New Upgraded Storage Facility at Risø (NUSF)

Case No. RO 27.0 31 October 2019

EIA-rapport (Environmental Impact Assessment)

0. Introduction and background

On 6 June 1958, Risø was officially inaugurated. The new government institution, "Nuclear Test Station Risø", was to do research in peaceful utilisation of nuclear energy. The research centre had three reactors (from 1960), a number of different laboratories and a treatment station. Later the Hot Cell and the fuel element production in the Technology Hall were added. Risø is bounded by the coastline and a security fence. There is no public access to the area. Access for staff and visitors takes place via the gatekeeper.

Risø has from the beginning had a waste receiving station for radioactive waste from the Danish society as part of the tasks of the Treatment Station. The treatment station has further received waste from the various departments at Risø, been responsible for the evaporator facility, the operation of the cleaning facility, as well as the active laundry and operating laboratories. After sorting and separating, the waste containing activity is packed in drums or containers and stored in one of the storage buildings located within the fence. The storage capacity has been increased several times since its start in 1960.

Risø has since the beginning had a set of operation conditions approved by the nuclear regulatory authorities[1]. These conditions contain requirements for the various facilities, requirements for inspection, requirements for operational and annual reports, etc. In connection with the split of Risø in 2003, Dansk Dekommissionering (DD) has been given "Conditions for Operation and Decommissioning" (CfOD) at the facilities, which were transferred to DD, and Danmarks Tekniske Universitet (DTU), (the Technical University of Denmark) has their conditions. In addition to DD and DTU, Aarhus University (AU) is also one of the tenants in some of the buildings within the security fence.

Danish Decommissioning (DD) was established in 2003[2]. Over a period of up to 20 years, DD was to dismantle and clean the buildings and facilities that have been used for or been affected by nuclear research or development to a level so that buildings, facilities and areas could be measured for release as so-called "greenfield" areas and thus be used for other purposes without radiological restrictions. A final depot was to be built in Denmark so that all the waste stored at Risø could be moved to this depot.

In 2003, the then Hovedstadens Udviklingsråd (HUR), (the Capital's Development Council) approved an EIA report on the decommissioning of the nuclear facilities in the period 2003-2023 on the condition that the waste would be moved. It is this EIA that today covers DD's business, incl. the expansion of the storage capacity and other new construction to the extent necessary in relation to the decommissioning.

The process around the final depot has taken longer than expected in 2003. In order to create enough time for more research, the Danish Parliament in 2018 decided that the waste must remain on Risø until it can be moved to a final depot by 2073[3].

DD has been appointed to take care of the waste until 2073, and to continue to operate the receiving station of radioactive waste from the Danish society. In addition, DD must participate in the work of

[1] *SIS (The National Institute of Radiation Protection under the Danish Health Authority) and the Danish Emergency Management Agency*
[2] *Parliamentary Resolution B 48 (2002/1 BSV 48)*
[3] *Parliamentary Resolution B 90 (2017/1 BSV 90)*

designing a final depot as well as complete the treatment of the waste so that it is suitable for being moved to a final depot when the depot is ready to receive the waste from Risø.

On the basis of the Danish Parliament's decision to continue storing the waste at Risø, as well as the desire to complete the decommissioning as close as possible to 2023, DD has drawn up a plan for how this is possible. You might say that the decommissioning until 2023 is covered by the HUR EIA, and the last part of the decommissioning after 2023 and the time after the decommissioning (until the year 2073) will be included in the forthcoming environmental impact report, once approved.

In general, DD will in future have the following buildings/facilities. In some of these buildings radioactive waste is being stored or is being processed.

1. New Upgraded Storage Facility, storage for all waste in new building
2. Receiving station for radioactive waste. The current location must be decommissioned, therefore the receiving station must be arranged in another existing or new building close to the NUSF and within the area of the district plan.
3. Analysis laboratory A-lab, to remain in building 208, incl. sample library. Building 208 was designed for the purpose in 2004.
4. Handling facility, to be fitted in existing or new building close to NUSF and within the area of the district plan.
5. An administration building incl. staff changing facility. This is also to be fitted in an existing building.
6. An exhibition facility that is also expected to be housed in an existing building.
7. Storage buildings for empty containers, drums and the like.

The buildings in item 1-4 must be surrounded by fences with access control. The buildings in item 5-7 does not need fencing but should be placed close to the other buildings partly for the sake of the staff but also because there should be an opportunity for guided tours in the storage facility, etc., which is also possible today. All the buildings in item 1-7 are situated behind the present security fence at Risø, where access is only possible via the gatekeeper.

In 2018, a new radiation protection law[4] was adopted. This law with its regulations is, among other things, to be taken into account when approving the new buildings/facilities.

To make room for NUSF, it may be necessary to demolish existing buildings. In addition, other buildings and facilities, including some of the storage buildings and tailings basins, will be demolished and the ore piles will be removed. Under the ore piles, soil and groundwater pollution has been identified. This pollution will be cleaned when the ore piles have been moved to the NUSF, and the area can then be released as a greenfield area. (The residual material from Risø's experiments with uranium extraction, called tailing, is stored in 2 basins, called the tailing basins).

DD is a government company, which is why the Danish Environmental Protection Agency is the authority on the EIA process.
In HUR EIA it was the effect of the reactors (2 kW, 5 MW and 10 MW, respectively) that led to DD being an Annex 1 company. As the waste remains at the site until 2073, it has been assessed that DD will remain an Annex 1 company, cf. section 2 subsection b), in relation to this application[5] for environmental impact assessment.

The assessment of the project's impact on the environment is gathered in an environmental impact report. It will contain:

1. A description of the project with information about the project's location, design, dimensions and other relevant features,
2. A description of the project's expected significant environmental impact *within* the following factors:

[4] *Act on Ionising Radiation and Radiation Protection (the Radiation Protection Act), Act No. 23 of 15/01/2018 and related regulations*
[5] *Act on environmental assessment of plans and programmes and of specific projects (EIA), Act No. 1225 of 25/10/2018*

1) The population and human health,
2) the biological diversity with particular emphasis on species and habitats protected under Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the preservation of wild birds,
3) land, soil, water, air and climate,
4) material assets, cultural heritage and landscape and
5) the interaction of the factors in no. 1-4.

3. A description of the specific features of the project or the measures envisaged to avoid, prevent or limit and, where possible, neutralise expected significant adverse effects on the environment,
4. A description of the reasonable alternatives considered by the developer and relevant to the project and its specific characteristics, and a description of the main reasons for the solution chosen, taking into account the project's environmental impact,
5. A non-technical summary of the information referred to in points 1-4 and
6. Any additional information referred to in Annex 7 to the Act, which is relevant to the specific characteristics of a particular project or type of project and of the environment that is likely to be affected.

The report includes an overall description of the expected environmental impacts. The information will be used to prepare material for the initial consultation of ideas and proposals and for the authority's opinion on how comprehensive and detailed the information should be, which the developer must provide in the environmental impact report. The following topics are described below:

1. Description of the project
2. Potential environmental impact of the project (described overall)
3. Options and reference scenario (described overall)
4. Relations to other planning and legislation
5. Sources

In addition, as part of the work on the environmental impact report, it will be necessary to assess whether there will be cross-border impacts from the facility, whereby neighbouring countries will need to be consulted on the given project.

1. Description of the project

1.1 Location and delimitation of the project

The area is located on the western part of Risø in Roskilde Municipality, commonly referred to as the "island part". The project area includes the part of the area, which lies west of Tværvej 8 (the road to the cleaning facility) and north of the avenue (see Figure 1). The area forms part of cadastre no. 61a, Veddelev City, Himmelev.

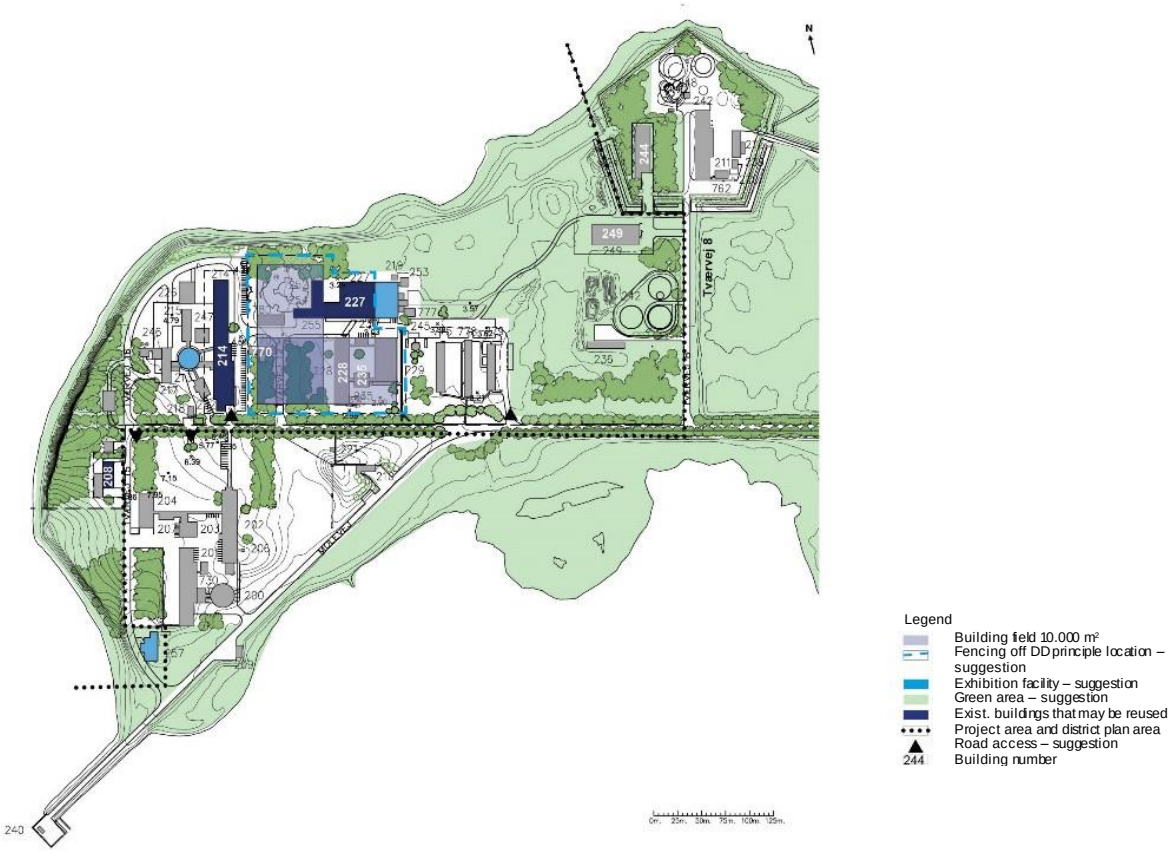

Figure 1. Delimitation of the project area

1.2 The physical characteristics of the project

The project includes the establishment of a *new upgraded storage facility* (NUSF) for all waste according to B 90. In addition, the project includes the establishment of a radioactive waste *receiving station*, a *handling facility* for special studies and final conditioning of the waste (packaging for final depot), an *administration building* for 15-20 employees and possibly an *exhibition facility* for approx. 110-120 people. The project also includes *demolition of buildings* to make room for the storage facility as well as demolition of other buildings etc., including some of the storage buildings. The project also includes the existing *measurement and analysis laboratory* (existing A-lab, building 208 including sample library), where waste is checked before being taken to the NUSF. No changes to the A-lab are planned. Dansk Dekommissionering hopes that it will be possible to establish the receiving station, the handling facility, the administration building and the exhibition facility in existing buildings. If not, new buildings will have to be established for the purpose within the area of the district plan.

The Danish Building Authority and Property Agency owns the buildings and the areas on Risø and rents them out to Dansk Dekommissionering (DD), AU and DTU. In terms of funding, it has been decided that DD must own the new storage facility on rented area.

In 2019-2021, DTU will move out of the buildings located north of the central road on the island part, which means that these buildings can be used for other purposes in accordance with the applicable planning. The buildings south of the central road will continue to be used by DTU.

The buildings, which DTU leaves, will give DD the opportunity to gather the future activities in buildings that are close to where the NUSF is expected to be erected. DD has prepared an overview of existing buildings, their use and indication of when DD does not expect to use these buildings anymore and under what preconditions. The note shows that there is only one building that is expected to continue unchanged

with its current use up to 2073. This is the A-Lab building (building 208). It will be attempted to have the others released in the period from 2019 - 2024, see also Figure 2.

When existing buildings, facilities and areas are decommissioned and measured for release, it will be possible to redesign and use buildings for purposes other than current ones.

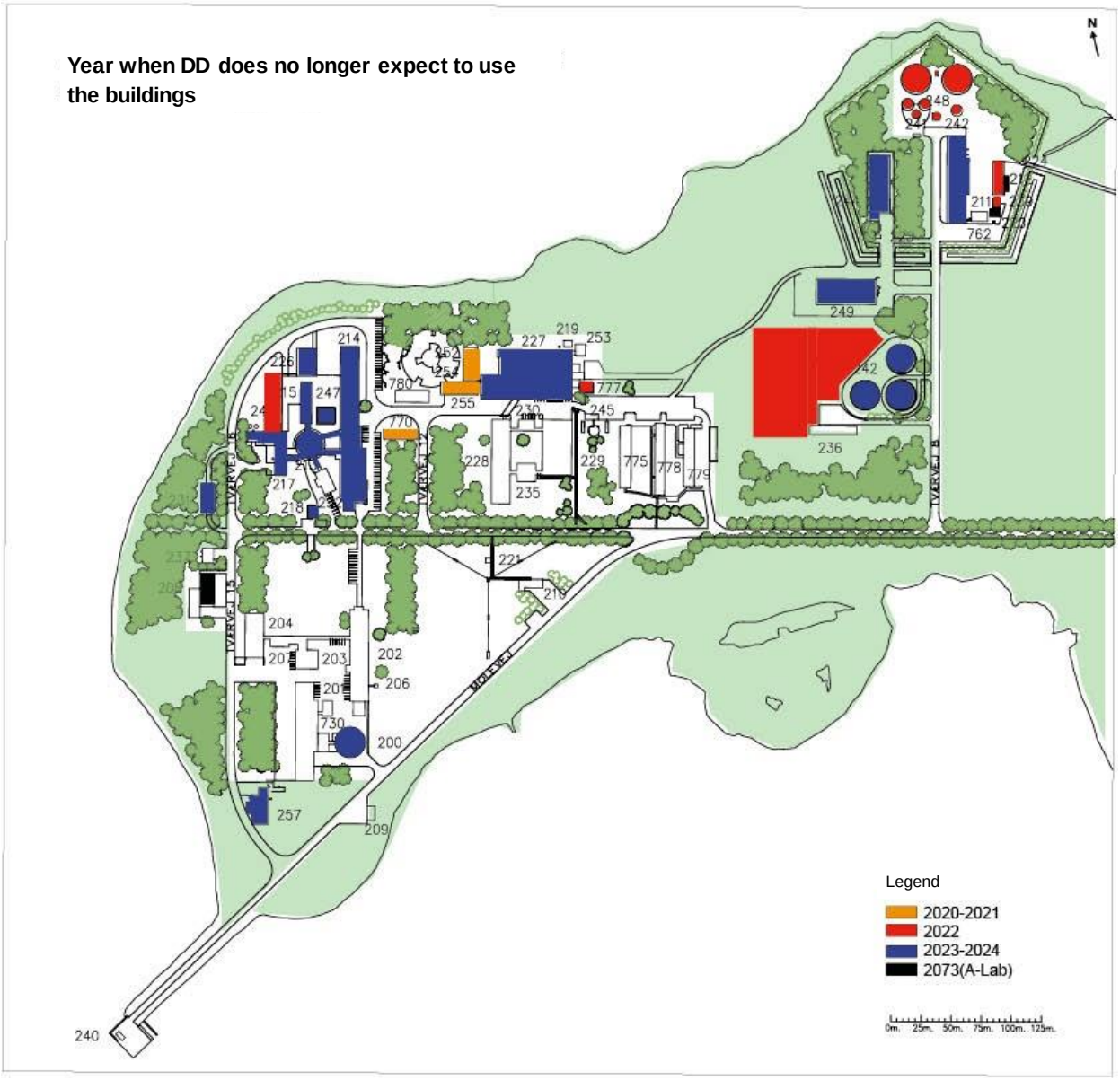

Figure 2. Year as to when DD no longer expects to use buildings, facilities and areas, or when it can be used for other purposes.

The final location of the NUSF is not known before 2020, but two building plots have been identified where the storage facility can be located. Once the location of the storage facility has been clarified, it will also be clear if there are existing buildings that need to be demolished to make room for the new storage facility for all waste. Assuming that only barracks are removed, DD could have its functions in the following buildings:

1. New Upgraded Storage Facility, storage for all waste in new building (see construction field in Figure 1).

2. The radioactive waste receiving station in existing or new building close to the NUSF and within the area of the district plan.
3. Analysis laboratory A-lab, to remain in building 208, incl. sample library.
4. Handling facility, to be fitted in existing or new building close to the NUSF and within the area of the district plan.
5. An administration building incl. staff changing facility, will be arranged in existing building, part of building 214, or 227.
6. An exhibition facility could be located in building 213, part of 227 or 257.
7. In addition, storage space may be needed for empty containers, drums, cement casting, features that may be housed in the former technology hall, building 229.

Below please find a description of the individual part elements of a plan for the implementation of parliamentary resolution B90:

1.2.1 New Upgraded Storage Facility (NUSF)

A new upgraded storage facility will accommodate the existing radioactive waste at Risø as well as new radioactive waste from the Danish society, with the exception of external NORM waste.

The radioactive waste at Dansk Dekommissionering will, after the decommissioning of the Risø facilities, consist of the following categories:

- Metal scrap and concrete from the demolition of the nuclear facilities
- Operational waste such as gloves, work clothes, cover plastic, needles, etc.
- Sources from external users (e.g. weak sources from smoke alarms and powerful sources from hospitals' blood irradiation facilities)
- Bitumen (concentrate from distillation of water with radioactive particles)
- Tailings (waste product from uranium extraction experiments) and uranium ore (a resource that is potentially waste)
- A smaller amount - 233 kg - irradiated test fuel

In addition, there is NORM waste, which is waste with naturally occurring radioactive material. Previously, smaller quantities have been received. NORM waste is no longer received at Risø. NORM waste such as soil and ore samples is packed in containers and drums and now stands in a separate NORM section of DD's low-level waste storage facility. Initially, the NORM waste must be moved to the new storage facility, but what will happen in the longer term with the NORM waste is awaiting a national NORM strategy.

Finally, at Risø, approx. 3,700 tons of uranium ore is stored. This is a resource that has previously been described as potential waste. This means that the ore must be transferred to the new storage facility if no other solution has been found before.

DD is continuously working on minimising waste volumes, among other things by means of recycling and volume reduction.

The storage facility will occupy an area of 6-10,000 m^2 and will be up to 15 m high.

There will be a need for part of the building to be a closed building with climate proofing, while for part of the storage facility only a so-called cold barn (roofing) is needed. The storage facility is expected to be equipped with an overhead travelling crane that can handle ISO and Jumbo containers as well as steel containers, which are the three storage units approved for the current intermediate storage facility in building 249 and which will also be storage units in the NUSF. Jumbo containers cannot be stacked. The others can be stacked by 4 on top of each other. This means that a building of up to 15 metres in height is needed. The final height can only be verified once the crane has been dimensioned. The cold part of the storage can be fitted to store steel containers and ISO containers (extension of crane rails and cables and insulation of outer wall), if needed. All of this will be possible without changing the physical dimensions or exterior expression of the building.

The buildings are secured against future high tide and coastal flooding. For this reason, the storage facility is planned to be established with a floor level at least 4 metres above sea level (elevation level +4).

There will be a need for architectural work on the facade of the building so that the visual impact is limited to the extent possible without compromising on security, technical and operational building requirements.

As mentioned, the NUSF is a storage facility for all waste. In the storage facility itself there are four functions: 1) placing and removal of waste; 2) inspection of storage units; 3) maintenance of building and technical facilities; and 4) traffic of storage units being transported to and from (the three container types). The filling will last approx. one year with 8-10 transports (trucks) within normal working hours on weekdays. Additionally there will be a period where new waste will arrive from the receiving station (1-2 times per month), as well as the opportunity to retrieve storage units and transport them to the handling facility.

There will be different sections in the building, as parts of the waste will require special security measures. The building must be a closed building with no windows in the storage area, as humidity and temperature must be controllable so that corrosion of the storage units is minimised.

All the NUSF storage units are handled in closed condition, like at DD's current intermediate storage facility. Inspection of the storage units will take place by the crane retrieving a storage unit to an inspection area in the NUSF. If the storage unit is intact, it can be replaced. If the storage unit shows signs of deterioration, it will be transported to the handling facility before it is returned to the storage facility.

When emptying the NUSF for the final depot, all storage units are expected to go to the handling facility for final conditioning. Whether the storage units from here can get directly to the final depot from the handling facility, or whether the storage units must return to the NUSF before transport to the final depot, must be decided by the planning around the final depot.

1.2.2 The radioactive waste receiving station

The receiving station receives waste from the Danish society. The waste is reported via DD's home page. By agreement, the waste is collected by DD or delivered to DD at Risø. The quantities can vary from year to year, but on average DD receives approx. 8 m^3 per year. For the NUSF, the expected volume until 2073 has been factored in.

Physically, the receiving station is part of the treatment station's buildings and is primarily located in building 212. In order for this building to be decommissioned, the equipment must be moved to another building. The area requirement for a new radioactive waste receiving station is expected to be 500-600 m^2 and with a height of up to 6-8 m. It is being investigated whether some of the buildings, which DTU will leave, may be designed for this purpose.

The primary tasks related to the received waste are:

- On receipt of the waste to have it registered in ADS, DD's waste system, by means of the reporting and measurements/assessments. Office workplace at the reception platform and in DD's administration.
- The glove box, with associated press for filling of 100-litre drum, embedded in concrete in a 210-litre drum.
- Evaporator drums, evaporation of non-radioactive liquids, leaving radioactive solids.
- Workplaces to separate different waste.
- Storage and supervision of the waste until it can be put into the storage facility.
- Before being stored, the waste must be characterised at the Measurement and Analysis Laboratory (A-lab).

All items get a bar code in the waste system. As an example, it could be a batch of fire detectors. The treatment at the receiving station will be a sorting of fire detectors with and without radioactive source. The radioactive fire detectors can be further separated into three parts: the radioactive source itself, a plastic part and an electronics part. Fire detectors without radioactive sources, plastics and electronics can be checked and disposed of through the normal waste schemes (this fraction of the original batch gets a new bar code).

The radioactive sources are also given a bar code, and when characterised at the A-lab, measurements and the like are entered under that particular barcode. It is therefore possible to determine the activity and the nuclides in this batch. The radioactive substances decay over time, i.e. the activity decreases and this information will be included in the design of a final depot.

When enough waste of a certain type has been collected, a storage unit (steel container or an ISO container) can be packed and transferred to the NUSF. It takes many years to collect enough drums to fill a storage unit and it will therefore be necessary to have the ability to pick up a partially filled storage unit from the NUSF to take it back to the receiving station, open the storage unit, insert the filled drum, close the storage unit and then return the unit to the NUSF.

1.2.3 Measurement and analysis laboratory

The existing measurement and analysis laboratory (A-LAB, building 208) will be continued as is. The building was designed in 2004 for the purpose.

The building contains various equipment that is used to take samples and analyse them to get knowledge of the material from which the sample was taken. In connection with the decommissioning, many samples have been measured. Most of these samples are stored in a sample library (cabinets with shelves and drawers, shielded with lead). The sample library provides the opportunity to determine and control the composition of materials etc., without having to retrieve a storage unit.

Drums pressed/packed in the receiving station are also measured at the A-lab. The drum is transported by truck from the receiving station to the A-lab. In the A-lab, the drum is lifted via a crane onto a rotary table. After the measurement, the drum is lifted back onto the pallet and the truck can transport the drum back to the receiving station.

This measurement, together with other information about the waste contained in the drum, will be a characterisation of the waste in that particular drum. The characterisation determines the activity content of the drum distributed by nuclides. The sum of all nuclides and their activity for all the waste is called the total inventory. The overall activity is each year reported to the nuclear regulatory authorities. Reporting is also done to the EU and the IAEA every 3-5 years.

The A-lab also has mobile equipment for measuring material that is too large to enter the building. This equipment has been widely used in the decommissioning. But the need will diminish, as the material for the receiving station rarely has such size.

1.2.4 Handling Facility

This facility is the place where in future it will be possible to open storage units from the NUSF if further information about the waste is needed, in addition to the information available in ADS or in the sample library. Such a need may arise when designing the final depot or if some of the waste needs to be processed abroad.

If the AH hall (part of building 214) can be measured for release, it may be adapted and reused for the handling facility, alternatively the facility will have to be located within the project area of an existing or new building. Regardless of whether the NUSF is placed in one or the other building field, it is possible to place a gate in the NUSF opposite the gate to the AH hall. Thus, the transport distance between the two buildings will be the shortest possible. Transport between these buildings will take place behind the same fence and inside the security fence.

In the AH hall, there is today a crane along the building with a capacity of 25 tons. This lifting capacity must be maintained, but the crane's control must be modernised so that the crane can be operated remotely. How else to arrange the handling facility is yet to be determined, but it must allow for performing the following tasks:

- The storage unit comes from the NUSF and is placed in a work area
- The storage unit is opened
- The planned work is carried out
- ADS is updated

- The storage unit is closed
- The storage unit is returned to the NUSF

All waste from the NUSF is characterised in ADS, so that the radiation level of the waste to be worked on is known. The work can thus be planned so that the staff is not exposed to unnecessary radiation doses. If waste with a very high radiation level needs to be examined, it may be necessary to build a Hot Cell in the handling facility.

In the storage unit, where there is high radiation level waste, the waste unit (e.g. a drum) has - in connection with moving it from the old storage facility (the decommissioning project) - been placed in a shielding container, and has thus been made manageable. When the storage unit from the NUSF is then opened, the shielding container can be taken out and can be brought into the front room of the Hot Cell. Via remote-controlled equipment, the lid of the shielding container can be removed and the waste material can be taken up and brought into the actual workroom of the Hot Cell. When the work is done, the waste material is returned to the shielding container, which is closed and put back into the storage unit.

In the workroom, for example, a sample of the waste (a few grams) can be taken. This sample (with its own bar code) is placed in a transport container, which is brought to the A-lab. At the A-lab the sample is measured and then stored in the sample library. The new measurements are recorded in ADS, which links the measurements to the original waste material.

If a storage unit from the NUSF needs to be further sorted or otherwise repackaged, this will also be done in the handling facility. The hall must be arranged for this work. If there is space in the AH Hall, the existing breakdown facility from the H Hall (Handling Hall) may be moved and reused.

Once the final waste conditioning before transport to the final depot has been decided, the handling facility may be arranged for this as well. At that point, the use of the new Hot Cell will be over, and it can be cleaned and removed, leaving room to establish other equipment.

For the above item 1.2.1-4 applies that the functions must be surrounded by a fence. A-lab (Building 208 item 3) must have its own fence as it is located separately. The other three functions will be behind the same fence. Transport between the receiving station, the NUSF and the handling facility is thus internal transport in the courtyard and does not contribute to increased traffic on Risø. Transport from the A-lab will take place on an ordinary road behind the security fence.

In order to secure the waste in the buildings against future high tide and coastal flooding, the NUSF must be established with floor elevation level +4, so that the storage units with reasonable certainty do not come into contact with water from the fjord. Thus, the requirements of the nuclear regulatory authorities are met, see further in item 3.

Geotechnical studies need to be carried out to determine where the subsoil has sufficient carrying capacity so that it is possible to build the desired buildings and facilities before the final building fields can be determined. The NUSF is sought to be placed outside the tree crowns in the avenue, so that the construction does not damage the root system (diameter crown = diameter root system). It is possible that the posts for the fence will stand under the tree crowns.

1.2.5 Office and changing facilities for 15-20 people

DD has 75-80 employees. Due to the watch schedule, not everyone is present every day. In building 214, the office part, there are approx. 50 desk workstations. Building 214 also contains toilet, bath and lunchroom. In building 770, DD has a common room for big meetings if everyone is to attend.

Building 214 can still be used as an office building for the 15-20 people that DD expects to have employed when the decommissioning is completed. Alternatively, building 228/235 or 227, which DTU vacates, may be considered. These buildings are being continuously renovated as part of the owner's maintenance of the buildings.

Today, as in the future, DD needs office workstations for the staff. Some of the staff work at their desk, others meet at their desk and handle their mail and the like before walking/cycling to the facility where the work assignment takes place. Transportation of large items between DD's buildings takes place by truck or delivery van. The van (electric car) is also used to collect various materials in Roskilde. In the long run, with fewer staff, the scope of driving will be reduced.

1.2.6 Possible exhibition facility for approx. 110-120 people

DD actively wants to be able to disseminate knowledge about Denmark's radioactive history. Not only about the waste that is stored, but also about Risø, decommissioning and the establishment of a final depot. It should be possible to receive 110-120 people, which equals two filled buses.

For DD, the primary purpose of the exhibition facility is to disseminate knowledge of the radioactive waste to relevant stakeholders in order to increase the awareness of the waste and thus support the decision-making process for a long-term solution. According to B 90, a long-term solution must be ready for use by 2073, so that the waste can be transferred from the storage facility at Risø.

The secondary purpose is to add positive branding and extra value to the local area by adding the exhibition facility and the Risø peninsula as an excursion opportunity.

Target groups

1. Stakeholders in relation to the long-term solution (e.g. local politicians, civil servants, NGOs, citizen groups from relevant municipalities)
2. Citizens and tourists in Roskilde Municipality
3. Schools and educational institutions

Contents

At first, the exhibition facility's exhibition is intended to contain a number of sections/"islands" on each topic:

- Introduction to radiation
- The history of nuclear station Risø
- The use of radioactive materials in the community (hospitals, etc.)
- What the waste contains
- Storage of waste in the NUSF (incl.: What is the risk of leakage?)
- The long-term solution/final depositing

The dissemination must be centred on a few key objects, with the possibility of elaborating information via a tablet or the like (cf. e.g. The Danish Castle Centre in Vordingborg). Some of the Risø objects handed over to the Steno Museum (the Danish Science Museums) may probably be borrowed back. Additional possibilities for interactivity could, for example, be a few experimental setups about radiation and shielding (cf. the Experimentarium).

Access to the exhibition facility must be easy and free. In connection with a visit, groups can book a tour that includes a visit to the NUSF. Visits to the exhibition must be reported to the gatekeeper at the security fence, as there is no free public access to Risø.

Physical framework

The exhibition facility should be close to the NUSF, but outside the fencing to the NUSF.

Visitors must have access to toilets. In addition, there should be a kitchenette and an auditorium/meeting room nearby.

If the exhibition facility is established in an existing building, a building related to the nuclear facilities is preferable. Although one or more of Risø's nuclear installations may be included, it should be emphasised that they must first be cleaned to the "greenfield" level before an actual exhibition facility can be set up.

The opportunity to look into the NUSF can be advantageously combined with the establishment of an exhibition facility - for example, with the establishment of a separate visit corridor and/or window in the NUSF so that visitors can see containers/drums from the exhibition facility. If for security purposes this is not possible, a camera can be installed, which can be controlled from the exhibition facility.

1.2.7 Demolition of buildings and facilities

DD is obligated to demolish building 249 and part of building 244. At the time of writing it has not been determined whether the remainder of building 244 and building 231 can also be demolished when the NUSF is put into service and the storage facilities are emptied. To make room for the NUSF, it is necessary to demolish one or more buildings. Exactly which will not be known before the final location of the storage facility has been decided. In addition, the tailings basins will be removed and the area can then be restored as a green area.

The removal of the ore piles and cleaning up of the soil and groundwater contamination that may have occurred as a result of leaching from the piles will only be possible once the NUSF is established. Therefore, the decommissioning of the tailing basins, the relocation of the ore piles and the purification after soil and groundwater pollution under the ore piles will be included in this environmental impact assessment.

1.2.8 Landscape and planting

As to the landscape, Risø is located off Roskilde Fjord. In several places, Risø has connected plant areas. The most characteristic is the avenue, which is expected to have a residual life of 30 years. DD does not expect the construction of the NUSF to affect the trees and wildlife of the avenue. DTU is responsible for the maintenance of the avenue. DTU has informed that, in order to retain the avenue as a scenic feature, they will develop a replanting strategy. Thus, a scenario where the NUSF could become more visible in the area due to cutting down all or large parts of the lime avenue will at once be avoided/minimised.

In the area where the new storage facility will be established, there are partly existing buildings (building 770, hut), which will have to be demolished and partly two planted areas with slightly larger trees. These trees will need to be cut down to make room for the storage facility.

The area, where building 249, the tailings basins and the ore depot are located, can - after the establishment of the NUSF - be designated as green areas that eventually will grow and create new nature in the area.

1.3 Time schedule

The target for commissioning of the NUSF is early 2023. With this timetable, the district plan and the environmental impact report must be prepared in 2019-2020, planning must be completed in 2020-21 and construction must be completed in 2021-22. Hereafter, the waste can be moved to the NUSF and the decommissioning of existing storage facilities can be initiated. Once the decommissioning is complete, building 249 and the tailing basins can be demolished. This is expected to be completed in 2023/2024.

2. Potential environmental impact of the project (described overall)

Dansk Dekommissionering's expectations to the project's potential environmental impact are described below. The topics, together with topics that arise in connection with the idea phase, will be further clarified in the environmental impact report.

2.1 The population and human health

The last part of the decommissioning, which will be done after 2023, will take place in the same way as the current decommissioning. This means that the applicable safety and working environment rules must be observed.

The transfer of the radioactive waste from the existing storage facilities and from ore piles and tailing basins to the NUSF will also be subject to the regulations for handling and transport of dangerous goods.

The activities in the NUSF, when the new storage facility is established, in the receiving station, the measurement and analysis laboratory and in the handling facility, will be the same as the ones DD is currently handling. This also means that the impact on the surrounding community from the new storage facility is not expected to be significantly different from the existing storage facilities.

The safety assessment, which must be approved by the nuclear regulatory authorities before the various facilities can be put into use at the new location, includes, among other things, an assessment of the consequences of operational and accidental releases.

The employees will still be subject to the regulations for working with ionising radiation. And transports must comply with the requirements of ADR (the international regulatory framework for the transport of dangerous goods on the road), etc.

2.1.2 Radioactive waste and release of hazardous substances

DD's work today has a number of exhausts to the outdoors through filters that are monitored for radioactivity emissions. In future, the extent of emissions will be smaller, but not zero. When existing equipment needs to be moved and new buildings are being built, the aim is that the NUSF, the receiving station, the A-lab and the handling facility will each have their own exhaust, with specific requirements. These are the operating requirements.

The consequences of an accident will be reflected in the safety assessment, which is under preparation. This will be prepared in parallel with the design of the NUSF.

Every six months DD prepares an emission report as well as an annual operation and decommissioning report for the nuclear regulatory authorities, cf. the requirements in the BfDA. No emissions are allowed above the permitted level. In the long term, the water volumes with possible radioactivity are expected to become smaller than today. Therefore, DD will do an analysis of how the treatment of "water with possible activity" can be done in relation to the total volume of water - smaller volume may mean a different evaporation process than today.

2.1.3 Impact from noise and vibrations

Noise and vibrations may occur in connection with the demolition and construction of the NUSF (including from piloting) and possibly from other new buildings for the receiving station, handling facility, administration building and the exhibition facility, where it will not be possible to reuse existing buildings.

The scope of noise coming from truck traffic during the construction of the NUSF and possibly other buildings and from the demolition is considered to be limited and not significantly different from the daily traffic to and from the Risø area.

In the operational phase, DD's traffic will be reduced compared to current traffic in connection with the decommissioning, among other things because DD will have fewer employees. The number of transports between the receiving station, the handling facility and the A-lab will be modest and will not affect the traffic load on the island part.

2.2 Biodiversity

2.2.1 Natura 2000 areas and other preservation interests

Roskilde Fjord and parts of the Risø peninsula are registered as Natura 2000 area (bird preservation) and Natura 2000 habitat area.

The coastal landscape around the Risø peninsula is covered by the beach preservation line. The wooded areas on the westernmost part of the peninsula facing the fjord are protected mixed oak forest. The north-western and western beach ridge is protected as an open wood habitat with annual plants. The northern and southern parts are salt meadows. And just south of the pier there is a smaller lime pasture area. The southern part of the Risø peninsula, the area east of Tværvej 2 and smaller areas towards the northern coast are protected salt meadows. There are also two smaller areas on the south-western part of the peninsula at the pier, which are designated as pasture areas. The area is designated as a geological area of interest.

A Natura 2000 assessment and a botanical screening have been initiated, explaining the preservation interests in the project area and outside. The report states that the majority of the project area is outside the boundary of the Natura 2000 area. The Natura 2000 area has been designated for a wide range of species and habitats, of which only 5 out of 27 are relevant for the impact assessment, mainly because they are not found in or near the affected areas.

A total of five species of breeding birds and nine species of migratory birds are included in the designation basis for Roskilde Fjord. Several of these can be found at or around the project area.

It is certain that the migratory birds in the bird preservation area use the area around Risø for resting and foraging, but the fjord off Risø is not considered to be a particularly important area for the bird preservation area's designation of migratory birds and breeding birds.

2.2.2 Impact on plants and wildlife

Five species are included in the designation basis for the Roskilde Fjord habitat area. None of these are considered to be found in the project area or the immediate area.

A targeted search for Annex IV species has not been conducted, but the potential of the affected areas for amphibians, reptiles and other Annex IV species is considered to be extremely limited. There are no protected water holes or other potential habitats for amphibians in the areas affected by the project.
It cannot be ruled out that some of the buildings may house bats, but neither buildings nor the area's woodland are considered to be of a nature that makes them immediately suitable for resting or breeding bats. Only in the old poplar avenue along the central road, through the area, the trees have a size and physique (holes after fallen branches, etc.), which make them potentially suitable as a resting place for species of bats.

2.3 Soil, water and climate

2.3.1 Soil

The entire Risø area has been mapped with demands for soil analysis. Soil contamination has been identified in the project area, but no V1 and V2 mapped contaminated areas have been identified on the area where the NUSF should be built. In connection with excavation work and possible removal of soil, permission must be sought in accordance with current regulations. As the NUSF is to be erected from elevation level 4, which corresponds to existing terrain or over existing terrain, the extent of any excavation work is expected to be limited.

In connection with the decommissioning of tailing basins and the ore depot, the soil will have to be purified in accordance with an enforcement notice from Roskilde Municipality. When the ore layer has been removed and the space has been measured for release, a soil contamination with, among other things, fluoride, arsenic and lead, cf. enforcement notice from Roskilde Municipality, must be handled.

2.3.2 Water

Groundwater and drinking water

The overall groundwater flow occurs to the west towards Roskilde Fjord from the well fields at Marbjerg and Brokilde waterworks. It is unknown how pumping at the well fields may affect the groundwater flow-environments between the well fields and the Risø peninsula. As the NUSF must be established from elevation level +4, no temporarily lowering of the groundwater should be necessary.

The flow of water into the ore pile has leached fluoride, which gives elevated concentrations in the groundwater just below the pile. DD has an enforcement notice to cover the ore pile and to establish a water pump & treat for the cleaning facility. Measurements on this water will show whether the concentrations are below the permissible. The NUSF does not affect this contamination.

Sewage

The NUSF will become a building that has only rainwater drains. There will be no floor drains or toilets in the building. Thus, backwash of water from the sewer system is avoided, should this be flooded. The floor areas in the NUSF will be inclined towards one or more pump sumps, so that rainwater from trucks can dry up. The floor areas will be controlled via a monitoring programme, but as the storage units are closed, the floors are considered not contaminated. These are the same conditions as for building 249 today.

The receiving station and the A-lab do not significantly add water, which may contain activity to the quantities processed in the evaporator today. No changes are expected in the volumes in these two facilities in the future.

2.3.3 Climate

Climate change and sea level rise

Any rising sea level will flood parts of Risø's low-lying area around the peninsula and along the coast. A rising sea level will change the balance between freshwater and seawater in the coastal zone. Increasing rainfall will also affect this balance. A rising sea level may affect coastal erosion and, combined with extreme storm events and floods, increased degradation and material transport may occur.

The storm Bodil caused a water level of +2.06 m in Roskilde Fjord. The nuclear regulatory authorities have given an enforcement notice for securing the existing storage facilities at an elevation level of +3.06 m. In order to have extra safety against hydraulic buoyancy, if the water level should reach the lower edge of the floor, it is planned that the NUSF should be built in elevation level +4.00.

2.4 Waste

2.4.1 Waste from demolition of buildings and facilities

When existing buildings and facilities are measured, the buildings can be reused for other purposes. If, after decommissioning the buildings, which are demolished, PCB, lead and asbestos are present in the buildings, this will at the demolition be removed and sorted in accordance with applying regulations.

As far as we know, the buildings and basins are all constructed with a pile foundation. The individual buildings and structures must be evaluated separately, having different depths of terrain before reaching their pile foundation.

2.5 Landscape, recreational conditions, architecture and archaeology

The Risø area is facing Roskilde Fjord approx. 2.5 km north of Roskilde's city boundary on both sides of Frederiksborgvej. The area is divided into the peninsula, the coastal area and the land area.

The western part of the *island, where the NUSF is planned to be established*, is in the range from approx. elevation level +3 and +4.5 m closest to the coastal area and to elevation level +9 at the slope towards the fjord. The coastal area is situated between the high part of the island to the west and the land area to the east, and the elevation levels in this area ranges from +1 to +3 metres. The land area rises from the coastal area up to elevation level +13 m at Frederiksborgvej.

The avenue, which runs east-west through the area, is a notable landscape feature. When the avenue needs to be replaced, due to age, it will affect the landscape and the visual appearance of the area until a new avenue grows and takes on character. In addition, there are some areas with trees and scrubs and larger open areas with wetland vegetation and salt meadows. There is no public access to the Risø area, as the area is surrounded by a security fence with a gatekeeper. But in connection with visits, walks in the area may be arranged. In connection with the planned exhibition facility, tours in the area may also be arranged.

Architecturally, the area is characterised by different styles over time and by the special activities that have taken place in the area. Many buildings are in one or two floors. On the land part, which is situated higher than the island part, some buildings are up to 12 metres above ground, corresponding to a roof elevation level of +25-26. On the island part, the reactor buildings reach the same elevation level (terrain level 4.5, building height of DR 3, 23 metres).

Coming from the south of Roskilde, DR 2 is the dominant building, but the avenue behind it hides DR 3. From the north, building 227, 214 and DR 3 are clearly visible and the avenue hides DR 2.

It is estimated that there will be significant visual impacts from the establishment of the NUSF in the Risø area, which will characterise the landscape experience of the fjord (see next paragraph).

Once the location of the NUSF is known, and it is therefore decided how to found it, contact will be made to Roskilde Museum for a review of the area. In connection with the construction of Risø, large quantities of sand were pumped onto the island part to raise the terrain to the current elevation levels. This means that excavations for elevation level +3.5 (floor elevation level +4) will be the excavation of material that was pumped in. Elsewhere, piles will protrude over the current terrain and thus no excavation will be required.

2.5.1 Visual effects of the NUSF

The new buildings will be visible from the immediate surroundings and may affect the landscape experience. The potential impact will be illustrated by preparing visualisations that show the storage facility from selected photo points in the surroundings where most people go, from the fjord (the excursion boat M/S Sagafjord) and from Bognæs (Skjoldungernes Land National Park).

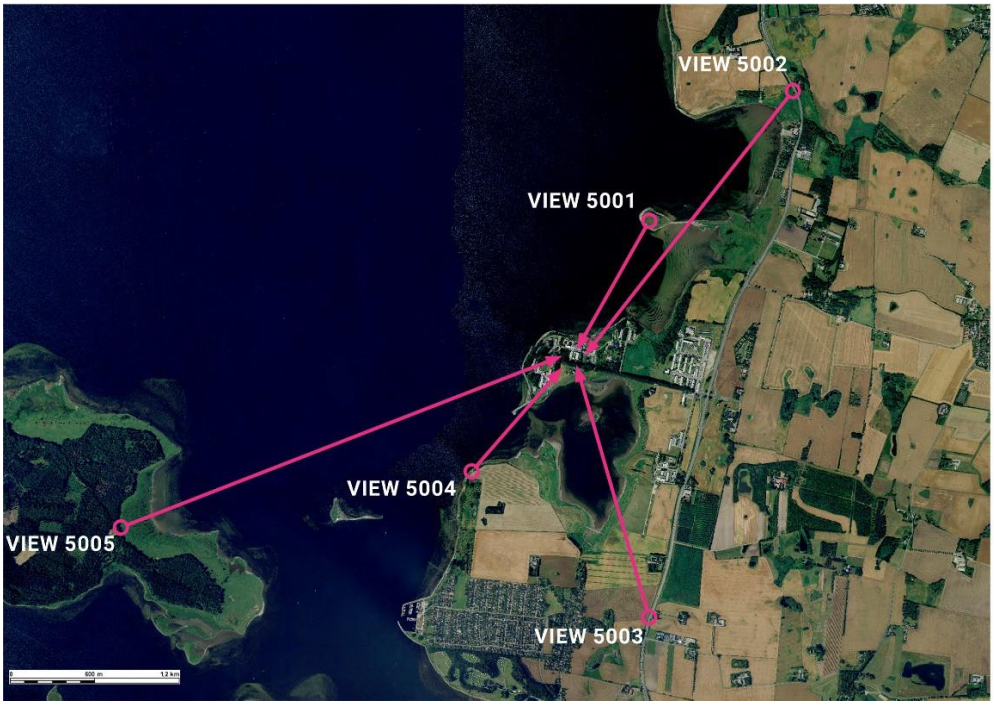

Figure 3. Viewpoints from which visualisations are expected to be prepared, showing the visual impact of the new, upgraded storage facility.

3. Options and reference scenario (described overall)

In 2018, the Danish Parliament decided that the waste should remain at Risø until 2073. Therefore, no other sites are in play.

Discussions with DTU, AU and the Danish Building and Property Agency, as well as DTU's relocation from some of the island part, have shown that the greatest flexibility is provided if the waste remains on the island part of Risø.

The chosen location of the NUSF is made based on the desire to obtain a complete storage facility as soon as possible, with the least possible demolition, and meeting the requirements set by the authorities for high water protection etc.

The starting point for the size of the NUSF building field is that steel containers and ISO containers can be stacked by four in height corresponding to the permit granted to DD in building 249. It is also a prerequisite that a crane solution and not a truck solution is chosen, as this only allows for moving a maximum of 3 storage units to get hold of the container, which is to be used.

If it is not possible to stack 4 units in height, but only three, the storage facility ground area will be 25% larger. The outcome of, among other things, the geotechnical investigations may provide a different design of the building or the need to divide the storage facility into several buildings. The final design is not known before the feasibility studies have been completed and the NUSF has been designed.

Theoretically, the existing storage facilities could be retained and a supplementary storage facility could be built with the missing capacity (approx. half of the NUSF). However, this solution provides two to three locations with storage facilities, which is not appropriate. In addition, this will mean that the existing storage facilities must be high water protected with dykes and pumping stations, the buildings must be sealed and insulated, and climate control must be installed.

For example, the nuclear regulatory authorities have issued an enforcement notice about high water protection of building 244 to a water level in the fjord of 3.06. This is complied with by means of an emergency team that can place a watertube around the storage facility if a water level of more than 2 metres is forecasted. With a smaller organisation, this emergency team cannot be maintained, nor is the solution a viable solution for a period of 50 years. Furthermore, building 244 is not insulated and not tight, which means that this building in any case is not an optimal waste storage facility.

Building 249 was built in the year 2004 and with the expectation that it should only stand for approx. 15 years, because then the waste would be transferred to a final depot. The layout of the storage facility is not optimal. If the inner storage unit is to be retrieved, all those in front if it must first be moved out in the open and afterwards put back in place.

Both building 244 and 249 have been expanded once, and in order for the decommissioning not to come to a standstill, 249 must either be slightly expanded or another storage facility must be found at Risø.

For all storage facilities goes that the waste must be moved before the buildings can be decommissioned and measured for release.

As DD would like to be able to decommission all buildings that have been in operation during the Risø era, it is therefore necessary to provide some storage space that will solve the various problems.

Therefore, the solution is to establish a single storage facility for all waste. A tight and solid building, with no windows, so that it is possible to control humidity and temperature. The floor elevation level is chosen to +4 in order to provide a little extra high water protection, the nature of the waste taken into account.

DTU's relocation also provides the opportunity to pool DD's other activities after the decommissioning, as equipment must also be moved from the existing location so that the current building can be decommissioned.

On this basis, there are no real alternatives to establishing the NUSF as a complete building unit on the western part of the "island".

4. Relations to other legislation and planning

The project area is covered by:

- Municipal Plan 2016 for Roskilde Municipality and Partial Town Planning By-law no. 45 from 1977. Roskilde Municipality is the authority for the municipal plan and the district plan and has decided that new municipal plan frameworks and a new district plan for the project must be prepared.
- The project area is covered by the Fingerplan 2017 for the metropolitan area planning. The project does not conflict with the Fingerplan.
- The Danish Environmental Protection Agency is the authority for the environmental impact assessment.
- SIS (The National Institute of Radiation Protection under the Danish Health Authority) and the Danish Emergency Management Agency constitute the nuclear regulatory authorities, which have issued the conditions for the operation and decommissioning of the nuclear facilities at Risø.

- Radiation protection in The Danish Health Authority and the Danish Emergency Management Agency ensure that the work is carried out in a safe and sound manner regarding radiation protection and safety conditions, and they must approve a safety assessment of the project.
- Moreover, Roskilde Municipality is the environmental authority for Risø.

The project area is also covered by the following plans:

- The Wastewater Plan 2015-21 for Roskilde Municipality
- The Water Supply Plan 2018-2025 for Roskilde Municipality
- The River Basin Plan 2015-2021 for River Basin District Zealand
- Strategic Energy Plan for Roskilde Municipality
- Circular Waste-Resource Plans for Roskilde Municipality 2015-2024

The project area is furthermore covered by the following legislation:

- The Planning Act, No. 287 of 16/04/2018
- Regulation of the Environmental Goals Act, etc. for International Nature Conservation Areas (Environmental Targets Act), No. 119 of 26/01/2017
- Regulation on the Designation and Administration of International Nature Conservation Areas and the Protection of Certain Species, Act no. 1595 of 06/12/2018
- The Nature Protection Act, No. 240 of 13/03/2019
- The Museum Act, No. 358 of 08/04/2014
- The Hunting and Wildlife Management Act, No. 265 of 21/03/2019
- The Environmental Protection Act, No. 241 of 13/03/2019
- The Water Supply Act, etc., No. 118 of 22/02/2018
- The Polluted Land Act, No. 282 of 27/03/2017
- The Regulation of Notification and Documentation in connection with Land Transfer, Act no. 1452 of 07/12/2015
- Act No. 170 of 16 May 1962 on Nuclear Facilities
- Act No. 244 of 12 May 1976 on the Safety and Environmental Conditions of Nuclear Facilities
- Regulation No. 278 of 27 June 1963 on Safeguard Measures against Accidents in Nuclear Facilities etc. with amendments in the Ministry of the Environment's Regulation No. 502 of 1 October 1974
- Act No. 23 of 15 January 2018 on Ionising Radiation and Radiation Protection (The Radiation Protection Act)
- The Radiation Protection Act and the Radioactivity Act

5. Sources

- Regulation No. 1225 of 25/10/2018
- Decommissioning of Risø's nuclear facilities, HUR, March 2003
- The Risø area: Geology and groundwater assessed in connection with the final depot project, GEUS 9.10.2012
- SIS (The National Institute of Radiation Protection under the Danish Health Authority) and the Danish Emergency Management Agency
- Parliamentary Resolution B 48 (2002/1 BSV 48)
- Parliamentary Resolution B 90 (2017/1 BSV 90)
- Act on Ionising Radiation and Radiation Protection (the Radiation Protection Act), Act No. 23 of 15/01/2018 and related regulations
- Regulation on Environmental Assessment of Plans and Programmes and of Specific Projects (EIA), Act No. 1225 of 25/10/2018

BM/MODA