Current Status of Interim Storage Facility for Spent Fuels in Japan

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Recyclable-Fuel Storage Company (RFS) has completed construction works of the storage building and fabrication of several metal casks as Japanese first off-site interim storage operator.

RFS is now undertaking the safety review under new regulation standards based on the lessons learned by Fukushima-daiichi accident and preparing for the start of the operation.
The necessity for interim storage facility

Summarized flow of nuclear fuel cycle

Uranium mine → Refining plant

Conversion plant → Uranium enrichment plant

UF6 → Reconversion plant

UO2 → Fabrication plant

MOX fuel fabrication plant

Reprocessing plant → Spent fuel

Radioactive Waste

Final repository site for High-level radioactive waste

UO2(depleted uranium) → MOX fuel fabrication plant

UF6 → UO2 → UF6

Recycling (recovered uranium/plutonium)

Recyclable fuel

Recyclable Fuel Storage Center (intermediate storage facility)

Vitrified Waste Storage Center

Spent fuel → Uranium fuel

Low-level radioactive waste disposal center

Nuclear power station

From reconversion plant

Recoverable fuel storage company.
Main features of the storage facility

- Storage capacity of the first building is up to about 3000 ton-U ie. 288 dry metal casks.
- Final storage capacity is planned to be 5000 ton-U.
- Dry metal casks are used for storage and transport ie. dual purpose.
- Spent BWR and PWR fuels for light water reactor are planned to be stored for up to 50 years.
- Natural air are used for the cooling system of the storage building.
Overview of the storage facility

**Schematic diagram of storage facility**

- Key dimensions of storage building:
  - Length: Approx. 131 m
  - Width: Approx. 62 m
  - Maximum height: Approx. 28 m
  - Ceiling height: Approx. 15 m
Outline of the storage facility

- **Storage capacity:** 3,000 tU (288 casks)
- **Receiving area**
  - 7 temporary racks
  - 1 inspection rack
  - 1 uprighting rack
  - 1 overhead traveling crane
- **Storage area**
  - Using air transport vehicle for moving casks
- **Others**
  - Indicators and recording systems for monitoring devices
Natural air cooling for the storage facility

Sectional diagram of the storage building

Flow of natural air

Building
Base plate
Underground post

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Temporary racks and Air transporter

Temporary racks

Mock-up cask

Air transporter
Main safety functions of the casks

- **Containment:**
  - Metal gaskets are set for double lids for storage
  - Negative pressure for the cavity/ Positive pressure for the part between double lids
  - Tertiary lids are set for transport

- **Shielding:**
  - Cask components and Resign/Propylene glycol

- **Subcriticality:**
  - Basket(Stainless steel/Aluminum alloy with born)

- **Heat removal:**
  - Heat transmission plates/fins etc.
Outline of the metal casks

<table>
<thead>
<tr>
<th>Items</th>
<th>Large size casks for BWR fuels</th>
<th>Middle size casks for BWR fuels</th>
<th>Casks for PWR fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type 1</td>
<td>Type 2</td>
<td></td>
</tr>
<tr>
<td>Overall Length</td>
<td>About 5.4 m</td>
<td>About 5.4 m</td>
<td>About 5.5 m</td>
</tr>
<tr>
<td></td>
<td>About 5.4 m</td>
<td>About 5.5 m</td>
<td>About 5.1 m</td>
</tr>
<tr>
<td>External diameter</td>
<td>About 2.5 m</td>
<td>About 2.5 m</td>
<td>About 2.4 m</td>
</tr>
<tr>
<td></td>
<td>About 2.5 m</td>
<td>About 2.4 m</td>
<td>About 2.6 m</td>
</tr>
<tr>
<td>Maximum number of loaded fuels</td>
<td>69 fuels</td>
<td>69 fuels</td>
<td>52 fuels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>21 fuels</td>
</tr>
<tr>
<td>Major materials</td>
<td>Low-alloy steel, Carbon Steel</td>
<td>Carbon Steel (for Shell, Primary lid, Secondary lid)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stainless Steel mixed with Boron, Aluminum alloy mixed with Boron (for Basket)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resin, Propylene glycol</td>
<td>(for Neutron shielding material)</td>
<td></td>
</tr>
<tr>
<td>Filled gas</td>
<td>Helium gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containment System</td>
<td>Double lids (primary lid, secondary lid)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When using casks for transport, tertiary lids and shock absorbers are set on them.

Schematic diagram of metal cask

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Experience of construction work for RFS facility (Storage building(1))

April 2013 (Construction rate: about 90%)
Experience of construction work for RFS facility (Storage building(2))

August 2013 (Construction rate: 100%)
Experience of construction work for RFS facility (Metal cask) (Type 2)
Operational flow and allotment of works

Reactor site → Storage facility (Dry storage) → Reprocessing

Work
- Inspection before shipment
- Loading
- Inspection during storage
- Monitoring etc.

Allotment
- Electric power companies
- RFS
- Electric power companies

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Image of inspection at each operational steps

**Inspection Before Shipment (before storage)**
- External appearance
- Leak tightness
- Pressure retention
- Dose rate
- Subcriticality
- Temperature measurement
- Lifting
- Weight*
- Content
- Surface contamination

**Reactor site**

**Transportation**

**Storage facility (Dry storage)**

**Inspection during Storage**
- External appearance
- Pressure between double lids (Leak tightness*)
- Shielding**
- Subcriticality*
- Heat transfer**
- Temperature measurement
- Content*
- Lifting* etc.

**Monitoring during storage**
- Pressure between double lids
- Cask surface temperature
- Inlet and Outlet air temperature
- Area radiation in the building etc.

**Inspection Before Shipment (after storage)**
- External appearance
- Leak tightness
- Pressure retention*
- Dose rate
- Subcriticality*
- Temperature measurement
- Lifting
- Weight*
- Content*
- Surface contamination

**Reprocessing**

**Transportation**

*Record
**Selected casks

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Image of monitoring during storage

- Measure the pressure between the double lids
- Measure the temperature at air outlet
- Measure the temperature on the surface of casks
- Measure the temperature at air inlet
- Measure the radiation inside building
- Measure the radiation inside building

Storage building

- Spent fuel storage space (cavity)
- Space between lids
- Positive pressure approx. 4 atm
- Negative pressure approx. 0.8 atm

Lids of metal cask

- Primary lid
- Secondary lid
- Tertiary lid
- Elastomer gasket
- Metal gasket

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A truck that carries a metal cask enters into the receiving area and visual inspection, radiation check, surface contamination check and others are conducted on the truck.

The metal cask is moved by using an overhead traveling crane from the truck onto a temporary rack and horizontally mounted on it.

Cask shock absorber are removed at the uprighting rack. Then, the cask is vertically lifted by using the overhead traveling crane.

The metal cask is moved from the temporary rack onto an uprighting rack to be vertically mounted.
The cask is moved onto a storage rack above the on-the-floor shock absorber, while limiting the lifting height and then fixed on the storage rack through four lower trunnions.

Air transporter is inserted under the storage rack, and the transporter is floated. And the cask is moved onto an inspection rack. The tertiary lid for transportation is removed, and radiation measurement and others are conducted.

The devices to measure the pressure between lids of the cask and the temperature on the side of the cask are installed.
Preparation works for RFS facility

- Further assessments for earthquakes, tsunami, volcanos and tornado etc. were conducted by RFS.
- RFS is now undertaking the safety review by the NRA (Nuclear Regulation Authority).
- RFS needs to get the renewal establishment permit as well as approvals for design and construction methods for spent fuel facilities, and operational safety program for the facility.
Appendix

Information on Recyclable-Fuel Storage Company
History of RFS

- RFS was established by TEPCO(80%) and JAPC(20%) in Nov.2005.
- RFS submitted application for establishment permit to operate the “Recyclable Fuel Storage Center” to the Nuclear and Industrial Safety Agency (NISA) of Ministry of Economy, Trade and Industry (METI) in March 2007.
- The establishment permit was issued in May 2010.
- RFS submitted application for approval of design and construction methods for spent fuel facilities to NISA of METI in June 2010.
- Approval of design and construction methods was issued in Aug.2010.
- RFS started the construction works in Aug.2010.
- RFS completed the construction works in Aug.2013
- RFS submitted application for establishment renewal permit to NRA in Jan.2014.