40 Years of Experience of ONDRAF/NIRAS and Belgoprocess on the Interim Storage of LLW, ILW and HLW in Belgium

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Content

- Introduction
- History
- Centralised interim storage facilities
- Inspections
- Observations
- Conclusion
Introduction: simplified organization chart of the bodies involved in radioactive waste management

Federal Government

Ministers Economic affairs and Energy

Radioactive waste management

ONDRAF - NIRAS

Belgoprocess (subsidiary company of ONDRAF–NIRAS)

Nuclear operators – Radioactive waste producers

Minister of the Interior

Security & Safety

F.A.N.C.
Who is ONDRAF/NIRAS?

ONDRAF/NIRAS, the Belgian Agency for Radioactive Waste and Enriched Fissile Materials is

- a public body created by Law of 8 August 1980
- charged with the management, including disposal, of all the radioactive waste that is present on Belgian territory.

Who is Belgoprocess?

- Since 1986, subsidiary company of ONDRAF/NIRAS
- Operating, under the control and responsibility of ONDRAF/NIRAS, the agency’s facilities for
  - Processing and conditioning
  - Interim storage on the central management site of Dessel/Mol
General missions ONDRAF/NIRAS

- Collection and transport of radioactive waste
- Processing and conditioning of radioactive waste
- Storage of radioactive waste
- Disposal of radioactive waste
- Inventory of all nuclear installations and sites containing radioactive materials
- Decommissioning and remediation
- Communication
Content

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History (1/3)

- Nuclear activities strongly developed from 1955:
  - Nuclear Research Centre SCK•CEN.
  - Eurochemic reprocessing facility.
History (2/3)

- First interim storage for LLW

- Sea dumping until 1982 for LLW:
  - Quality requirements for waste drums -> low
    - drum in carbon steel.
    - short cycle time production and interim storage.
History (3/3)

- Interim storage building 127 for ILW in operation from 1978

- 1983-1985: Re-orientation waste management
  - Quality requirements for waste drums
  - Life cycle 10 year
  - Surface disposal planned for mid 90's
  - New interim storage building 150 LLW

- 1985-......: Surface disposal delayed (operational 2022)
  - Continuous improvement waste drums.
    - Galvanized
    - Epoxy coating
    - Life expectation 75 years
    - New extra interim storage building 151 LLW

- 1985-.... : new interim storage buildings for ILW and HLW
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Centralised storage facilities on the BP1 site in Dessel

Storage facilities LLW

<table>
<thead>
<tr>
<th>Buildings  (31-12-2015)</th>
<th>Number packages (#) / volume (m³)</th>
<th>Capacity (m³) /filling rate (%)</th>
<th>Waste Type</th>
<th>Drum</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>3330 / 1922</td>
<td>1929 / 99,6 %</td>
<td>LLW</td>
<td>Different volumes</td>
</tr>
<tr>
<td>151</td>
<td>34446 / 13985</td>
<td>14707 / 95,1 %</td>
<td>LLW</td>
<td>400 liter</td>
</tr>
<tr>
<td>155</td>
<td>6603 / 2694</td>
<td>4221 / 63,8 %</td>
<td>L&amp;ILW (alpha-radium)</td>
<td>400 liter</td>
</tr>
</tbody>
</table>
## Storage facilities ILW

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<tr>
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</thead>
<tbody>
<tr>
<td>127</td>
<td>15910 / 3885</td>
<td>4650 / 83,5 %</td>
<td>ILW</td>
<td>220 and 400 liter bituminised and cemented</td>
</tr>
</tbody>
</table>
### Storage facilities ILW & HLW

<table>
<thead>
<tr>
<th>Buildings (31-12-2015)</th>
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<th>Drum</th>
</tr>
</thead>
<tbody>
<tr>
<td>129</td>
<td>2335 / 215</td>
<td>250 / 86,1 %</td>
<td>ILW (vitrified)</td>
<td>60 and 150 liter canisters</td>
</tr>
<tr>
<td>136- zone C</td>
<td>390 / 70</td>
<td>106 / 66,2 %</td>
<td>HLW (vitrified)</td>
<td>150 liter canisters</td>
</tr>
<tr>
<td>136- zone D</td>
<td>556 / 147</td>
<td>600 / 24,5 %</td>
<td>ILW (compacted and cemented)</td>
<td>150 liter canisters and 560 liter drums</td>
</tr>
<tr>
<td>156</td>
<td>7 castors</td>
<td>8 castors / 88,0 %</td>
<td>Irradiated fuel BR3 reactor</td>
<td>Castor BR3 cask</td>
</tr>
</tbody>
</table>

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129

136

156
Conditioned waste in interim storage (situation 31/12/2015)

- LLW: 18,760 m³
- MLW: 4,247 m³
- HLW: 70 m³
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Inspections

- During routine inspections: non conformities observed
- In 2003 NIRAS/Belgoprocess decided to start a Visual Inspection Program of all conditioned waste packages that ended in 2012
- Decision for a systematic inspection:
  - Before storage all conditioned waste packages inspected.
  - Witness program on selected conditioned waste packages after 3 years and then after 10 years.
Inspections method LLW

- Semi-automatic system
  - Individual inspection: making pictures and measuring dose rate
  - Operation from control room.
  - No dose impact for operator (ALARA).
Inspections method ILW

- Global inspection of the 220L bituminized drums
  - Camera system on rails (future 3D-camera)
  - No dose impact for operator (ALARA)

- Semi-automatic system of the 400L drums
  - Individual inspection:
    - making pictures and measuring dose rate
  - Operation from control room
  - No dose impact for operator (ALARA)
Inspections method ILW & HLW

- Inspection of witness drums
  - Canisters ILW & HLW are inspected in de unloading cell of building 136
  - No dose impact for operator (ALARA)
Observations LLW (1/4)

- Low Level Waste
  - Expanding bitumen
    - Cause:
      - Hydrogen production by radiolysis
      - RX pictures demonstrated that bells are present
  - Corrective action for interim storage:
    - Puncturing original drum
    - Drum placed in overpack
Observations LLW (2/4)

- Low Level Waste
  - Corrosion drums
    - Cause: Due to contact of the waste with the metal surface of the drum
  - Corrective action interim storage:
    - Drum placed in overpack
    - Placeholders and baskets are developed to prevent direct contact.
Observations LLW (3/4)

- Low Level Waste
  - ASR (alkali-silica reaction) in homogeneous conditioned concentrate waste from NPP Doel

![Images showing different stages of gel formation](image-url)
Observations LLW (4/4)

- Low Level Waste
  - ASR affected drums
    - The NPP Doel halted the condition of evaporator concentrates.
    - Major inspection program on ± 9000 potentially affected drums.
  - Research and development program of the ASR-Phenomenon
  - Construction of a new storage building 167X
    - Individual inspection possible
    - Follow up of the life cycle of the gel (thermographic)
Observations ILW (1/2)

- Intermediate Level Waste
  - Expanding homogeneous conditioned sludge of salts in bitumen
  - Cause:
    - Radiolysis caused formation of hydrogen.
    - Expanding the bitumen and pushing out the matrix.
  - Mitigation:
    - Safety study for hydrogen formation
      » Concentrations are very low
      » Measurements confirm the study
Observations ILW (2/2)

- Intermediate Level Waste
  - Corrosion
    - Cause:
      - Construction method of the drum (chromated material)
      - Chromation impurities included into the weld
  - Interim storage/measures:
    - Drying system was installed
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Conclusion

- ONDRAF/NIRAS and Belgoprocess have gained over time an extended experience on the interim storage of Low-Intermediate and High level waste.
- An systematic inspection strategy was developed in order the verify the conformity of the different waste-packages and corrective measures were taken to guarantee safe storage conditions.
- From 2022, ONDRAF/NIRAS will operate a surface disposal facility for LLW
Thank you for your attention

Surface Disposal in Dessel for LLW from 2022