DANISH DECOMMISSIONING

A Small Inventory Disposal Programme

14 September 2020 • Ole Kastbjerg Nielsen, Man. Director

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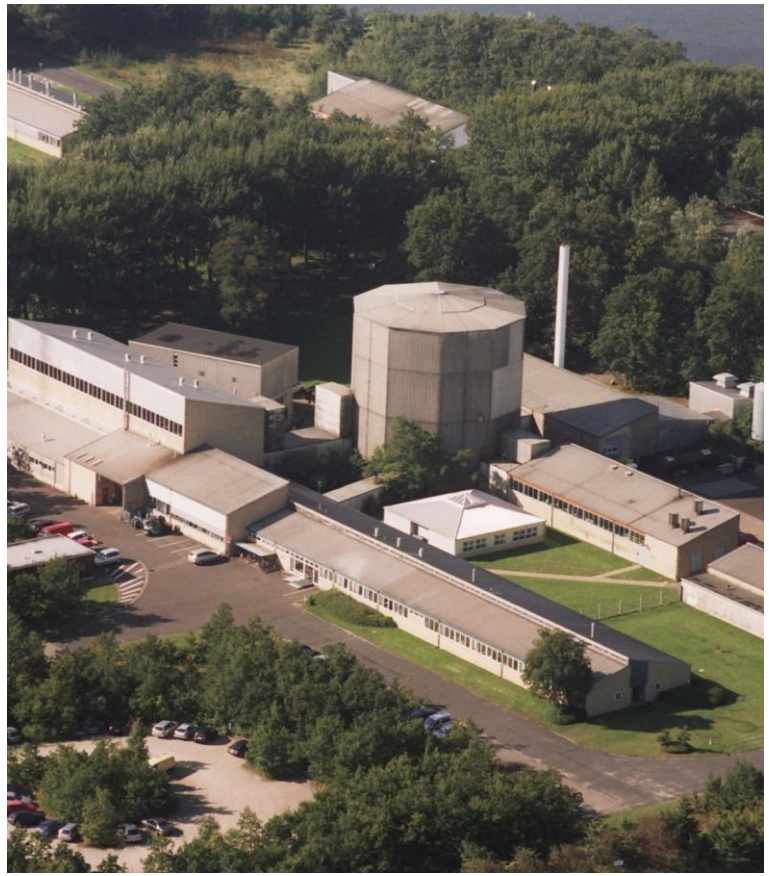
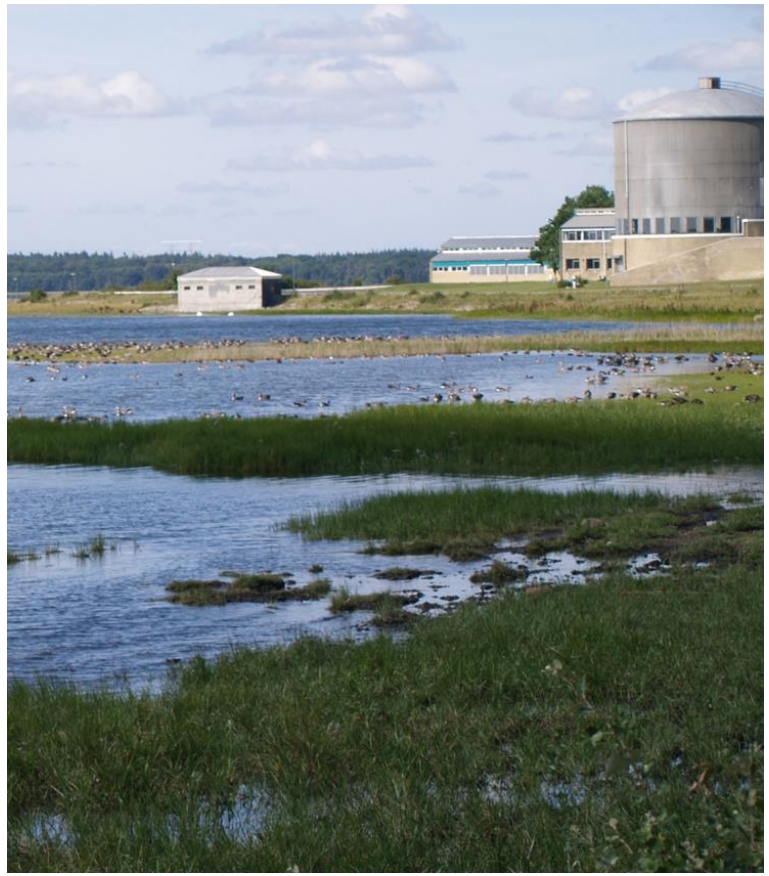
RISØ HISTORY

- 1956-58: Risø National Laboratory was established
- Aim: To prepare for the introduction of nuclear power in Denmark
- Research areas in the first 20-25 years: Reactor physics and technology, physics, chemistry, health physics, electronics, metallurgy
- 1976: Scope broadened to include research in other energy sources (wind, oil/gas)
- 1985: Parliament decided that nuclear power should not be introduced in Denmark
- Subsequently, RNL's nuclear related research was reduced
- 2000: DR 3 reactor closed; decomm. planning started



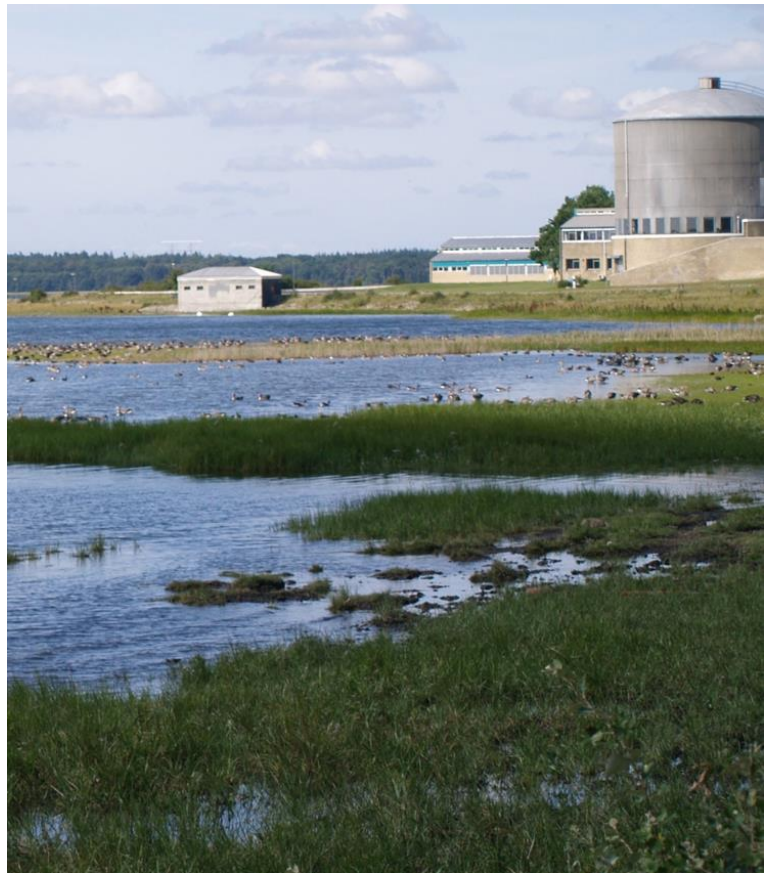
DANISH DECOMMISSIONING (DD)

- Established in 2003 as a separate organisation under Ministry of Science, Technology and Innovation
- Tasks:
  - ❑ Decommission RNL to ”greenfield”
  - ❑ Receive, treat and store Danish radioactive waste
  - ❑ Assist in a long-term solution for waste



DANISH DECOMMISSIONING

- Time frame for the decommissioning:
  up to 20 years from 2003
- Estimated total cost:
  ~2.1 billion DKK
  (~334 MUSD ~282 MEUR)
  (2020 price level)
- Excluding costs for a long-term solution for the waste and upgraded storage facility
- Upgraded storage facility (~ 300 MDKK/~40 MEUR/~48 MUSD) (2020 price level)



DANISH REPOSITORY PROCESS SO FAR

2003: Parliament decides to initiate a technical study

2008: Technical study of repository is presented

2009: Parliament decides to initiate a pre-feasibility study

2011: Pre-feasibility study presented; 6 recommended sites

2012: Parliament decides to initiate studies of longterm storage

2013-15: Local area-studies & environmental assessment of 6 sites

2015: Technical study of longterm storage is presented

2016: Further analyses of longterm storage are presented

NEW PARLIAMENTARY RESOLUTION IN 2018

- Intermediate storage of waste continues at Risø for a period of up to 50 years. Storage facilities will be upgraded and moved onto higher grounds to ensure safekeeping of the waste
- Efforts to find an international solution for the 233 kg of special waste are continued
- Geological survey of the Danish possibilities for a deep repository for all waste is initiated
- A thorough political process involving municipalities and other relevant stakeholders is initiated

THE DANISH RADIOACTIVE WASTE

- **Amount**
  - 5-10.000 m^3
- **Type:**
  - Low- and intermediate level waste
  - Primarily short lived waste
  - A small amount of 'special waste' and long lived waste
  - NORM waste
- **Origin:**
  - Research
  - Health sector
  - Industry
  - Decommissioning

DECOMMISSIONING WASTE

DR1, DR2, DR3 :

Graphite, Aluminium, Stainless steel, steel, concrete, heavyweight concrete containing barite, Tops shield ring, Top shield plug, cadmium, beryllium, lead

Hot Cells:

Stainess steel, steel, lead, concrete, other components, paint containing e.g. PCB

WASTE TYPES BASED ON ORIGIN

- **Compressed low activity solid waste (paper, plastic, work clothes, glass metal etc.)**
- **Discarded radioactive equipment**
- **Sludge from waste water treatment at Risø (bitumen covered evaporation residue, ion exchange residue etc.)**
- **Discarded radioactive sources (from health care, research and industry)**
- **Waste from decommissioning of the nuclear facilities (primarily metal parts and concrete)**
- **Special waste, which is waste not included in the above categories. This includes small pieces of irradiated fuel used in material research, natural and depleted uranium, and core solution from DR 1 (Danish Reactor 1), one of the former reactors.**

In red: some is legacy waste

MATERIAL TYPES

- Metal; e.g. steel, aluminium, lead, cadmium
- Concrete
- Combustible operational waste such as gloves, plastic, work clothes etc.
- Bitumen waste (sludge cast in asphalt)
- Disused radioactive sealed sources, made up of one or two radioactive metals
- Graphite
- Waste containing PCB
- Uranium containing waste (both metal and non-metal uranium).

EXAMPLES OF CHALLENGING WASTES

- Sludges;
- Organic Waste;
- Spent Ion exchange resins (SIERs);
- Bituminized waste;
- Graphite;
- Uranium/radium/Thorium bearing waste;
- Decommissioning Waste;
- Particular spent research fuel such as metal uranium and aluminium cladding;
- Disused radioactive sealed sources;
- Waste containing chemotoxic materials such as beryllium, mercury; asbestos; lead


TARE
127KG
2427KG


A-09-04
B-09-04
C-08-04
D-08-04
A-10-03
B-09-03
C-10-03
E-10-03
G-10-03
I-10-03
C-11-02
E-11-02
G-11-02
I-11-02
A 4754
A 4845
A-12-01
B-11-
C-12-01
D-11-01
A 4775
A 4768
E-12-01
I-12-01

THE WAY FORWARD – UPGRADED STORAGE FACILITY

- **Upgraded storage facility ready mid 2024**
  - App. 10.000 m2.
  - Uranium ore and tailings to be placed in a separate, new facility.
- **Waste will be placed in the facility by 2027 (establishment phase).**
  - Three types of containers: ISO half height, steel container and jumbo containers.
  - As reversible conditioning and packaging as possible, as WAC for repository are not known yet.
- **Facility to be operated until 2073 at the latest (operational phase)**
  - Plan for continuous control with the building and the waste.
  - Plan for further treatment of the waste: supplementary characterisation, minimisation, packaging and conditioning in accordance with WAC for final repository.
  - Construction of necessary waste handling facilities.

THE WAY FORWARD – PREPARING THE FINAL REPOSITORY

- **Waste Management Strategy and Plan**
  - Project to be initiated in 2021, in cooperation with an international WMO, to respond to:
    - What do we know about the waste now?
    - What do we need to know in order to decide on the overall repository concept? (GDF, near surface/intermediate depth repository combined with borehole?) And to make a robust safety analysis?
    - How do we get there in terms of resources, competences, methodology, technology, facilities, R&D?
  - Output a waste management strategy and plan, setting the course for the way towards a final repository and defining the R&D needs.
- **Thorough political process, based on partnerships with volunteering municipalities**
  - Learn from other countries that have been through similar process.
- **Waste placed in final repository by 2073 at the latest**
  - Geological Survey of Denmark and Greenland implementing a project investigating the Danish geology in depths of app. 500 m.

THE WAY FORWARD – PREPARING THE ORGANISATION

- **Historical journey: from a science organisation during the reactors' operation to a decommissioning organisation, and on our way to become a waste management organisation.**
  - Organisational and cultural transformation.
  - Capacity building through national R&D program, training, courses, participation in international cooperation, recruitment of supplementary resources, etc.
  - Use experience from many years of operation, waste handling and decommissioning.
- **Benefit from international cooperation**
  - Very valuable knowledge and information foreseen from EURAD, both R&D, SS and KM.
  - Fruitful cooperation in the Routes WP: knowledge, network, knowledge transfer from LIMS to SIMS
  - Get the most out of an often limited amount of resources by sharing knowledge, methods, competences, predisposal and disposal facilities.
    - Risk of competence shortage in many SIMS on a longer term basis. Can be overcome by sharing competences internationally.
    - ERDO cooperation very valuable.

THE WAY FORWARD – PAVING THE WAY

- Essential learning form previous process: Communication is core to a successful outcome!
- Openness and involvement.
- Contact fora (national and local in Roskilde municipality) have improved communication and public acceptance considerably.
    - Similar contact fora to be formed in volunteering municipalities.
- Outside the municipality of Roskilde, knowledge about RW is very limited.
    - Capacity building outside the organisation very important.
    - Invite relevant stakeholders to participate in the future process to build knowledge.

THANK YOU FOR YOUR ATTENTION

COMPRESSED WASTE FROM EXTERNAL USERS AND OPERATIONS – ADDITIONAL INFORMATION

- Plastic, bituminised sludges from wastewater treatment, dried sludges, soil, clothes, laboratory equipment, discarded tools, discarded sources, smoke detectors, biological material, small amounts of liquids packed in absorbing material, aluminium, small amounts of U-235 etc.
- The waste is mixed, and in older waste the smoke detectors have been mixed in with short-lived waste.

DECOMMISSIONING WASTE – ADDITIONAL INFORMATION

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