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Procurement of a New A-type Transport Cask for Radioactive Structural Materials

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ABSTRACT

As part of VTT's overall radioactive materials handling infrastructure renewal, a certified A-type transport cask was procured. Following review of different options, it was concluded that the dimension requirements of both the expected payloads and VTT hot cell facility dimensions required a custom design. The cask package delivery included, in addition to the A-Type certification, the lifting and handling gear for use of the cask on NPP sites, and two ISO containers with IP-2 certification for transport and storage of the cask and its handling gear. The cask can be loaded dry or wet, in vertical or horizontal orientation. As such, the delivery includes a separate turning frame and block, to assist in bringing the cask to a vertical orientation, as well as a vertical resting stabilizer plate. The cask was delivered to VTT in June 2021. Later in the year, training in cask handling was held at VTT, in which the use of the lifting gear and other accessories was exercised. With a certified A-type cask available in Finland, transports of radioactive materials within Finland, as well as between Finland and sites outside of Finland, are expected to become easier. Design and fabrication by an experienced company engaged in radioactive transports commercially gives confidence in the functionality for a wide range of locations from which radioactive transports are required.

1 INTRODUCTION

When VTT first began conducting radioactive materials testing in the late 1970's, the customers were exclusively domestic Finnish nuclear power plants. The primary materials transported were reactor pressure vessel (RPV) surveillance capsules. For that purpose, it was sufficient to utilize an uncertified transport cask with "exceptional" permission from STUK, since transports were only conducted within Finland. However, that cask has not been well suited for some of the required shipments. Simultaneously, VTT is increasingly conducting research and testing in an international arena, for which transportation of the radioactive materials to VTTs facilities is necessary. For example, when the Jules Horowitz Reactor is completed, VTT is anticipating an opportunity to conduct irradiations there, and then transport the materials back to Finland for testing and examinations. As such, it was decided to procure a new, certified transportation cask with an internal cavity of sufficient size for a variety of surveillance capsules and other structural materials payloads.

2 PROCUREMENT SPECIFICATION

The most important specifications when seeking a new transport cask, were the internal cavity dimensions, the external cask dimensions, and the total weight.

2.1 Cavity Requirements

The internal cavity of the cask was required to be big enough for the principle objects of transports, which are surveillance capsules for the various plant designs in operation, construction or planning in Finland. The dimensions considered are shown in Table 1. To accommodate all of the different capsule geometries without removing any external portions, the inner cavity would have to be at least 2297 mm long and 160 mm wide. However, the OL1&2 capsules can have external portions removed before transport, making the 2044 mm of OL3's capsule design the next longest object to be transported

Table 1 Surveillance capsule sizes

NPP	Capsule form	Capsule size full size	Capsule size reduced size
LO 1&2	Cylinder tube	Ø 28 mm length 97 mm 6-10 capsules folded in pile	N/A
OL 1&2	Cylinder tube	Ø 100 mm length 2397 / 1916 mm	Ø 58 mm length 1100 / 375 mm
OL 3	Box	37 x 28 x 2044 mm	37 x 28 x 1914 mm
HK 1	Box	160 x 57 x 570 mm	N/A

2.2 Cask Dimensional restrictions

The external dimensions of the cask, meanwhile, were limited by the VTT laboratory facility reception bay and reception hot cell. The airlock for transport of goods has a 3 m wide door at 90 degrees to the airlock orientation, designed with the intention that a cask can be delivered into the airlock on a forklift truck (across the forks). That set the cask length limit to something that could fit through that door. Likewise, as shown in Figure 1, the reception hot cell had some dimensional restrictions for the cask to mate with the horizontal unloading port. The key dimension was that the mating front surface of the cask must be no larger than 780 mm in diameter. But considering casks also have handling trunnions on their sides, there was also a width limitation, depending upon the location of the trunnions along the cask body.

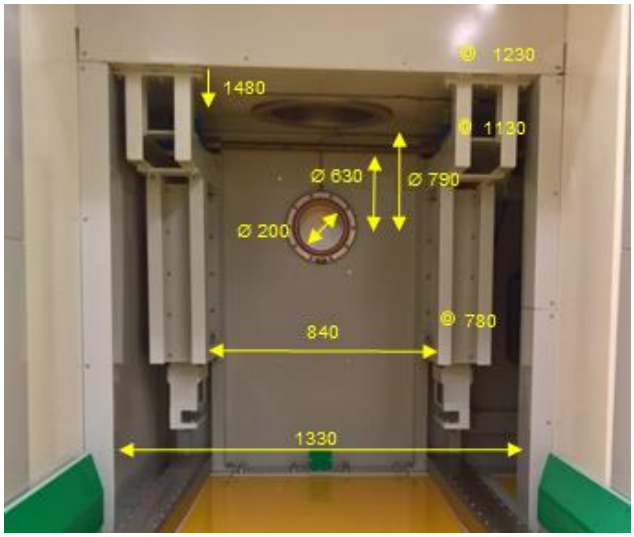

Figure 1: Several key dimensions of the reception hot cell restricted some aspects of the cask size.

2.3 Other Factors

In addition to the external dimensions and the cavity size, the weight of the cask was limited by the capacity of the handling equipment in VTT's laboratory. In practice, both the overhead bridge crane and the motorized pallet jack have a load capacity of 10 tonnes, so the maximum weight of the cask needed to be under that. In practice, the weight of the cask is related to the shielding. Ultimately the difference between the exterior diameter and the interior cavity enabled sufficient shielding when made of steel, while still meeting the weight limits.

Finally, it was required that the case be able to be loaded and unloaded in either horizontal or vertical orientation, and either dry or wet (i.e. submerged in a pool as at a nuclear power plant).

3 CASK PACKAGE

Upon considering different options on the market, it was ultimately determined that a custom design would be required. Such a package was ordered from Daher Nuclear Technologies GmbH (now Orano NCS GmbH). Its model is DNT21, and is designed and manufactured in the same manner as a much larger, B(U)-type cask owned and operated by Orano NCS GmbH.

Figure 2 shows the key dimensions of the cask that was delivered. The internal cavity is 220 mm diameter and 2128 mm long, while the cask overall length is 2900 mm and diameter is 730 mm. The locations of the pairs of trunnions is suitable for handling with VTT's reception cell.

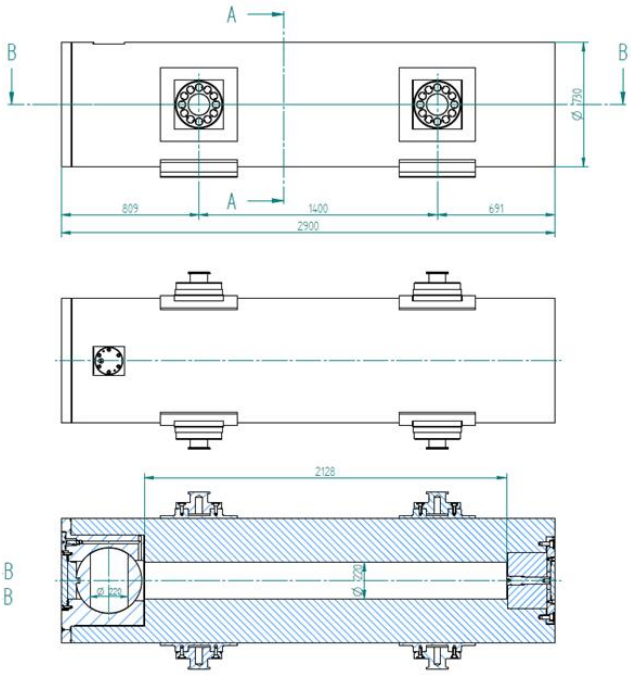

Figure 2: Dimensions of the procured DNT21 cask.

In addition to the A-type certification of the cask, the delivery included auxiliary gear for handling the cask. This includes a lifting beam and lifting lugs, a turning frame, and a vertical stabilization plate for parking the cask in a vertical orientation. The delivery also included two ISO containers with IP-2 certification, for storing and transporting the cask and associated auxiliary gear.

The cask and auxiliary gear were delivered to VTT in June 2021, and training on cask handling was held later in the year, to which staff from TVO, Fortum and Platom were invited. As shown in Figure 3 and Figure 4, handling utilizing the lifting beam and

lugs can be done in an outside yard using a crane, which makes it suitable for handling on-site at a NPP.

Figure 3: DNT21 handling in turning frame using lifting beam and lugs hung from a mobile crane.

Figure 4: DNT21 cask being placed in its vertical stabilization frame for e.g. loading underwater in a pool on an NPP site.

4 NEXT STEPS

Currently the carriage for transporting the cask into VTT's laboratory handing bay is being adapted to accommodate the DNT21. Once the cask has been brought into the facility, its functionality will be tested in conjunction with the reception hot cell, after which the final paperwork can be completed to enable applying for operating permissions.

Once operational, exercises will be carried out with Finnish NPP staff to ensure usability on their sites.

5 CONCLUSIONS

With a certified A-type cask available in Finland, transports of radioactive materials within Finland, as well as between Finland and sites outside of Finland, are expected to become easier. Design and fabrication by an experienced company engaged in radioactive transports commercially gives confidence in the functionality for a wide range of locations from which radioactive transports are required.

ACKNOWLEDGEMENTS

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