# Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

# National Report from Denmark

## First Review Meeting, 3 – 14 November 2003

National Board of Health
National Institute of Radiation Hygiene
April 2003

*Cover picture: Waste Management Plant at Risø National Laboratory seen from southeast*

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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, and the Convention was accepted 3 September 1999 by letter from the Foreign Ministry to the International Atomic Energy Agency (IAEA). Until further notice the Convention does not apply for the autonomous territories Greenland and the Faroe Islands, which both do not possess spent nuclear fuel or radioactive waste.

The present report is the Danish National Report for the First Review Meeting to the Convention, which takes place 3 – 14 November 2003 at IAEA in Vienna. The report is made in accordance with the Guidelines regarding the Form and Structure of National Reports (INFCIRC/604, 1 July 2002) established by the Contracting Parties under Article 29 of the Convention at the Preparatory Meeting at IAEA 10 - 12 December 2001.

The report is prepared by the National Institute of Radiation Hygiene under the National Board of Health, in co-operation with Risø National Laboratory and the Nuclear Office under the Danish Emergency Management Agency. It is concluded in the report that Denmark meets all obligations of the Convention.

# Section B. Policies and Practices

*Article 32. Reporting (Paragraph 1)*

In 1985 the Danish Parliament made the decision that Denmark would not use nuclear energy. Spent fuel management has therefore only been relevant in connection with the operation of the three research reactors DR 1 (2 kW), DR 2 (5 MW) and DR 3 (10 MW) at Risø National Laboratory.

The overall policy and practice for the spent fuel management for DR 2 and DR 3 have been to temporary store the fuel elements in dedicated storage facilities after irradiation, awaiting transfer to USA's jurisdiction according to an agreement with the US Department of Energy. DR 2 was taken out of operation in 1975 and DR 3 in 2000 and all spent fuel from these two research reactors are by June 2002 transferred to USA. The spent fuel from DR 1 (15,8 litres of a solution of uranyl sulphate in light water), which was taken out of operation in 2001, is stored under safe and secure conditions awaiting a decision on the final management. In addition to the above-mentioned spent fuel from the Danish research reactors about 233 kg experimentally produced and irradiated spent fuel of power reactor type remaining from post-irradiation investigations in the former Hot Cells at Risø is stored under safe and secure conditions awaiting a decision on the final management.

The overall policy and practice for radioactive waste management have so far been to collect and store all Danish radioactive waste (low and medium level waste) under safe and secure conditions at dedicated storage facilities at Risø National Laboratory awaiting the decision on the decommissioning of the Danish nuclear facilities. The stored radioactive waste comprises waste from the operation of the three research reactors and other nuclear facilities at Risø and radioactive waste from the use of radioactive materials for medical, industrial and research purposes in Denmark.

All waste from nuclear facilities and from isotope laboratories etc. is defined as radioactive waste. This radioactive waste can be cleared from the regulatory system and treated as ordinary waste after adequate measurements and documentation in accordance with prescribed conditions given either in the legislation or in a specific license. Solid radioactive waste stored at the approved storage facilities is categorized in accordance with European Commission Recommendation of 15 September 1999 on a classification system for solid radioactive waste (1999/669/EC, Euratom). This EU-recommendation is with exemption of the criteria for heat generation rate in high level waste identical to the classification in IAEA Safety Series No. 111-G.1.1 on Classification of Radioactive Waste.

The Danish Parliament has in March 2003 agreed to the costs and the general decommissioning approach for all the nuclear facilities at Risø with the objective to decommissioning all nuclear facilities at Risø as soon as possible within a timeframe of 20 years. At the same time the Parliament agreed to start the work to establish a basis for decisions on a Danish disposal facility for low and medium level waste. This work will start with an assessment of the need for a revision of the legal basis including the question of an open and transparent decision process. The initial work should also propose fundamental principles and requirements for a disposal facility in accordance with national and international obligations and recommendations.

# Section C. Scope of Application

*Article 3. Scope of Application*

As Contracting Party to the Joint Convention Denmark has:

- Not declared reprocessing to be part of spent fuel management.
- Not declared waste that contains only naturally occurring radioactive materials as radioactive waste for the purpose of the Convention.
- Not declared spent fuel or radioactive waste within military or defence programmes as spent fuel or radioactive waste for the purpose of the Convention.

However, the management of radioactive waste that contains only naturally occurring radioactive materials and all radioactive waste from the Danish military are identical to the management of radioactive waste as described in this report as this waste is covered by the legislative and regulatory system described in section E.

# Section D. Inventories and Lists

*Article 32. Reporting (Paragraph 2)*

**Spent fuel management facilities**
There are no spent fuel management facilities in Denmark subject to the Convention (primary purpose). However, minor amounts of spent fuel is stored at the storage facilities for radioactive waste at the site of Risø National Laboratory. Figure 1 shows the position of the Risø site in the middle of Zealand about 6 km


*Fig. 1. Map of Denmark and of the narrow Roskilde fjord with the Risø peninsula about 6 km north of Roskilde*

north of Roskilde and 30 km west of Copenhagen. The site coordinates are 55° 42' N, 12° 06' E.

The minor amounts of spent fuel are stored under safe and secure condtitions with appropriate surveilance in the following buildings:

- The DR 3 building complex
- 'Centralvejslageret' (see under radioactive waste management facilities)

No special precautions for heat generation and dissipation are necessary for these materials. An inventory of the stored spent fuel is given in table 1.

*Table 1. Inventory of spent fuel*

| Spent fuel | Storage facility | Material | Mass / Volumen | Activity in 2000 |
|---|---|---|---|---|
| Spent fuel from DR 1 | DR 3 building complex | Solution of 20% enriched uranyl sul-phate in light water | 15,8 l | 130 GBq fission products<br><br>3 GBq actinides |
| Experimental irradiated spent fuel of power reactor type | Centralvejs-lageret | Uranium oxide pellets mostly in cut length of zircalloy tube | 233 kg | 610 TBq fission products<br><br>53 TBq actinides |

**Radioactive waste management facilities**

The only radioactive waste management facility subject to the Convention is the Waste Management Plant at the site of Risø National Laboratory with the location described above under spent fuel management facilities.

The Waste Management Plant has responsibility for the collection, conditioning and storage of radioactive waste from the nuclear facilities and laboratories at Risø and, on a commercial basis, also from all other users of radioisotopes in Denmark.

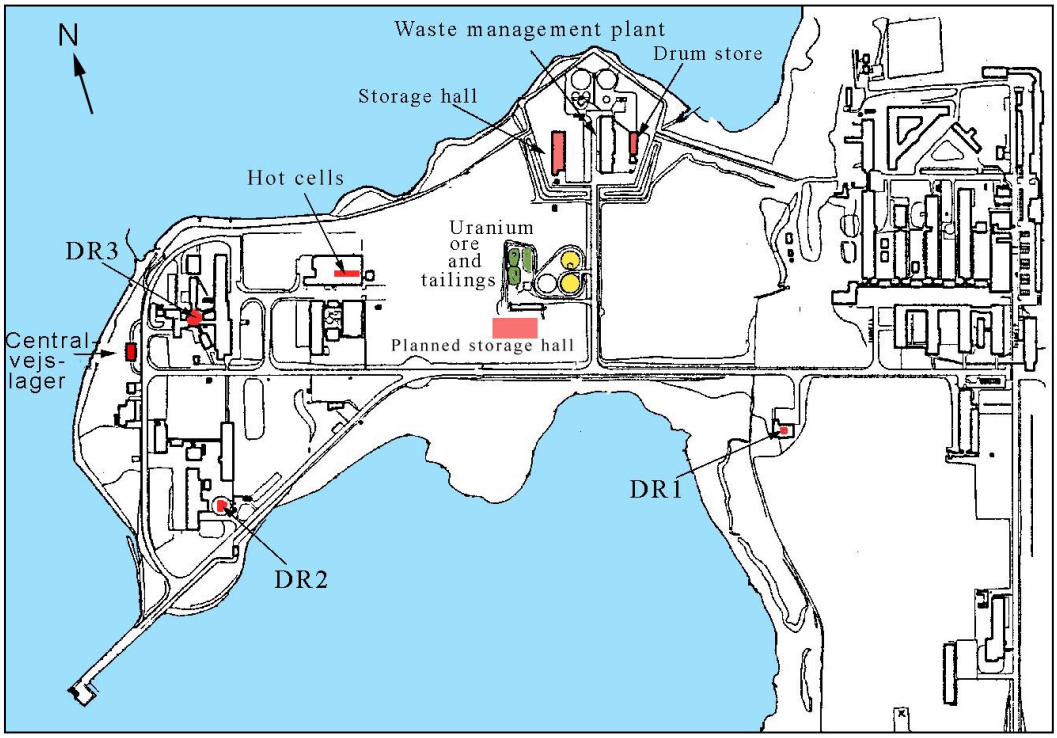


*Figure 2. Map of Risø, including the positions of the three reactors, various waste facilities, etc. The public A6 main road is to the right, just outside the map*.

The Waste Management Plant is situated on an artificial pentagon at the northern shore of the Risø peninsula, figure 2. The Waste Management Plants buildings relevant for handling radioactive waste are listed below:

- The main building with offices, laboratories, the active and inactive laundry, a distillation plant for radioactive wastewater reducing the volume of the wastewater, and a bituminisation plant where the rest water is evaporated. The solids with the activity are finally embedded in a bitumen matrix and filled in drums and stored in the 'Storage Hall', described below.

- The building called 'Drum Store' with the receiving point for radioactive waste coming from outside Risø. The building also contains a sorting glove-box mounted with a hydraulic press reducing the volume of low and intermediate level (LILW) solid waste before filling into waste drums. In addition there is a shielded area used as decay store for drums filled with low level short lived waste (LILW-SL).

- The storage building called 'Storage Hall' contains drums filled with LILW waste.

- The storage building called 'Centralvejslageret' is situated at the western part of the Risø peninsula. The storage comprises an underground concrete block with pits for standard containers and pits used for non-standard packages. In these pits is stored LILW waste that needs special shielding, e.g. Co-60 sources coming from Danish hospitals.

- Storage basins where tailings and excess ore remains after uranium extraction experiments using ore from Kvanefjeld in Greenland. The taillings are stored under water.

An inventory of radioactive waste that is subject to the Convention is given in table 2 for conditioned waste and in table 3 for unconditioned waste. It should be noticed that Denmark has no high level waste (HLW).

*Table 2. Inventory of conditioned radioactive waste stored at Risø. All radioactive waste is classified as low and intermediate short lived waste (LILW-SL). Activities are referred to year 2000.*

| Storage | Volume ($m^3$) | Activity (TBq) |
|---|---|---|
| Storage Hall | 1.100 | 5 |

*Table 3. Inventory of unconditioned radioactive waste stored at Risø. All radioactive waste is classified as low and intermediate long lived waste (LILW-LL). Activities are referred to year 2000.*

| Storage | Mass (tons) | Activity (TBq) |
|---|---|---|
| Drum Store and Centralvejslageret | 125 | 366[1)] |
| Taillings and ore | 4.800 | 0,1 |

1) The main part of the waste (340 TBq) may be classified as LILW-SL in connection with future sorting and conditioning. The rest of the activity consists of 22 TBq long lived $\beta$-activity and 4 TBq $\alpha$-activity.

**Nuclear facilities under decommissioning**

A list of the nuclear facilities in the process of being decommissioned and the status of the decommissioning activitites is given in table 4. All facilities are located at Risø. It should be noticed that the list in table 4 covers all Danish nuclear facilities except the Waste Management Plant, which since 2002 has been the only nuclear facility in operation in Denmark.

*Table 4. Nuclear facilities under decommissioning*

| Nuclear facility | Type | Taken out of operation | Decommissioning status |
|---|---|---|---|
| DR 1 | Small homogeneous 2 kW reactor mainly used for educational purposes | 2001 | Fuel removed. Decommissioning to "green field" is under planning |
| DR 2 | 5 MW research reactor of the swimming pool type | 1975 | Fuel elements removed. Reactor and the cooling circuit emptied for water. Decommissioning to "green field" is under planning |
| DR 3 | 10 MW heavy water research reactor of the DIDO type | 2000 | Fuel elements removed. Decommissioning to "green field" is under planning |
| Hot Cells | Facility for post irradiation investigations of nuclear fuel | 1990 | Cells emptied, cleaned and sealed. Decommissioning to "green field" is under planning |
| Fuel fabrication | Fuel fabrication facilities for DR 2 and DR 3 | 2002 | Decommissioning to "green field" is under planning |

# Section E. Legislative and Regulatory System

*Article 18. Implementing measures*
*Article 19. Legislative 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. A list of relevant Acts, Orders etc. in force per 1 January 2003 is given in annex A.

The Danish legislative and regulatory system also implements all legislative requirements with regard to the Treaty Establishing the European Atomic Energy Community (Euratom). A list of relevant legal instruments according to the Euratom Treaty is given in annex B.

The main legal instruments are the Nuclear Installations Act and the Radioactivity Materials Act.

**Nuclear Installations Act**
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 Office under the Danish Emergency Management Agency and the

National Institute of Radiation Hygiene under the National Board of Health). Nuclear installations encompass installations for storage or disposal of spent nuclear fuel and installations for storage or disposal of radioactive waste.

Based on the general authorisation of the nuclear installations at Risø National Laboratory the Nuclear Regulatory Authorities have issued Operational Limits and Conditions for the site at Risø and for the individual nuclear installations. Operational Limits and Conditions are formulated in accordance with other relevant Danish legislation, e.g. the National Board of Health Order (1997) on dose limits for ionising radiation, including:

- Justification of all new types of practices resulting in exposure to ionising radiation
- Optimisation of protection from all exposures (ALARA)
- Dose limitation; at present members of the public should not be exposed to a dose of more than 1 mSv/a from all man-made sources of ionising radiation other than from medical exposure
- Use of dose constraints

During the long operational period of the nuclear installations at Risø the discharge limits have been expressed with reference to the dose limit for members of the public of 1 mSv/year and a prompt reporting requirement to the Nuclear Regulatory Authorities for expected or actual semi-annual releases exceeding ten times typical values over previous years. Reporting according to the "10-factor-rule" has never occurred.

**Radioactive Materials Act**
According to the Radioactive Materials Act (1953) production, importation, possessing etc. of radioactive materials are subject to prior authorisation by the National Institute of Radiation Hygiene under the National Board of Health. The National Institute of Radiation Hygiene is empowered to issue detailed legislation regarding production, importation, 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.

The detailed legislation (annex A) covers common Orders for all users regarding dose limits, transfers and transport of radioactive materials and specific Orders for four main areas of use of radioactive materials (sealed sources, unsealed sources, gamma radiography, consumer products). The four specific Orders contain requirements on how to deal with the radioactive materials when these become waste (e.g. return to producer, transfer to approved storage facility at Risø, specific clearance).

Clearance of radioactive materials from the regulatory system is regulated in the Ministry of the Interior and Health Order no. 192 of 2 April 2002 on exemptions from Act on use etc. of radioactive materials. According to this Order clearance of radioactive materials is subject to prior authorisation from the National Institute of Radiation Hygiene under the National Board of Health unless the clearance can be done in accordance with requirements in the above-mentioned detailed legislation. Authorisations or detailed legislation issued by the National Institute of Radiation Hygiene shall be based on principles set out in an annex to the Order (see annex C). Authorisations can contain requirements regarding characterisation and measurements of materials before clearance and requirements regarding documentation and quality assurance. For solid man-made radioactive materials the Order prohibits dilution with the aim of complying with a defined clearance level.

*Article 20. Regulatory body*

Both the Nuclear Installation Act and the Radioactive Materials Act and their administration belong to the responsibility of the Minister of the Interior and Health and are as such independent of the Ministry of Science, Technology and Innovation under which the operation of the nuclear installations at Risø belongs.

The Nuclear Regulatory Authorities according to the Nuclear Installation Act (the Danish Emergency Management Agency and the National Institute of Radiation Hygiene) and the Regulatory Authority according to the Radioactive Materials Act (National Institute of Radiation Hygiene) 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.

The Danish legislative and regulatory system described above implements all obligations under Article 18 (Implementing measures), Article 19 (Legislative and regulatory framework) and Article 20 (Regulatory body) of the Convention.

# Section F. Other General Safety Provisions

*Article 21. Responsibility of the licence holder*

As the only Danish waste management facility subject to the Convention Risø National Laboratory holds, as part of the general authorisation, the license to collect, conditioning and store radioactive waste at the Waste Management Plant from the nuclear facilities and laboratories at the Risø site as well from all other users of radioisotopes in Denmark.

According to the Nuclear Installations Act (Section E) the prime responsibility for the safety of a nuclear installation rests with the holder of the licence. In the Nuclear Installations Act it is also stated that the Nuclear Regulatory Authority can redraw a license due to safety concerns or other compelling reasons, i.e. if the holder do not meet its responsibility. Ultimately the punishment for violations of this Act and/or provisions is penalties or imprisonment for up to two years.

During the more than 40 years of operational lifetime Risø National Laboratory has been subjugated inspections by the National Regulatory Authorities and redrawing the license has never been considered.

According to the Radioactive Materials Act and the pursuant Orders given for users of radioisotopes (Section E) it is the responsibility of such a license holder to ensure that all radioactive waste produced under his license is handled in a safe manner and finally either returned to the manufacturer or send to the Waste Management Plant at Risø National Laboratory. The license holders are subjugated inspections by the National Institute of Radiation Hygiene and their license can be redrawn for a period until the corrective measures requested are fulfilled. Ultimately the punishment for violations of this Act and/or provisions is penalties.

*Article 22. Human and Financial Resource*

Requirements on qualifications of and educational programs for staff-members working with safety issues are included in Operational Limits and Conditions for

Risø as a whole as well as for the Waste Management Plant.

Risø National Laboratory is government property placed under the Danish Ministry of Science, Technology an Innovation and as such, the financial situation for the Waste Management Plant is and will be secure also in the future in order to ensure adequate financial resources to meet the requirements to the safety of the storage facility set by the Nuclear Regulatory Authorities.

### *Article 23. Quality Assurance*

The quality assurance at Risø nuclear installations is traditionally based on the Nordic NARS system (Nordic Working Group in Reactor Safety Recommendations, 1975). For the new situation, after the closure of all installations, one part of the requirements set by the Nuclear Regulatory Authorities will be that the quality assurance system for the entire process of decommissioning including all radioactive waste management is based on international standards, which at present, for the general Quality Assurance will be DS/EN ISO 9001, version 2000. Additional requirements on complying with specific International Standards e.g. for the competence of the laboratory characterising, measuring, handling and sorting waste will also be set.

### *Article 24. Operational Radiation protection*

The National Board of Health/National Institute of Radiation Hygiene has issued the general Order on dose limits for ionising radiation. This Order covers both nuclear and non-nuclear practices in Denmark. The general principles for radiation protection (justification, optimisation, dose limitation) and the numerical dose limits for both workers and the general public prescribed in the Order are in accordance with Council Directive 96/29/EURATOM and the 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60.

In Operational Limits and Conditions for Risø there are given stringent rules on reporting received doses to the Nuclear Regulatory Authorities in normal situations where doses are within the dose limits as well as in abnormal situations where doses might have exceeded the dose limits.

The requirements in Operational Limits and Conditions make sure that discharges are limited and measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment. The requirements are covered in chapters with the following headlines:

- Discharge systems
- Discharge limits
- Precautions against abnormal incidents; and
- Prompt reporting to the Nuclear Regulatory Authorities in case of abnormal situation and/or violation of Operational Limits and Conditions.

In addition there are requirements of within two weeks after an abnormal situation sending a report to the Nuclear Regulatory Authorities including:

- A detailed description of the scenario leading to the abnormal situation
- What has been done to mitigate any effects; and
- What measures are taken to prevent similar situations in the future.

During the more than 40 years of operational lifetime of the nuclear installations at Risø the discharge limits have been expressed with reference to the dose limit for members of the public of 1 mSv/year and a prompt reporting requirement to the Nuclear Regulatory authorities for expected or actual semi-annually releases exceeding ten times typical values over previous years. Reporting according to this "10-factor-rule" has never occurred.

Releases of radioactive materials from the Waste Management Plant are and have always been dominated by liquid releases of tritiated heavy water and particulate activity to Roskilde Fjord. These releases derive from the distillation plant for radioactive wastewater, since the distillate is conducted to the inactive waste water system, from where it is taken through a pipeline to Roskilde Fjord.

The releases of tritiated heavy water to Roskilde Fjord have in recent years been around a few thousand GBq/y. The release of dissolved gross $\beta/\gamma$-activity has been less than 0.2 GBq/y of which about half is the naturally occurring $^{40}K$.

In figure 3 is shown the annual releases of tritium into Roskilde Fjord from the Waste Treatment Plant in the period 1978-2001 and in figure 4 correspondingly the annual releases of particulate activity (measured as gross $\beta$-activity).

The increased release of tritium in 1994 was the result of tritium in the active wastewater from the research reactor DR 3, as well as tritium in used ion exchangers that were supplied to the bitumen facility. The extraordinarily large release in 1999 was the result of a handling error that resulted in a release of heavy water into the active outlet at DR 3 (approx. 100 litres). DR 3 was taken out of operation in 2000 resulting in the much lower release of tritium in 2001.

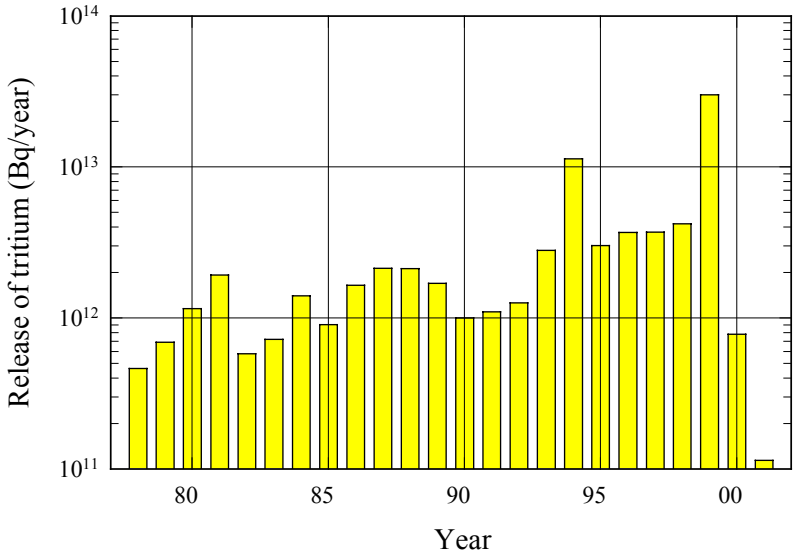


*Figure 3. Annual releases of tritium into Roskilde Fjord from the Waste Treatment Plant.*

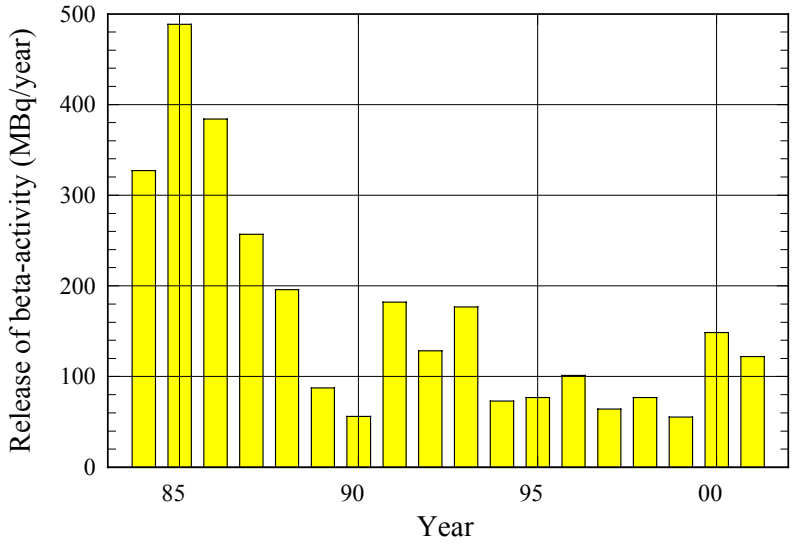


*Figure 4. Annual releases of β-activity into Roskilde Fjord from the Waste Treatment Plant.*

To illustrate the radiological consequences of the releases from the Waste Treatment Plant individual doses have been calculated to the critical group living around Roskilde Fjord and to people in Sweden from assumed annual releases of 2000 GBq tritium and 0,3 GBq $^{137}$Cs. Doses have been calculated for both children and adults. The assumed exposure pathways are consumption of fish exclusively from Roskilde fjord or Kattegat and intake of water exclusively from Roskilde Fjord. The results are given in table 5[1].

*Table 5. Annual doses to children and adults in Denmark and Sweden from annual releases of 2000 GBq tritium and 0,3 GBq $^{137}$Cs to Roskilde Fjord.*

| Radionuclide | Individual doses in Denmark (μSv/a) | | | | Individual doses in Sweden (μSv/a) | |
|---|---|---|---|---|---|---|
| | Water | | Fish | | Fish | |
| | Child | Adult | Child | Adult | Child | Adult |
| $^{3}$H | $6\cdot10^{-2}$ | $8\cdot10^{-2}$ | $4\cdot10^{-3}$ | $3\cdot10^{-3}$ | $5\cdot10^{-7}$ | $4\cdot10^{-7}$ |
| $^{137}$Cs | $2\cdot10^{-3}$ | $1\cdot10^{-2}$ | $2\cdot10^{-2}$ | $3\cdot10^{-2}$ | $2\cdot10^{-6}$ | $4\cdot10^{-6}$ |

*Article 25. Emergency Preparedness*

The Danish Emergency Preparedness System for Nuclear Accidents is under the responsibility of The Minister of Interior and Health. The operative organisation is based primarily on the Nuclear Division and the National Rescue Corps under the Danish Emergency Management Agency.

Denmark has a nation-wide nuclear emergency plan in case of accidents at nuclear installations in Denmark or at facilities in foreign countries. The plan is

[1] The calculated doses and the model used are from the report: *General Data as called for under Article 37 of the Euratom Treaty, Decommissioning of the Nuclear Facilities at Risø National Laboratory, Denmark, National Institute of Radiation Hygiene, 2003.*

tested regularly and it has special precautions for nuclear installations close to Danish territory as well as specific on-site and off-site emergency plans for Risø.

A service with a nuclear emergency officer from the Emergency Management Agency on duty 24 hours a day is maintained. This officer is authorised to decide on the activation of the emergency response system.

Early warning in case of a radiological emergency in Denmark or at a facility in the vicinity of Denmark is based on international agreements on exchange of information (IAEA, EURATOM) and on bilateral agreements, which Denmark has entered with a number of neighbouring states (Sweden, Germany, Finland, United Kingdom, Poland, Russia and Lithuania).

As a supplement to the early warning agreements an on-line system for automatic monitoring of radioactivity is in service 24 hours a day. The system provides monitoring data from 11 stations placed strategic in the country. The data are collected automatically at the Emergency Management Agency, where a computer will give a signal to the officer on 24 hours duty if any increase in gamma radiation could be attributed to causes other than natural increase of the radon content in the air.

*Article 26. Decommissioning*

As stated under Article 22 Risø is national property and as such, the financial situation are and will be secure also in the future until all the installations are fully decommissioned.

The Danish Parliament has in March 2003 agreed to the costs and the general decommissioning approach for all the nuclear facilities at Risø with the objective to decommissioning all nuclear facilities at Risø as soon as possible within a timeframe of 20 years.

The Nuclear Regulatory Authorities will subsequent license the procedures in general and specific technical projects at a more detailed level ensuring the safety of the decommissioning in agreement with Article 26.

In conclusion for section F, it is found that the Danish regulatory system implements all obligations under Article 21 (Responsibility of the licence holder), Article 22 (Human and financial resources), Article 23 (Quality assurance), Article 24 (Operational radiation protection), Article 25 (Emergency preparedness) and Article 26 (Decommissioning).

# 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 described in section B the overall policy and practice for the past spent fuel management for the Danish research reactors have been to temporary store the fuels elements in dedicated storage facilities after irradiation awaiting transfer to USA. By June 2002 all research reactors have been taken out of operation and the spent fuel has been transferred to USA's jurisdiction according to an agreement with the US Department of Energy.

The only exemption from this is the minimal amount of spent fuel from the research reactor DR 1 and about 233 kg experimentally produced and irradiated spent fuel of power reactor type remaining from post-irradiation investigations in the former Hot Cells. This minimal amount of spent fuel is stored under safe and secure conditions awaiting a decision on the final management. The storage does not give rise to any discharges of radioactive materials to the environment and hence no exposure of the public.

In addition there are at present no considerations or plans for taking any kind of nuclear reactors into operation in Denmark. As a consequence of this there are no plans for siting, designing, construction or operation of spent fuel facilities or disposal of spent fuel.

With the present legislation on nuclear installations mentioned in section E Denmark therefore complies with articles 4 to 10 in the Convention regarding safety of spent nuclear fuel management.

# Section H. Safety of Radioactive Waste Management

*Article 11. General safety requirements*

Requirements in Operational Limits and Conditions on handling, storing and transport of fissile materiel make sure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed.

One of the policies incorporated in all Danish Orders with articles regulating handling of radioactive waste is sorting at the source. This policy applied at the national level ensures that the generation of radioactive waste is kept to the minimum practicable and that biological, chemical as well as other hazards are taken into account.

As stated in Section F protective methods providing for effective protection of individuals, society and the environment are part of the national framework legislation and with due regard to internationally endorsed criteria and standards.

*Article 12. Existing facilities and past practices*

According to the Nuclear Installations Act (Section E and F) the Waste Management Plant has during its more than 40 years of operation been subjugated inspection by the Nuclear Regulatory Authorities. These inspections have been carried out continuously and as such also at the time when the Convention came into force.

At the time when the Convention came into force no intervention for reasons of radiation protection is considered necessary as a result of past practices in Denmark.

*Article 13. Siting of proposed facilities*
*Article 14. Design and construction of facilities*
*Article 15. Assessment of safety of facilities*
*Article 17. Institutional measures after closure*

As stated in section B the Danish Parliament has in March 2003 agreed to initiate the process preparing a basis for decisions concerning a Danish disposal facility for low and intermediate waste. This initial process will make sure that all necessary steps are taken to implement fundamental principles and requirements for such a disposal facility in compliance with national and international obligations and recommendations.

Prior to siting, construction and commissioning of a Danish disposal facility the project will be subject to an Environmental Impact Assessment according to Danish legislation which implements Council Directive 85/337/EEC and 97/11/EC.

In addition, prior to the commissioning of a disposal facility the European Commission will be provided with general data relating to the disposal project making it possible for the Commission to assess whether the implementation of the project is liable to result in a radioactive contamination of the water, soil or airspace of another Member State as called for under the Article 37 of the Euratom Treaty. The presented data will be in compliance with the Commission Recommendation 1999/829 of 6 December 1999.

*Article 16. Operation of facilities*

The Waste Management Plant at Risø existed before the Nuclear Installations Act was put into force in 1962. Consequently this law did not regulate the original design of the installations and the initial constructions. However the design and construction of the installations are in accordance with international practice and all later modifications have been subject to approval by the Nuclear Regulatory Authorities and regulated through Operational Limits and Conditions in accordance with the Nuclear Installations Act as described in section F.

Safety assessments were performed for each nuclear installation at Risø and approved by the Danish Atomic Energy Commission when the nuclear installations at Risø were commissioned in the 50'es. The safety analyses have subsequent been updated in accordance with requirements in the Operational Limits and Conditions and the procedures in agreement of 15 august 1989 between the Nuclear Regulatory Authorities and Risø National Laboratory.

In conclusion for section H, it is found that the Danish regulatory system implements all obligations under 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), Article 16 (Operation of facilities) and Article 17 (Institutional measures after closure).

# Section I. Transboundary movement

*Article 27. Transboundary movement*

The National Board of Health/National Institute of Radiation Hygiene has issued Order no. 969 of 13 December 1993 on international transfer of radioactive waste. This Order implements all obligations under Article 27 (Transboundary movement) of the Convention. The Order was originally issued as the Danish implementation of Council Directive 92/3/EURATOM of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community. The Order does not cover, in compliance with the Council Directive, shipments of sealed radioactive sources not containing fissile material when returned by its user to the supplier of the source in another country.

The National Board of Health/National Institute of Radiation Hygiene has issued Order no. 993 of 5 December 2001 on transport of radioactive materials in accordance with the recommendations given in IAEA's Regulations for the Safe Transport of Radioactive Materiel No. TS-R-1, 1996 Edition (Revised).

The National Institute of Radiation Hygiene has until now never received an application and consequently never issued any licence for a transboundary movement of radioactive waste with Denmark as the country of origin or with Denmark as the country of destination.

The National Institute of Radiation Hygiene has authorized only a few transboundary movements between EU-countries with Denmark as a country of transit since the above-mentioned Order came into force 1 January 1994. The latest reported data from the European Commission on such shipments is given in *Third Report on the application in the member States of Directive 92/3/EURATOM of 3 February 1992 on the supervision and control of shipments of radioactive waste between member states and into and out of the Community (1996 – 1998), COM(2001) 270 final, Brussels 25.05.2001*.

# Section J. Disused sealed Sources

*Article 28. Disused sealed sources*

The National Board of Health/National Institute of Radiation Hygiene has issued Order no. 308 of 24 May 1984 concerning industrial gamma radiography installations, Order no. 154 of 6 March 1990 on smoke detectors and consumer products containing radioactive materials and Order no. 918 of 4 December 1995 on the use of sealed radioactive sources in industry, hospitals and laboratories. These three Orders implement all obligations under Article 28 of the Convention ensuring that the possession and storage of disused sealed sources take place in a safe manner.

As stated in section F it is the responsibility of the licence holder to ensure that disused sealed sources are handled in a safe manner and finally either returned to the manufacturer or send to the Waste Management Plant at Risø.

In Denmark neither manufacturing nor remanufacturing of sealed sources takes place. There are only a few suppliers in Denmark processing minor sealed sources for reexport. Reentry of such disused sources for storage will on application be considered case by case.

# Section K. Planned Activities to Improve Safety

For nuclear activities in Denmark including radioactive waste management the year of 2003 will constitute an important transition from the operation of nuclear research facilities and central storing of radioactive waste to the beginning of full scale decommissioning of the nuclear facilities and expanding the radioactive waste management to include considerations of final disposal of such waste.

As mentioned in section B the Danish Parliament has in March 2003 agreed to the costs and the general decommissioning approach for all the nuclear facilities at Risø with the objective to decommissioning all nuclear facilities at Risø as soon as possible within a timeframe of 20 years. At the same time the Parliament has agreed to start the work to establish a basis for decisions on a Danish disposal facility for low and medium level waste. This work will start with an assessment of the need for a revision of the legal basis including the question of an open and transparent decision process. The initial work should also propose fundamental principles and requirements for a disposal facility in accordance with national and international obligations and recommendations.

As the integrated process for both the decommissioning and the radioactive waste disposal considerations are more or less new in a Danish context a comprehensive and transparent process can be conducted based on Nordic and other international recommendations from the International Commission on Radiological Protection (ICRP), the European Commission (EU) and the Internal Atomic Energy Agency (IAEA). The Safety Standards published by IAEA will in particular be of importance, e.g. IAEA Safety Guide No. WS-G-2.1, Decommissioning of Nuclear Power Plants and Research Reactors (1999) and IAEA Safety Fundamentals No. 111-F, The Principles of Radiation Waste Management (1995), IAEA Safety Guide No. 111-G-3.1, Siting of Near Surface Disposal Facilities (1994), IAEA Requirements No. WS-R-1, Near Surface Disposal of Radioactive Waste (1999) and IAEA Safety Guide No.WS-G-1.1, Safety Assessment for Near Surface Disposal of Radioactive Waste (1999).

# Annex A. Danish Legislation – Spent Fuel and Radioactive Waste

The Danish legislation listed below is in force per 1 January 2003. The legislation is available in Danish at the web site of the National Institute of Radiation Hygiene: 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 the Interior and Health) 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 the Interior and Health) Order no. 574 of 20 November 1975 on precautionary measures for the use etc. radioactive substances.

Ministry of the Interior and Health 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 Office under the Danish Emergency Management Agency and the National Institute of Radiation Hygiene under the National Board of Health)**:**

Operational Limits and Conditions for the site at Risø.

Operational Limits and Conditions for the individual nuclear installations at Risø.

**Orders from the National Board of Health (National Institute of Radiation Hygiene):**

National Board of Health Order no. 308 of 24 May 1984 concerning industrial gamma radiography installations with amendments in Order no. 790 of 19 October 1999.

National Board of Health 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.

National Board of Health Order no. 546 of 23 June 1993 on transfer of radioactive materials.

National Board of Health Order no. 969 of 13 December 1993 on international transfer of radioactive waste.

National Board of Health 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.

National Board of Health Order no. 918 of 4 December 1995 on the use of sealed radioactive sources in industry, hospitals and laboratories etc. with amendments in Order no. 794 of 19 October 1999.

National Board of Health Order no. 823 of 31 October 1997 on dose limits for ionizing radiation.

National Board of Health Order no. 954 of 23 October 2000 on the use of unsealed radioactive sources in hospitals, laboratories etc.

National Board of Health Order no. 993 of 5 December 2001 on transport of radioactive materials.

# Annex B. Legal Instruments according to the Euratom Treaty – Spent Fuel and Radioactive Waste

Council Directive 90/641/EURATOM of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionizing radiation during their activities in controlled areas.

Council Directive 92/3/EURATOM of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community.

Council Regulation 93/1493/EURATOM of 8 June 1993 on shipments of radioactive substances between Member States.

Council Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation.

# Annex C. Principles for Clearance of Radioactive Substances

(Annex 3 in Ministry of the Interior and Health Order no. 192 of 2 April 2002 on exemptions from Act on use etc. of radioactive materials)

1. Radioactive substances or materials containing radioactive substances may be cleared from their regulatory control due to their radioactivity, when special radiation protection requirements regarding activity levels etc. are fulfilled. This mean in practice that cleared materials can be treated and handled as non-active materials. Clearance can include disposal as non-active materials, recycling and reuse of the materials in question.

2. The special radiation protection requirements are defined, cf. article 12 in the Order, by the National Board of Health (National Institute of Radiation Hygiene) either in a specific authorisation or in regulations for a given area of application. The special radiation protection requirements shall ensure:

a) That the radiological risks to individuals caused by the cleared materials are sufficiently low
b) That the collective radiological impact is sufficient low, and
c) That the activity of the cleared materials from a radiation protection point of view is without significance, with no appreciable likelihood of scenarios that could lead to a failure to meet the criteria in (a) and (b).

3. For materials containing man-made radionuclides, the special radiation protection requirements shall, among others, be based upon, that the following dose criteria are met in all feasible circumstances:

a) The effective dose expected to be incurred by any member of the public due to the cleared material is of the order of 0,01 mSv or less per year, and
b) Either the collective committed effective dose per year due to the clearance is of the order of 1 manSv or less or an assessment of the optimisation of protection shows that clearance is the optimum solution.

4. For materials containing natural radionuclides, the special radiation protection requirements shall, among others, be based upon, that the following dose criteria are met in all feasible circumstances:

a) The effective dose expected to be incurred by any member of the public due to the cleared material in addition to the normal background radiation from naturally occurring radionuclides is less than 0,3 mSv per year.

5. Principles for setting and calculating clearance can be found in the following EU-reports:

- *Recommended radiological protection criteria for the recycling of metals from the dismantling of nuclear installations, Radiation Protection 89, European Commission 1998.*
- *Recommended radiological protection criteria for the clearance of buildings and buildings rubble from the dismantling of nuclear installations, Radiation Protection 113, European Commission 2000.*
- *Definition of clearance levels for the release of radioactively contaminated buildings and buildings rubble, Radiation Protection 114, European Commission 2000.*
- *Methodology and models used to calculate individual doses from the recycling of metals from the dismantling of nuclear installations, Radiation Protection 117, European Commission 2000.*

- *Practical use of the concepts of clearance and exemption – Part I, Guidance on general clearance levels for practices, Radiation Protection 122, European Commission 2000.*
- *Practical use of the concepts of clearance and exemption – Part II, Application of the concepts of exemption and clearance to natural radiation sources, Radiation Protection 122 – Part, European Commission 2001.*