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# COUNCIL DIRECTIVE 2011/70/EURATOM FOR THE RESPONSIBLE AND SAFE MANAGEMENT OF SPENT FUEL AND RADIOACTIVE WASTE

First report from Denmark

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Danish Health and Medicines Authority (Sundhedsstyrelsen)
Axel Heides Gade 1
2300 København S
sundhedsstyrelsen.dk
National Institute of Radiation Protection
Knapholm 7
DK-2730 Herlev
Denmark

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# CONTENTS

# 1
# INTRODUCTION

The bulk of radioactive waste in Denmark originates from the decommissioning of the former research reactors and supporting facilities at Risø, where all nuclear installations in Denmark are located. All radioactive waste in Denmark is classified as Low Level Waste and Intermediate Level Waste (IAEA, GSG-1, 2009). Minimal amounts of experimentally irradiated spent fuel of power reactor type and fuel from one former research reactor is stored under safe and secure conditions by the operator of the nuclear facilities under decommissioning in Denmark. Denmark has no active nuclear programme, and the annual production of radioactive waste from users of radioactive substances in research, industry and the medical sector in Denmark is very limited.

Danish Decommissioning is the operator responsible for undertaking the decommissioning of the former research reactors and supporting facilities at Risø. Danish Decommissioning is also responsible for the safe and secure management of spent fuel and radioactive waste arising from the decommissioning activities as well as radioactive waste originating in the research, industrial and the medical sectors in Denmark.

The Nuclear Regulatory Authorities in Denmark are composed of the National Institute of Radiation Protection under the Danish Health and Medicines Authority and the Nuclear Division of the Danish Emergency Management Agency. The Nuclear Regulatory Authorities are empowered to have direct access at any time to all premises, buildings etc. for inspection purposes and to withdraw licenses and suspend operations in cases where safety or security cannot be demonstrated.

The current Danish national policy for spent fuel and radioactive waste management was defined in 2003 by the Danish parliament adopting a decision to commence with the decommissioning of nuclear facilities at Risø and, at the same time initiate the work to establish a repository for all Danish radioactive waste. In the later years, aim of long term management of radioactive waste in Denmark has been taken up for revision at the political level. Pending current investigations into the options for establishing a long term storage solution for Danish radioactive waste, the policy decision from 2003 may be updated or revised. The current 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 national framework for the safe and responsible management of spent fuel and radioactive waste is based on legislative, regulatory and organizational structures which ensure an adequate legal base for regulatory oversight, effective independence of the regulatory authorities and proper assignment of responsibilities to operators in the field of spent fuel and radioactive waste management.

The National Programme for the management of spent fuel and radioactive waste as defined on the basis of the parliamentary decision in 2003, defines a 20 year time limit for completion of decommissioning projects, and hence the establishment of a repository for radioactive waste in Denmark. While decommissioning projects are progressing as planned, the potential update or revision of the Danish policy carries the risk of delays in the process of establishing a long term management solution for Danish radioactive waste.

This report was prepared by the National Institute of Radiation Protection under the Danish Health and Medicines Authority with contributions from the Nuclear Division of the Danish Emergency Management Agency (DEMA) and Danish Decommissioning (DD).

# 2
# REPORTING ARTICLE BY ARTICLE

## 2.1 ARTICLE 4 – GENERAL PRINCIPLES

The Danish “National policy and programme for safe and responsible management of spent fuel and radioactive waste in Denmark” (National Programme, in Danish, given in Annex 1) states that the ultimate responsibility for the management of spent fuel and radioactive waste generated in Denmark, including spent fuel or radioactive waste shipped for processing or reprocessing to another Member State or a third country, rests with the Danish state.

The general principles upon which the Danish national policy for the safe management of radioactive waste are based, are presented in the Danish "National Programme”. The document describes the current status of the Danish policy, the basis of decision for the policy, and the procedure for decision making. Waste stream endpoints are also defined.

## 2.2 ARTICLE 5 – NATIONAL FRAMEWORK

### 2.2.1 Article 5.1a-h

The legislative, regulatory and organizational framework for safe and responsible management of radioactive waste in Denmark is based on:

- Law no. 94 of 31 March 1953 on the use etc. of radioactive substances, Ministry of the Interior (now Ministry of Health).
- Law no. 170 of 16 May 1962 on nuclear installations, Ministry of the Interior (now Ministry of Health),
- Circular Letter of 21 December 2011 from the Minister of Health and Prevention to the Nuclear Regulatory Authorities,

An overview relevant ministerial orders etc. issued in accordance with these laws is presented in the National Programme (Annex 1).

Denmark has further ratified the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) as well as the Convention on Nuclear Safety.

The responsibilities of the Nuclear Regulatory Authorities (National Institute of Radiation Protection under the Danish Health and Medicines Authority and the Nuclear Division of the Danish Emergency Management Agency) are defined in Act No. 170 of 16 May 1962 on Nuclear Installations. In addition, Act No. 244 of 12 May 1976 on Nuclear Installation Safety and Environmental Impacts (partially enacted) defines the Nuclear Division’s obligations in relation to international cooperation on nuclear safety, including the safety of

spent fuel management and the safety of radioactive waste management. According to Act No. 170 of 16 May 1962 on Nuclear Installations, the Nuclear Regulatory Authorities are empowered to have direct access at any time to all premises, buildings etc. for inspection purposes and to withdraw licenses and suspend operations in cases where safety or security cannot be demonstrated. Further, it is the responsibility for the Nuclear Regulatory Authorities to initiate legal action, should a breach of law become known to the authorities.

Administratively, the National Institute of Radiation Protection under the Danish Health and Medicines Authority is an agency under the Ministry of Health while the Nuclear Division of the Danish Emergency Management Agency is a unit of an agency under the Ministry of Defence. The operator responsible for the decommissioning of the nuclear installations at Risø is Danish Decommissioning, which is an institution under the Ministry of Higher Education and Science. This position of the Nuclear Regulatory Authorities in the Danish organizational and legal system ensures a functional separation from the operator with primary responsibility for the safety of spent fuel and the safety of radioactive waste management.

Under Act No. 170 of 16 May 1962 on Nuclear Installations, construction and operation of nuclear installations are subject to authorization by the Minister of Health. The Act defines "the holder (or proprietor) of a nuclear installation" as the person (legal or natural) authorized by the minister as the holder (or proprietor) of the nuclear installation. A license includes responsibility for the safety of the licensed nuclear installation. The Operational Limits and Conditions for the nuclear installations at Risø issued by the Nuclear Regulatory Authorities to the licence holder (Danish Decommissioning), explicitly states (Chapter 2 General conditions, Section 2.1 Responsibilities), that:

> *Danish Decommissioning, represented by the Director (DD's management) shall, in due consideration of other relevant legislation, ensure that the decommissioning (including the safe management of resulting spent fuel and radioactive waste) of the nuclear facilities at Risø is carried out in accordance with:*
>
> *- Operational Limits and Conditions for Danish Decommissioning*
>
> *- Acts and Orders relating to radiation protection and nuclear safety.*

The contents of the Operational Limits and Conditions for Danish Decommissioning are given in Annex 2 (in Danish).

The bulk of radioactive waste generated in Denmark originates from the decommissioning of the former research reactors and supporting facilities located at Risø. No other nuclear installations exist in Denmark, and the waste treatment plant at Danish Decommissioning receives, manages and stores radioactive waste from all other waste generators in Denmark in accordance with the above mentioned legislative requirements.

### 2.2.2 Article 5.2

The Circular Letter of 21 December 2011 from the Minister of Health and Prevention to the Nuclear Regulatory Authorities stipulates that the Nuclear Regulatory Authorities every three years shall submit a progress report on nuclear safety to the Minister of Health and Prevention, who shall transmit the report to the Danish Parliament (Folketinget). The progress report shall include a status for and the development of nuclear safety in Denmark, including any circumstances giving rise to the need for changes in the Danish legislative, regulatory or organisational framework. If a circumstance occurring during the 3-year reporting period implies a need for an immediate change of the Danish framework, the Nuclear Regulatory Authorities shall inform the Minister of Health accordingly.

## 2.3 ARTICLE 6 – COMPETENT REGULATORY AUTHORITY

The position of the Nuclear Regulatory Authorities within the Danish organizational structure and legal system is portrayed in section 2.2 – National Framework, and aspects regarding the functional independence, legal powers and human and financial resources are further detailed in the National Programme (Annex 1).

## 2.4 ARTICLE 7 - LICENCE HOLDERS

### 2.4.1 Article 7.1, 7.2 and 7.3

The legislation which assigns the responsibility for the safety of spent fuel and radioactive waste management facilities as well as the assessment of safety to the licence holder is portrayed in section 2.2 – National Framework, and is further detailed in the National Programme (Annex 1).

### 2.4.2 Article 7.4

Danish Decommissioning, as license holder, has in accordance with Operational Limits and Conditions for Danish Decommissioning given in Annex 2 (in Danish), established and implemented integrated management systems, including quality assurance, which give due priority to safety and are regularly verified by the Nuclear Regulatory Authorities.

### 2.4.3 Article 7.5

The provisions for maintaining adequate financial and human resources to fulfil the obligations of the license holder with respect to the safety of spent fuel and radioactive waste management are detailed in the National Programme (Annex 1). Assurance of adequate financial resources is provided by the Danish state.

## 2.5 ARTICLE 8 – EXPERTISE AND SKILLS

Danish Decommissioning, as license holder, is required to comply with the following specific requirements regarding competences and training as stipulated in the Operational Limits and Conditions:

> *At any level in the organizational structure of nuclear safety and radiation protection staff must be qualified through education and training corresponding to the job description related responsibilities.*
>
> *When hiring the director, chief of sections and project managers, the Nuclear Regulatory Authorities shall be given a summary of the qualifications of the selected candidate before transferal of responsibilities and powers associated with the position may take place.*
>
> *Staff groups involved in the decommissioning of the nuclear facilities shall receive education and training in radiation protection. Danish Decommissioning shall ensure that external consultants, contractors, etc. who are required to work on the dismantling of nuclear installations, are provided with a level of education prior to the commencement of works, that ensures a proper performance of all tasks in terms of nuclear safety and radiation protection.*

The National Programme (Annex 1), further details the arrangements for education and training of staff in Denmark as a country with no active nuclear programme and a limited burden of decommissioning.

For the nuclear regulatory authorities the maintenance and further development of expertise and skills is primarily gained through the participation in international cooperation. For instance participation in the IAEA Safety Standards Committees on radiation protection and safety in waste management (Radiation Safety Standards Committee - RASSC and Waste Safety Standards Committee - WASSC), participation in reporting and review meetings to the Waste Convention, relevant IAEA projects and participation in other international courses dealing with decommissioning and waste management. On a European level the authorities and operator contribute to EURATOM cooperation with the participation in the European Nuclear Safety Regulators Group (ENSREG), European groups related to the decommissioning as well as EURATOM Articles 31 and 37 expert groups.

## 2.6 ARTICLE 9 – FINANCIAL RESOURCES

The adequacy of the financial provisions for the implementation of the Danish national programme has been ensured through the guarantee of the Danish state to cover all necessary costs to ensure a safe and responsible management of radioactive waste in Denmark. Further details on financing and allocation of funds to both operators and authorities are provided in the National Programme (Annex 1).

## 2.7 ARTICLE 10 – TRANSPARENCY

The website of the Ministry of Health (www.sum.dk) contains an archive of publications relating to the process of establishing a long term management solution for low- and intermediate level radioactive waste in Denmark. This includes results of public national and international hearings as well as meetings with stakeholders.

The Circular Letter of 21 December 2011 from the Minister of Health and Prevention to the Nuclear Regulatory Authorities stipulates, that the Nuclear Regulatory Authorities in cooperation with the license holder, provide all relevant information of importance to nuclear safety, including the safety of spent fuel management at nuclear installations, to the public, taking into account security provisions.

On the web sites of the Nuclear Regulatory Authorities (National Institute of Radiation Protection: www.sis.dk, Danish Emergency Management Agency: www.brs.dk), information is provided regarding the Danish legislation on safety radioactive waste management and radiation protection as well as the Operational Limits and Conditions issued to the license holder, Danish Decommissioning. The Danish Emergency Management Agency (DEMA) directs planning and coordination of the nuclear emergency preparedness. At the national level ministries are responsible for emergency planning within their respective areas of responsibility. This includes where appropriate specific advice to citizens on how to react in case of a nuclear emergency and could include use of respective websites, social media, close co-operation with the public media and, potentially, call centers.

The mentioned websites also contain publications regarding safety of sites, links to the General Data provided by Denmark in 2003 to the European Commission in accordance with Article 37 of the Euratom Treaty regarding the Decommissioning of the Nuclear Facilities at Risø as well as the Environmental Impact Assessment (EIA, in Danish; VVM) conducted in 2003 before the decommissioning activities were initiated. Furthermore, all national reports from Denmark to the Joint Convention, including answers to questions are provided.

On the web site of Danish Decommissioning (www.dekom.dk), a substantial number of reports etc. relevant to the decommissioning activities of the nuclear installations and to the safety of radioactive waste management at Risø are presented.

Further description of the transparency policy and process is provided in the National Programme (Annex 1).

## 2.8 ARTICLES 11 AND 12 – NATIONAL PROGRAMMES

### 2.8.1 Article 11.1

The National Programme (Annex 1) including a description of the Danish National Policy is available through the website of the National Institute of Radiation Protection. The National Programme presents the evolution and present status of the national policy and associated national programme.

### 2.8.2 Article 11.2

As detailed in the National Programme (Annex 1), the aims of the Danish national policy is undergoing reconsideration and awaits further studies before a political decision regarding the future objectives for radioactive waste management in Denmark. If the decision results in significant changes in the National Programme, these will be reported to the Commission.

### 2.8.3 Article 12.1

Denmark reported the inventory of radioactive waste as of August 2014 to the Joint Convention at the review meeting in May 2015. Details are provided in the Fifth Danish Report to the JC (Annex 3) and summarized below.

Radioactive waste in Denmark is stored either by Danish Decommissioning or at the site of operators in the oil and gas industry (the latter only host NORM waste).

Classification of radioactive waste in Denmark is based on the IAEA Classification of 2009 (IAEA Safety Guide “Classification of Radioactive Waste”, GSG-1, 2009). The use of the category “Very Low Level Waste” (VLLW) may only take place after specific approval by the Nuclear Regulatory Authorities.

*Spent Fuel*

There are no spent fuel management facilities in Denmark. 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. Based on these properties, activity concentrations in the spent fuel, and for communicative purposes, the spent fuel has been designated as ILW. An inventory of the stored spent fuel is given in Table 1.

| 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<br>15.8 l | 50 GBq fission products<br>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<br>32 TBq actinides |

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

*Conditioned and unconditioned radioactive waste.*

Danish Decommissioning stores radioactive waste originating from the decommissioning of the nuclear facilities at Risø as well as waste produced by users of radioactive substances in industry, research and the health sector in Denmark. The currently stored amounts of radioactive waste are reported in tables 2 and 3 below, with reference to the specific facilities at Danish Decommissioning.

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

*Table 2. Inventory of conditioned radioactive waste stored at Danish Decommissioning, classified as low level waste (LLW). The waste inventory listed is predominantly short lived and was classified as LILW-SL according to the 1999 EC recommendations.*

| 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 |

*Table 3. Inventory of unconditioned radioactive waste stored at Danish Decommissioning as of August 2014, classified as intermediate level waste (ILW).The waste inventory listed is predominantly long lived and was classified as LILW-LL according to the 1999 EC recommendations.*

Quantities of radioactive waste received from external waste producers generally vary between 2 and 6 tons per year.

Danish Decommissioning also stores a combined amount of 4800 tons of ore and tailings with a total activity of 0,1 TBq. NORM waste originating from the oil and gas industry is stored at operator sites and constitute a combined volume of approximately 450 tons. The estimated annual growth of NORM waste from the oil and gas industry is 50-100 tons per year.

The expected total inventory of radioactive waste intended for final disposal was estimated in 2008 to 5000 – 10.000 $m^3$, depending on the final choice for long term management of NORM waste in Denmark.

# 3
# ANNEXES

Annex 1

National Programme

Annex 2

Operational Limits and Conditions for Danish Decommissioning

(In Danish: Betingelser for Drift og Afvikling for Dansk Dekommissionering)

Annex 3

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Fifth National Report from Denmark

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