Design of Spent Fuel Transportable Storage Cask

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INTRODUCTION

The spent fuel discharged from Japanese LWR will be stored as the recycled-fuel-resources in an interim storage facility. The cask storage is one of the primary forms of the spent fuel interim storage, and it is also recommended to use transportable storage casks for the interim storage from the economical point of view.

OCL and NFT have designed a transportable storage cask that has superior economical and safety performances.

SUMMARY OF DESIGN

As shown in Figure 1, **Ne**w **O**CL/**N**FT (NEO) transportable storage cask is constructed of a cask body, a basket and lids. The cask body consists of main body, bottom plate made of forged carbon steel, and outer shell made of stainless steel. The inner surface of the body is carried out a surface treatment by the aluminum thermal spraying. The outer surface of the body and the top flange surface are overlaid with stainless steel weld. The major gamma shield is the forged carbon steel of the body. Propylene-glycol-water-solution neutron shield is filled in the cavity between the main body and the outer shell. A resin neutron shield is installed in the bottom plate. This simple structure of the cask leads to good thermal performance, and short manufacturing time as shown in Figure 2, as well as good cost performance. The cask is vertically held down with four bottom screwed trunnions on a storage skid during storage.

The basket is constructed by stacking machined forged aluminum alloy plates with compartments for fuels and it has no welding. This structure results in good thermal performance, facility of quality control, and inspection. Neutron absorbing plates made of borated aluminum are inserted in slits of forged aluminum plates as shown in Figure 3. These borated aluminum plates can contain much enriched boron because the plates are not parts of the structural strength of the basket. As a result, the basket performs well for subcriticality.

There is a primary and a secondary lid with metallic gaskets for use as a storage cask. The resin neutron shield is installed in the primary lid. After the primary lid is set on the cask top flange, the cask cavity is vacuum-dried and filled with helium gas to easily remove decay heat, and to keep the integrity of the contents. Also, the cask cavity is maintained with negative pressure to keep radioactive materials contained over a long period of time. After the secondary lid is set on the primary lid, the narrow cavity between both lids is pressurized with helium gas. There are pressure sensors between the two lids for continuous monitoring of the leak tightness as shown in Figure 4. An auxiliary shielding lid is attached on the secondary lid during storage time. This auxiliary lid is not only effective to reduce the dose rate in upper direction of the cask, but is useful to prevent the metallic gaskets of the secondary lid and the top flange surface from corroding.

For use as a transport cask, an additional third lid with double elastomer O-rings is attached to make the containment boundary of the cask instead of the auxiliary shielding lid as shown in Figure 5. This triple lid system allows the cask to satisfy the accident conditions of IAEA transport regulation easily. It also enables the cask to be transported from an interim storage facility with no hot cell, if the metallic gasket loses the leakage seal.

For use as a transport cask, impact limiters and thermal barrier are attached in order to meet with IAEA transport regulations, as shown in Figure 6.

TYPICAL CASK DESIGN SPECIFICATION

The cask should be designed in accordance with spent fuel specifications and various restricted facility conditions. Typical NEO cask designs are listed in Table 1. Both casks are designed for nuclear plants provided with a 125 metric tons crane at the time of vertical lifting of the cask. These casks satisfy not only IAEA transport regulation but also Japanese strict regulation in the field of shielding, that is limited to be below 100μSv/h at one meter from the cask surface under the normal transport condition.

SUMMARY

OCL and NFT have designed a transportable storage cask for the use at independent spent fuel storage installations. The most distinctive feature of the cask is triple lid system. This triple lid system enables the cask to be transported from an ISFSI with no hot cell and no welding facility of lids, if the metallic gasket loses the leakage seal. The secondary distinctive feature of the cask is the use of a water solution neutron shield. This design concept leads to good thermal performance, short manufacturing time, and good cost performance.

REFERENCES

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[3] Ueki, K. et al., "Shielding Ability of a Modular Shielding House for Keeping Spent Fuel Transportable Storage Casks in an Interim Storage Facility", This Symposium Paper – Session 3.13 (2001).

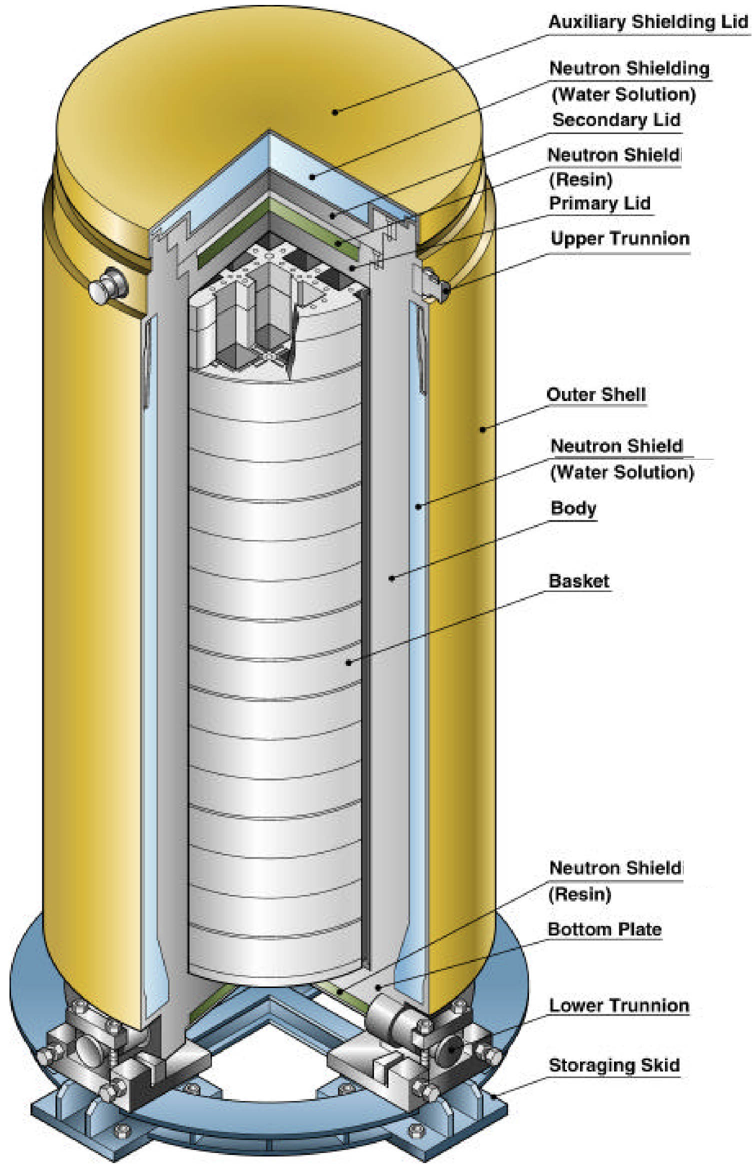

Figure 1. Overview of NEO Transportable Storage CASK (at Storage)

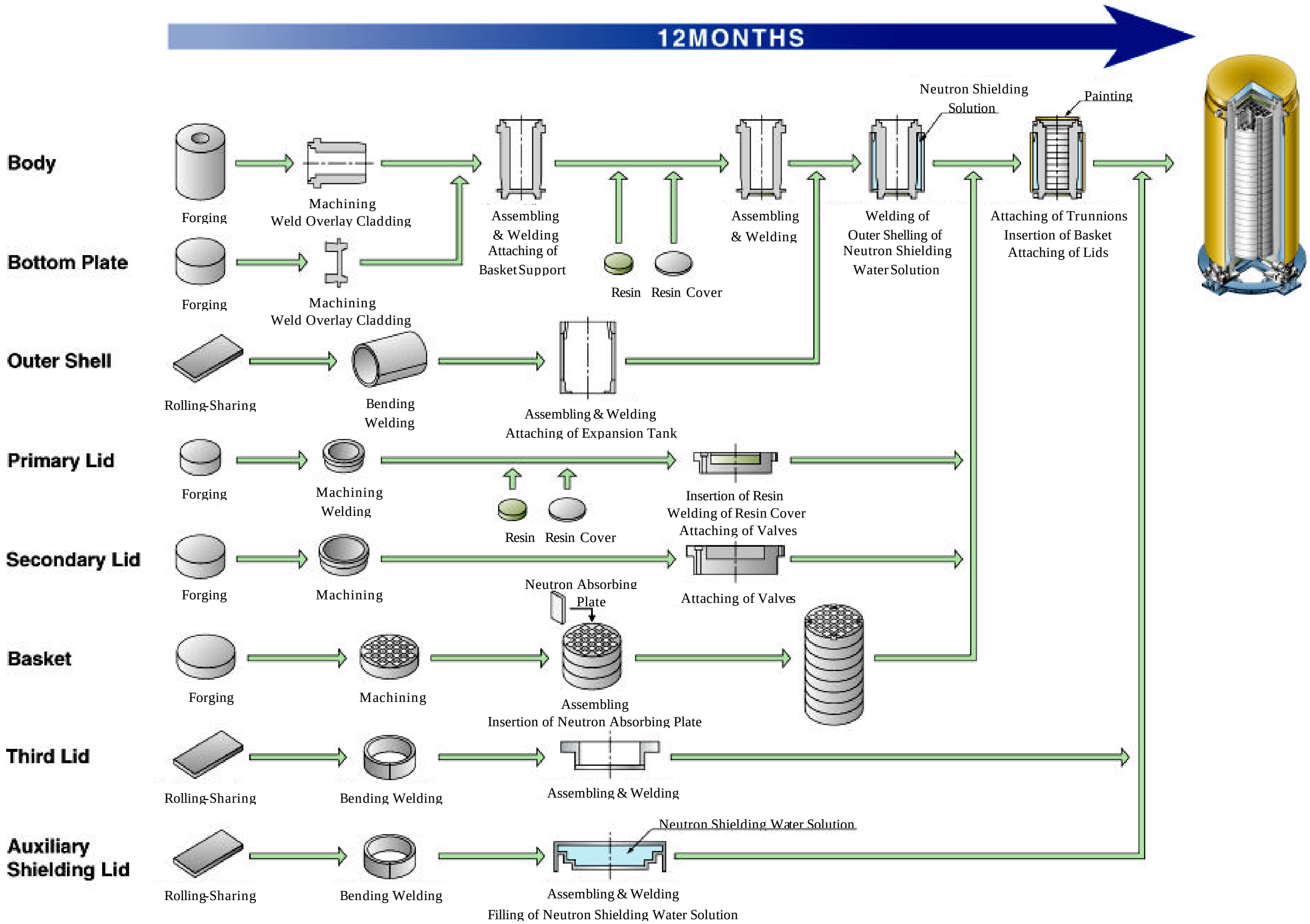

Figure 2. Manufacturing Process of NEO CASK

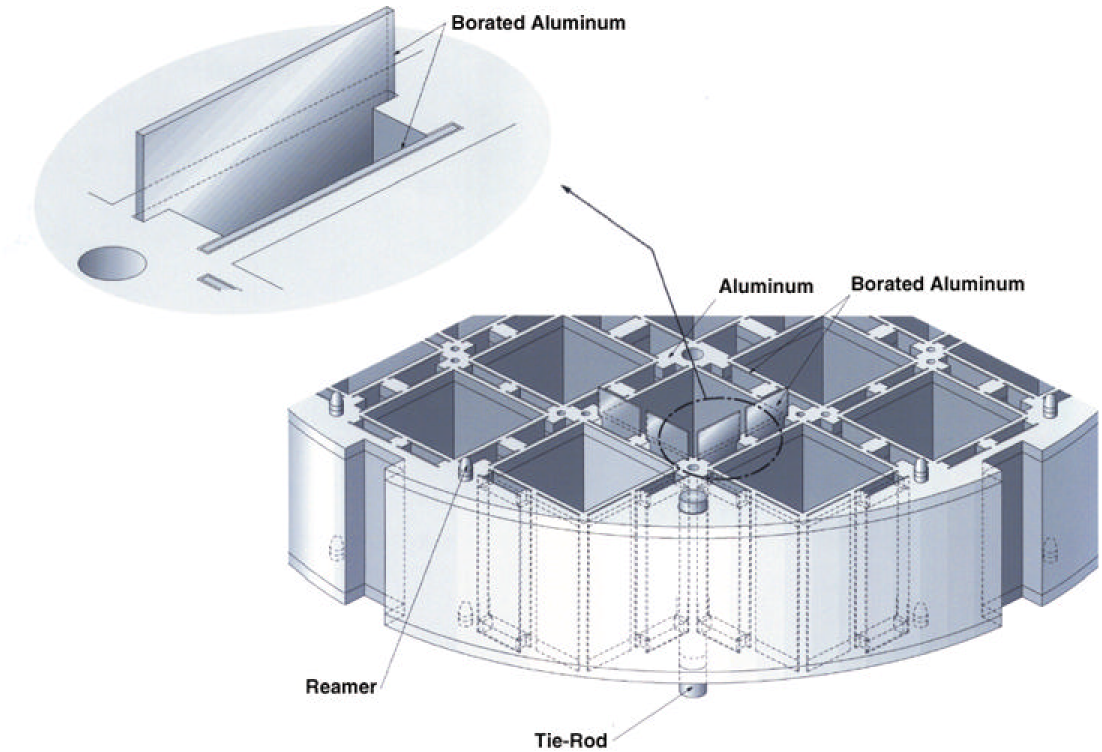

Figure 3. Basket Detail of NEO CASK for PWR Fuel

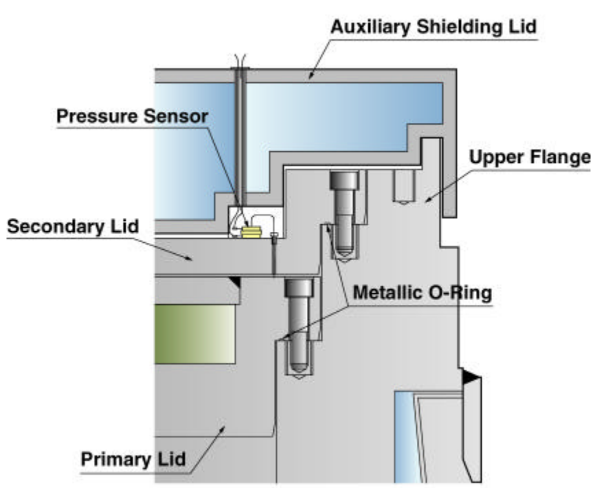

Figure 4. Lid Detail (at Storage)

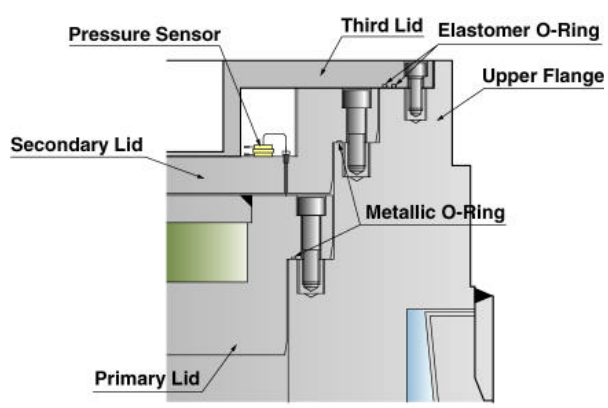

Figure 5. Lid Detail (at Transport)

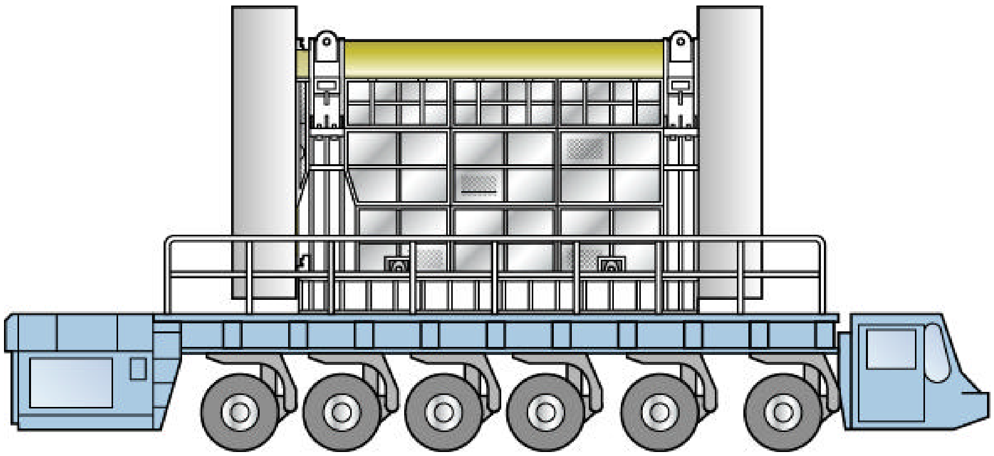

Figure 6. Overview of NEO CASK (at Transport)

Table 1. Typical NEO CASKS (Examples)

CASK Type	NEO-2521	NEO-2561
No. of Fuel Assemblies	PWR : 21	BWR : 61
Enrichment	4.8w/o	3.67w/o
Maximum Burnup	55 GWD/MTU	50 GWD/MTU
Cooling Time	10 Years	10 Years

NEO-2521 : 125 Ton Crane Available