

THE MONOLITH CONTAINER: A NEW DEVELOPMENT FOR TRANSPORTATION AND STORAGE OF REACTOR VESSEL EQUIPMENT AND REACTOR VESSEL PARTS

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ABSTRACT

The cast iron container MONOLITH is a shielding container corresponding to the Konrad VI container with a max weight of 20 t. As cask content only dry activated and contaminated metallic material is allowed. After loading with this radioactive material the empty spaces inside the container are filled with other contaminated liquid iron through a lid opening to create a monolithic cask. Until now five MONOLITH containers are created with good success and stored inside at the storage site Mitterteich.

INTRODUCTION

When the dismantling of a nuclear power plant is nearing completion, parts of the reactor vessel and the reactor vessel equipment have to be loaded into shielded containers for transportation and storage after cutting.

In order to optimise the cutting and loading of these parts, the container MONOLITH had been developed by the foundry Siempelkamp and the service company GNS, based on an idea from the Gundremmingen nuclear power plant.

The MONOLITH is a cast iron container, which is loaded inside the power plant with a packing concept.

In the foundry Siempelkamp all empty spaces inside the container are filled with liquid iron through an opening in the lid. By using this process a monolithic container is created. The MONOLITH container and the experience gained during loading the first five containers are described here.

DESCRIPTION OF THE MONOLITH CONTAINER

The dimensions of the MONOLITH container correspond to the Konrad Type VI container but only half in height. Due to the weight restriction of 20 t max for the Konrad final disposal repository, a larger container is not possible.

The MONOLITH container is made of a cast iron body and a lid with two additional openings. The lid is screwed to the cast body and sealed with a glass fiber sealing. Easy handling of the container is provided by ISO-corner fittings at all 8 corners.

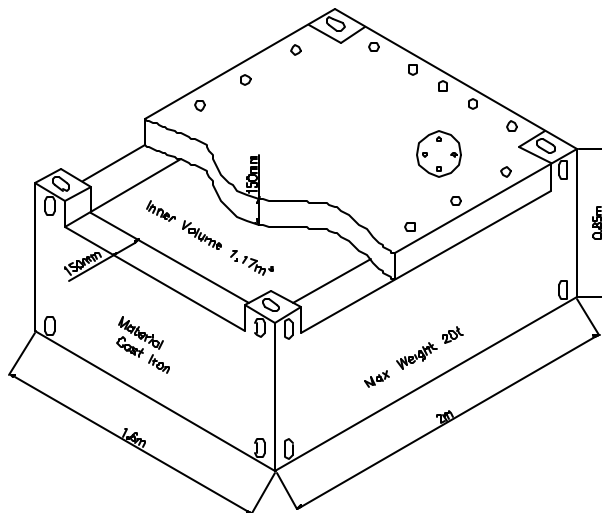


Fig. 1. MONOLITH Container

Only solid dry metallic material is allowed in the MONOLITH casks.

The MONOLITH casks are licensed to transport radioactive material LSA I/II/III and SCO I/II as an IP 2 package.

The container is also licensed for interim storage in the German Mitterteich storage facility and the Konrad final repository.

LOADING THE MONOLITH CONTAINER

The hot loading of the first five containers took place in a small German power plant under going decommissioning.

During this first campaign the thermal shielding core installations and parts of the reactor vessel were cut and loaded to the MONOLITH container.

Cutting and loading of the Thermal Shielding

The thermal shielding is a cylindrical vessel with a wall thickness of 32 mm and an outer diameter of 2390 mm and a height of 2200 mm. The weight of this part is approx. 4 t. This vessel was cut with horizontal and vertical cuts in a total of 72 segments. During treatment all data such as dimensions, weight and dose rates of each segment are recorded. Based on this data 55 segments were collected for loading into one MONOLITH container.



Fig. 2. Thermal Shielding loaded into one MONOLITH

Cutting and loading of core installations

This part consists of a cylindrical vessel with a wall thickness of 51 mm and an outer diameter of 1803 mm and an additional ring with a diameter of 2320 mm. Due to the activity of these parts it was necessary to load them into two containers. 12 Segments with a total weight of 1834 kg were loaded first into a loading basket together with 10 pieces of the thermal shielding with a weight of 577 kg. The second container was loaded with 6 segments of the core installation with a total weight of 1411 kg together with 7 segments of their thermal shielding with together 385 kg.

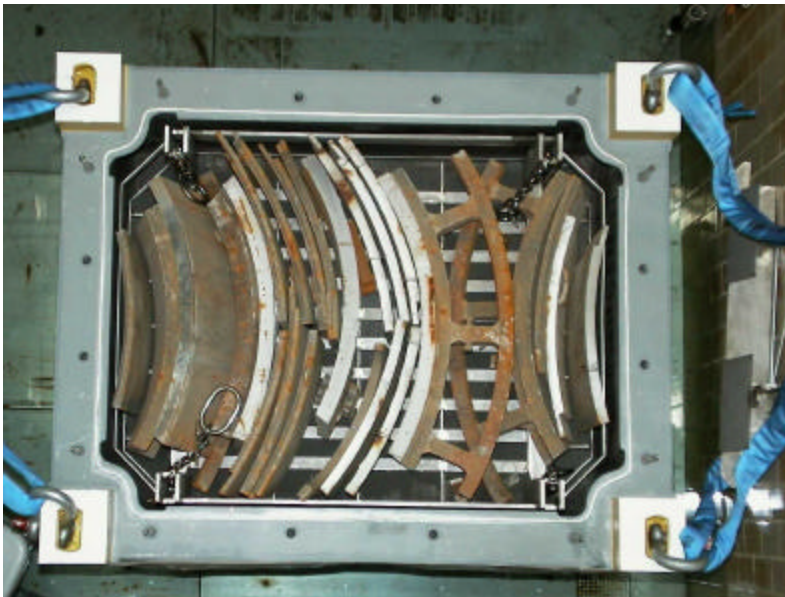


Fig. 3. MONOLITH loaded with core component and Thermal Shielding

Cutting and loading of Reactor vessel parts

The reactor vessel was a cylindrical part with a wall thickness of 104.5 mm and an inner diameter of 2438 mm. The material is carbon steel with a stainless steel plating on the inside. A segment of this vessel with a height of 1550 mm was cut in 16 parts of the same size. 8 parts with a total weight of 5050 kg were loaded into each MONOLITH container.



Fig. 4. MONOLITH loaded with reactor vessel Parts

FILLING THE MONOLITH WITH LIQUID IRON

To fill the spaces between the core component with liquid iron, the same working steps have to be carried out. The first is to transport the container to a foundry with a license for handling and melting radioactive metals.

The main data which were used to prepare the transport documentation are shown in Table I.

Table I: Activity, Dose rate and cask weight

Ident No.	Inlaid pieces	spez. Activity Bq/g	calculated Activity Bq	Surface Doserate (mSv/h)	weight of parts (kg)	weight of liquid iron (kg)
6002	Thermal shield	2,72 E+05	1,5 E+12	5,9 E-02	2871	5519
6003	Incore components	6,79 E+05	4,2 E+12	2,5 E-02	2117	6183
6004	Incore components				2313	
6005	Reactor pressure vessel	1,54 E+04	1,3 E+11	1,3 E-02	5325	2935
6006	Reactor pressure vessel	1,69 E+04	1,4 E+11	1,3 E-02	5227	3053

Another very important step is the drying of the container content. This is necessary because water or other liquids inside the container lead to a heavy reaction when in contact with liquid iron.

The drying takes place by routing hot dry air through the container via the lid openings. Finally a filling funnel is installed on one lid opening.

Now the MONOLITH is ready for filling. Other parts of the reactor vessel, for example the reactor vessel lid with an activity lower than 200 Bq/g, were melted for fill material.

After cooling down the MONOLITH some weeks and preparing the storage documentation the containers are ready for transport to the German interim storage.

Two of the containers have been at the Mitterteich storage facility since July 2000.

While filling the MONOLITH No. 6004 with liquid iron, the bottom of the container was damaged by the liquid iron due to an improper foundry technique.

At the moment a repair concept is being discussed with the authority.

CONCLUSION

The performance of treatment and conditioning of activated core components shows that the MONOLITH container is one possible way to prepare this waste for interim storage and final disposal.

The advantages of the MONOLITH containers are:

- relatively large segments of core components can be loaded into the container. (minimising the number of cuts)
- radiation exposure of the involved people during loading and transport is low because of the container shielding
- total use of the volume by filling the container with radioactive liquid iron (saving capacity for interim storage and final disposal)
- the filled container is a safe arrangement during handling and transportation even under accident conditions

A necessary requirement to use the MONOLITH technique is a foundry with a license to melt activated and contaminated metal.