Denmark

(based on JC national report, NEWMDB and NEA country profiles)

a) National framework for management of spent fuel and radioactive waste

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 was completed by the end of 2015. Release from regulatory control is expected by the end of 2016. 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.

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' 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. The impact assessment is scheduled for completion towards the end of 2014.

Since the spring 2012 JC meeting, the plan to establish a Danish repository for Low and Intermediate Level Waste (LILW) were 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 for management of radioactive waste in Denmark. In spring 2015, the efforts to find an international solution encompassing all of the Danish LILW were stopped, and the plan to establish a Danish LILW repository were put on hold while further investigations into the implications of establishing a long term storage solution are conducted. This work is anticipated to be complete ultimo 2016, after which time a final political decision regarding the long term management of Danish LILW is expected to be made.

The current 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.

b) National legal and regulatory framework

The Danish legislation for spent fuel management and radioactive waste management is part of the overall Danish legislation on radiation protection and nuclear safety. The Danish legislative and regulatory system also implements all legislative requirements with regard to the Treaty Establishing the European Atomic Energy Community (Euratom).

Under the Nuclear Installations Act (1962) erection and operation of nuclear installations are subject to authorisation from the Minister of the Interior and Health and installations are subject to inspection from the Nuclear Regulatory Authorities (The Nuclear Division under the Danish Emergency Management Agency and the Danish Health Authority, Radiation Protection). Nuclear installations encompass installations for storage or disposal of spent nuclear fuel and installations for storage or disposal of radioactive waste.

According to the Radioactive Materials Act (1953) production, import, possession etc., of radioactive materials is subject to prior authorisation by the Danish Health Authority, Radiation Protection. The Danish Health Authority, Radiation Protection is empowered to issue detailed legislation regarding production, import, use, storage, transport, disposal etc. of such materials and to inspect all holders of authorisations and locations, where radioactive materials are or could be present.

Both the Nuclear Installation Act and the Radioactive Materials Act and their administration belong to the responsibility of the Minister of the Health and are as such independent of the

Ministry of Ministry of Higher Education and Science under which the operation of the nuclear installations at Risø belongs.

The Nuclear Regulatory Authorities according to the Nuclear Installation Act (The Nuclear Division under the Danish Emergency Management Agency and the Danish Health Authority, Radiation Protection) and the Regulatory Authority according to the Radioactive Materials Act (Danish Health Authority, Radiation Protection) are defined in the Acts and are given their own budget on the annual Fiscal Act. The Authorities are empowered to have direct access to all premises, buildings etc. for inspection purposes and to withdraw licensees and stop operations in case of unsecured situations.

c) Radioactive waste management, decommissioning and spent fuel strategy

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 postirradiation investigations in the former Hot Cells. This material is stored, under safe and secure conditions with appropriate surveillance, at the storage facilities for radioactive waste at Danish Decommissioning awaiting a decision on the final management. The radionuclide inventory occurs with activity concentrations of less than 104 TBq/m3 and heat production from the waste in its originally designed waste packages is less than 1 kW/m3. 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 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.

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.

Table 1 Radioactive Waste In Storage (including spent fuel that is considered waste)

Route Waste Class	Processed (type)/Un processed	Total Current Volume (m3)	Estimated Disposal Volume (m3)	Distribution (%)							Planned Disposal Route (if known)
				RO	FFE	RP	NA	DF	DC/ RE	ND	
All Classes											
All Classes											
LLW	Yes	1200									
ILW	No	5646 tons									

NEWMDB waste origin type codes:
RO – reactor operations
FFE – fuel fabrication & enrichment
RP – fuel reprocessing
NA – nuclear applications
DF - defence
DC/RE - decommissioning & remediation
ND - Not Determined

Table 2 Radioactive Waste Disposed (as disposed volume)

Waste Class	Processed (not)	Total Volume (m3)	Distribution (%)							Disposal Route Used
			RO	FFE	RP	NA	DF	DC/RE	ND	
All Classes										
ILW										
LLW										

Table 3 Spent fuel in Storage (MTHM)

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total Spent Fuel Storage		0.23
Wet storage (AR)		
Wet storage (AFR)		
Dry storage (AR)		
Dry storage (AFR)		
Total spent fuel held in storage for other countries (amounts also included above)		

Table 4 Spent fuel sent for reprocessing (in the country or sent to another country) (MTHM)

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total amount Spent Fuel sent to Reprocessing (in your country)		
Total amount Spent Fuel sent to Reprocessing (in another country)	0	0
Total amount of Spent Fuel received from another country for reprocessing and recycling		
Total amount of Spent Fuel (MTHM) or radioactive waste (cubic metres) returned to country of origin for storage/disposal		

Table 5 Example of a translation matrix (from NEWMDB) that can be used for transition from a national classification system to IAEA classification

National Waste Classification Name	VLLW	LILW	ILW	HLW

Table 6 Waste management facilities

Type	Planned	Construct.	Commiss.	In Operation	Shutdown	Decomm.	Other	Total
Spent Fuel Storage								
Spent Fuel Reprocessing and Recycling								
Spent Fuel Conditioning								
Spent Fuel disposal								
Waste processing								
Waste storage								
Waste disposal								

Table 7 Summary of major sources of waste

Type	Planned	Construct	Commiss.	In Operation	Shutdown	Decomm.	Other	Total
Research reactors								
Nuclear Power reactors								
Spent Fuel Reprocessing and Recycling								
Other								

Table 8 Future prospects

Type	Current amount	Estimated Current amount when prepared for disposal	Current Disposal Capacity	Total forecast at 2030	Disposal Capacity 2030	Total forecast at 2050	Disposal Capacity 2050
Spent Fuel Storage							
Wet storage (AR)							
Wet storage (AFR)							
Dry storage (AR)							
Dry storage (AFR)							
Total amount Spent fuel sent to Reprocessing and Recycling							
Total amount Spent fuel disposed							
Waste in storage							
Waste disposal							