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JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

National Report from Denmark
Fifth Review Meeting, 11 - 22 May 2015

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive waste Management – National Report from Denmark

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Section A. Introduction

Denmark signed the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management 29 September 1997, the day it opened for signature. The Convention was accepted 3 September 1999 by letter from the Ministry of Foreign Affairs to the International Atomic Energy Agency (IAEA). Until further notice the Convention does not apply for the autonomous territories Greenland and the Faroe Islands.

The present report is the Danish National Report for the Fifth Review Meeting to the Convention. The meeting takes place 11-22 May 2015 at IAEA headquarters, Vienna. As described in the Guidelines regarding the Form and Structure of National Reports, (INFCIRC/604 rev. 2, 07 September 2012) duplication within the reporting, including repetition of former reports, should be avoided. At the same time it is stated that the report should be a stand-alone report. Consequently, Denmark has in this report decided to focus on what is considered highlights and new developments since the National Report from the Fourth Review Meeting. Readers wishing a more detailed description of the Danish practices and understanding of the development before 2012 will find the former reports as well as the questions and answers submitted via the homepage for the Joint Convention[1].

Main developments since the 2012 meeting fall within the following areas of work: 1) decommissioning of Danish Reactor 3 (DR 3), 2) decommissioning of the Fuel Fabrication Facility and 3) the process leading to a final management solution for LILW (Low and Intermediate Level Waste). Below, the current status is briefly summarised.

The Danish nuclear facilities are all located on the Risoe peninsula to the North of Roskilde. Decommissioning works have been in progress since 2003, when operation and decommissioning of the nuclear facilities, as well as continued waste management at the Waste Management Plant was transferred to Danish Decommissioning. DR 1 (Danish Reactor 1) is fully decommissioned and released from regulatory control. As of 2008, DR 2 is also fully decommissioned, but the reactor building has not been released from regulatory control, as it serves as a handling and storage hall for work associated with the decommissioning of the Hot Cell facility and of DR 3. With respect to DR 3, a plan for the complete decommissioning to »green field« was approved by the Nuclear Regulatory Authorities in December 2011. Decommissioning work is in progress, and opening of the reactor tank, by removal of the “Top Shield Plug”, was completed in May 2014. The plan for decommissioning of the Fuel Fabrication Facility was approved by the Nuclear Regulatory Authorities in August 2013 and decommissioning is expected to be completed by the end of 2014. At the Hot Cell facility, reconstruction of the air handling system according to ISO-standard no. 17873 is in progress, while design and test of the remote handling equipment intended for decontamination of the cell interior walls is underway. An overview of facilities and their decommissioning status is given in figure 1 and in table 2 in section D of this report.

Since the spring 2012 meeting, the plan to establish a Danish repository for Low and Intermediate Level Waste (LILW) has been supplemented with two additional lines of effort; a survey of the basis for, and implications of, establishing a long term storage solution for the Danish LILW, and an effort to explore the options for an international solution for all of the Danish LILW. The three lines of work are conducted in parallel so as to ensure a minimum delay in the efforts to establish a long term solution

[1] http://www-ns.iaea.org/conventions/waste-jointconvention.htm

for management of radioactive waste in Denmark. The background and details in the sequence of events leading to this situation is outlined in later sections of this report.

The present report also considers the challenges mentioned in the Rapporteur's Report for Denmark at the 2012 meeting:

- Increased demands for maintenance of competence during decommissioning of the Hot Cells and DR 3.
- Hot Cell decontamination and dismantling of the inner parts of DR 3.
- Disposal solution for minimal remaining spent fuel (international or planned Danish repository).
- Public involvement and participation during siting of repository

The report is prepared by the National Institute of Radiation Protection under the Danish Health and Medicines Authority in co-operation with Danish Decommissioning and the Nuclear Division of the Danish Emergency Management Agency. The report demonstrates that Denmark meets all obligations of the Convention.

Section B. Policies and Practices

Please refer to the previous National Reports[2].

The policy and practice for radioactive waste management is to collect, characterize, manage and store all Danish radioactive waste under safe and secure conditions in dedicated storage facilities under responsibility of Danish Decommissioning.

The availability of adequate financial resources is assured also in the future, inasmuch as Danish Decommissioning is government property under the administration of the Ministry of Higher Education and Science. Thus the financial capacity to maintain and, if necessary, improve the safety of facilities for spent fuel and radioactive waste management in accordance with the regulatory requirements is ensured.

[2] National Reports from Denmark:

Joint Convention Report 2003.pdf

Joint Convention Report 2005.pdf

Joint Convention Report 2008.pdf

Joint Convention Report 2011.pdf

Section C. Scope of Application

As Contracting Party to the Joint Convention Denmark has declared that:

- Reprocessing is not part of the spent fuel management.
- Waste that contains only naturally occurring radioactive materials is not radioactive waste for the purpose of the Convention.
- Spent fuel or radioactive waste within military or defence programmes is not spent fuel or radioactive waste for the purpose of the Convention.

However, waste that contains only naturally occurring radioactive materials as well as radioactive waste from the Danish military or defence programmes, is managed identically to the radioactive waste described in this report, as this kind of waste in Denmark is covered by the legislative and regulatory system mentioned in section E.

Section D. Inventories and Lists

Article 32. Reporting

D.1 Spent fuel management facilities

There is no new development regarding spent fuel. The present situation is described below.

There are no spent fuel management facilities in Denmark subject to the Convention. However, minor amounts of spent fuel are stored, under safe and secure conditions with appropriate surveillance, at the storage facilities for radioactive waste at Danish Decommissioning. Special precautions for heat dissipation are not necessary for these materials. An inventory of the stored spent fuel is given in Table 1.

Table 1. Inventory of spent fuel. Activities as of June 2008, list updated 2014.

Spent fuel	Storage facility	Material	Mass/ Volume	Activity
Spent fuel from DR 1	DR 3 building complex	Solution of 20% enriched uranyl sulphate in light water	4.9 kg U 15.8 l	50 GBq fission products 0,4 GBq actinides
Experimentally irradiated spent fuel of power reactor type	The Centralvej Storage	Uranium oxide pellets mostly in zircalloy tube	233 kg U	758 TBq fission products 32 TBq actinides

D.2 Radioactive waste management facilities

An overview of nuclear facilities and associated buildings at Danish Decommissioning is given in Figure 1, and listed in Table 2.

The extended Low Level Waste Storage taken into use in 2008 accommodates approximately 1,200 drums of Short Lived LILW (LILW-SL) (Table 2). The storage also comprises a facility for repackaging of corroded and old drums. The repackaged drums are eventually transferred to The Intermediate Storage.

A new waste reception facility for radioactive waste from external producers has been established at the Waste Management Plant.

Following inspection and approval by the Nuclear Regulatory Authorities ultimo 2005, the Radiological Characterization Lab (A-lab) for sampling and characterisation of materials from facilities, buildings, and areas has in 2010 undergone external audit of quality assurance according to DS/EN ISO 9001: 2008. All filled drums intended for storage in the Low Level Storage facility are characterized using Ge-detectors prior to storage.

The Clearance Laboratory (F-lab) for decommissioning waste upholds an independent accreditation (ISO/IEC 17025) of the lab, granted by DANAK in 2007, and confirmed during the latest audit in 2013. The Clearance Laboratory handles clearance tasks with no restrictions on the amount or type of decommissioning waste.

Since the publication of the last National Report, a total mass of 167 tons of material has passed the clearance criteria and has been released from regulatory control.

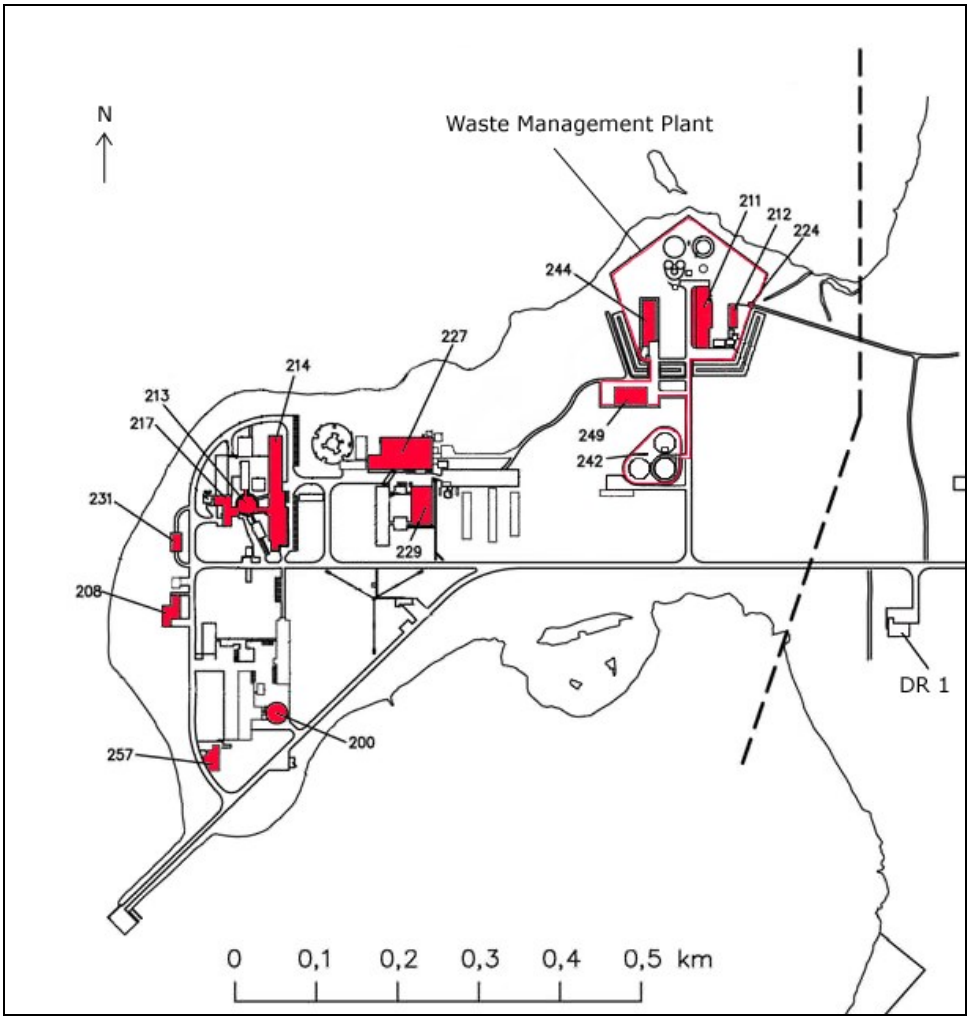

Figure 1. Nuclear facilities and associated buildings at Danish Decommissioning. Names of buildings in Danish as well as English are listed in Table 2. Danish names refer to nomenclature used in previous reports. The stippled line delineates the evacuation zone of Danish Decommissioning to the West (left).

An inventory of radioactive waste subject to the Convention is given in Table 3 for conditioned waste and in Table 4 for unconditioned waste. Table 5 shows secondary waste (waste with a non-decommissioning origin) as well as unconditioned waste received from external producers.
The inventory of conditioned LILW-SL waste stored at The Low Level Waste Storage remains essentially unchanged compared to previous years (Table 3).The amount of unconditioned waste stored at The Intermediate Storage (Table 4) is less than listed in the last report, mainly due to conditioning (decontamination followed by release from regulatory control), re-packaging and relocation to other storage facilities. The activity stored at The Intermediate Storage is updated based on gamma-spectrometry measurements conducted in the spring of 2014.

Table 2. List of buildings at Danish Decommissioning

Building	Danish designation (used in previous reports)	English designation
200	H-hallen (DR 2, reaktorhal)	DR 2 Reactor Containment Hall
208	Aktivt Laboratorium	Radiological Characterization Lab (A-lab)
211	Behandlingsstationen	Waste Management Plant, Main Building
212	Tromlelager	Drum Storage (w. drum press)
213	DR 3, reaktorhal	DR 3 Reactor Containment Hall
214	Danish Decommissioning kontor, AH-hal	Danish Decommissioning Offices, DR 3 Active Handling Hall
217	DR 3, driftsbygning	DR 3 (auxiliary building) and Decontamination Cabinet
224	Lager for radioaktive væsker	Radioactive Liquids Storage
227	Hot Cell og Fiberlab	Hot Cells / Materials Research Laboratory
229	Teknologihallen	Fuel Fabrication Facility
231	Centralvejslager	The Centralvej Storage
242	Tailingsbassiner	Tailings and Ore
244	Lager for Lavaktivt Affald	Low Level Waste Storage
249	Mellemlager og Bufferlager	The Intermediate Storage
257	Frigivelseslaboratorium	Clearance Laboratory (F-lab)

Table 3. Inventory of conditioned radioactive waste stored at Danish Decommissioning, classified as low and intermediate level waste - short lived (LILW-SL).

Storage facility	Volume (m^3)	Activity (TBq)
Low Level Waste Storage	~1,200	5

Table 4. Inventory of unconditioned radioactive waste stored at Danish Decommissioning as of August 2014, classified as low and intermediate level waste - long lived (LILW-LL).

Storage facility	Mass (tons)	Activity (TBq)
Drum Store and The Centralvej Storage	~127	430*
Taillings and ore	4,800	0,1
The Intermediate Storage	719	117**

** Includes 18 TBq LL β/γ-emitters and 4 TBq α-emitters. The mass of this waste inventory is presently being updated.*
*** Calculation based on new gamma spectrometry measurements on the most active waste components, April 2014*

The substantial increase in inventory at The Intermediate Storage (4 TBq estimate reported in the fourth national report) can be assigned to the former reactor tank seal from Danish Reactor 3 (DR 3), the Top Shield Plug (TSP), now stored in this facility. The inventory of TSP consists of 84 TBq longlived $\beta-$ and $\gamma-$emitters and 32 TBq shortlived $\alpha-$, $\beta-$ and γ-emitters. The 4 TBq estimated inventory of waste units other than the TSP has been adjusted to ~1 TBq as a result of the newly conducted gamma spectrometric survey.

Table 5. Unconditioned waste produced/received (decommissioning waste not included).

Year	2011	2012	2013
Secondary waste (tons)	2,6	2,0	0,4
Waste received from external waste producers (tons)	2,6	3,8	5,6

Secondary waste consists of waste generated from use of consumables (lab coats, gloves, etc.) during the decommissioning activities. Decommissioning waste consists of dismantled parts, building components, etc. from the dismantling and demolition of the nuclear facilities. Quantities of Waste received from external waste producers generally vary between 2 and 6 tons per year, and the amounts received since the last report are thus within the normal range.

D.3 Nuclear facilities under decommissioning

Challenges highlighted in the 2012 Rapporteur's Report were the decontamination of Hot Cells and the dismantling of the inner parts of DR 3. The decommissioning is proceeding and in the following a brief status of already completed work, as well as an account of progress with ongoing decommissioning work, is given.

The smallest reactor DR 1 is fully decommissioned and the building has been released from regulatory control. As of 2008, DR 2 is also fully decommissioned, but the reactor building has not been released from regulatory control, as it serves as a waste handling area. With respect to DR 3, a plan for the complete decommissioning to »green field« was approved by the Nuclear Regulatory Authorities in

December 2011. Decommissioning work is in progress, and opening of the reactor tank, by removal of the Top Shield Plug, was completed in May 2014. The plan for decommissioning of the Fuel Fabrication Facility was approved by the Nuclear Regulatory Authorities in August 2013 and decommissioning is expected to be completed by the end of 2014. At the Hot Cell facility, reconstruction of the air handling system according to ISO-standard no. 17873 is in progress, while design and test of the remote handling equipment for a revised method of decontamination of the cell interior walls is underway.

The status of decommissioning of nuclear facilities at the Risoe peninsula is given in Table 6 and described in further detail for DR 3, the Fuel Fabrication Facility and the Hot Cell facility in the subsections below.

Table 6. Nuclear facilities under decommissioning (updated August 2014).

Nuclear facility	Type	Taken out of operation	Decommissioning status
DR 1	Small homogeneous 2 kW reactor mainly used for educational purposes	2001	Fully decommissioned and released from regulatory control in 2006.
DR 2	5 MW research reactor of the open pool type	1975	Reactor fully decommissioned, but the building serves as waste handling area
DR 3	10 MW heavy water research reactor of the PLUTO type	2000	Final decommissioning plan approved by Nuclear Regulatory Authorities December 2011. Decommissioning of peripheral systems completed. Reactor tank opened and dismantling of reactor internals and biological shield underway.
Hot Cells	Facility for post irradiation investigations of nuclear fuel	1989	Final decommissioning plan approved by Nuclear Regulatory Authorities in spring 2008. Upgrade of the air handling system and design and test of the remote handling equipment for decontamination of the cell interior walls is underway.
Fuel fabrication	Fuel fabrication facilities for DR 2 and DR 3	2002	Plan for decommissioning to »green field« approved by Nuclear Regulatory Authorities in August 2013 and decommissioning is expected to be completed by the end of 2014.

D.3.1 Danish Reactor 1 (DR 1)

After regulatory approval of the specific decommissioning plan in mid 2004, DR 1 was successfully dismantled and demolished in 2005. On the basis of a detailed final decommissioning report[3] presented by Danish Decommissioning in late 2005, the Nuclear Regulatory Authorities finally released the building and area from regulatory control in 2006. A further summary of the

[3] Decommissioning of DR1.pdf

decommissioning process for DR 1 including the findings of a “lessons learned” study is available in the Third National Report to the Convention[4].

D.3.2 Danish Reactor 2 (DR 2)

After regulatory approval of the specific decommissioning plan in late 2005, DR 2 was successfully dismantled and demolished from 2006 to early 2008. A final decommissioning report was submitted by Danish Decommissioning to the Nuclear Regulatory Authorities for approval in October 2008[5]. The building now serves as waste handling area. The building will remain under regulatory control until this use is terminated.

D.3.3 Danish Reactor 3 (DR 3)

DR 3 was a 10 MW, heavy water moderated research reactor of the PLUTO type. It was in operation from 1960 to early 2000, and was shut down permanently in the year 2000. A final plan for decommissioning of DR 3 was prepared by Danish Decommissioning based on an extensive method selection study. The plan takes into account comments supplied by a group of international experts asked to review the suggested procedure. The final decommissioning plan was submitted to the Nuclear Regulatory Authorities in summer 2011 and was approved in December 2011. The plan specifies the overall strategy (sequence and choice of methods) for the decommissioning work. The approval specifies that further detailed descriptions of subprojects, e.g. decommissioning of the reactor inner parts, the biological shield, and the Active Handling Hall, are to be independently prepared and subsequently approved by the Nuclear Regulatory Authorities.

Dismantling operations completed since the last report include:

- Removal of all the peripheral systems
- Removal of the primary cooling system in the D_2O plant room
- Clearing of the reactor top to the master plane level (app. 70 cm)
- Construction and installation of a new Movable Top Shield (MTS)
- Removal of the Top Shield Plug (TSP)
- Cutting of the upper part of the Reactor Aluminium Tank (RAT)
- Method selection study for removal of the biological shield

Figure 2 shows a cross-sectional view of DR 3.

[4] Joint Convention Report 2008.pdf

[5] Decommissioning of DR2.pdf

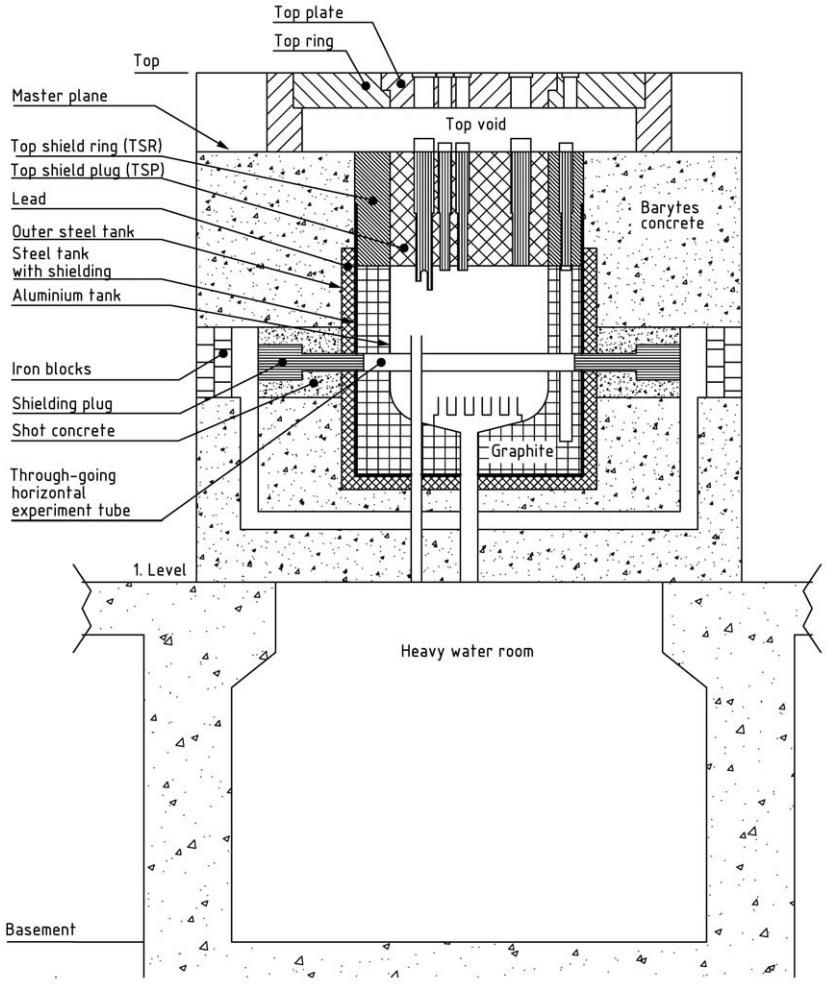

Figure 2. Cross sectional view of DR3

The overall decommissioning works on DR 3 has been based on a phased approach:

Phase 1: Preparatory works:
Dismantling and removal of the remaining peripheral systems (secondary cooling systems, experimental set-ups, and electrical systems). This work took place on the three decks surrounding the reactor block; basement, 1st floor and top deck. The top deck was cleared in 2009. Cleanup of the 1st floor was completed in 2010 with the removal of the so-called “horizontal silicon facility”. Clearing of the basement deck was completed by the end of 2011.

Phase 2: Dismantling of the primary cooling components in the heavy water plant room (figure 3):
This work commenced in late 2011 and was completed by the end of 2012.

Figure 3. Removal of the last heat exchanger from the heavy water plant room. Photo courtesy of Danish Decommissioning.

Phase 3: Dismantling and removal of the inner reactor parts:
The DR3 inner parts include the Top Shield Plug (TSP), Top Shield Ring (TSR), the Reactor Aluminium Tank (RAT) and surrounding graphite reflector, boral plates, inner and outer steel tanks and the lead shielding (figure 2). Preparatory examinations conducted in 2012 showed that the anticipated Co-60 activity resulting from activation of the stainless steel base of the TSP was 4.1 TBq.
Danish Decommissioning carried out a comprehensive analysis of methods to dismantle and remove the internal parts of the reactor. The analysis was presented to an international consultancy panel as well as the Nuclear Regulatory Authorities. The selected method takes into account experiences from application of well tested technical solutions, health physics, conventional safety, waste packaging and minimization of generated secondary waste, and is summarized below:
In preparation of the dismantling of the reactor inner parts, the work platform on the reactor top needed to be cleared to the Master plane level (figure 2). The structures mounted on top of the Master plane were dismantled and removed (figure 4).

Figure 4. Top: Reactor top level. Master plane level is at the blue surface below in the picture. Bottom: Reactor top cleared to Master plane level with storage blocks still in place. Photo courtesy of Danish Decommissioning.

The original seal of the reactor tank consisted of the TSP surrounded by the TSR (figure 2). The upper rim of the RAT formed an integral part of this seal and needed to be separated from the rest of the RAT before the entire sealing assembly of the reactor could be removed. To ensure an efficient seal of

the reactor tank after removal of TSP, a Movable Top Shield (MTS) (figure 5), enabling the reactor opening to be sealed after removal of the TSP was designed. Danish Decommissioning submitted detailed technical documentation for safety features of the MTS and its intended mode of operation for approval by the Nuclear Regulatory Authorities. The approval for a limited range of operations was granted in May 2014. Other operational modes of the MTS, as well as modifications to the design remain subject to approval by the Nuclear Regulatory Authorities.

Figure 5. Movable Top Shield: a sliding platform enabling the reactor opening to be sealed after removal of the TSP. Photo courtesy of Danish Decommissioning.

The planned sequence for removal of the original sealing assembly is described in the overall decommissioning plan for DR3: 1): removal of TSP, 2): cut of the upper rim of RAT and 3): removal of TSR. Prior to commencement of this work, technical safety assessments, work plans and health physical assessments were submitted for approval by the Nuclear Regulatory Authorities. Approval for conducting the removal of TSP was granted in May 2014, and the work successfully carried out by an external contractor in May 2014 (figure 6). Health physical data based on the initial estimate of activity of the TSP predicted collective doses to workers of about 0.5 mSv. Actual registered collective doses amounted to 0.2 mSv.

Figure 6. Final test of lifting procedure for TSP. The TSP was lifted directly from its position on the reactor top into a shielding container. The shielding container was transferred into a transport and storage container and transported to the Danish Decommissioning storage facilities. Photo courtesy of Danish Decommissioning.

Cutting of the upper rim of RAT was conducted in August 2014 (figure 7), and removal of TSR is expected to take place in October 2014 after approval of safety assessments, work plans and health physical assessments by the Nuclear Regulatory Authorities.

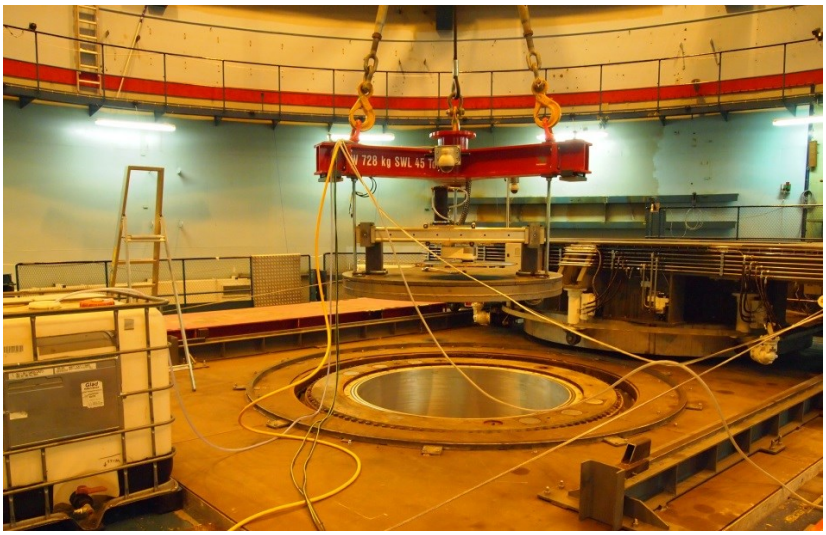

Figure 7. Lowering of the cutting equipment into the reactor opening prior to cutting of the RAT. The MTS with circular shielding plate is viewed in the background. Photo courtesy of Danish Decommissioning.

Following these operations, the dismantling of the RAT and other DR3 inner parts by robotic remote handling is planned as illustrated in figure 8.

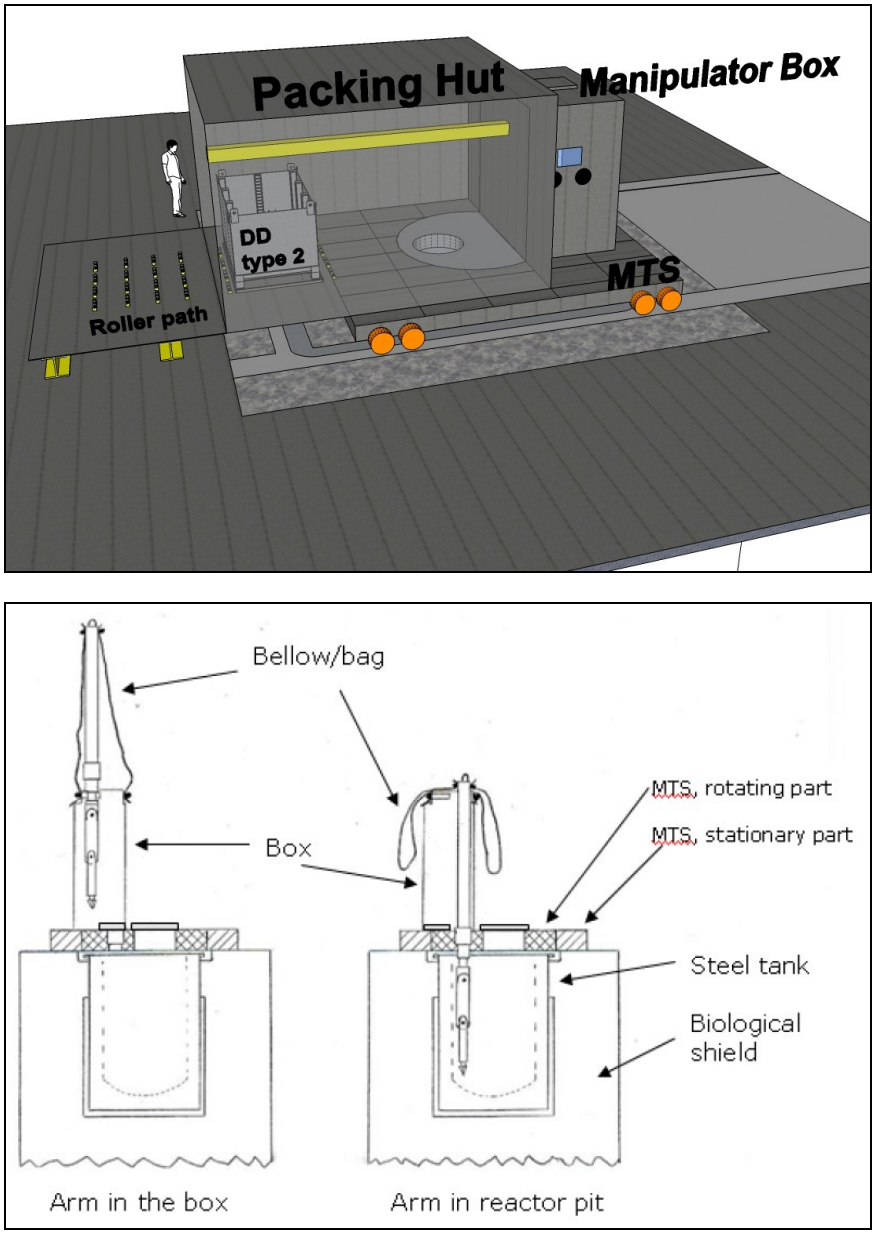

Figure 8. The Movable Top Shield (MTS) is positioned on the reactor top to seal off the reactor tank volume. The Packing Hut based on top of the MTS enables insertion of a robotic tool arm into the reactor tank through the circular opening in the MTS. The opening is located in a rotating part of the MTS such that access to all parts of the reactor tank is facilitated. When not in use, the robotic arm can be retracted and left in stand by position inside a sealed box resting on top of the MTS. Top: Model of intended setup of Moveable Top Shield (MTS), manipulator box and packing hut on top of DR 3. Below: Suggested operation of the robotic tool arm. Source: Danish Decommissioning.

Phase 4: Decommissioning of the biological shield and surrounding buildings.
This phase marks the completion of the decommissioning of DR3. Method selection studies have been carried out, showing the preferred tool for cutting the reactor block barite concrete in blocks is a wall saw, while the steel shot concrete will be demolished by use of a Brokk mounted scabbler.

D.3.4 Hot Cells

The Hot Cells facility was in active use during the period 1964 – 1989. The facility consists of 6 interconnected concrete cells, which were each equipped with master-slave manipulators and lead glass windows. Each cell could be isolated from the next by means of a steel door and could be individually accessed from the back through a set of airtight seal-doors enclosing a concrete plug mounted on a rail system.

The Hot Cells were used for post-irradiation examination of fuel pins irradiated in the DR 3 reactor, the Halden reactor in Norway and other reactors. Power reactor fuel pins, including plutonium enriched pins, from several foreign reactors were examined. A variety of non-destructive and destructive physical and chemical examinations were performed in the facility. In addition, various radiotherapy sources – mainly Co-60 sources - were produced.

In the process, dust containing fission and activation products was released in the cells and settled on workbenches and wall surfaces. Hence, Sr-90 and Cs-137 as well as a number of transuranic α-emitters are still present in the cells. In addition, a number of Co-60 pellets were dropped and not retrieved, and now appear as hot spots on workbenches, transfer ducts and floors.

The overall project plan for decommissioning of the Hot Cells was approved by the Nuclear Regulatory Authorities in the spring of 2008. The intention is to decontaminate the Hot Cell interior steel clad walls by corundum sand blasting. A manually operated arm penetrating the cells through the existing holes in the cell-front will be used for controlling the angle and distance from the sandblasting nozzle to the cell inner walls (figure 9). A similar arm for controlling the suction hose intended to collect the blast material bouncing off the walls is being designed. Mock-up tests using a pre-prototype arm have been carried out and showed very positive results. Blasting tests on the end-pieces of plugs for the holes on cell-fronts have verified that corundum blasting is efficient and can reduce the contamination level to clearance levels also at extreme angles and distances.

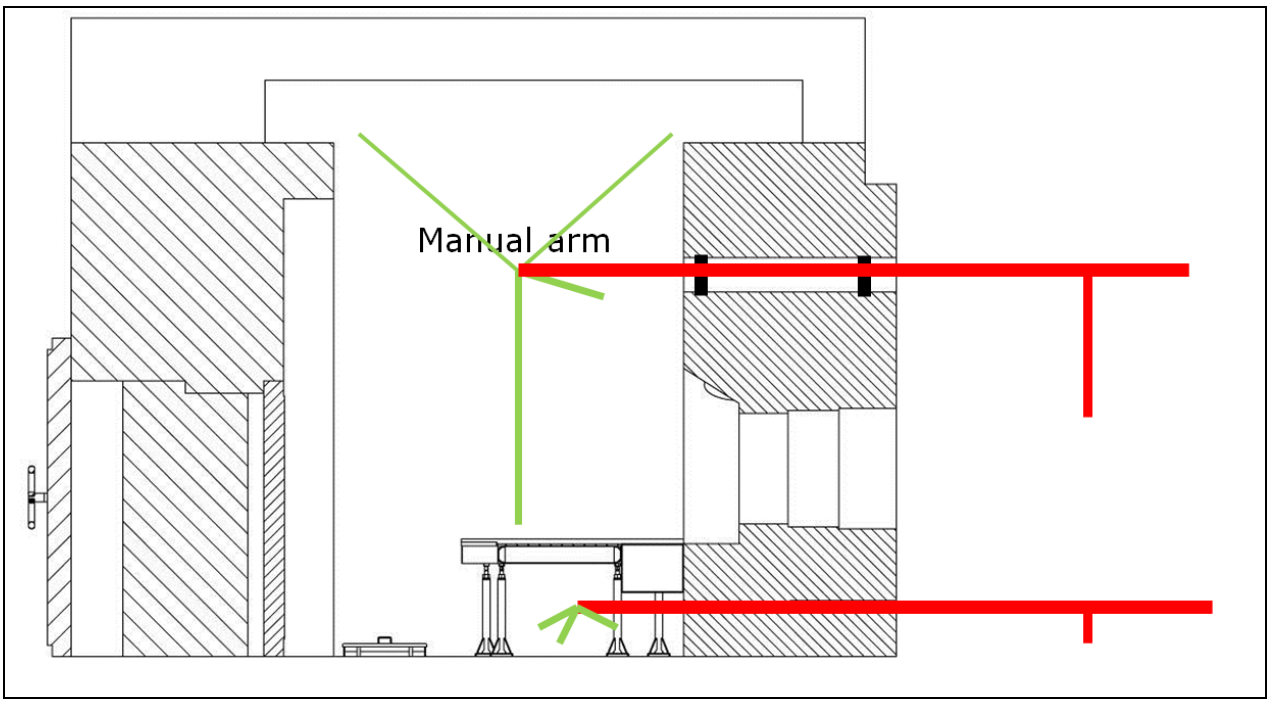

Figure 9. Cross section of a hotcell showing the principle of use for the manual arms. Courtesy of Danish Decommissioning.

The concrete structure, once released from regulatory control, will be left as an integral part of the building structure. Prior to the actual decommissioning work, a new ventilation system for the Hot Cells was established and is now being upgraded according to ISO-standard no. 17873, “Nuclear facilities — Criteria for the design and operation of ventilation systems for nuclear installations other than nuclear reactors”. The upgrade is planned to begin early in 2015.

D.3.5 Fuel Fabrication Facility

The Fuel Fabrication Facility provided fuel elements for DR2 and DR3 as well as prototypes of fuel elements for power reactors until 2002, when production was permanently shut down. All rooms were initially cleaned, but no decommissioning work was carried out. Several pieces of equipment were left in place while others were monitored for contamination and cleaned before being referred to other uses. The Fuel Fabrication Facility was established at a time where the eventual decommissioning was not considered in the design, and the decommissioning of the facility has therefore been addressed through a graded approach taking into account the limited amounts of activity handled at the facility, the initial cleaning efforts and generally low level of risk associated with the task. The remaining tasks associated with the decommissioning of the Fuel Fabrication Facility are monitoring and minor decontamination programs to comply with requirements for release from regulatory control. A limited number of areas and pieces of equipment have been identified as potentially or certainly contaminated, which will be evaluated in terms of suitability for decontamination, volume reduction or disposal. The overall project proposal for decommissioning of the Fuel Fabrication Facility was submitted for approval by the Nuclear Regulatory Authorities in July 2013 after review by a panel member of the international expert advisory panel associated to Danish Decommissioning. Approval of the overall decommissioning plan was granted by the Nuclear Regulatory Authorities in December

2013. The overall decommission plan divides the facility into areas (rooms, equipment, ventilation ducts, drains etc.) that are known to be contaminated, possibly contaminated areas and areas not contaminated (figure 10). The division is based on the plant operation history, interviews with previous employees and radiological characterization.

Figure 10. Radiological classification of ground level areas in the Fuel Fabrication Facility as of 2013: Red – Contaminated. Yellow – Probably contaminated, Blue – Not contaminated, reassurance measurements required, Green – Not contaminated, reassurance measurements not required.

The decommissioning plan outlines a sampling plan for verification of the initial subdivision of areas, and specifies trigger levels for further investigations, and possible decontamination efforts. Areas classified as red or yellow are required to undergo decontamination and/or clearance measurements. Areas classified blue and green require some or no reassurance/clearance measurements. All measurement types and reassurance/clearance protocols are specified in the decommissioning plan. The decommissioning has proceeded according to schedule, and all yellow and blue areas have undergone clearance/reassurance measurements meeting the clearance criteria. The classification of areas in ground level of the Fuel Fabrication Facility as of August 2014 is shown in figure 11. A similar effort of potential decontamination work as well as clearance and reassurance measurements on the first floor of the facility is scheduled.

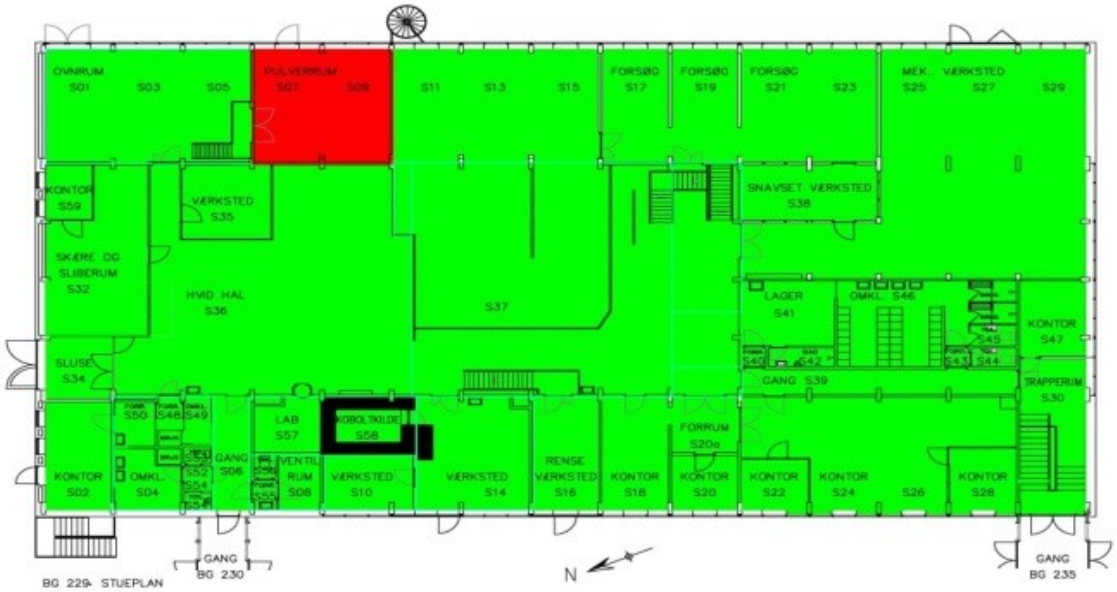

Figure 11. Radiological classification of ground level areas in the Fuel Fabrication Facility as of August 2014.

The decommissioning of the Fuel Fabrication Facility is scheduled to be completed by the end of 2014, by which time a final decommissioning report will be submitted to the Nuclear Regulatory Authorities for approval prior to release from regulatory control.

D.4 International expertise and decommissioning

A representative from the Nuclear Regulatory Authorities participates in the IAEA International Project on Decommissioning Risk Management (DRiMa) which builds on the outcome from the IAEA Project on Use of Safety Assessment Results in Planning and Implementation of Decommissioning of Facilities Using Radioactive Material (FaSa). Furthermore, staff from the Nuclear Regulatory Authorities participate in the IAEA Safety Standards Committees for Radiation Safety (RASSC) and Waste Safety (WASSC).

Representatives from the decommissioning projects at Danish Decommissioning participate in the Technical Advisory Group (TAG) which is a part of a joint project between NEA and OECD: The International Co-operative Program for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD).

Section E. Legislative and Regulatory System

Article 18. Implementing measures

Article 19. Legislative and regulatory framework

The Danish legislation for radioactive waste and spent fuel management is unchanged. A list of relevant Acts, Orders etc. in force by 01 October 2014 is given in Annex 1.
On 09 July 2013, Denmark notified the European Commission about the implementation of Directive 2011/170/Euratom into Danish legislation through the above mentioned Acts, Orders etc., and supplemented by the following documents:

- Order No. 1510 of 15 December 2010 on environmental impact assessment of certain public and private facilities (EIA).
- Circular letter of 21 December 2011 from the Minister for Health to the Nuclear Regulatory Authorities.
- Motion B 48 of 13 March 2003 on the decommissioning of the nuclear facilities at Risø National Laboratory.
- Minister for Health Statement R4 of 15 January 2009 to the Parliament on the basis for decision for a Danish repository for low and intermediate level waste.
- Information from the Minister for Health of 22 January 2013 about the further process for the location of radioactive waste currently stored at Risø.

Article 20. Regulatory body

Please refer to the previous National Reports[6].

The Nuclear Regulatory Authorities have undergone staff reductions and loss of staff, and efforts to mitigate the effects of this ongoing development are needed.

[6] National Report from Denmark,2003, 2005, 2008 and 2011:

Joint Convention Report 2003.pdf

Joint Convention Report 2005.pdf

Joint Convention Report 2008.pdf

Joint Convention Report 2011.pdf

Section F. Other General Safety Provisions

F.1 Responsibility of the licence holder

Article 21. Responsibility of the licence holder

The only Danish waste management facility subject to the convention is located at the Risoe peninsula and is licensed to and operated by Danish Decommissioning. Danish Decommissioning is collaboratively hosted by the Danish Technical University at Risoe (DTU Risø Campus). The property owner is the Danish Building & Property Agency owned by the Danish state.

As written in previous national reports, the Nuclear Installations Act (Section E) assigns the prime responsibility for the safety of a nuclear installation to the licence holder. The related requirements are determined and administered by the Nuclear Regulatory Authorities by means of so-called 'Operational Limits and Conditions' for Danish Decommissioning. As the decommissioning of the nuclear facilities at the Risoe peninsula is ongoing, the Operational Limits and Conditions are progressively updated. In analogy to the ´Operational Limits and Conditions' for Danish Decommissioning, similar conditions have been issued for DTU Risø Campus, addressing the role and obligations of the institution hosting the nuclear facilities at the Risoe peninsula.
Public versions of the ´Operational Limits and Conditions´ are available on the websites of the Nuclear Regulatory Authorities and Danish Decommissioning[7].

Article 22. Human and financial resources

The responsibility for operation and decommissioning of the nuclear facilities, as well as continued waste management at the Waste Management Plant was transferred to Danish Decommissioning from the Risoe National Laboratory in 2003. The staff originally assigned to the decommissioning and for operating the Waste Management Plant was reassigned to Danish Decommissioning assuring qualified and adequate human resources needed for safety related activities during the decommissioning and the operating lifetime of the Waste Management Plant.

The Operational Limits and Conditions for Danish Decommissioning states that every employee at any level in the organisation shall maintain adequate training and instruction necessary to comply with the requirements of the position, in full accordance with the safety provisions prescribed by the Nuclear Regulatory Authorities. As Danish Decommissioning is subject to minor, but continuous staff adjustments and replacements, training courses, seminars, and more extensive classes are therefore undertaken in order to ensure both an adequate level of qualification as well as transfer of relevant experience from skilled members of the staff.

[7] Links to "Operational Limits and Conditions"

Danish Decommissioning, "Operational Limits and Conditions"

DTU Risø Campus, "Operational Limits and Conditions"

For Danish Decommissioning, the availability of adequate financial resources is also assured, inasmuch as the organization is subordinate to the Ministry of Higher Education and Science. Thus the financial provisions to support the safety of facilities for radioactive waste management are in place.

Article 23. Quality assurance

Danish Decommissioning was certified according to ISO 9001 in June 2004. Since then, the quality assurance system for the entire process of decommissioning, including all radioactive waste management has been based on this standard. The system is inspected biannually by Danish Standards (DS) and every third year a complete audit of all certified functions is conducted. Inspection was carried out in 2012 and a full audit in 2013 confirmed the validity of the DS/EN ISO 9001:2008 certification. All audit reports are available to the Nuclear Regulatory Authorities. Danish Decommissioning regularly conducts internal audits as required by the standard.

The Radiological Characterization Lab (A-lab) for sampling and characterisation of materials from facilities, buildings and areas has undergone external audit of quality assurance according to DS/EN ISO 9001: 2008 in 2010. All filled drums intended for storage in the Low Level Storage facility are characterized using Ge-detectors prior to storage.

The Clearance Laboratory (F-lab) for decommissioning waste upholds an independent accreditation (ISO/IEC 17025) of the lab, granted by the Danish Accreditation Fund (DANAK) in 2007, and confirmed during the latest audit in 2012. The present accreditation is valid until 2016. The Clearance Laboratory handles clearance tasks with no restrictions on the amount or type of decommissioning waste.

A computerized Waste Documentation System with bar code identification ensures documentation of inventories and enables real-time spatial tracking of any characterised waste item. In addition, extensive use of colour-coded waste categories, waste containers and waste routes, has successfully minimized the number of waste handlings as well as waste destination errors. The Waste Documentation System simplifies the process of tracking down potential handling errors. The integrity of the system is continually monitored by Danish Decommissioning and reported through a formal bug-tracking system. The maintenance contract with the system supplier ensures an 8 hour response time for urgent problems. Waste registered in previous databases have been reformatted and transferred to Waste Documentation System in order to give a better overview of the total waste inventory.

Article 24. Operational radiation protection

In accordance with the Nuclear Installations Act (1962), Danish Decommissioning is subject to Operational Limits and Conditions, which set out regulations covering all aspects of decommissioning, including administrative structure, project planning and management, detailed operation planning, quality assurance, characterization of radioisotope inventory, operational radiation protection, safety assessment, environmental impact assessment and documentation.

The general principles for operational radiation protection in relation to decommissioning are similar to those applied during operation of the facilities. The operational radiation protection program must comply with the regulations given in Operational Limits and Conditions for Danish Decommissioning.

Accordingly, the mandatory radiation surveillance programs cover all relevant decommissioning operations, and the received doses are reported to the Nuclear Regulatory Authorities for all operational as well as accident conditions.

With respect to personnel at the contractor level, it is the responsibility of Danish Decommissioning to ensure that all relevant personnel are instructed to the necessary level, in order to accomplish the assignments properly in terms of health physics and radiological safety. These conditions are also stated in the Operational Limits and Conditions for Danish Decommissioning and are in full compliance with the legislation concerning dose limits for external workers.

F.2 Discharge

Releases of radioactive materials from the Waste Management Plant are primarily liquid and originate in the radioactive wastewater distillation plant from which the purified liquids are transferred to the inactive waste water system and in turn into Roskilde Fjord.

Since the reactors were taken out of operation, the release of tritium to Roskilde Fjord has been reduced by almost two orders of magnitude and has over the past 5 years averaged values around 100 GBq/y as shown in Figure 12. As facilities containing tritium have been progressively decommissioned, the remaining tritium inventory is low and is discharges are similarly expected to remain so.

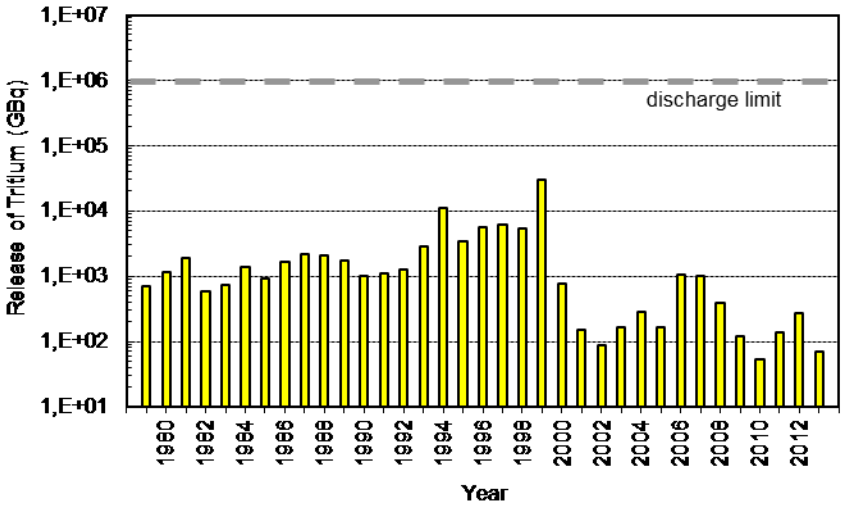

Figure 12. Annual release of tritium into Roskilde Fjord from the Waste Management Plant.

The annual release of activity into Roskilde fjord determined as dissolved gross β/γ-activity has generally been stable at values around 0,1GBq/y since the reactors were taken out of operation. The annual releases, which mainly can be attributed to distillation waste water and overflow from the tailing basins, are shown in Figure 13.

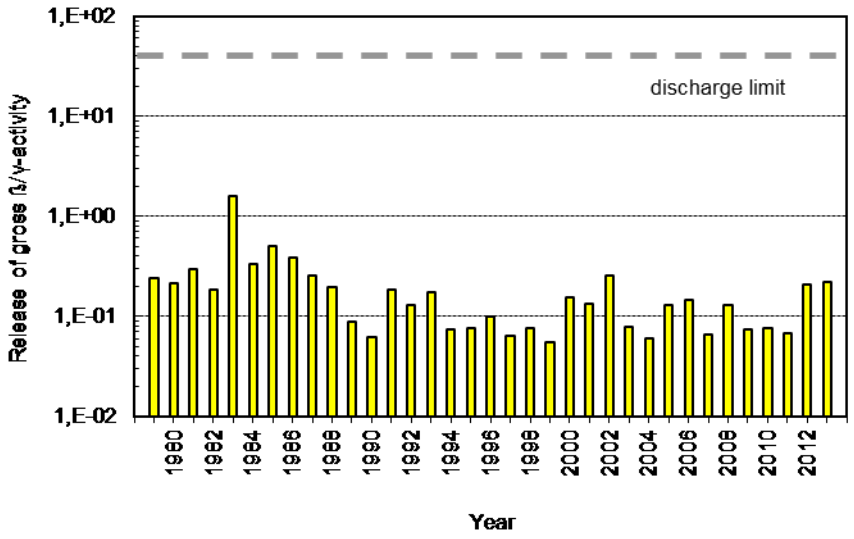

Figure 13. Annual release of gross ß/γ-activity into Roskilde Fjord from the Waste Management Plant.

Article 25. Emergency preparedness

Sector based responsibility is fundamental for the Danish emergency preparedness and, wherever possible, the Danish nuclear emergency preparedness system is based on organisations and preparedness arrangements already in force for other purposes with the adequate amendments regarding special matters within the nuclear area. A revised nationwide nuclear emergency preparedness plan entered into force in 2014.

F.3 Decommissioning

Article 26. Decommissioning

F.3.1 Doses from the decommissioning of DR 1 and DR 2

The decommissioning of DR 1 was finalised in late 2005. A final account of accumulated doses from the decommissioning of DR 1 was given in the final decommissioning report for DR 1 and referred in the third report to the Joint Convention (2008). In summary, Danish Decommissioning personnel

received a total collective dose slightly above 1 person-mSv and no doses were recorded for the external contractors who carried out the concrete demolition.

Decommissioning of DR 2 was finalised during spring 2008. An account of doses and surveillance techniques from this undertaking was reported in the final decommissioning report for DR 2 submitted to the Nuclear Regulatory Authorities in 2009. Staff from Danish Decommissioning received a collective dose 1.6 person-mSv. Staff from the external contractors who carried out the demolition of concrete received a collective dose of 3.2 person-mSv.

F.3.2 Doses from the decommissioning of DR 3, Hot Cells, Fuel Fabrication Facility and work at the Waste Treatment Plant

The maximum individual and collective doses can not be accounted for on the basis of each facility. This is because several workers are involved in multiple projects and hence accumulate doses from working in more than one facility. However, as in the example of decommissioning of DR3, individual doses are monitored for each sub-project in the decommissioning process. The cumulative collective dose, as determined by the sum of read-outs from personal dosimeters, for work associated with decommissioning and waste treatment in the years 2011-2013 was less than 20 person-mSv, with a maximum individual dose of 2.2 mSv.

Section G. Safety of Spent Fuel Management

Article 4. General safety requirements

Article 5. Existing facilities

Article 6. Siting of proposed facilities

Article 7. Design and construction of facilities

Article 8. Assessment of safety of facilities

Article 9. Operation of facilities

Article 10. Disposal of spent fuel

As a consequence of the decision taken by the Danish Parliament in 1985, there are, at present, no considerations or plans for taking any kind of nuclear reactors into operation in Denmark. Thus, there are no plans for siting, designing, constructing or operating spent fuel facilities or for systematic disposal of spent fuel. Spent fuel from the research reactors DR 2 and DR 3 has been transferred to the jurisdiction of USA according to an agreement with the US Department of Energy.

The only exemption from this is the spent fuel from the research reactor DR 1 and about 233 kg of experimentally produced and irradiated spent fuel of power reactor type remaining from post-irradiation investigations in the former Hot Cells. This material is stored under safe and secure conditions awaiting a decision on the final management. The radionuclide inventory occurs with activity concentrations of less than 10^4 TBq/m^3 and heat production from the waste in its originally designed waste packages is less than 1 kW/m^3. Storage of this material thus requires no special precautions regarding heat dissipation. The storage does not give rise to any discharges of radioactive materials to the environment and hence no exposure of the public.

Denmark has since the Fourth Review Meeting continued the search for an international solution regarding the above mentioned 233 kg, but until now this effort has proven unsuccessful. If an international solution cannot be found, the option for Denmark will be to place the waste in intermediate storage, or to dispose of it in a Danish repository for low and intermediate level radioactive waste. Therefore, in the planning for a potential intermediate storage solution as well as a final repository, the spent fuel from the research reactor DR 1 and the 233 kg of experimentally produced and irradiated spent fuel is considered part of the waste volume to be stored or disposed of; see section H for further details.

Section H. Safety of Radioactive Waste Management

Article 11. General safety requirements

Article 12. Existing facilities and past practices

Article 13. Siting of proposed facilities

Article 14. Design and construction of facilities

Article 15. Assessment of safety of facilities

At Danish Decommissioning, all radioactive waste related to the decommissioning activities as well as all other radioactive waste produced in Denmark is stored under safe and secure conditions in one of the following facilities: the Low Level Waste Storage, the 'Centralvej' Storage, the Drum Storage, the Intermediate Storage, Radioactive Liquids Storage or Tailings and Ore.

Waste storage facilities are inspected by the Nuclear Regulatory Authorities on a routine basis with a maximum interval of 6 to 12 months. Furthermore, Danish Decommissioning conducts internal reviews to verify compliance with Operational Limits and Conditions and all other operational instructions at the waste storage facilities.

The 2012 Rapporteur's Report for Denmark lists the public involvement and participation during the siting of a repository for LILW as a challenge. This links to the challenge in the 2009 Rapporteur's Report regarding the process of establishing a final LILW repository. As mentioned in the introduction of the present report, the plan to establish a Danish repository has been supplemented with two additional lines of effort; a survey of the basis for, and implications of, establishing a long term storage solution (intermediate storage) for all of the Danish radioactive waste, as well as an exploration of the options for an international solution for all of the Danish radioactive waste. The three lines of work are conducted in parallel to ensure a minimum delay in the efforts to establish a long term solution for management of radioactive waste in Denmark. The background for this situation is described below, followed by an account of the state of progress for each of the three tracks.

The Danish Parliament agreed unanimously in March 2003 to initiate the preparation of a 'Basis for Decision' for the establishment of a Danish disposal facility for LILW.
The 'Basis for Decision' describes the background, requirements and scope of the project to the decision makers at the political level as well as stakeholders, taking legal aspects, foreign experiences and the amount and type of waste to be deposited into account. It also suggests various design solutions and describes a way forward for the siting process including stakeholder involvement.
The 'Basis for Decision' was finalized by a cross-ministerial Working Group in late 2008 and submitted to the Danish Parliament. In 2009, the Danish Parliament supported initiation of the recommended process, of which the initial step was the preparation of three preliminary studies; a technical survey of disposal concepts, a radiological risk assessment for transport of radioactive waste in Denmark and a geological siting survey to identify potential disposal areas.

The results of the preliminary studies were presented in May 2011 to the parties in the Danish Parliament, the municipalities and in the media to the public with the following main conclusions: The study of disposal concepts presented design solutions and generic construction concepts found to be consistent with pre-specified safety requirements. The transport study demonstrated that assessed

radiological risks associated with transport place no constraints on the selection of a site. The findings of the geological siting survey pointed out 22 potential areas in Denmark for a future repository, and identified 6 of these areas as geologically more suitable for hosting a repository.

All parties in the Danish Parliament expressed continued support to proceed with the project as planned. However, an extensive public and local political debate arose, and in January 2013 the Ministry of Health, as chair of the cross-ministerial Working Group presented a revised scheme for defining a long term management solution for the Danish radioactive waste. According to this scheme, the initial efforts for establishing a Danish repository were to be continued. In addition, the basis for, and implications of, establishing a long term storage solution (intermediate storage) for all of the Danish radioactive waste was to be explored. Lastly, the options for an international solution for all of the Danish radioactive waste were to be investigated. The Ministry of Health was charged with the task of overseeing progress of these 3 parallel tracks with the support from relevant ministries, departments, agencies and operators. Progress of these three lines of effort is expected to be presented towards the end of 2014, after which time a political decision regarding which line to pursue is expected to be made

Below, the state of progress of each of the three tracks is presented.

H.1 Danish repository for low and intermediate level waste

In the last report, a detailed account of legal aspects, waste inventory, safety principles, the findings of the preliminary studies and the site selection process was given. Hence, in the following, only a shorter summary of these findings will be given, followed by an account of events since the last report.

H.1.1 Waste characteristics - overview

The Danish radioactive waste originates partly from nuclear research and decommissioning of the related facilities and partly from other Danish users of radioactive materials, e.g. the industry, health and research sectors. Estimates of the inventory of waste intended for disposal in a Danish repository were prepared in 2008 and are currently considered for revision based on the results from the an on-going waste characterisation program. The estimates as of 2008 are shown in figure 14.

The waste category “Decommissioning” presented in figure 14 refers to waste already generated and expected to arise during the decommissioning of the nuclear facilities, while the other categories refer to waste already in existence. All decommissioning waste belongs to the categories of Low or Intermediate Level Waste. The category “low level” refers to the inventory stored at the Low Level Waste Storage. The majority of the special waste is classified as Intermediate Level Waste and consists of the following units: 233 kg of experimentally irradiated uranium, 4.9 kg 19.9 % uranium in a 15.8 l solution equivalent to approximately 975 g U-235 in total, ~20 larger alpha-sources, 1.2 kg of irradiated uranium, originally in solution, now solidified in concrete, and 2,000 kg of non-irradiated uranium. The Tailings are remains from uranium extraction research carried out in the 1970’s and 80’s.
At present, the total activity inventory of the waste in figure 14 is approximately 1.300 TBq out of which the special waste constitutes approx. 840 TBq. 95% of activity in the special waste is due to short lived $\beta-$ and γ emitters.

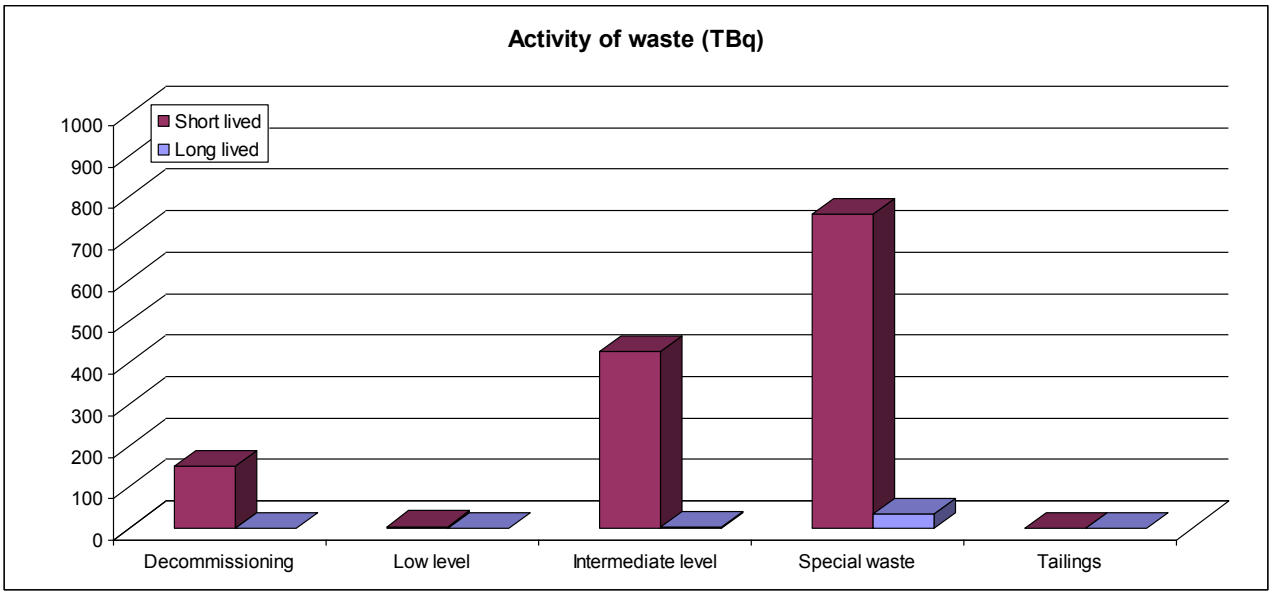

Figure 14. Activity of the various waste types. Inventories as of 2008.

H.1.2 Radiation protection - policy

In accordance with the overall objectives in the Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste and with the policy to follow the principles outlined in IAEA Fundamental
Safety Principles, ICRP and other relevant international organisations, Denmark has established 4 principles for all work related to establishing of a repository for LILW:

Protection of humans and the environment
Radioactive waste shall be managed in such a way as to secure an acceptable level of protection for humans and the environment.

Protection beyond national borders
Radioactive waste shall be managed in such a way as to assure that possible effects on human health and the environment beyond national borders will be taken into account.

Protection of future generations
Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today. Likewise, radioactive waste shall be managed in such a way that will not impose undue burdens on future generations.

The legal framework
Radioactive waste shall be managed within an appropriate national legal framework including clear allocation of responsibilities and provision for independent regulatory functions.

From these principles, quantitative criteria for the protection of humans and the environment have been derived in the form of reference doses.

During the operational period, the requirements shall be similar to the existing dose limits and dose constraints in the present Danish legislation: worker dose limit is set at 20 mSv/y and dose limits of 1 mSv/y with a reference dose for nuclear installations of 0.1 mSv/y for individual members of the population. After closure, the reference dose is 0.01 mSv per year with regard to the expected development of the repository. This is equal to the clearance criteria stipulated in "Operational Limits and Conditions" for Danish Decommissioning.

In addition, there is a reference dose for potential isolated incidents, such a minor earthquakes or intrusion, of 1 mSv per year. The recommended safety criteria for the repository are presented in the table below.

Table 7. Derived safety criteria (reference doses) for individual members of the public.

Period	Scenario	Reference dose, mSv per year
Operational period	Normal operation	0.1
After closure	Expected development	0.01
	Potential incidents	1

An incident, that is very unlikely, or where the consequences by far overshadow the effects of dispersal of the deposited LILW inventory (e.g. in the case of a large meteorite impact or major earthquake), is not included in the above scenarios.

H.1.3 Preliminary studies

As mentioned, the three preliminary studies of disposal concepts, radiological risk assessment for transport of radioactive waste in Denmark and a geological siting survey were conducted in parallel and had the following outcomes:

H.1.3.1 Pre-feasibility study for final disposal of radioactive waste. Disposal concepts.

In this study[8], suitable conceptual designs of a final repository were identified, taking into account the waste properties and requirements for dimensions, construction, surface/subsurface location, surrounding geology and generic safety requirements. Three repository concepts were considered:

- a near surface repository (above or below the surface to a depth of 30 m)
- a near surface repository (above or below the surface to a depth of 30 m) combined with a borehole for the long-lived waste

[8] Pre-feasibility study for final disposal of radioactive waste. Disposal concepts.

- a medium depth repository placed at 30 to 100 m below the surface.

The concepts are illustrated in Figure 15.

The generic safety assessments included risk analyses related to the activities of the different periods in the overall life time of the repository such as: a) placement of the waste in the repository, b) operation and c) a passive period after closure of the repository. The generic safety assessments also included assessments of the potential impact on a reference person due to long term release of radioactive substances from the repository.

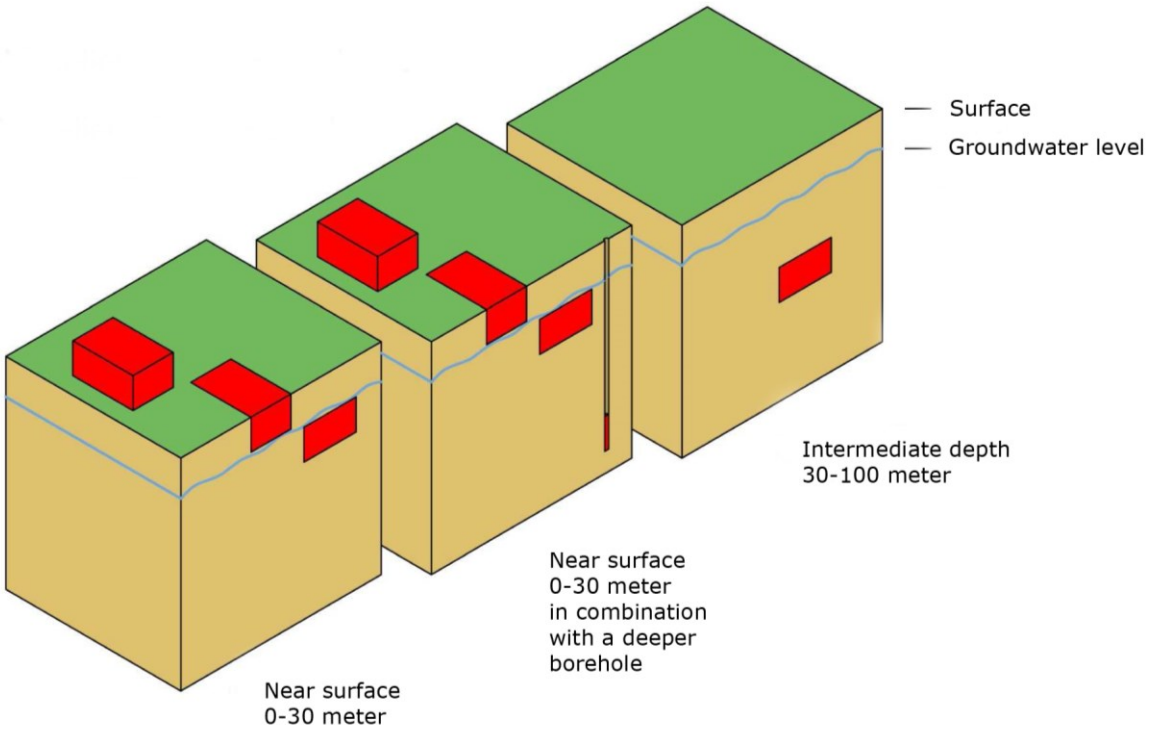

Figure 15. Conceptual designs of a final repository for the complete inventory of Danish radioactive waste. Source: Danish Decommissioning.

The study showed that all three repository concepts can be applied. Compared to subsurface repositories, more elaborate technical measures are required to isolate and confine the radioactive materials in a near surface repository.

H.1.3.2 Radiation doses from the transport of radioactive waste to a future repository in Denmark – A model study

The purpose of the second preliminary study was to investigate the risk of transporting the complete inventory of Danish radioactive waste from the Risoe-site, to a future repository and to assess whether

the risk of transportation would limit the site selection. The study[9] was conducted by the National Institute of Radiation Protection under the Danish Health and Medicines Authority. The study was carried out as a model study using the RADTRAN modelling tool, calculating radiation doses for incident free transports as well as for accident situations, taking into account waste type, chemical and physical properties of the waste, activity and dose rate, package type, vehicle type and dimension, route characteristics, as well as crew members, bystanders and the population density along the route.

The study showed that modelled radiation doses would be small for both incident free transports and in the event of a potential accident. It was further concluded that the risks associated with road and sea transport, pose no limitations on the future selection of a repository site.

H.1.3.3 Low- and intermediate level radioactive waste from Risø, Denmark. Location studies for potential disposal areas

The third preliminary study pointed out 22 areas in Denmark in which a site could be located as potentially host for a repository for the complete inventory of Danish radioactive waste. The study[10] was conducted by the Geological Survey of Denmark and Greenland (GEUS).

The geology of the future repository site must contribute to the confinement of the radioactive materials by ensuring that any migration of the radioactive substances will be minimal. To do so, the geological conditions of the area surrounding the repository must provide for a homogeneous and low-permeable host rock of sufficient horizontal and vertical extent to completely enclose or underlay (in the case of a surface repository) the repository. In addition, drinking water interests, nature conservation, population density, and the potential effects of future climate changes were taken into consideration. The study was based on existing data only leaving detailed field investigations to a later phase. This preliminary study resulted in the initial selection of 22 suitable areas (Figure 16). A summarizing report recommended further focus on 6 areas of interest in particular, based on the geological suitability of these areas. The 6 areas are shown with a blue marking in Figure 16.

[9] Radiation doses from the transport of radioactive waste to a future repository in Denmark – A model study

[10] Low- and intermediate level radioactive waste from Risø, Denmark. Location studies for potential disposal areas

Figure 16.The 22 potential areas for a future repository for the Danish radioactive waste. The marking in blue shows the six areas of particular interest. Source: GEUS.

H.1.4 Developments since last report

The preliminary studies were presented in May 2011 to the parties in the Danish Parliament and all parties expressed continued support to proceed with the project as planned.

The studies were presented to the public and municipality officials from the five municipalities hosting the six areas of interest (two of the selected areas are within the same municipality). In one of the municipalities a public meeting was arranged, to present the findings of the preliminary studies and give citizens the chance to raise questions regarding the studies and of the project as a whole.

With the conclusion of the preliminary studies, vicinity studies were initiated covering the six areas of interest. The studies presented further details regarding geology, the effects of planning acts at local, regional and state level, use of groundwater as a drinking water resource and nature preservation and protection plans. The findings of these studies were presented in January 2013. Following this, the

preparation of a Strategic Environmental impact Assessment (SEA) of the plan proposal for establishing a final repository was initiated (Danish law stipulates that not only the conduct of a plan, but also the plan itself be assessed in terms of potential environmental effects, in the broad sense of the word). Consequently as a first step, in spring 2014, a series of public hearings regarding the scoping for impact assessment of the proposed plan for establishing a repository were held in the 5 municipalities hosting the 6 potential sites. An additional hearing was held in the present host-municipality of the nuclear facilities at Risoe in Roskilde. This hearing was conducted in order to evaluate the environmental impact of the "0-alternative", i.e. maintaining the present-day operational regime and storage facilities. Representatives from relevant ministries, departments, agencies and operators as well as the municipalities and NGOs took part in the hearings. The suggested topics to be considered in the impact assessment of the plan proposal were also sent for notification in reference to Espoo Protocol Art. 4.2, appendix 1.3 and Art. 10. The findings of these hearings will be incorporated into a finalized plan for establishing a repository for low and intermediate level radioactive waste in Denmark. This plan and associated impact assessment will also undergo both a national public hearing procedure and a renewed Espoo notification. The resulting plan and impact assessment is scheduled for completion towards the end of 2014.

Should it be decided to continue the efforts to establish a repository for low and intermediate level radioactive waste in Denmark, the overall course of events is outlined below.

A plan and a budget that reserves relevant areas and ensures funding for the subsequent field investigations will be prepared. The plan and budget will be presented to the Danish Parliament. Following this, detailed field investigations and area specific environmental impact assessments will be performed. Safety assessments will include information from the field investigations. As these investigations are costly, they are expected to cover only 2-3 areas, although at least two areas must be investigated thoroughly. The next stage in the project will be to design the repository in detail and to build the safety case.

H.2 Intermediate storage of all of the Danish Radioactive Waste

The basis for, and implications of, establishing a long term storage solution (intermediate storage) for all of the Danish radioactive waste is being examined under the auspices of the cross ministerial working group. A subgroup consisting of representatives for the operator (Danish Decommissioning), the Geological Survey of Denmark and Greenland and the National Institute of Radiation Protection under the Danish Health and Medicines Authority are contributing to this effort following an outline with the following main points: Legal aspects, International standards and guidelines, waste inventory, protection of people and the environment, safety, design concepts, environmental considerations. The work is in progress and is expected to come to a conclusion towards the end of 2014. Should the political decision be made to adopt a policy of intermediate storage, the issue of a final long term solution for the low and intermediate level radioactive waste in Denmark will need to be addressed.

H.3 International solution for all of the Danish Radioactive Waste

The options for finding an international solution for all of the Danish Radioactive Waste are being explored through the cross-ministerial working group with the assistance of the Ministry of Foreign

Affairs in Denmark. The outcomes of these studies are expected to be presented towards the end of 2014.

Article 16. Operation of facilities

There have been no new developments in the general operation of the waste management facilities since the last report to the convention. However, there has been the following development with regard to the handling and storage of waste: A new reception facility for radioactive waste from external producers has been established at the Waste Management Plant. Some waste packages containing historical waste have been radiologically characterised and placed in storage in the intermediate storage facility.

Article 17. Institutional measures after closure

No new development. Please refer to the second National Report, 2005[11].

[11] Joint Convention Report 2005.pdf

Section I. Transboundary movement

Article 27. Transboundary movement

The European Council has adopted Directive 2006/117/EURATOM of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel. Denmark implemented this directive in Order no. 1175 of 25 December 2008 replacing Order no. 969 of 13 December 1993 on international transfer of radioactive waste. The directive and the Order cover all shipments of radioactive waste and spent fuel, whether it is intended for disposal or for reprocessing.

The National Institute of Radiation Protection under the Danish Health and Medicines Authority has in the period from the last Review Meeting received 30 notifications concerning one or more transboundary movements between EU-countries.

Section J. Disused sealed Sources

Disused sealed sources are occasionally but rarely found in metal scrap. To date, the radioactive sources have been detected by means of portal monitoring systems typically installed at major scrap yards rather than in surveys. Monitoring systems are thus recommended in advisory material distributed to the scrap dealers. A strategy for management of disused sealed sources in the scrap industry is under development. In this regard contacts have been made to the Danish association of recycling industries in order to establish a more detailed understanding of the scrap flow. Emphasis is placed on the procedures at major scrap yards serving as collection points for minor scrap dealers. In particular, an evaluation underway of the potential radiological impacts of the increasing numbers of smoke detectors containing Am-241 accumulating at scrap yards as these older types of smoke detectors are being phased out.

At the administrative level, a national data integration interface combines data for relevant individuals in Denmark with the Danish Central Business Register (CVR) to enable a proactive and timely intervention by the authorities in case of bankruptcy, or discontinuation for other reasons, of companies possessing radioactive sources.

Section K. Planned Activities to Improve Safety

K.1 International co-operation

Participation in international co-operation regarding the safety of spent fuel and radioactive waste management is essential to a small country without a nuclear power programme such as Denmark. Denmark participates with its limited resources in a suite of international groups in order to follow and take part in the evolution of the safety of nuclear fuel and radioactive waste management. The international co-operation is essential for both the Nuclear Regulatory Authorities and the operator of nuclear installations and both have taken active part in this for many years.

In the IAEA context, Denmark has contributed to the development of the IAEA Safety Standards by representation in two Committees (RASSC, WASSC) since 2005. A representative from the Nuclear Regulatory Authorities participates in the IAEA International Project on Decommissioning Risk Management (DRiMa) which builds on the outcome from the IAEA Project on Use of Safety Assessment Results in Planning and Implementation of Decommissioning of Facilities Using Radioactive Material (FaSa). In preparation of an upcoming Integrated Regulatory Review Service (IRRS), staff members of the Nuclear Regulatory Authorities have taken part in preparatory IRRS training courses held by the IAEA. Representatives from the decommissioning projects in Danish Decommissioning participate in the Technical Advisory Group (TAG) which is a part of a joint project between NEA and OECD: The International Co-operative Program for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects (CPD).

In the Euratom context, Denmark has for many years been actively engaged in EU working groups preparing EU legislation or given advice on the implementation of EU legislation in EU Member States, especially within the Euratom Article 31 Group of Experts. Since 2007, the two Danish Nuclear Regulatory Authorities have been represented in the European Nuclear Safety Regulators Group (ENSREG), which is an independent authoritative expert body composed of senior officials from national regulatory or nuclear safety authorities from all 28 member states in the EU. ENSREG, which was originally established as the European High Level Group on Nuclear Safety and Waste Management, aims to maintain and further improve the safety of nuclear installations and the safety of the management of spent fuel and radioactive waste.

Co-operation between the Nordic countries (Sweden, Iceland, Finland, Norway and Denmark) has been on-going for many decades, and has been focused on the development of common Nordic principles and strategies, as well as day-to-day operational collaboration between the authorities. An example of this is the very close harmonisation in nuclear and radiological emergency planning and preparedness, which has recently resulted in the publication of joint set of generic guidelines for protective measures concerning the population and functions of society in case of nuclear or radiological emergencies. The publication entitled:”Protective Measures in Early and Intermediate Phases of a Nuclear or radiological Emergency. Nordic Guidelines and Recommendations” includes practical criteria for early protective measures as well as for actions after contamination events and in addition addresses criteria for lifting measures.

Section L. Annexes

Annex A. Danish Legislation – Spent Fuel and Radioactive Waste

The Danish legislation listed below is in force per 14 October 2011. The legislation is available in Danish at the web site of the National Institute of Radiation Protection: www.sis.dk.

Acts:

- Act No. 94 of 31 March 1953 on use etc. of radioactive materials.
- Act No. 170 of 16 May 1962 on nuclear installations.

Ministerial Orders:

- Ministry of the Interior (now Ministry of Defence) Order No. 278 of 27 June 1963 on protective measures against accidents in nuclear installations (atomic installations) etc. with amendments in Order No. 502 of 1 October 1974.
- Ministry of the Environment (now Ministry of Health and Prevention) Order No. 574 of 20 November 1975 on precautionary measures for the use etc. radioactive substances.
- Ministry of the Interior and Health (now Ministry of Health and Prevention) Order No. 192 of 2 April 2002 on exemptions from Act on the use of radioactive substances.

Operational Limits and Conditions issued by the Nuclear Regulatory Authorities (The Nuclear Division under the Danish Emergency Management Agency and the National Institute of Radiation Protection under the Danish Health and Medicines Authority):

- Operational Limits and Conditions for Danish Decommissioning.
- Operational Limits and Conditions for DTU Risø Campus.

Orders from the Danish Health and Medicines Authority (National Institute of Radiation Protection):

- Danish Health and Medicines Authority Order No. 154 of 6 March 1990 on smoke detectors and consumer products containing radioactive materials with amendments in Orders No. 547 of 23 July 1993 and No. 793 of 19 October 1999.

- Danish Health and Medicines Authority Order No. 546 of 23 June 1993 on transfer of radioactive materials.
- Danish Health and Medicines Authority Order No. 663 of 12 July 1994 on outside workers, who are exposed to ionizing radiation in a CE-country with amendments in Order no. 824 of 31 October 1997.
- Danish Health and Medicines Authority Order No. 823 of 31 October 1997 on dose limits for ionizing radiation.
- Danish Health and Medicines Authority Order No. 954 of 23 October 2000 on the use of unsealed radioactive sources in hospitals, laboratories etc.
- Danish Health and Medicines Authority Order No. 993 of 5 December 2001 on transport of radioactive materials.
- Danish Health and Medicines Authority Order No. 985 of 11 July 2007 on sealed radioactive sources.
- Danish Health and Medicines Authority Order no. 1175 of 5 December 2008 on international transfer of radioactive waste and spent nuclear fuel.

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