An optimized cask technology for conditioning, transportation and long term interim storage of « End of Life » nuclear waste

Gilles Clément
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Customers feedback

Customers have currently - or will have - to

- Manage waste remaining into the pool and/or waste issued from the decommissioning phases
- Consider a large diversity of nuclear waste in terms of:
  - types, volumes and activities – from High Level to Low level,
  - with different natures such as: activated fuel structure, control rods, thimble plugs, contaminated equipment, sludge, resins ...

Customers are concerned with the complexity, cost and sub-optimization of the current waste management strategies. Looking for minimizing the volume of final waste to dispose of.
Authorities feedback

Country specific positions

- Definition of the waste acceptance criteria for Intermediate and High Level Waste under consideration

- Final Repository waste acceptance requirements for HLW/ILW long life are not yet defined
Waste Management Approaches

Two possible options depending on Countries Regulations

**Determine - at the earliest stage a comprehensive strategy for waste conditioning and packaging and storage**

**Benefits:**
- minimize costs for future package development & manufacturing
- avoid multiple handling of waste package transfer for transportation
- push for standardization of packages as far as possible, saving costs

**Drawbacks:**
- uncertainties related to long term storage

**Containerize waste temporarily, waiting for criteria for storage and disposal**

**Benefits:**
- leave the options opened
- reduce the initial costs, and consequently postpone the major investments

**Drawbacks:**
- uncertainties and unknowns related to long term costs and risks of future retrieving and re-packaging
- potential evolutions/ degradations of the containerized waste, with production of additional secondary waste
To reconcile both waste management approaches, taking into account the cost optimization

Customer is looking for:

⇒ B(U) cask

⇒ Simple

⇒ Flexible

⇒ Easy to handle

⇒ To condition today

⇒ Long term interim ‘storable’ for a period of at least 40 years

⇒ ‘Transportable’ today and tomorrow, to the final repository at the end of the interim storage period

⇒ At market price...
Waste Management of European Reactor

**Operational Waste in Pool**
- Fuel assembly structure
- Thimble plugs
- Control rods
- Various components in boxes (grids, springs, ...)
- Irradiated materials
- Filters ...

**Waste from Dismantling**
- RPV
- RPV Internals
- Biological shield
- Fuel racks
- Auxiliary systems
- Other primary components

**Cutting operations or Direct cask loading**

**Interim Storage**

**Final Repository**
Introducing the new TN® MW Cask

- AREVA is developing the TN® MW (MW for Multi Waste)
  - For interim storage and transportation
  - To provide high integrity waste packaging solutions
  - Avoiding multiple handling and reconditioning operations,
  - While minimizing the risks of non-compliance with future WAC (Waste Acceptance Criteria)

TN® MW a New Cask for Waste

- Design objectives:
  - Design is based upon standard and proven models & technologies already developed and in use at AREVA for other B(U) casks
  - Relying on the wide AREVA experience in dual purpose casks
The TN® MW cask:

- B(U) package 2012 IAEA Regulations
- Maximum weight: 10 T
- Maximum payload: 2T
- Easy to handle with a forklift or a hoist
- Activity up to 300 TBq for Co-60
- Wet or dry loading
- Safe for operators and site
- 50 years of storage life without maintenance in normal storage conditions
- Prevent corrosion during pool operations and storage lifetime
Leak tightness of the cask is provided by two gaskets

4 lifting lugs or special gripping and handling interfaces

Different types of basket depending of waste characteristics

*NB: for Dry Loading Version, vent orifice at the bottom is not present*
Main features of the TN® MW in Storage Condition

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>Ø</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>External dimensions</td>
<td>1,080</td>
<td>1,475</td>
</tr>
<tr>
<td>Cavity for ILW</td>
<td>680</td>
<td>1,017</td>
</tr>
<tr>
<td>Cavity for HLW with additional internal shielding</td>
<td>515</td>
<td>900</td>
</tr>
<tr>
<td>Maximum weight (without shock absorbers)</td>
<td>10 T</td>
<td></td>
</tr>
</tbody>
</table>

TN® MW
with its additional on-site transport chair

On-site transport chair
TN® MW in Transport Conditions

- 2 shock absorbers (top and bottom)
- Transport in horizontal position with a dedicated frame
- Attached to the cask by means of screws
- Transport in vertical position under development

Overall dimensions:
- Diameter: 1860 mm
- Height: 2320 mm
• TN® MW can be customized to various customer needs

• Up to now, 4 additional versions are under development:
  – On site transport version (<100A2) for 400 L drum
    • Commissioned in 2016
  – IP-2 version for storage and transport of liquid waste, contaminated waste and sludge
  – Type B(U) Fissile version with a dedicated basket for criticality
    • Licensed in France & Belgium in April 2017
  – Type B(U) – Large Version: cask for storage and transportation of activated waste

Main Characteristics of the Large version

<table>
<thead>
<tr>
<th>Approximate weight</th>
<th>48 T</th>
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</thead>
<tbody>
<tr>
<td>Cavity Length</td>
<td>4 500 mm</td>
</tr>
<tr>
<td>Cavity diameter</td>
<td>1 700 mm</td>
</tr>
<tr>
<td>Max. load (without shock absorbers)</td>
<td>60 T</td>
</tr>
</tbody>
</table>
Conclusion

- **TN® MW**, new cask generation for waste allows to
  - address a large spectrum of waste
  - avoid the development of new concepts/equipment and the multiple handling operations at each stage (transport/ interim storage)
  - condition at the earliest stage
  - reduce and control waste management costs

- Fabrication, licensing and delivery of the first TN® MW is scheduled in 2017