a later stage.

A revision of the construction budget was undertaken in 2021 when Danish Decommissioning had found that the storage facility specifications of 2017 were not sufficient to meet construction requirements of the facility emanating from a detailed review of facility functions/items. The construction budget was revised to cover: 1) the addition of new items to the construction programme, and 2) the indexation of costs to the price and wage index level of 2021.

The changes in the construction budget included the following items:

- Expansion of the facility area/volume and scope of the storage facility project.
- A separate storage for NORM waste, including tailings from fuel extraction experiments.
- A separate perimeter guarding system, incl. security gate, for the storage facility (in addition to the existing security gate at the entrance to the Risø Campus area).
- Upgrades of facility features to meet regulatory requirements following from the Radiation Protection Act of 2018 and subsequent executive orders, cf. subsection 1.4. above.
- Payment to the Danish Building and Property Agency of the residual value of buildings to be removed from the building site prior to construction of the storage facility. The buildings are owned by the Danish Building and Property Agency which is the regulatory authority in charge of Danish state property enterprises, contractor services and supply of government work spaces.

As a result of the construction budget revision, a motion of approval was presented to the Finance Committee of the Danish Parliament (for an outline of the appropriation procedure, see subsection 8.2.1). An appropriation on the basis of the motion of approval was adopted by the Finance Committee in December 2021. The details of the motion of approval remain confidential until the award of the public tender of the storage facility has been decided, in order not to compromise the market position of Danish Decommissioning.

Disposal facilities

The concept of the disposal facility remains to be decided. Danish Decommissioning is tasked with the identification and recommendation of a generic disposal facility concept, cf. subsections 1.1.4. and 10.1.4. In 2011, an initial cost assessment of generic disposal facilities was presented in a pre-feasibility study[17 and 18]. Costs were assessed using a conservative estimate of the disposal facility designs. The cost assessment will be updated and further elaborated when a generic disposal facility concept is decided and further specified for cost assessment purposes.

The pre-feasibility study outlined 18 different disposal facility designs which were assessed according to the following items to be covered by the cost estimates:

- Acquisition of area
- Additional facilities at the disposal facility
- Construction
- Operation
- Closure
- Monitoring

General assumptions for cost item estimates are summarized in the following:

Acquisition of area

It is considered that the land acquired for the disposal facility is located in a rural scarcely populated area. Depending on various conditions, such as land use, location and quality of land, etc., the square meter price will vary significantly.

Additional facilities at the disposal facility

The additional facilities are considered to be the same for all concepts and are thus treated once for all. It is assumed that the additional facilities at the disposal facility are established based on containers and lightweight steel structures or similar inexpensive solutions.

Construction

Construction costs include: detailed design, invitation to tender, and field investigations. Construction costs are determined based on bills of quantities (BoQs). The cost estimates are based on bids for similar projects and on actual price quotes, in order to reflect market prices.

The market situation may be considered by assuming a general uncertainty of 15 pct. to 20 pct. on all price estimates related to the disposal facility structures. 17.5 pct. are taken as plus/minus variation on the most likely costs.

[17] Danish Decommissioning, Disposal pre-feasibility study (2011) (Danish)
[18] Danish Decommissioning, Disposal pre-feasibility study (2011) (English)

Operation

It is estimated that the disposal facility will operate an active period of 31 years of which the first year is considered an initial filling year in which additional operational costs have to be taken into account. It is considered that the initial filling period, where the bulk waste amount shall be placed in the facility, lasts for one year. Hereafter, it is assumed that the active operation continues for 30 years with an inbound waste flux of approx. 8 m^3 per year. For the cost estimate it is assumed that the waste is supplied, packed and ready for deposit, i.e. the cost estimate excludes packing, transport, etc.

Due to the 31 years of operation, the total operational costs are very sensitive to assumptions concerning staffing and salaries. For the determination of the most likely price it has been assumed that the basic operation during 31 years is realised by a permanent staff that is hired at certain, individual annual salaries (incl. social charges, etc.). For the initial filling period it is assumed that additional external personnel is hired from a contractor at much higher unit prices for the various (short-term) jobs. The overall uncertainty for the operation costs is considered by using minimum and maximum percentages of the most likely costs of 75 pct. and 150 pct., respectively.

Closure

In correspondence with the construction costs, closure costs are determined by means of Bill of Quantities based on experience from recent comparable projects and actual price quotes. Thus, the general uncertainty of 15 pct. to 20 pct. on all most likely estimated costs also applies to the closure. 17.5 pct. are taken as plus/minus variation on the most likely costs.

Monitoring and institutional control

Monitoring during operation and after closure does not differ to a large extend and are thus treated together. The monitoring period taken into account for the cost estimates is 1+30 years and the depreciation period is set to 50 years, ending in 2122. Monitoring will be required after the closure. The expenditure on post-closure monitoring may actually be at the same level as the monitoring during the first 31 years.

The costs of monitoring during the first year of initial filling are considered to correspond to the costs for monitoring during the 30 years of active period. Monitoring costs are considered to largely agree between different facility types (differences in the cost for the required devices are negligible), except the costs for establishing the monitoring wells that might vary with the required depth.

One initial lump sum plus an annual lump sum are assumed and used for the estimate of the most likely monitoring costs for all types of disposal solutions. The initial lump sum includes the establishment of the monitoring wells and the costs for other equipment, whereas the lump sum per year includes personal costs and costs for the analyses.

The overall uncertainty for the monitoring costs is considered by using minimum and maximum percentages of the most likely costs of 75 pct. and 150 pct. respectively.

8.1.7. Cost profile over time and essential assumptions

Cost profiles over time are included in Parliamentary Resolutions B48/2003 (for decommissioning) and B90/2018 (for long-term storage and disposal facilities). An average interest rate of 5 pct. p.a. is calculated on the annual costs of the long-term storage facility as well as the disposal facility. A rate of depreciation is calculated on the basis of a 50 year period for each facility type.

8.2. Financing schemes, needs and estimations

The Danish National Programme is financed through the following allocations on The Financial Act:

- The operating costs of the competent regulatory authority are funded through allocations to the ministries in charge (Health and Defence).
- The operating costs of Danish Decommissioning (license holder) are funded through allocations to the Ministry of Higher Education and Science.
- The project costs of decommissioning are financed through a separate reserve fund of approx. DKK 1 bn.
- The costs of the long-term storage facility and the disposal facility are financed through a separate reserve fund of approx. DKK 2.3 bn. The operating costs of both facilities are covered by the reserve fund. For the long-term storage facility, the reserve fund will finance a 50-year operation period from 2023-2073[19]. For the disposal facility, the reserve fund will finance a 50-year operation period from 2073 to 2122. It should be noted that the budget position of the reserve fund is subject to change due to appropriations by the Finance Committee in the future, cf. subsection 8.2.1. below, as exemplified by the motion of approval of a revised budget of the storage facility mentioned in subsection 8.1.6.

8.2.1. Responsibilities, adequacy, availability and security

The responsibility of funding the Danish National Programme lies with the Danish Parliament. The adoption of the annual Financial Act, which is a requirement in the Danish constitution, confirms the obligations of Parliament to meet the costs of the National Programme and to guarantee the availability of funds at the time when they are needed.

In the event of an unforeseen budget requirement, a motion of approval is prepared by the responsible ministry to be presented to the Finance Committee of the Danish Parliament. The Finance Committee will decide the motion of approval and allow for an additional appropriation. This procedure is typically used for handling the finance of activities where costing is difficult to perform accurately, such as decommissioning projects and other activities related to the management of radioactive waste.

[19] The operation period will be shorter as the long-term storage facility will not enter into operation before 2028 at the earliest.

All additional appropriations approved during the financial year are collected in a single appropriations act which is then adopted by Parliament immediately after the closing of the financial year.

8.2.2. Re-assessments and validations

Annual re-assessments and validations of required financial resources are performed routinely in coordination with the preparation of The Financial Act. The responsibility lies with the ministries in charge. Hence, the Ministry of Higher Education and Science is responsible for validating required financial resources for Danish Decommissioning's activities and for reporting the results of the validation to the Ministry of Finance for inclusion in the proposal for next year's Financial Act

9. Transparency

Article 10 – Transparency

1. Member States shall ensure that necessary information on the management of spent fuel and radioactive waste be made available to workers and the general public. This obligation includes ensuring that the competent regulatory authority inform the public in the fields of its competence. Information shall be made available to the public in accordance with national legislation and international obligations, provided that this does not jeopardise other interests such as, inter alia, security, recognized in national legislation or international obligations.
2. Member States shall ensure that the public be given the necessary opportunities to participate effectively in the decision-making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations.

9.1. Information from the competent authority

All relevant legislation and guidance pertaining to the responsible and safe management of radioactive waste in Denmark is publicly available on the website of the Danish Health Authority[20]. All acts, executive orders, circulars and significant parts of guidance documents are also available in English.

The Danish Health Authority compiles and publishes the contents of the National Programme for the responsible and safe management of radioactive waste[21] and in the reporting period, the 3rd report to the European Commission on the implementation of Council Directive 2011/70/Euratom was published[22].

In addition, the Danish Health Authority publishes the key outcomes of self-assessments and peer reviews carried out under the provisions of Council Directives 2009/71/Euratom (as amended by Council Directive 2014/87/Euratom), article 9.3, and 2011/70/Euratom, article 14.3. The outcomes of the IRRS[23] and ARTEMIS[24] missions to Denmark are available through the website of the Danish Health Authority.

The Danish Health Authority also compiles, presents and publishes Danish National reports to the International Joint Convention of 5 September 1997 on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management under the IAEA, and reports on the outcomes of the ensuing review meetings available to the public[25].

[20] Danish Health Authority, Radiation Protection, Legislation
[21] National Programme Denmark
[22] Council Directive 2011/70/Euratom 3rd report from Denmark
[23] IRRS Denmark 2021
[24] ARTEMIS Denmark 2022
[25] IAEA Joint Convention 7th Review Meeting National Report Denmark

9.2. Transparency and public participation

Mechanisms for enhancing transparency in the process of establishing a long-term management solution for radioactive waste and spent fuel in Denmark were introduced by the Ministry of Higher Education and Science in 2016. A dedicated landing page on the Ministry's website provides one-stop access to information, publications and news regarding activities of the long-term solution/National Programme. A contact forum to provide information and solicit views and opinions from national stakeholders was formed in 2016. A panel of independent experts has been formed to provide access for the general to public to scientifically vetted information on central aspects of radioactive waste management. The panel also contributes advice and assessment to the Ministry of Higher Education and Science on an ad hoc-basis. Also, in 2016 Danish Decommissioning formed an international experts' group in order to gain access to advice and counselling on technical matters relating to radioactive waste management.

In 2019, an additional contact forum was established in Roskilde Municipality to provide a venue for local stakeholders to follow Danish Decommissioning's long-term storage facility construction project under Parliamentary Resolution B90/2018. The forum was established in response to local opinion wishing to secure a channel to make local stakeholder views heard. The Ministry of Higher Education and Science acknowledges that Roskilde Municipality has a significant stake in the National Programme by being appointed to host the radioactive waste until the commissioning of the disposal facility. The Roskilde Contact Forum meets at regular intervals to discuss and provide counsel on various aspects of the long-term storage facility project and its implications for local society. The Danish Agency for Higher Education and Science provides administrative assistance to Roskilde Contact Forum. Members of the contact forum include: representatives of Roskilde Municipal Council, local and national NGOs/concerned citizens' groups, the municipal administration, the Nuclear Regulatory Authorities (optional), Danish Decommissioning staff, other institutional stakeholders on the Risø location, and The Geological Survey of Denmark and Greenland (optional).

10. Implementation of the National Programme

Article 11 – National programmes

1. Each Member State shall ensure the implementation of its national programme for the management of spent fuel and radioactive waste ('national programme'), covering all types of spent fuel and radioactive waste under its jurisdiction and all stages of spent fuel and radioactive waste management from generation to disposal.
2. Each Member State shall regularly review and update its national programme, taking into account technical and scientific progress as appropriate as well as recommendations, lessons learned and good practices from peer reviews.

Article 12 – Contents of national programmes

1. The national programmes shall set out how the Member States intend to implement their national policies referred to in Article 4 for the responsible and safe management of spent fuel and radioactive waste to secure the aims of this Directive, and shall include all of the following:
   - (a) the overall objectives of the Member State's national policy in respect of spent fuel and radioactive waste management;
   - (b) the significant milestones and clear timeframes for the achievement of those milestones in light of the over-arching objectives of the national programme;
   - (c) an inventory of all spent fuel and radioactive waste and estimates for future quantities, including those from decommissioning, clearly indicating the location and amount of the radioactive waste and spent fuel in accordance with appropriate classification of the radioactive waste;
   - (d) the concepts or plans and technical solutions for spent fuel and radioactive waste management from generation to disposal;
   - (e) the concepts or plans for the post-closure period of a disposal facility's lifetime, including the period during which appropriate controls are retained and the means to be employed to preserve knowledge of that facility in the longer term;
   - (f) the research, development and demonstration activities that are needed in order to implement solutions for the management of spent fuel and radioactive waste;
   - (g) the responsibility for the implementation of the national programme and the key performance indicators to monitor progress towards implementation;
   - (h) an assessment of the national programme costs and the underlying basis and hypotheses for that assessment, which must include a profile over time;
   - (i) the financing scheme(s) in force;
   - (j) a transparency policy or process as referred to in Article 10;
   - (k) if any, the agreement(s) concluded with a Member State or a third country on management of spent fuel or radioactive waste, including on the use of disposal facilities.
2. The national programme together with the national policy may be contained in a single document or in a number of documents.

10.1. Implementation progress 2021-2024

Implementation progress of the National Programme will be stated below for each of the six programme tracks defined in the programme by their relation to either the technical or the socio-economic area.

10.1.1. Technical area: Waste Management Track - Upgraded storage facility

The project proposal for tender was approved by Danish Decommissioning in 2023. The safety assessment of the storage facility has been developed through continuous dialogue between Danish Decommissioning and the Nuclear Regulatory Authorities since 2018 and is currently in its fourth iteration of February 2024. Provided that the safety assessment sufficiently addresses the issues necessary to enable consideration by the Nuclear Regulatory Authorities, an application to the Minister for the Interior and Health to grant approval for the construction under The Nuclear Installations Act will be filed during the autumn of 2024. In parallel, the environmental impact assessment is under scoping and will be processed for approval by the Danish Environmental Protection Agency under § 25 of The Environmental Impact Assessment Act. In order to legalise the storage facility under The Planning Act, the City Council of Roskilde Municipality will need to adopt a local plan. Following the approval of the application by the Minister for the Interior and Health, the approval of the environmental assessment, and the approval of the local plan, an application for a construction permit will be filed with Roskilde Municipality for approval. Current estimation by Danish Decommissioning is that all necessary approvals/permits will be obtained by April 2025.

Radiological analysis of the transboundary impact of the storage facility according to Article 37 of the Euratom Treaty is currently being prepared and will be included in the environmental impact assessment. Preliminary findings suggest that that there will be no transboundary impact of radiological significance.

The procedure of public tender of the storage facility will be coordinated with the processing of approvals/permits and is estimated to take place in the first quarter of 2025.

Provided that all issues of approval/permission have been settled by April 2025, construction work is planned to begin by April-May 2025.

The construction phase is estimated to run until October 2028, followed by a licensing procedure. The commissioning of the storage facility into operation is estimated to take place in December 2028.

10.1.2. Technical Area: Waste Management Track – Probing for international solution + Storage, predisposal and disposal

No progress has been reported in the probing for an international solution for the so-called “special waste” in 2021-2024. Following the National Programme, planning of the disposal solution will continue to include the “special waste” fraction which places critical constraints on predisposal management and the disposal facility concept.

10.1.3. Technical Area: Geology and Siting

In January 2022, The Geological Survey of Denmark and Greenland published an evaluation of desk studies and modelling exercises based on a review and compilation of existing data. Characterisation and evaluation of geological properties and conditions at 500 meters depth has led the Survey to conclude that further in situ studies are required to establish detailed data on the subsurface properties and conditions at depths to 500 meters. The acquired data will be used as input to a safety case with the purpose of demonstrating whether the combined disposal concept of geological and engineered barriers can provide the required level of safety and performance on both the short and long term.

In April 2024, the Ministry of Higher Education and Science commissioned a supplementary desk study from The Geological Survey of Denmark and Greenland with the purpose of juxtaposing existing geological data with a disposal facility concept based on the combination of near surface/intermediate level disposal (30-200 m depth) of LLW-ILW with borehole disposal of the “special waste” in approx. 500 m depth. This disposal facility concept was first mentioned in the pre-feasibility study of 2011 and is recommended by Danish Decommissioning for further consideration.

The supplementary desk study by The Geological Survey of Denmark and Greenland will be reported by 2025-Q4. The purpose of the study is to inform the second phase of geological studies which will be focusing on detailed geological data acquisition and investigations for characterization of the geological properties at two sites. Based on the new data, an evaluation of the geological suitability for the disposal facility concept at each of the two sites will be made. The timing of the second phase of geological studies is depending on a stakeholder communication process prior to localizing two sites for in situ investigation, following Parliamentary Resolution B90/2018.

10.1.4. Technical Area: Disposal Solution

Danish Decommissioning has been tasked with the development of a disposal solution concept. In 2021, an overview of generic disposal concepts was presented by Danish Decommissioning along with a preliminary consideration of two relevant concepts to be further developed: 1) a deep geological facility and 2) an intermediate-depth facility in combination with a borehole. Danish Decommissioning considers the borehole concept particularly relevant for disposal of the “special waste”, given the very limited mass and volume of this fraction of the Danish inventory. However, it is acknowledged at the same time that borehole disposal is a technology with a comparatively low TRL (Technology Readiness Level) and will require further consolidation through research, development and demonstration.

Following a recommendation of the IAEA ARTEMIS review in May 2022, Danish Decommissioning has begun the preparation of an implementation plan to cover the entire period until 2073 when commissioning of the disposal facility is due according to Parliamentary Resolution B90/2018 and the subsequent national strategy/National Programme (see 12.1). The implementation plan will cover the compilation of design

criteria, the site selection procedure, establishment of the knowledge basis, including necessary research, and the identification of milestones for decision making on disposal facility options, design, licensing, construction, operation, closure and post closure phase.

A first draft of the implementation plan has been discussed between Danish Decommissioning and an advisory group of international experts in September 2023. It was recommended that Danish Decommissioning should:

- develop a generic safety concept with the purpose of clarifying the criteria for site selection and for potential host rock characteristics
- define the milestones of the implementation plan more clearly in terms of deliverables/results/outcomes and link the milestones to actions in relation to processes and stakeholders
- strengthen competence requirements management to perform tasks and activities defined in the implementation plan.

Further discussions of the implementation plan took place in December 2023 between Danish Decommissioning and the Nuclear Regulatory Authorities as well as The Geological Survey of Denmark and Greenland. The discussions focused on the issues of defining generic waste acceptance criteria for a disposal facility concept and the current state of characterisation of the historic waste fractions, including the “special waste”.

Danish Decommissioning is currently reviewing the implementation plan in the light of these consultations in order to revise and develop the plan further in terms of defining milestones and performance indicators. The review will be reported as part of Danish Decommissioning’s target and performance plan for 2024.

10.1.5. Socio-Economic Area: Organisational Framework

As part of the transformation *from* an organisation primarily tasked with decommissioning tasks *to* becoming a waste management organisation tasked with waste storage and disposal, Danish Decommissioning has changed the organisation structure in 2021. The current organisation is illustrated in Figure 1.

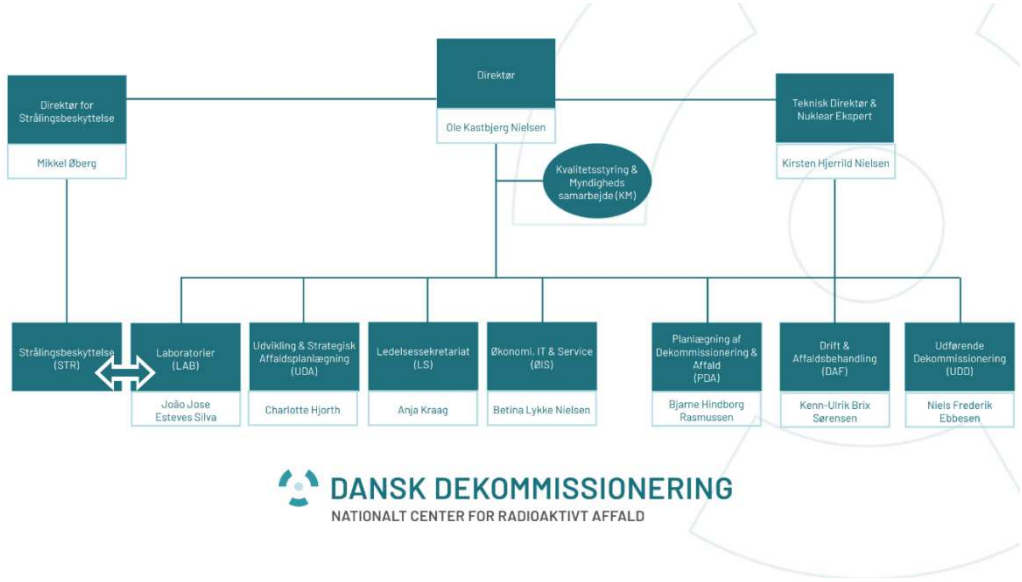


Figure 1. Organisation chart of Danish Decommissioning as of 15 May 2024.

The purpose of the new organisation is to allocate more resources to development tasks and other new tasks assigned to Danish Decommissioning following Parliamentary Resolution B90/2018. The new organisation has enabled the set-up of smaller units with specific tasks and hence will allow for in-house development of specialised competences needed for driving the upgraded storage facility project and the disposal facility project. The new organisation is a leaner organisation from a managerial perspective, as three previous levels of management have been reduced to two.

Danish Decommissioning has prepared a waste management plan for the period 2022-2024 on the basis on a waste strategy adopted in 2021. The waste management plan includes the following projects:

Ongoing projects (launched before the current waste management plan):

- Waste routes to the upgraded storage facility and review of waste routes to existing storage facilities.
- International cooperation on depleted uranium (reduction of waste volume)
- Recycling of sources
- Characterisation of historical waste in drums (stored in LLW storage facility)
- Solidification of liquids (WAC of the upgraded storage facility do not allow storage of liquids in the new facility)
- Generic repository concepts (preliminary survey of potential disposal facility designs)

New projects (launched under the current waste management plan):

- Implementation plan for disposal facility
- Generic WAC for disposal facility
- The special waste, Track 1: Characterisation

- The special waste, Track 2: Research and Development on conditioning
- Competence strategy

The waste management plan will be updated and extended for 2025-2026 by the end of 2024.

10.1.6. Socio-Economic Area: Stakeholder Engagement

Stakeholder engagement is performed within the framework outlined in subsection 9.2. and is consistent with the requirements and practices stated in subsection 2.4. of the National Programme.

Following from the decision by the Ministry of Higher Education and Science to commission a supplementary desk study from The Geological Survey of Denmark and Greenland in order to consolidate geological data for the evaluation of potential geological host environments for a near surface/intermediate level disposal facility in combination with a borehole facility, cf. subsection 10.1.3, the communication process with local stakeholders on the feasibility of voluntary partnerships between one or more municipalities and the Ministry of Higher Education and Science to identify potential sites for detailed geological in situ-research has not been initiated in 2022, as foreseen in subsection 10.1.5 of the third report from Denmark on Council Directive 2011/70Euratom.

The initiation of the communication process is pending political decision after reporting of the supplementary desk study by 2025-Q4.

10.1.7. Socio-Economic Area: Finances and Costing

The instruments for securing adequate finance for the National Programme have been implemented as prescribed in section 6 of the National Programme. In 2021, the budget for the upgraded storage facility was augmented through an appropriation by The Finance Committee of the Danish Parliament, cf. subsection 8.1.6 above.

The 2022 IAEA ARTEMIS review suggested that the cost estimation for the disposal facility should be updated as soon as a comprehensive implementation plan is available. Danish Decommissioning is currently preparing a study of disposal facility concepts, cf. subsection 10.1.4, which includes a cost estimation of three disposal concepts to provide a first indication of the budget needed for the development, construction and operation of a disposal facility.

10.2. Review and update of National Programme

Steps toward establishing a process for review and update of the National Programme are in the planning stage, and are expectedly formally to be started in the autumn of 2024. The process will include feed-back from experiences gained during implementation of the National Programme in previous reporting periods as well as the findings of the IRRS and ARTEMIS review missions.

11. Peer reviews and self-assessments

Article 14 – Reporting

3. Member States shall periodically, and at least every 10 years, arrange for self-assessments of their national framework, competent regulatory authority, national programme and its implementation, and invite international peer review of their national framework, competent regulatory authority and/or national programme with the aim of ensuring that high safety standards are achieved in the safe management of spent fuel and radioactive waste. The outcomes of any peer review shall be reported to the Commission and the other Member States, and may be made available to the public where there is no conflict with security and proprietary information.

11.1. IRRS and ARTEMIS review missions

Denmark hosted a full scope IRRS mission from August 30 to September 8, 2021, in accordance with the requirements in Council Directives 2009/71/Euratom, article 9.3 regarding national framework and authorities for nuclear safety.
The mission identified potential for further enhancement of the safety of radioactive waste management through the review of legislation related to future radioactive waste management facilities, in particular for disposal, and by revision of the policy and strategies for the management of radioactive waste to include all types of radioactive waste. The mission report is publicly available through the website of the Danish Health Authority[26].

Further to this review, an ARTEMIS mission was conducted in Denmark from May 1 to May 9, 2022 in compliance with requirements of 2011/70/Euratom, article 14.3 regarding review of the national framework, competent regulatory authority and National Programme.

The review mission acknowledged the progress made in the field of decommissioning, while at the same time identifying challenges related to future radioactive waste management activities, in particular with respect to the transformational stages in the National Programme related to implementation of long-term plans. The mission resulted in seven recommendations and two suggestions addressing the needs for updates to the National Programme, further detailing of plans for implementation and strengthening of competences to carry out tasks specified in the National Programme. The mission also made recommendations for enhancing the implementation of the programme by defining appropriate interim targets and end states to allow for monitoring and control of the

[26] Danish Health Authority, Radiation Protection, IRRS mission 2021

implementation. The mission report is publicly available through the website of the Danish Health Authority[27].

Actions to address findings in review missions

The Danish Health Authority initiated review activities of the executive orders issued under The Radiation Protection Act in 2022 with the aim of performing a general review of the legal framework, and also to address recommendations and suggestions provided during the IRRS and ARTEMIS missions. The expected updates include specification of requirements regarding decommissioning and further provisions on radioactive waste management. Updated executive orders are expected to enter into force in 2025.

Similarly, the Ministry of Higher Education and Science and Danish Decommissioning initiated actions to address ARTEMIS recommendations and suggestions directed at the main implementer of the National Programme. These actions are addressed in chapter 10.

The Danish Health Authority is monitoring progress with implementation of actions taken to address all recommendations and suggestions given in IRRS and ARTEMIS missions.

[27] Danish Health Authority, Radiation Protection, ARTEMIS mission 2022

12. Annex

12.1. Implementation plan for a future Danish disposal facility (DRAFT)

DANSK
DEKOMMISSIONERING
CENTER FOR RADIOAKTIVT AFFALD
Unikke løsninger på komplekse problemer

Roskilde, den 14. august 2024

Reference: Anja Kraag
Chef for Ledelsessekretariatet

Implementeringsplan for et kommende dansk slutdepot

Processen for et kommende dansk slutdepot er beskrevet i overordnede træk i Danmarks nationale program for ansvarlig og sikker håndtering af radioaktivt affald

I det nationale program arbejdes der med følgende faser:

1. Kort sigt (forundersøgelser)
2. Mellemlangt sigt (lokalisering og planlægning)
3. Langt sigt (etablering og drift)
4. Lukning (institutionel kontrol og afvikling)

Tidsplanen fra det nationale program kan ses på næste side.

Løbende opdatering af implementeringsplanens tidsplan
I forlængelse af det nationale program er der behov for en detaljering af tidsplanen for etableringen af slutdepotet, hvor fasernes forskellige arbejdspakker, og de indbyrdes afhængigheder, beskrives.

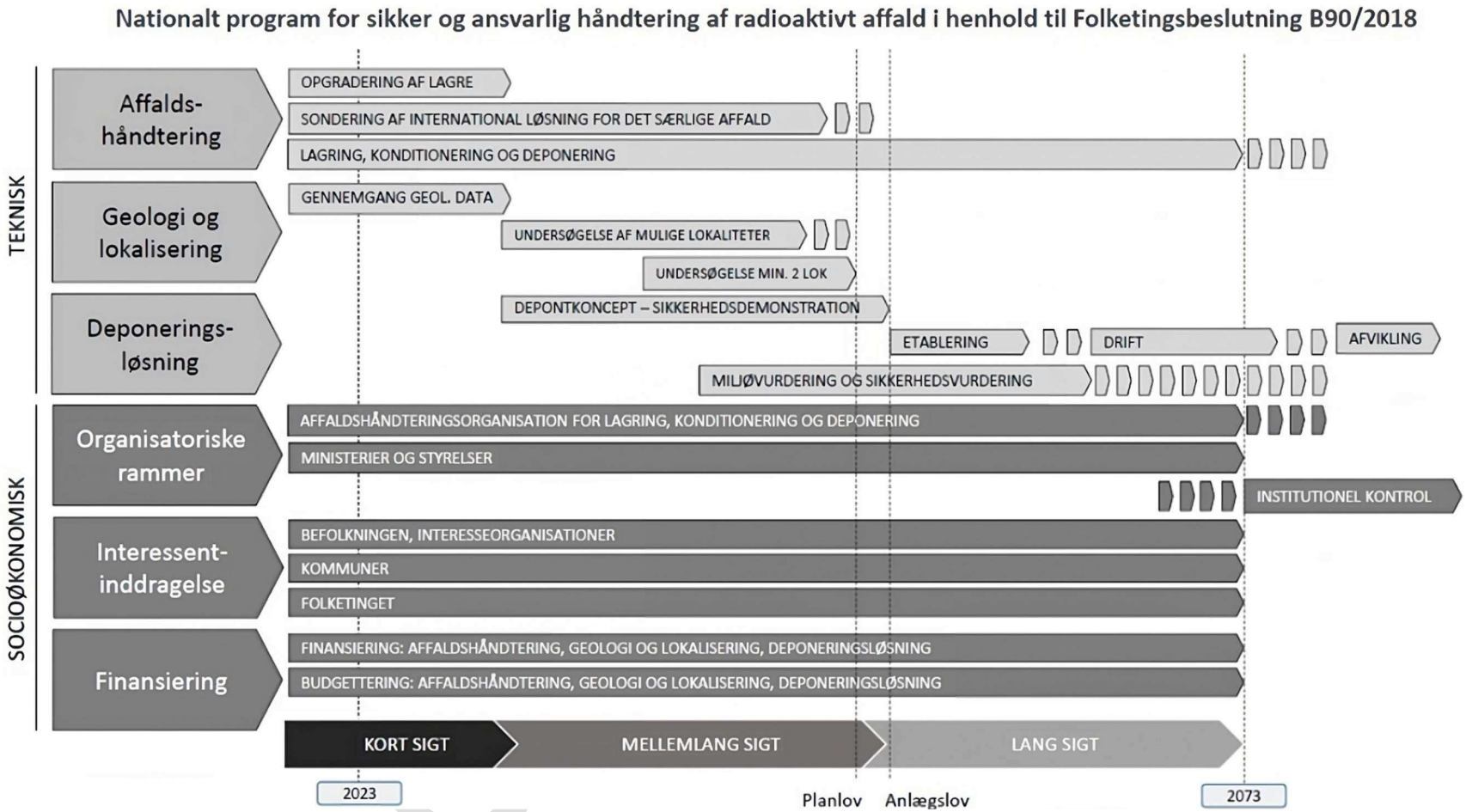
Tidsplanen angivet i denne implementeringsplan er første bud på, hvordan implementeringen af slutdepotet kan foregå. Der er fortsat mange arbejdsopgaver, som skal defineres klarerer før de kan starte op, og derfor vil tidsangivelserne i denne plan løbende blive opdateret i takt med den konkretisering.

Modtage- og håndteringsfacilitet på Risø
Et nyt slutdepot forudsætter, at affaldet er færdigkonditioneret og lever op til Waste Acceptance Critieria (WAC) for slutdepotet. Derfor er der behov for at opføre en modtage- og håndteringsfacilitet ved Dansk Dekommissionerings eksisterende faciliteter på Risø-halvøen i Roskilde Kommune.

I implementeringsplanen for slutdepotet fremgår derfor også arbejdspakker og tidsplan for modtage- og håndteringsfaciliteten, da ibrugtagningen til tiden af denne facilitet er en forudsætning for gennemførelsen af store dele af tidsplanen for slutdepotet.

Modtage- og håndteringsfaciliteten skal stå færdig ved udgangen af 2031.
De forskellige faser for etablering af modtage- og håndteringsfaciliteten vil ikke blive gennemgået her, men kan ses i implementeringsplanen.

Dansk Dekommissionering · Frederiksborgvej 399 · Bygning 214, postcenter 15 · DK-4000 Roskilde
T: +45 46 33 63 00 · M: dd@dekom.dk



Figur 1: Tidsplan fra det nationale program

Slutdepot
Et kommende dansk slutdepot skal kunne rumme al Danmarks radioaktive affald, herunder eventuelt også NORM-affald (Naturligt Forekommende Radioaktivt Materiale).

Slutdepotet skal gennem en række geologiske og konstruerede barrierer sikre, at affaldet kan opbevares sikkert for eftertiden uden menneskelig overvågning.

De forskellige faser for etableringen af slutdepotet bygger videre på faserne beskrevet i det nationale program og ser således ud:

1. Kort sigt: Forundersøgelser
2.a Mellemlangt sigt: Lokalisering
2.b Mellemlangt sigt: Planlægning
3.a Langt sigt: Konstruktion
3.b Langt sigt: Ibrugtagning og drift
4.a Lukning: Afvikling
4.b Lukning: Institutionel kontrol

Fase 1: Forundersøgelser
I henhold til det nationale program skal der på kort sigt igangsættes en række forundersøgelser, som skal understøtte den kommende lokaliseringsproces og levere data hertil. Der foretages i denne fase også en forventningsafstemning med relevante interessenter, herunder særligt de nukleare tilsynsmyndigheder (DNT), for at sikre et fælles afsæt for det mangeårige arbejde, som etablering af et slutdepot er.

Fase 1 er igangsat, og der er foretaget en geologisk kortlægning af den danske undergrund ned til 500 meters dybde ved De Nationale Geologiske Undersøgelser for Danmark og Grønland (GEUS). Resultatet af denne analyse blev fremlagt i 2022 og materialet kan ses på GEUS hjemmeside. Da denne arbejdspakke blev afsluttet i 2022 fremgår den ikke af implementeringsplanen.

Når fase 1 afsluttes vil der være udpeget 1-2 lokaliteter, hvor der i fase 2.a skal foretages yderligere undersøgelser omkring egnetheden til placering af et slutdepot.

Fase 1 indeholder følgende arbejdspakker:

Arbejdspakke	Beskrivelse	Interessenter (tovholder fremhævet)	Tidsplan
Metode for og opstart af lokaliseringsproces	Uddannelses- og Forskningsstyrelsen (UFS) arbejder på et koncept for lokaliseringsprocessen for slutdepotet. Processen vil basere sig på frivillighed fra de danske kommuners side til at melde sig til at få foretaget yderligere undersøgelser af, om de pågældende kommuner har egnede steder til et slutdepot.	• **UFS** • DD • DNT • Kommuner	Afventer
Implementeringsplan	Implementeringsplanen er en detaljering af tidsplanen i det nationale program og er et vigtigt skridt i konkretiseringen af slutdepotet. Implementeringsplanen opdateres løbende.	• **DD** • UFS • DNT • GEUS	2022-
Valg af muligt depotkoncept	Med udgangspunkt i nationale og internationale erfaringer omkring slutdepotkoncepter udarbejdes der en indstilling til politisk beslutning om valg af et muligt koncept for slutdepot.	• **DD** • UFS	2024-25
Revurdering af budget for slutdepot	Det eksisterende budget baserer sig i dag på ældre data fra 2011, og skal derfor genbesøges. Implementeringsplanen kombineret med et valg af depotkoncept giver et godt grundlag for at kunne revurdere budgettet for etableringen af slutdepotet.	• **UFS** • DD	2024
Forventnings-afstemning og rolleafklaring med myndighederne	Etablering af et slutdepot er en mangeårig proces med mange interessenter. Det er vigtigt at få et godt og fælles afsæt for projektet, og derfor skal der foregå en forventningsafstemning	• **DD** • DNT • Planmyndighed	2025

	og en rolleafklaring, særligt mellem DD som teknisk udførende part og de nukleare tilsynsmyndigheder.		
GAP-analyse omkring lovgivning og vejledningsmateriale	Gældende lovgivning på det nukleare område er i dag ikke lavet med et slutdepot for sigte, og derfor skal der som en del af forundersøgelserne udarbejdes en GAP-analyse, som skal vise, om der er behov for yderligere lovgivning og/eller vejledningsmateriale.	• **DNT** • DD	2025-26
Requirements Management (EURAD projekt)	European Joint Program on Radioactive Waste Management (EURAD) er et projekt, der skal hjælpe EU-medlemslandene med at opnå den nødvendige knowhow til at implementere sikker og langsigtet håndtering af radioaktivt affald. DD deltager i forskellige EURAD-projekter, og her fremhæves Requirements Management projektet, da det vil munde ud i et værktøj til at opbygge et kravspecifikationssystem for et slutdepot. DD vil efter projektets afslutning tage stilling til eventuelt indkøb og implementering af værktøjet.	• **EURAD** • DD	2024
Implementering af RMS hos Dansk Dekommissionering	På baggrund af erfaringerne fra EURAD-projektet om RMS vil DD arbejde på at implementere et RMS system	• **DD**	2024-26
Skabelon til sikkerhedsvurdering	Der skal udarbejdes en skabelon til en sikkerhedsvurdering for at sikre det bedste afsæt for den endelige sikkerhedsvurdering. GEUS vil bidrage omkring hvilke sikkerhedsmæssige forhold, der er vigtige at få belyst vedrørende geologiske barrierer. Arbejdet omkring opbygningen af skabelonen vil foregå i tæt dialog med DNT.	• **DD** • DNT • GEUS	2022-26

Fase 2.a: Lokalisering
I fase 2.a fastlægges den endelige lokalisering af slutdepotet, og der vil pågå et tæt samarbejde med den kommune, som skal huse slutdepotet for at sikre, at der bliver opbygget tilstrækkelig viden omkring radioaktivitet til at beslutningen om lokalisering kan træffes på et oplyst grundlag.

UFS er ansvarlig for lokaliseringsprocessen mens DD bidrager til arbejdet med vidensopbygning i lokalsamfundene.

I forbindelse med valg af lokalisering vil der på baggrund af de 1-2 lokaliteter fundet i fase 1 blive foretaget en række uddybende undersøgelser, bl.a. geologiske boreprøvninger ved GEUS, socioøkonomiske undersøgelser m.v.

Fase 2.a om lokalisering indeholder følgende arbejdspakker:

Arbejdspakke	Beskrivelse	Interessenter (tovholder fremhævet)	Tidsplan
Geologiske undersøgelser og prøvetagning	For at sikre tilstrækkelig data omkring undergrundens egnethed til et slutdepot skal der laves flere boringer i de kommuner, som måtte melde sig frivilligt til at være værtskommune for slutdepotet.	• **GEUS** • UFS • DD • DNT • Kommuner •	2027-28
Socioøkonomisk analyse af lokationsområdet	Ved valg af lokation er det vigtigt med et oplyst grundlag for borgere og politikere, og derfor vil en socioøkonomisk analyse af lokationsområdet blive udformet i samarbejde med interessenterne for at få belyst de parametre, som er af særlig betydning for det pågældende lokalsamfund (fx turisme, landbrug, fødevarer, fortidsminder m.v.)	• **UFS** • DD • Kommuner	2027-28
Valg af lokation, herunder vidensopbygning og borgermøder i lokalsamfundene	Som opfølgning på opstartsprocessen i fase 1, hvor en eller flere kommuner har meldt sig frivilligt til at få mere viden om slutdepotet vil der blive afholdt borgermøder og opbygget viden i lokalsamfundet omkring radioaktivitet og et slutdepots funktion og betydning for lokalsamfundet og Danmark.	• **UFS** • DD • DNT • GEUS • Kommuner	2027-2033

Fase 2.b: Planlægning
I fase 2.b pågår den detaljerede planlægning af slutdepotet, som kan starte, når processen omkring valg af lokalisering i fase 2.a giver tilstrækkelig information hertil.

Planlægningen vil bygge videre på arbejdet fra forundersøgelserne i fase 1 og konkretisere det generiske arbejde, som har været et nødvendigt startskud på rejsen mod slutdepotet.

I fase 2.b vil således både sikkerhedsvurdering og WAC blive udformet i deres endelige form og udgøre grundlaget for de nødvendige tilladelser til at opføre slutdepotet.

Med WAC for slutdepotet kan den endelige konditionering af affaldet også begynde, og affaldet kan pakkes og klargøres i dets endelige form inden det kan transporteres til og fyldes i slutdepotet.

Fase 2.b om planlægning indeholder følgende arbejdspakker:

Arbejdspakke	Beskrivelse	Interessenter (tovholder fremhævet)	Tidsplan
Eventuelt ny lov om nukleare anlæg	På baggrund af GAP-analysen omkring lovgivning og vejledningsmateriale som udføres i fase 1 skal der eventuelt udarbejdes en ny lov om nukleare anlæg.	• **DNT** • UFS • DD	2025-2029
Depotkoncept, herunder yderligere geologiske undersøgelser	I fase 1 besluttes et generisk depotkoncept, som i fase 2 skal konsolideres. Dette gøres bl.a. gennem yderligere geologiske undersøgelser, som kan afdække hvorvidt det kan forventes muligt at opnå en tilfredsstillende sikkerhedsvurdering.	• **DD** • GEUS • UFS • DNT	2034-38
Projektforslag for endeligt slutdepot	Når det endelige slutdepotkoncept er valgt skal der udarbejdes et konkret projektforslag som i detaljer beskriver, hvorledes slutdepotet kan etableres på den givne lokation.	• **DD** • UFS • GEUS • DNT	2039-41
Udkast til instrukser for arbejdet i driftsfasen	I forbindelse med udarbejdelsen af sikkerhedsvurderingen vil der være behov for at udarbejde udkast til instrukser for arbejdet i driftsfasen. De endelige instrukser vil først blive udarbejdet i driftsfasen, hvor arbejdsgangene er kendt.	• **DD** • DNT	2039-51
Endelig sikkerhedsvurdering	På baggrund af skabelonen og den foreløbige sikkerhedsvurdering, som er udviklet i fase 1, vil der i fase 2 blive lavet en endelig sikkerhedsvurdering for slutdepotet. Dette er en meget vigtig milepæl for projektet, da sikkerhedsvurderingen er af afgørende betydning for, at slutdepotet kan placeres på den givne lokalitet.	• **DD** • DNT • GEUS	2039-51

Miljøkonsekvens-vurdering	En miljøkonsekvensvurdering af et projekt udarbejdes dels for at inddrage offentligheden og myndighederne i vigtige beslutninger, dels for at sikre, at der tages hensyn til væsentlige påvirkninger af miljøet, før der tages endelig stilling til, om projektet skal gennemføres. Miljøkonsekvensvurderingen belyser mange parametre og er en væsentlig milepæl i processen mod slutdepotet.	• **DD** • Miljøstyrelsen • DNT • GEUS	2042-51
ESPOO-høring	En Espoo-høring omhandler eventuelle grænseoverskridende skadevirkninger på miljøet. Ved en Espoo-høring får offentligheden samt berørte myndigheder og interesseorganisationer i alle de områder, der må antages at blive berørt af et påtænkt projekt mulighed for at deltage i processen om vurdering af projektets miljøpåvirkninger, det vil sige også områder beliggende i andre lande.	• **DD** • SIS • Nabolande	2052
Paragraf 25 tilladelse i henhold til Miljøvurderingsloven	På baggrund af miljøkonsekvensvurderingen udarbejder Miljøstyrelsen en paragraf 25 tilladelse i henhold til Miljøvurderingsloven, som giver formel tilladelse til at gå videre med projektet.	• **Miljøstyrelsen** • DD	2052
Artikel 37 høring	I henhold til Euratom-traktatens artikel 37 skal EU-medlemsstaterne give Kommissionen oplysninger vedrørende planer om planlagt udledning eller uforudset udslip af radioaktive stoffer i luftformig, flydende eller fast form i eller til omgivelserne i forbindelse med driften af et nukleart anlæg. Dette gør det muligt for Kommissionen i sin udtalelse at afgøre, om gennemførelsen af en sådan plan kan medføre	• **DD** • SIS • Nabolande	2048-51

	radioaktiv kontaminering af en anden medlemsstats vand, jord eller luftrum.		
Anlægslov	Da slutdepotet udgør et større offentligt anlægsprojekt vil der være behov for en anlægslov som fastlægger finansieringen og giver hjemmel til eventuelle ekspropriationer som måtte være nødvendige for at gennemføre projektet.	• **UFS** • DD	2051-52
Lokalplan og evt. kommuneplantillæg	Efter anlægsloven vil der være behov for en lokalplan i den pågældende kommune, hvor slutdepotet skal ligge. Lokalplanen fastlægger hvordan udviklingen skal være i et afgrænset område og giver borgere og øvrige interessenter mulighed for at komme med deres bemærkninger til projektet, som herefter behandles politisk i kommunen. Afhængig af kommuneplanens rammer det pågældende sted kan der endvidere være behov for et tillæg til kommuneplanen, som muliggør anvendelsen af området til slutdepot.	• **Lokations-kommune** • DD • UFS	2052-53
Lukning af bygningsdesign med DNT	For at kunne igangsætte udbuddet omkring projektering og opførelse af slutdepotet på det bedst mulige grundlag skal bygningsdesignet fastlåses i samarbejde med DNT. Projekteringen af slutdepotet kan herefter gå i gang.	• **DD** • DNT	2054
Waste Management Plan	DD beskrev i 2022 arbejdet mod et slutdepot i Strategi for affaldets vej mod slutdeponi fra 2022, hvor der fremgår en række strategiske pejlemærker, som rækker ud i fremtiden. Som opfølgning på strategien udarbejdede DD i 2022 en Waste Management Plan (WMP), hvor de strategiske pejlemærker udmøntes i specifikke projekter, som bliver konkrete skridt i håndteringen af affaldet og i processen omkring et slutdepot.	• **DD**	2022-63

	I henhold til strategien fokuserer projekter i WMP på: • Muligheder for yderligere sortering og volumenreduktion skal undersøges • Klassificeringen af affaldet skal revurderes • Behovet for yderligere karakterisering skal vurderes • Behovet for forsknings- og udviklingsaktiviteter samt ekstern bistand skal vurderes WMP opdateres løbende for at sikre, at de rigtige projekter omkring affaldshåndtering sættes i søen.		
Generisk WAC slutdepot	Affaldet skal leve op til en række kriterier (WAC) for at kunne deponeres i slutdepotet. I første omgang vil der blive udarbejdet generiske WAC for slutdepotet for at sikre, at arbejdet med klargøring af affald kan foregå på det bedst mulige grundlag på nuværende tidspunkt. Generisk WAC vil blive fastlagt på et tidspunkt, hvor hverken lokalitet for eller barrierer i slutdepotet er kendt, og derfor skal dette skridt ses som et foreløbigt skridt mod de endelige WAC.	• **DD**	2024-26
Plan for R&D	I forbindelse med et så komplekst projekt som et slutdepot er der behov for Research & Development (R&D), og DD står overfor at udarbejde en plan herfor.	• **DD**	2024-25
R&D test/forsøg	På baggrund af planen for R&D vil der blive udført en række test og forsøg, som skal give yderligere viden om det affald, der skal deponeres. Forsøgene vil køre over en lang årrække for løbende at give plads til nye metoder og ny viden.	• **DD**	2026-63

Affaldsveje til slutdepot	For en del af affaldet, der i dag lagres og modtages på Risø, eksisterer der endnu ikke fuldstændige affaldsveje hele vejen frem til slutdepot. Disse vil derfor blive udviklet over en årrække.	• **DD**	2025-31
Klargøring af affald inden færdigkonditionering	Klargøringen af affaldet forudsætter, at en ny modtage- og håndteringsfacilitet er taget i brug. DD forventer, at faciliteten står klar ultimo 2031, hvorfor klargøringen først kan starte i 2032.	• **DD**	2032-56
WAC slutdepot	WAC for slutdepotet er en meget vigtig milepæl. Kriterierne vil bygge videre på de generiske WAC, og skal fastlægges som en vigtig parameter i sikkerhedsvurderingen. Endelig WAC for slutdepotet skal derfor foreligge tidligt i processen i arbejdet med sikkerhedsvurderingen, og arbejdet kan med fordel påbegyndes inden selve arbejdet med sikkerhedsvurderingen. Når WAC er fastlagt vil færdigkonditioneringen af affaldet kunne finde sted.	• **DD** • DNT	2027-41
Færdigkonditionering af affald	Inden færdigkonditioneringen af affaldet kan påbegyndes, skal de endelige WAC for slutdepotet foreligge. Dette skyldes, at færdigkonditioneringen bliver en irreversibel proces, og det vil derfor ikke være muligt eller i hvert fald blive meget vanskeligt at omgøre færdigkonditioneringen. Denne milepæl er meget væsentlig for projektet, da affaldet efter færdigkonditionering er klar til transport til slutdepotet.	• **DD**	2042-63

Fase 3.a: Konstruktion
I fase 3.a går selve konstruktionen af slutdepotet i gang. Konstruktionen skal projekteres og byggetilladelse skal opnås.

Der vil være behov for mange eksterne kompetencer i denne fase.

Fase 3.a om konstruktion indeholder følgende arbejdspakker:

Arbejdspakke	Beskrivelse	Interessenter (tovholder fremhævet)	Tidsplan
Projektering	Når bygningsdesignet er lagt fast i sikkerhedsvurderingen samt høringer (Espoo, artikel 37 og miljøkonskvensvurdering) er afsluttet kan projekteringen af slutdepotet igangsættes.	• **DD** • Rådgiver	2054-55
Byggeansøgning inkl. byggetilladelse	Efter endt projektering skal der indsendes en byggeansøgning til den lokale byggemyndighed hos kommunen, som kan udstede en byggetilladelse.	• **DD** • Kommune	2056
Konstruktion	Selve konstruktionen af slutdepotet foregår med rådgiver og entreprenør og i tæt dialog med lokalsamfundet omkring anlægsarbejdet.	• **DD** • UFS • DNT • GEUS • Rådgiver • Entreprenør	2057-61

Fase 3.b: Ibrugtagning og drift
I denne fase skal der efter slutdepotet står færdigt opnås en række tilladelser til ibrugtagning og drift. Endvidere skal der søges tilladelse til transport af affaldet, hvorefter affaldet kan begynde at blive fyldt i slutdepotet.

Alt affald forventes at være deponeret på slutdepotet ultimo 2067.

Der vil også i denne fase blive udarbejdet endelige instrukser for arbejdet i driftsfasen.

Fase 3.b om ibrugtagning og drift indeholder følgende arbejdspakker:

Arbejdspakke	Beskrivelse	Interessenter (tovholder fremhævet)	Tidsplan
Ibrugtagningstilladelse fra kommunen	Efter endt konstruktion skal den lokale kommune give ibrugtagningstilladelse til slutdepotet med udgangspunkt i kommunal lovgivning.	• **DD** • Kommune	2062
Driftslicens fra DNT	De Nukleare Tilsynsmyndigheder skal inden ibrugtagningen af slutdepotet tildele operatøren af slutdepotet en driftslicens på baggrund af sikkerhedsvurderingen.	• **DD** • DNT	2062
Transporttilladelse i henhold til ADR-konventionen	Reglerne for transport af radioaktivt affald fremgår af ADR-konventionen, og der skal søges om transporttilladelse i henhold her til.	• **DD** • DNT	2062
Transport af affald og fyldning af slutdepot	Efter de nødvendige tilladelser er opnået vil transporten af affaldet kunne påbegyndes og affaldet kan over en årrække fyldes i slutdepotet.	• **DD**	2063-2067
Endelige instrukser for arbejdet	I takt med at arbejdsgangene under driftsfasen bliver kendt vil instrukserne herfor blive udarbejdet i endelig form.	• **DD**	2067-

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Fase 4.a: Afvikling
Slutdepotet vil være i drift i en kortere årrække, hvorefter det skal lukkes og afvikles og overgå til institutionel kontrol.

Formålet med implementeringsplanen er i første omgang at opnå en detaljeret tidsplan for fase 1-3 indtil slutdepotet er etableret og taget i brug.

På nuværende tidspunkt er denne fase derfor ikke beskrevet, men vil i stedet indgå som en væsentlig del af det videre arbejde med sikkerhedsvurderingen for slutdepotet.

Fase 4.b: Institutionel kontrol
Når slutdepotet er afviklet overgår det til institutionel kontrol, som er juridiske begrænsninger for arealanvendelsen omkring slutdepotet. Lovgivningen omkring begrænset brug af jorden hjælper med at bevare slutdepotets integritet og understøtter gennem administrative forholdsregler også strålingsbeskyttelsen af mennesker

Formålet med implementeringsplanen er i første omgang at opnå en detaljeret tidsplan for fase 1-3 indtil slutdepotet er etableret og taget i brug.

På nuværende tidspunkt er fase 4.b derfor ikke beskrevet, men vil i stedet indgå som en væsentlig del af det videre arbejde med sikkerhedsvurderingen for slutdepotet.

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