CASTOR THTR TRANSPORT/STORAGE CASKS

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Abstract

For the management of spent fuel from nuclear power plants, two possibilities are available in Germany. One possibility is the reprocessing of the spent fuel and the realization of a so-called closed nuclear fuel cycle, the other is the direct disposal after a period of interim storage, without reprocessing. For the German GCR plants "THTR 300" and "AVR", only the way of direct disposal is available to date for managing the spent fuel (pebble-bed fuel). For the period of interim storage, dry storage in casks was selected.

Development

In order to insure the prompt availability of such casks for interim storage, the development of the CASTOR THTR/AVR (see Fig. 1) began in 1982. The design of this cask was based on experience gained in the application of ductile cast iron (GGG 40) for the manufacture of CASTOR transport and storage casks for radioactive materials.

Within the scope of development and licensing, a drop test of a prototype cask without shock absorbers onto a yielding foundation was performed, in addition to the usual analyses - required by the IAEA-Regulations - necessary to obtain transport license. The reason for this additional drop test was that the casks are not stored standing alone, but with two casks one stacked on top of the other (see Fig. 2). This saves half the number of storage positions in the storage facility.

All analyses and test results have shown that the CASTOR THTR/AVR goes far beyond simply meeting the requirements placed on it.

On the basis of the safety analysis report, and the tests performed the transport license was issued in 1987. The storage license for BZA was issued in 1992 and for AVR in 1993.
FIG. 1. CASTOR THTR/AVR
CASTOR - Cask

The CASTOR THTR/AVR cask consists of a thick-walled cylindrical body which is closed with two lids, the primary and secondary lid, as well as a protection plate. For handling, the cask is equipped with two trunnions respectively at the top and bottom ends of the cask.

The primary lid is made of forged carbon steel (TStE 355) and is bolted with 28 bolts to the cask body. The primary lid is sealed off with a metal and an elastomer gasket. In the primary lid, one penetration is located for performing the necessary leak-tightness tests. This orifice is closed with a small lid (flange) and a metal gasket.

The secondary lid is made of carbon steel plate (St 52-3) and is also bolted with 28 bolts to the cask body. The secondary lid is sealed with a metal and an elastomer gasket. There are two penetrations in the secondary lid. One is used for leak testing.
and setting the monitoring-pressure between primary and secondary lid. It is closed by a small lid (flange) with a metal gasket as well. The other is used for installation of the pressure monitoring system.

The protection plate is also made of carbon steel plate (St52-3) and is fastened over the primary and secondary lids with 20 bolts. It serves to protect the lid system from dust, moisture and mechanical influences, for example during handling.

The trunnions are made of forged carbon steel (TStE-355) and are connected in pairs at the top and bottom ends of the cask with 12 bolts each.

The outer surfaces of the cask, as well as primary and secondary lid are provided with a multi-coated decontaminable paint. The inner cavity is protected with a zinc-silicate coating. The trunnions are protected with a zinc-coating.

The outer dimensions are:
- length: 2743 mm
- diameter: 1380 mm

The inner dimensions are:
- length: 1964 mm
- diameter: 640 mm

The overall weight is approx. 28 t (incl. shock absorbers)

Cask Contents

The loading of the cask is performed differently in the two GCR-plants. For the THTR 300, the cask is loaded with one fuel canister containing approx. 2100 fuel elements. For the AVR, the cask is loaded with 2 fuel canisters, which together accommodate approx. 1900 fuel elements.

Fabrication

Fabrication of the cask began in 1987. From 1987 to 1996 a total of 463 casks of the type CASTOR THTR/AVR were made, with 150 casks being manufactured in the years 1991 and 1992 respectively.
Transport / Intermediate Storage

For the transport of the casks, both from the manufacturing plant to the THTR 300 as well as from there to the interim storage facility in Ahaus (BZA) special rail wagons were developed and built (see Fig. 3). Three of these transport units were finished in 1988 and commissioned. Each unit can accommodate 3 CASTOR THTR/AVR casks in special transport frames with the shock absorbers, which are integrated into the structure of the wagons. For reduction of the dose exposure of personnel during loading and unloading of the wagon, all handling operations would be done by remote control.

During the time from June 1992 to April 1995, a total of 305 CASTOR THTR casks were transported in 57 shipments to BZA and placed into interim storage. The casks contain all the fuel elements which were used in the THTR 300.
For the interim storage of the AVR fuel elements, a facility was built at the site in Jülich. In the time from August 1993 to date, 96 CASTOR THTR/AVR casks have been put into storage there.

In both storage facilities, the leak-tightness of the casks is permanently monitored by a pressure monitoring system in order to guarantee safety throughout the period of interim storage. This system monitors the pressure (approx. 6 bar) between the primary and secondary lid. A loss of pressure down to a pre-set level (approx. 3 bar) is indicated by an alarm.

**Finale Storage**

On the basis of the current status of planning at the BfS, a final disposal of spent fuel assemblies in a salt dome can be assumed.

The casks to be used for this purpose must withstand the rock pressure of the salt dome during its operation and remain leak-tight during this time.

Estimations of the pressure resistance of the CASTOR THTR/AVR-cask body and of the lid system have shown that these casks are able to withstand the rock pressure to be expected in the final storage site without failure.

The leak-tightness is guaranteed by the existing sealing system provided that no alkaline salt solution reaches the sealing system. In order to ensure this safely, it is possible to close the CASTOR THTR/AVR in the top area with a lid welded to the cask body, so that it is leak tight against alkaline solutions.

The feasibility of such a welded connection in a cask body of ductile cast iron has been confirmed by preliminary tests within the scope of the POLLUX-final-disposal-project. Within the scope of these tests, a cask lid of ductile cast iron was manually welded to a cask body.

The analyses aimed at ensuring this concept will begin shortly.