Proceedings of the 18th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2016
September 18-23, 2016, Kobe, Japan

Feature and role of Metal Cask Handling Equipment in the Interim Storage Facility for Spent Fuels

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Abstract

Recyclable Fuel Storage Center is the first spent fuel interim storage facility at far from reactor site in Japan. This facility adopts dry storage metal casks. This facility is operated by RFS (Recyclable Fuel Storage Company). The storage capacity of this facility is up to 288 metal casks (3000ton-U). These spent fuels will be stored for up to 50years and sent to the reprocessing plant. Kobe Steel supplied handling equipment for this facility. In this paper, the feature and the role of the handling equipment are explained.

Introduction

The spent fuel generated from the operation of a nuclear power plant is to be treated in the reprocessing plant in Rokkasho, Aomori. At present, spent fuel is stored in the nuclear power plant until it is reprocessed. However the amount of spent fuel generated exceeds the capacity of the reprocessing plant. Hence an additional spent fuel storage facility is needed for the nuclear fuel cycle. Recyclable Fuel Storage Center is the first spent fuel interim storage facility at far from reactor site in Japan. This facility has a variety of handling equipment for dry storage metal casks.

Handling Procedure of Metal Cask

Fig. 1 shows the bird eye view of the facility. The handling flow of this facility is as follows.

Metal cask is transported by the vehicle into the receiving area and is transferred by an Overhead traveling crane from the vehicle to a Temporary rack and horizontally mounted on it. The Metal cask is then moved onto an Uprighting rack to be horizontally mounted and Metal cask shock absorbers are removed at this timing. Then, the Metal cask is vertically lifted by the Overhead traveling crane and moved onto a Storage rack.

Air transporter is inserted under the Storage rack, and the cask is moved onto an Inspection rack. The devices to monitor the pressure between double lids and surface temperature of a Metal cask are installed there for storage. The Storage rack with a cask is transferred by the Air transporter into the storage area and then the Storage rack is fixed on the floor by bolts. The fixation with the bolts in consideration of an earthquake is also typical in Japan.

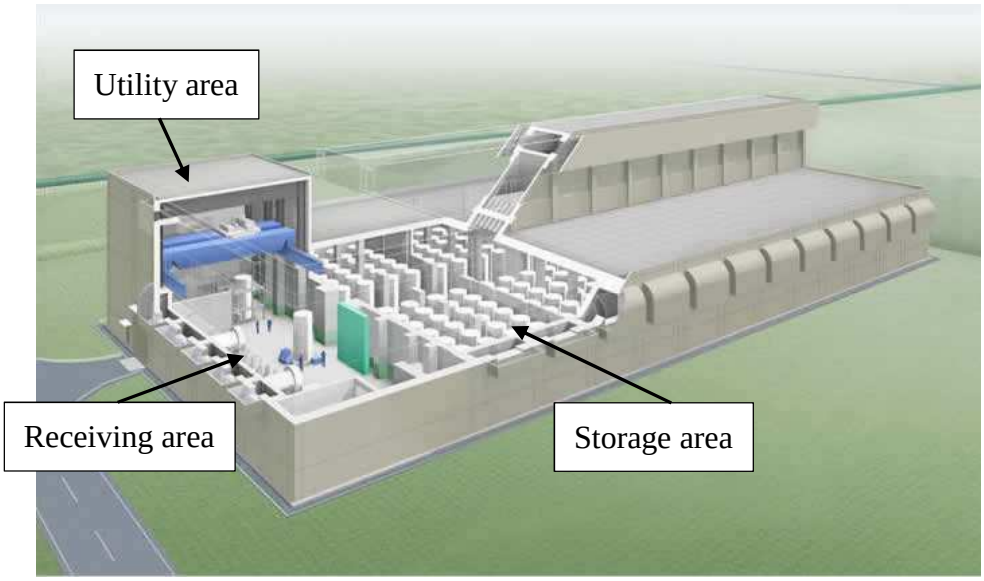


Figure 1 Interim Storage facility for spent fuel in recyclable fuel storage center[1)]

Feature and role of Handling Equipment

Overhead traveling crane

Fig. 2 shows photograph of Overhead traveling crane. The Metal cask is the heavy goods that it is about 2.5meter, and length about 5.5meter and weight becomes about 130ton. In addition this facility do not have hot cell. Therefore it is important that handling equipment do not let the Metal cask drop and damage. Overhead traveling crane has interlock to handle cask safely. The interlock is as follows.

- Limit of lift up distance (Prevention of damage by the drop)
- Restriction on Moving (Prevention of collision between Metal Cask)

Overhead traveling crane is designed not to drop even if an earthquake is occurred.

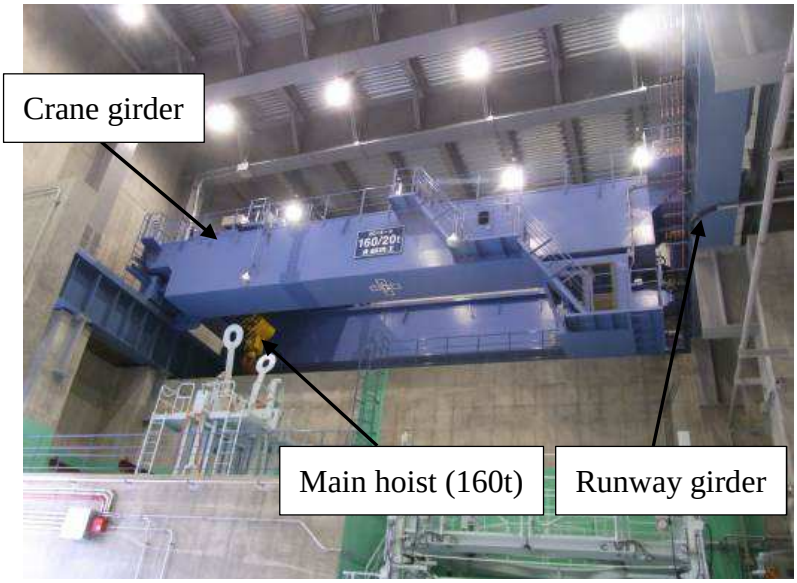


Figure 2 Overhead traveling Crane

Uprighting rack

Fig. 3 shows photograph of Uprighting rack. Uprighting rack is used for lifting the Metal cask in a vertically position from in a horizontally position. This facility will storage four types of Metal cask. Therefore Support leg of Uprighting rack can be adjusted it in diameter direction and the long distance direction.

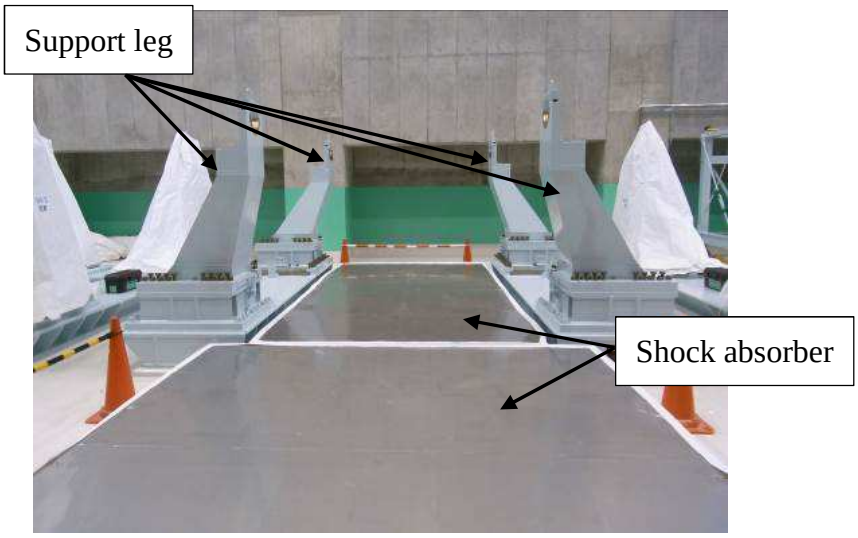
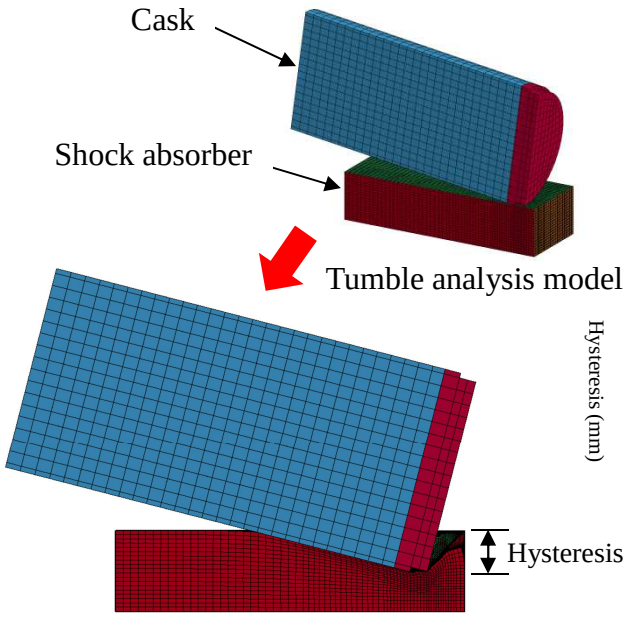


Figure 3 Uprighting rack

Shock absorber

Fig. 3 shows photograph of Shock absorber. Shock absorber is set on the floor around Uprighting rack to avoid the metal cask from severe damage with respect to transporting ability. This is because this facility do not have hot cell to fix severe damaged cask or spent fuels from cask to cask.



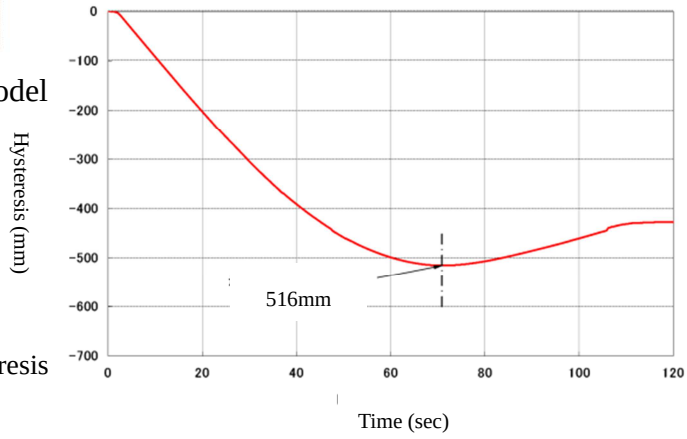


Figure 4 Result of tumble analysys

Figure 5 Deformation hysteresis

Shock absorber made in woods covered with stainless steel plates. It absorbs tumble energy of the Metal cask by strain energy of the wood. We checked the performance of Shock absorber by tumble analysis. Fig.4 shows three-dimensional solid models of Metal cask and Shock absorber and result of tumble analysis. This analysis was carried out by a finite element method (Analysis code: LS-DYNA). Fig.5 shows deformation hysteresis of Shock absorber. The maximum deformation is 516mm. this result is smaller enough than the height of the Shock absorber. Thus Shock absorber can absorb tumble energy of the Metal cask.

Inspection rack

Fig. 6 shows photograph of Inspection rack. Inspection rack received the Metal cask in a vertically set state using the Air transporter. The removal of the tertiary lid for transportation and the install of the device to measure the pressure between lids of the cask and the temperature on the side of the cask is carried out in this rack. Inspection rack consists of upper deck and lower deck. The upper deck and lower deck opens and closes for receiving the Metal cask and the upper deck goes up and down for adjusts four types of the metal casks.

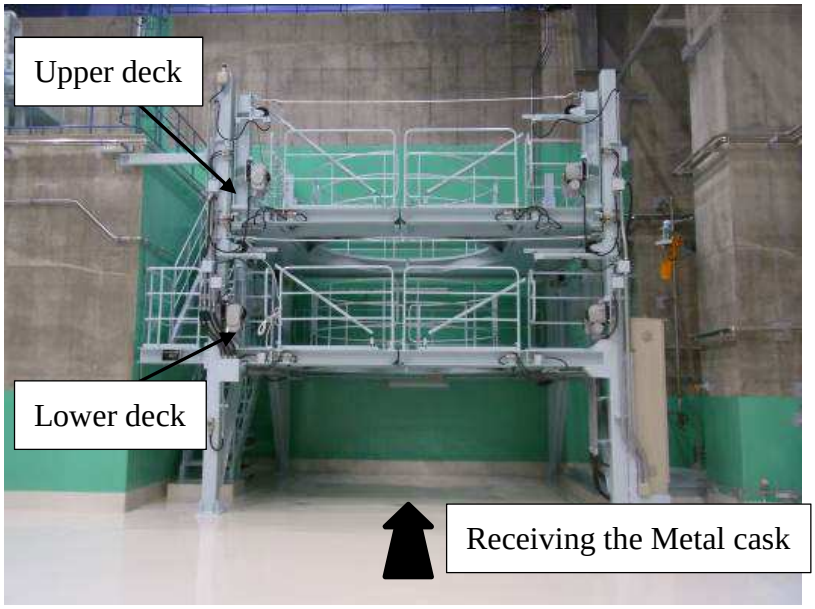


Figure 6 Inspection rack

Fixing hardware for storage

Fig. 7 shows photograph of Fixing hardware for storage. Fixing hardware for storage is buried in floor. The Metal cask is fixed on the floor by ten bolts (male screw). So this equipment has ten internal thread bosses (female screw). Internal thread boss required high installation accuracy. So there are connected by the Frame. Anchor bolt is attached to the Internal thread boss to resists drawing force at the time of the earthquake.

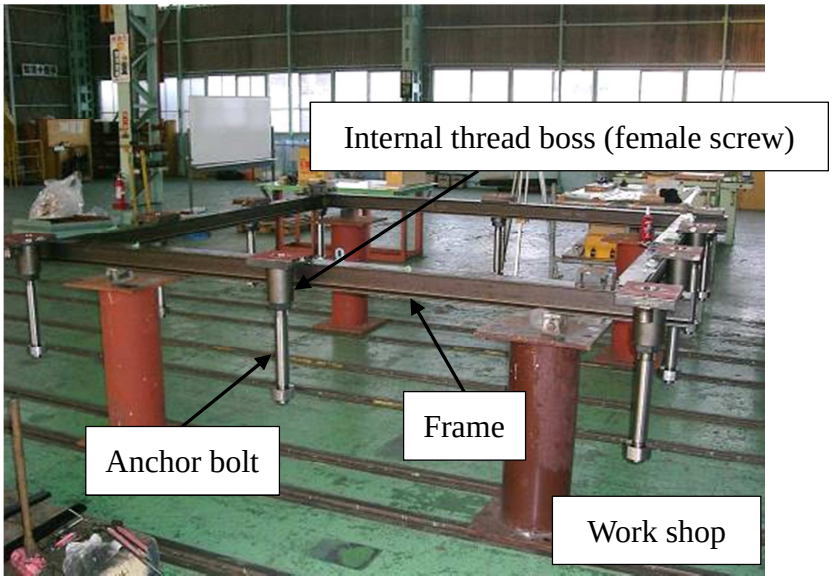


Figure 7 Fixing hardware for strorage

Conclusions

We confirmed that our supply equipments could handle the Metal cask without interfering it by commissioning. Fig. 8 shows lifting the Mock-up Cask in a vertically position from in a horizontally position on Uprighting rack. Fig.9 shows the fixation to the floor of the Mock-up Cask. So we confirmed that ten bolts and Internal thread boss of Fixing hardware for storage is connected through the Storage rack. We were able to contribute to promotion of the customer's cask storage business by supplying these handling equipment.

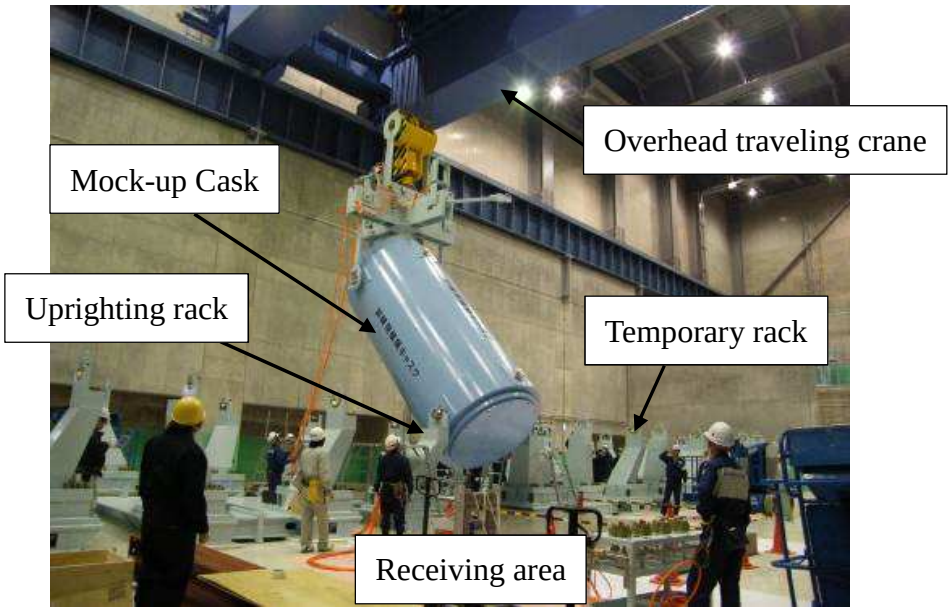


Figure 8 Cask handling test

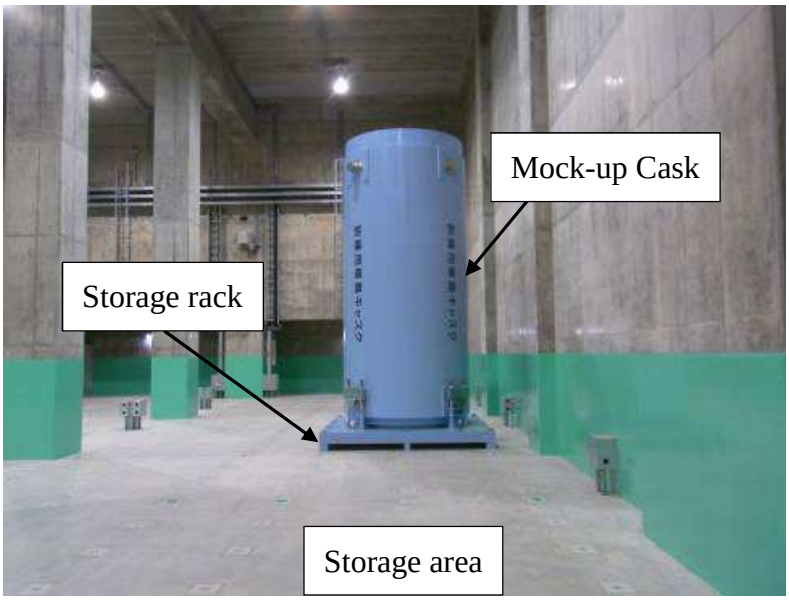


Figure 9 Cask fixing on the floor

RFS is now undertaking the safely review by NRA (Nuclear Regulation Authority) under new regulation standards.[2] We cooperates that RFS get the renewal establishment permit as well as approvals for design and construction methods for spent fuel facilities.
Our company will work on the cask storage facility that is expected to expand the demand in the future.

Acknowledgments

We deeply grateful to Recyclable Fuel Storage Company for approve a publication to PATRAM and for suggesting the topic treated in this paper.

References

1) Recyclable Fuel Storage Company. Home page of business overview.
2) Tatsuya Ishikawa. Current Status of Interim Storage Facility for Spent Fuels in Japan. 19-12 May 2014, IAEA work shop for DPC