Manufacturing Technology of Dry Storage Cask

Yeon-oh Lee, Sung-kug Hwang, Jong-sul Park, and Jae-min Lee*,
SeAH Besteel Corp., 522, Oehang-ro, Gunsan-si, Jeollabuk-do, Republic of Korea
*sb205sk@seah.co.kr

1. Introduction

Most of spent fuels have been storing in the pool of domestic plant, the current capacity of spent fuel pools is not enough for the increasing generation of spent fuels. Unit 1 of Kori nuclear power plant was permanently shut-downed, spent fuels of the domestic plant will be offload to a storage cask. With premature reactor shutdowns by a government policy, the number of Casks required in the near term will increase as the full pool, including reactor core in the world. but there are a lack of experiences & technology for the manufacturing storage cask, just having a fabrication & operation experience of transport cask in Korea. Based on this, studies on finding improved material and manufacturing process for storage casks are needed

2. Storage Cask

2.1 General Information

Dual purpose cask (storage & transportation) has been successfully adopted worldwide and metal cask system is unique in dry storage. metallic cask generally are made from cask steel with one or two lid that are bolted or welded at the cask body. The steel cask provides a leak-tight containment of the spent fuel and provides shielding against gamma radiation. Inside the cask, there is a special resin (e.g., polyethylene) that shields neutrons. The external surface of the cask has trunnions which allow the cask to be lifted and displaced. The basket structure consists of an assembly of stainless steel cells with borated aluminum or aluminum metal matrix composite plates for the necessary criticality control and to provide the heat conduction paths from the fuel assembly to the cask cavity wall. A general schematic structure of dry storage cask is given in Fig. 1.

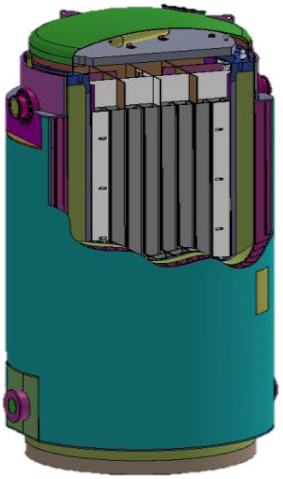


Fig. 1. Dry Storage Cask.

2.2 Applicable Code and Standard

Metal cask will be fabricated in accordance with Code and standard as follows

- ASME Boiler & Pressure Vessel Code
- American National Standard Institute (ANSI)
- American Society for Non-Destructive Testing
- Regulations

Code of Federal Regulations, Title 10, Part 21 / 50 / 71 / 72

- Regulatory Guides

US NRC Regulatory Guide 1.38

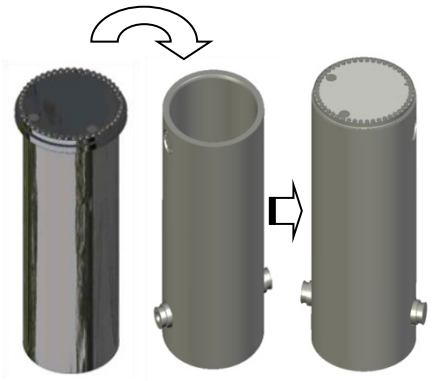
- KOREA NSSC Notification No.2014-50
- IAEA Safety Series No. TS-R-1 & 116

2.3 Metallic Cask

During manufacturing of cask, the material and assembly of cask shall be especially controlled and managed as below

2.3.1. Material of Cask Body. Cask body for KN-18 Spent Fuel Transport Cask shall be designed by Metal Design Minimum Temperature(MDMT) -40℃, Drop Weight Test shall be performed at -74℃ according to the requirement of Code and the result of Drop Weight Test is satisfied.

2.3.2 Shrink Fitting. In case of metal cask such as Fig. 1, Shield shell will be shrink fit onto the inner shell which is a pressure part & containment boundary as below.



Inner shell Shield shell Cask Body Shell

Fig. 2. Shrink Fitting Flow.

2.3.3 Neutron Shielding Material (RESIN). Radial neutron shield boxes filled in resin are arrayed around shield shell and outer shell will be assembled to the outside of cask as per Fig. 1.

Fig. 3. Neutron Shield Box Assembly.

2.3.4 Sealing Surface between cask body and lid. Mock-Up Test performed to verify welding overlay process of Stainless Steel and leakage. The result is satisfied for such as below ;

- Surface Roughness
- Liquid Penetrant
- Helium leak test

3. Conclusions

According to the international standard and domestic standard, A full scale Prototype has being manufactured, that manufacturing techniques have also developed to meet the requirements. And the tests and inspections have been performed.

REFERENCE

[1] Development of SNF Transportation and Storage Cask in Korea, Cho chun-hyung Ph.d (2016).

[2] Dry Cask Storage, Hoi Ng (2014).

[3] Advantages of Dry Hardened Cask storage over wet storage for spent nuclear fuel, Luiz Sergio Romanto (2011).