

Topical Peer Review II Country Review Workshop
'Fire Protection'

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National Presentation of Denmark
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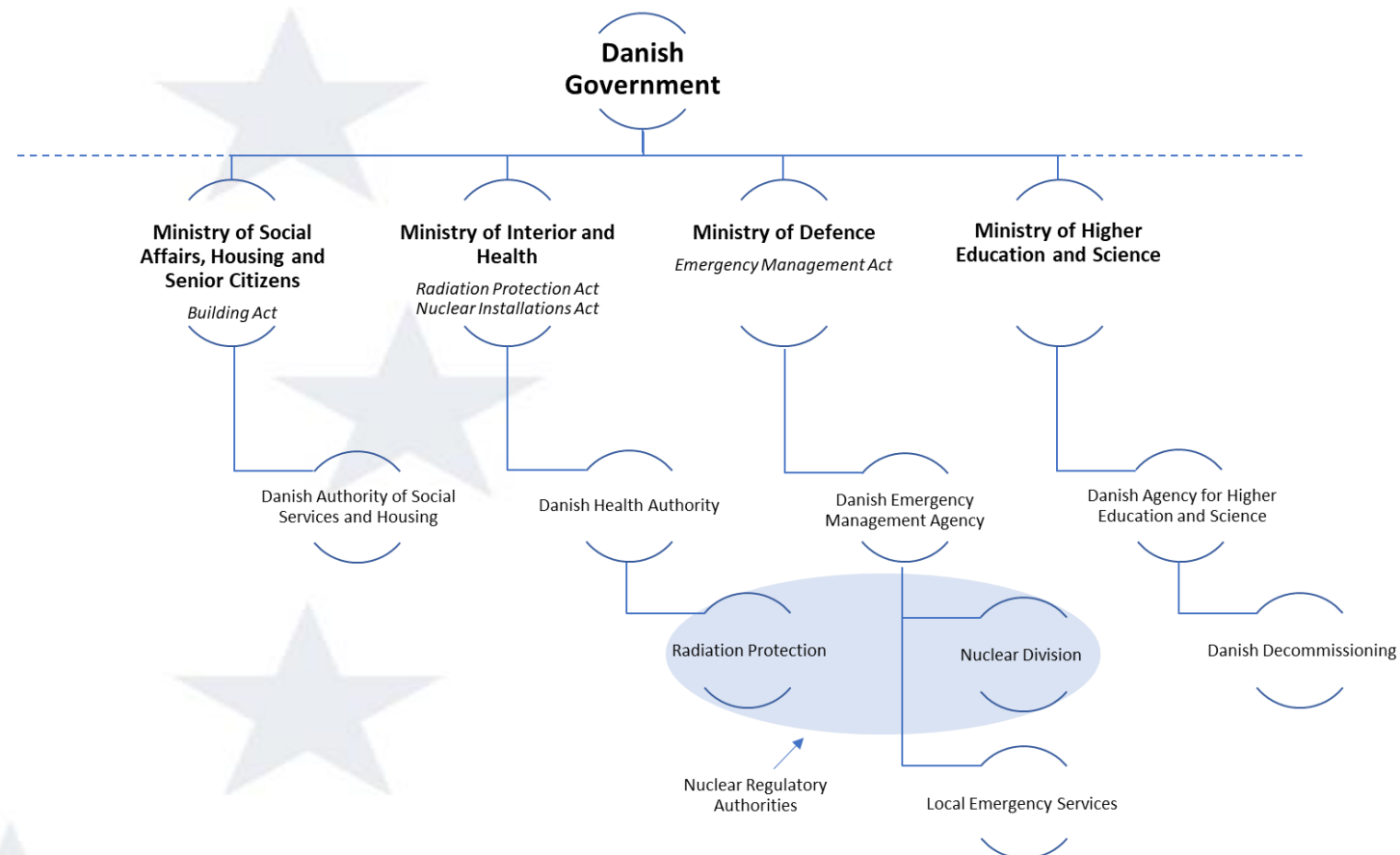
National regulatory framework concerning fire safety:

- ☐ Nuclear Installations Act
- ☐ Radiation Protection Act
- ☐ Building Act
- ☐ Emergency Management Act

WENRA SRL's have no legally binding effect in Denmark

IAEA and WENRA guidelines serves as basis for the planning, preparation and conduct of decommissioning activities as well as operational activities related to management of radioactive waste.

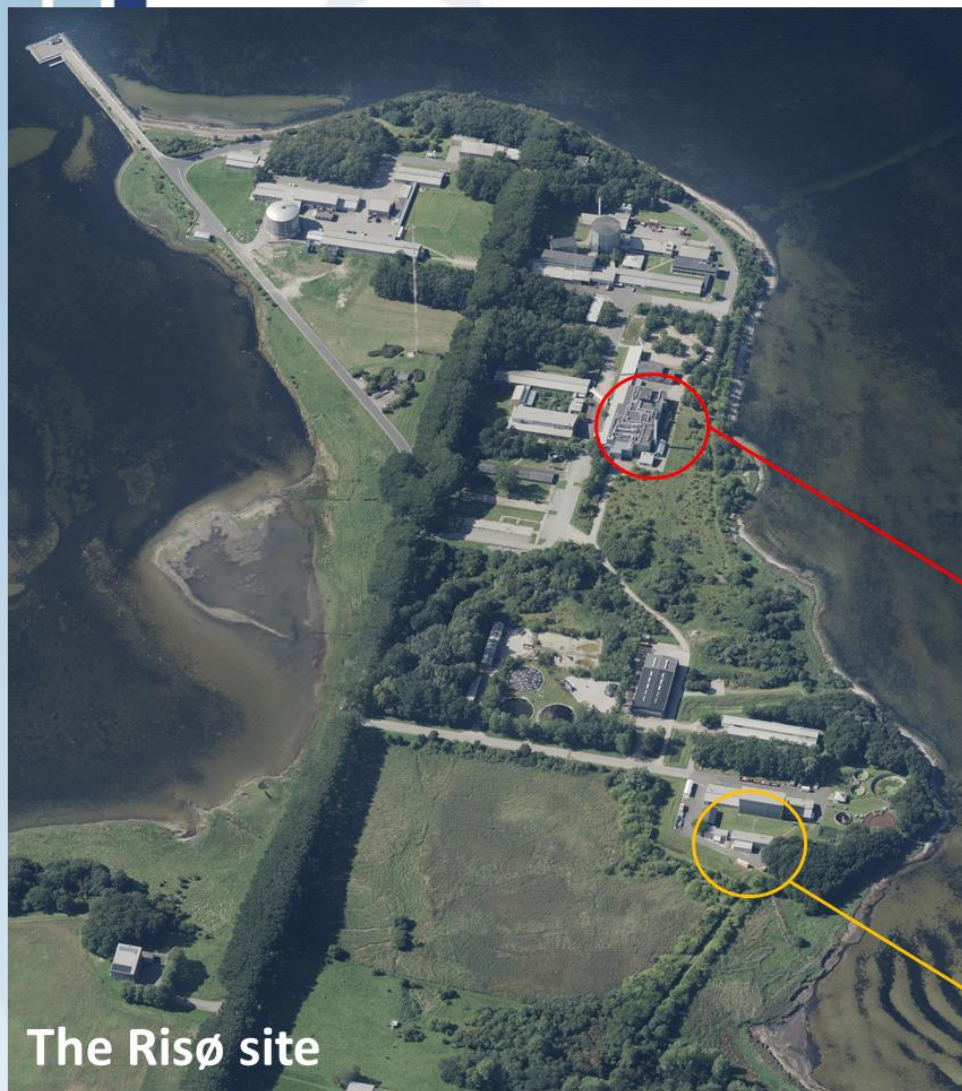
National Presentation Denmark



The organization structure of the Danish authorities at the time of publication of the NAR

Nuclear installations in Denmark

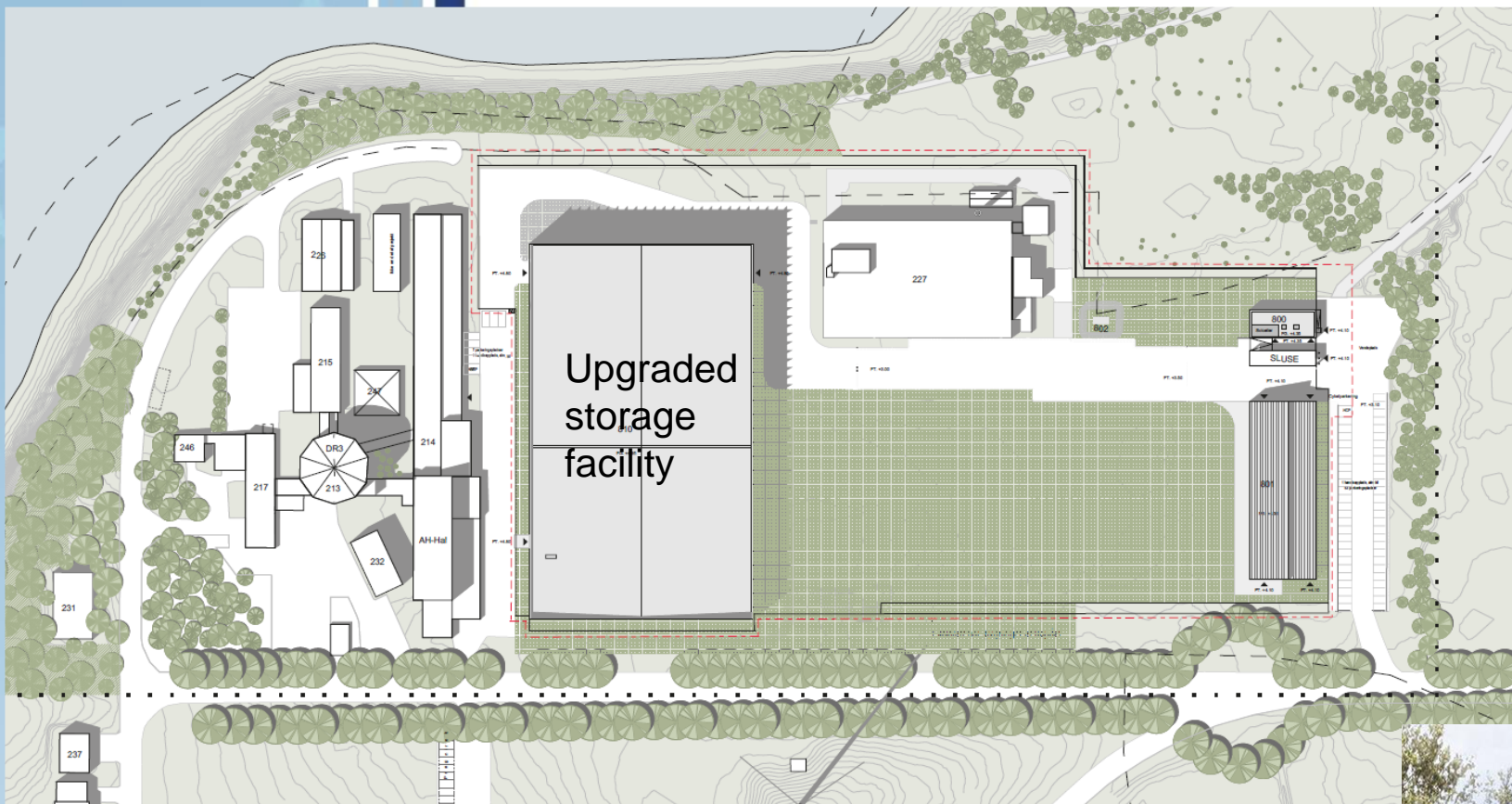
Candidate installations:



Nuclear facility	Type	Taken out of operation	Decommissioning status
Danish Reactor 1 (DR 1)	Small homogeneous 2 kW reactor mainly used for educational purposes	2001	Fully decommissioned and the building was released from regulatory control in 2006.
Danish Reactor 2 (DR 2)	5 MW research reactor of the open pool type	1975	The reactor is fully decommissioned, but the Reactor Containment Hall is in used for handling of contaminated waste objects.
Danish Reactor 3 (DR 3)	10 MW heavy water research reactor of the PLUTO type	2000	Only the structural component of the biological shield remains to be removed before decommissioning of the reactor hall can commence.
Hot Cell Facility	Facility for post irradiation investigations of nuclear fuel	1989	Initial remote cleaning of all 6 cells is complete, and each cell is ready for secondary robotic cleaning.
Fuel Fabrication Plant	Fuel Fabrication Plant for DR 2 and DR 3	2002	Decommissioning were completed early 2014, the building was released from regulatory control in 2023.
Waste Management Plant including waste storage facilities	Radioactive waste management facilities	2019	In May 2019, the Nuclear Regulatory Authorities approved the decommissioning plan. The preparatory work and initial decommissioning of building 211 is ongoing.

Future facilities at the Risø site

Upgraded storage building and associated facilities



Upgraded storage facility

- Planning stage
- Storage for Danish radioactive waste
- Operational period up to 50 years
- Footprint approximately 10.000 m²
- Storage capacity 10.000 -15.000 m³



Candidate installations:

Hot Cell Facility

- A Facility under decommissioning.
- Ongoing activities include remote cleaning of contaminated surfaces.
- The installation has a larger potential for release in case of a fire compared to other installations under decommissioning at the Risø site

Drum Storage

- A storage of radioactive waste.
- The storage area is a “tub”-like concrete construction covered with a metal roof.
- Historical radioactive waste stored in 210 L steel drums. Some drums contain combustible bitumen and a some contain asphalt.
- The storage has a larger potential for release in case of a fire compared to other storage facilities at the Risø site

Fire safety analysis Waste (Drum storage) Decommissioning (Hot Cells)



Storage facilities and installations currently under decommissioning at the Risø site were originally designed and constructed in accordance with building codes and regulations in force at the time of construction, i.e. dating back to the mid-1950s

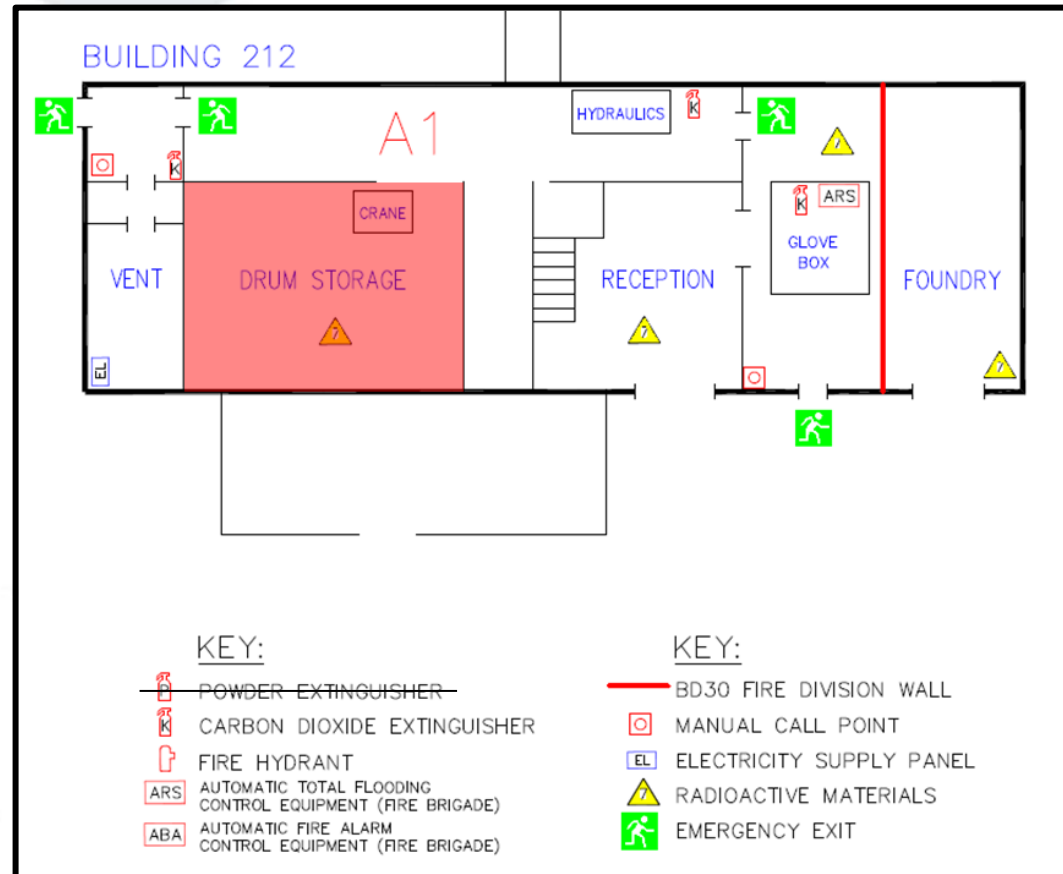
In the years 1998 – 2000, operational activities at the Risø site significantly decreased. A fire safety analysis was conducted which concluded the local fire department to be sufficient, hence the on-site fire department was disbanded.

The analysis identified areas/rooms where Systems, Structures and Components (SSC) necessary for safety, which could be affected by a fire or where a fire potentially could result in release of radioactive substances.

The requirements for nuclear safety during operation and decommissioning at the Risø site including provisions for fire safety are implemented in the operational limits and conditions for Danish Decommissioning (OLC). The OLC is updated continuously to ensure the safety on site.

Active fire protection Waste (Drum Storage)

Drum Storage



Active fire protection Waste (Drum storage)

The Drum Storage is exempt from the requirement for the number of fire detectors. This is due to:

- The low fire load, and
- justification of exposure versus the benefits related to the instalment of detectors.

There are a total of 8 permanently installed automatic fire detectors (Automated Fire Alarms) in Drum Storage.

The fire alarm system at the Risø site ensure alarms directly to the municipal fire brigade, as well as to DD's technical duty officer (monitoring the technical state of facilities) and Risø site main entrance duty officer (24/7).

In Drum Storage there is a total of three carbon dioxide extinguishers. These are placed according to instructions from the fire technical advisers who carry out fire inspections for DD.

Active fire protection Waste (Drum Storage)

According to the OLC:

- Fire-extinguishing equipment must be available
- The equipment must be checked and inspected by an authorized company in accordance with applicable guidelines.

The Drum Storage:

- Is difficult to access
- The dose rate in the storage area is elevated

The poor access conditions impose limits to manual fire suppression activities. However firefighting is possible from the reception room which is easily accessible.

Firefighting is carried out by the municipal fire brigade, who will decide on the extinguishing agent depending on the nature of the specific fire and the radiological risk. DD will provides on-site health physical advice on these matters.

Passive fire protection Waste (Drum Storage)

The Drum Storage is a “tub” type of construction located inside a room in building 212.

The walls facing the other rooms in the building are made of 44 cm concrete, with a primary shielding function, but at the same time are effective heat barriers.

Due to the staggered openings (maze) into the Drum Storage, the storage itself does not constitute a fire compartment.

Conclusions

Waste (Drum Storage)

Strengths:

- Structural and layout features: The building consists of concrete floors, concrete and brick wall and a concrete roof. As such, fire load of the building itself is low;
- Operational features: The storage area is not accessed by staff, and waste units are not routinely added to or removed from the storage area.

Weaknesses:

- Rooms are not everywhere separated by doors, in particular the storage area does not have a door;
- Fire preventive measures in the Drum Storage rely in part on the structural and layout features of the building itself, and partly on the adherence to operational procedures;
- Due to the level of radiation the Drum Storage itself is constructed in a way that it is difficult to access, also in case of a fire.

Decommissioning Hot Cells



The fire protection concept has been adapted throughout the transition from the operational to the post-operational period, and as decommissioning activities have progressed.

Fire protection during the operational period strongly relied on the presence of a dedicated, on-site fire service

Fire safety in the post-operational period has to a higher degree relied on passive safety features with respect to detection and alarm measures, while fire safety during conduct of decommissioning activities in addition to detection and alarm measures strongly depends on adherence to operational protocols (keeping fire loads low, limiting the number of ignition sources, etc.)

Decommissioning Hot Cells

Hot Cells



Decommissioning Hot Cells



Operational procedures for Hot Cells in the decommissioning phase dictate:

- Thorough planning for conduct of activities
- Post activity clean up focusing *inter alia* on fire safety
- Provisions for reducing ignition sources, the amount of combustible materials and fire load in general.

Fire safety today relies mainly on:

- The operator's adherence to provisions for fire safety in building regulations when restructuring or modifying the areas surrounding the row of hot cells, and
- Day-to-day operational provisions for maintaining a low fire load, and a low-ignition environment in the working areas surrounding the row of hot cells.
- The more than 100 fire detectors (Automated Fire Alarms) installed.

This approach has proven adequate to date.

Decommissioning Hot Cells



The OLC are continuously updated and adjusted to ensure safety operation and decommissioning of the nuclear facilities under decommissioning

For each identified decommissioning action detailed work plans are developed, including assessment of hot work (welding, flame cutting).

Fire inspections of each facility includes review of:

- Fire-technical documentation
- Fire-technical conditions, including assessments of ignition sources, their location in relation to combustible surfaces, and fire loads.

Conclusions

Decommissioning (Hot Cells)

Strengths:

- Structural and layout features: the risk of start of a fire inside the now vacated cells is limited, as is the risk of spread of a fire from the surrounding areas to the cell blocks.
- The abundance of fire detectors installed

Weaknesses:

- Fire preventive measures in the Hot Cell facility rely to a higher degree on the adherence to operational procedures specified in the OLC etc. than on the structural and layout features of the building itself.
- The ventilation system may act as a conduit for fire spread through the system of air ducts.

General conclusions from the Nuclear Regulatory Authorities



Facilities with long operational histories require continuous assessment of fire safety and subsequent relevant adaptations of fire safety measures, taking into account operational histories, current operational regimes and future plans.

For facilities under decommissioning this becomes particularly challenging towards the later stages of decommissioning, when radiological risks decrease and conventional and radiological fire safety criteria have to be balanced.

A regulatory regime based on legislative requirements from different governmental sectors add complications to this process.

The transition from the operational into a post-operational phases may lead to gradual erosion of fire safety competences available to the licensee.

This presents a risk that the (fire) safety culture erodes over time, leading to poor implementation of the fire protection concept.

These lessons will be included in the continuous development of the fire protection concept for the remaining ongoing decommissioning activities and in the definition of a new fire protection concept for a planned upgraded storage facility at the Risø site.