PUSA: A NEW MOBILE WASTE TREATMENT AND CONDITIONING FACILITY FOR POWDER RESINS

G. Gestermann, O. Oldiges
GNS Gesellschaft für Nuklear-Service mbH
Hollestrasse 7 A
Germany 45127 Essen

W. Behrens
Kernkraftwerk Brunsbüttel GmbH & Co. oHG
Otto-Hahn-Straße
Germany 25541 Brunsbüttel

ABSTRACT

In Germany, powder resins are used to clean the primary water from boiling water reactors (BWR). When these resins become spent , they are dried in 200-l-drums and then placed in a shielded storage facility at the nuclear power plant

After a decay time of some years, the resins are taken out of this storage and are treated and conditioned in accordance with the German final storage criteria and then transported to an internal or external interim storage facility.

The new waste treatment system PUSA is a compact mobile unit. Its general design is based on the experience with the older waste treatment unit FAFNIR which has operated for many years in different power plants. The new unit consists of two main parts. One part opens the 200-l-drums by drilling and sucking out the dry resin, the other part transports the resin into shielded casks or containers by vacuum.

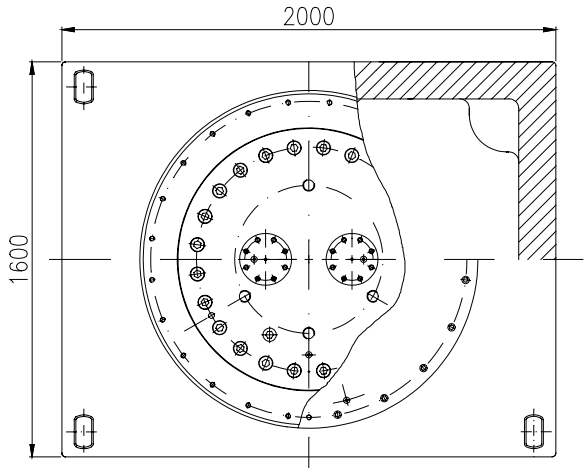
This paper will describe the waste treatment and conditioning procedure and report on the experience with the new PUSA unit.

INTRODUCTION

For nearly 20 years, spent powder resin from German boiling water reactors have been conditioned and loaded into cast-iron containers. This method is chosen to take into consideration the following:

- Optimised volume reduction
- Shielding of the rather high specific activity waste
- Safe transport and storage even under exigent conditions
- Observance of the German final disposal criteria

One major part of this treatment system is a cast-iron container with a wall thickness of 150 mm and an empty weight of about 18,000 kg. To fulfill the German final storage criteria, a maximum of 20,000 kg of resin can be loaded into this container. The main dimensions and data of this container which holds low and medium level wastes are given in Figure 1.



Dimensions	
Length	2000 mm
Bright	1600 mm
Height	1700 mm
Wall thickness	
Cast Iron	150 mm
Weight	
empty	17800 kg
max. loaded	20000 kg
Volume	
outside	5,44 m^3
inside	2,83 m^3

Fig. 1. KONRAD Container Type IV

CONDITIONING SYSTEM OF THE PUSA FACILITY

The powder resin in German boiling water reactors are dried in 200-l-drums and placed in shielded storage areas. When the capacity of the storage area is reached, the resin is treated for external storage until the final repository in Germany opens. The resin is treated with PUSA or the older FAFNIR unit.

The main treatment steps of this conditioning are:

- Transportation of the 200-l-drums to the unit
- Opening of the drums with a saw
- Preparation of cast iron container with vibration equipment
- Transport of the resins from the 200-l-drums into the container
- Preparation of the container for transportation and storage

These working steps are explained more in detail below:

Transportation of 200-l-drums to the Unit

The 200-l-drums are transported from the internal storage in the power plant to the PUSA unit using shielding containers (concrete or cast iron) and loaded into a special shield cask. This cask can be tilted and turned to secure the unloading of the drum.

Opening of the Drums with a Saw

To open the lid of the drum, a hole- saw is used to create an opening of about 100 mm in diameter. A lance will be used to transfer the resin from the drum through this hole.

The drums are reused for drying by gluing a metal plate over the hole in the lid.

Preparation of the Container with Vibration Equipment

Vibration equipment is positioned inside the container prior to loading. With this equipment it is possible to fill all the space inside the container with resin, resulting in a higher waste density. In the past, a 200-l-drum equipped with a vibrating motor was used to vibrate the media. Today, a simple vibrating motor stand is used. The main reason for this change is to reduce equipment weight to load more resin into each container. The two vibration units are shown in Figure 2.

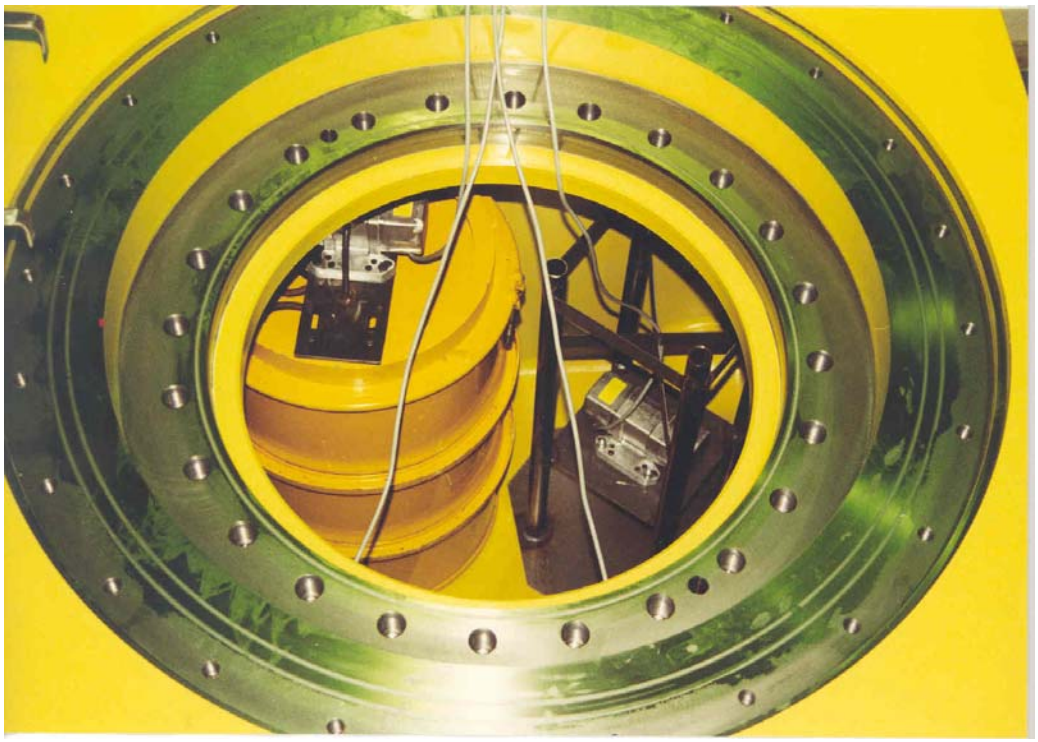


Fig. 2 Container equipped with vibration units

Transport of Resin from the 200-l-drums into the Container

The resins are transported from the drum into the container by using a vacuum lifting system. First, the container is evacuated with a vacuum. Using the control system of the unit, the corresponding valves are opened and the resins are sucked out of the drum through a lance into the container. During this process the 200-l-drum is rotated and tilted to transport resin out of the drum which are not in powder conditions. During the loading process the vibration unit inside the container is operated from time to time. A flow chart of the PUSA unit is shown in Figure 3.

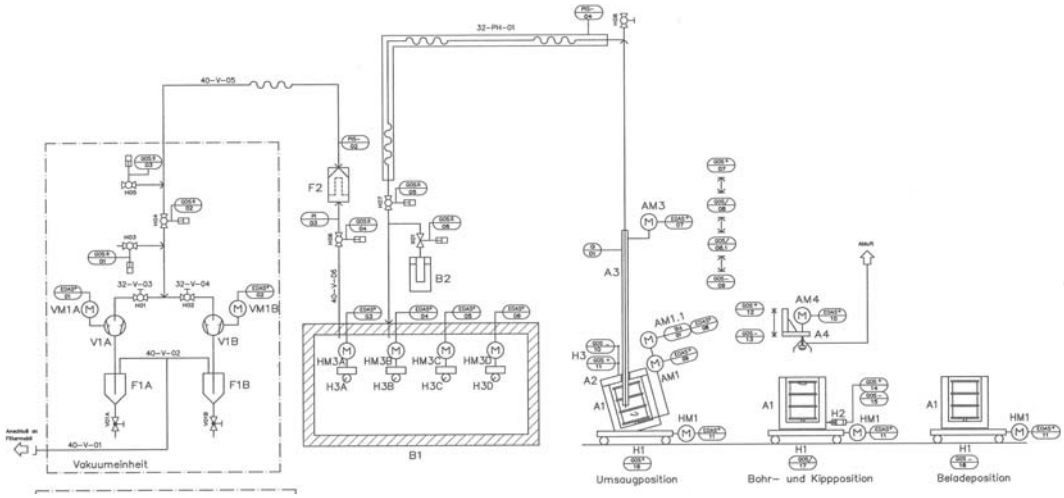


Fig. 3. PUSA flow chart

Preparation of the Container for Transportation and Storage

After loading the container with resin up to the maximum weight of nearly 20,000 kg, the electrical connection to the vibration unit is cut off and the container lids are installed. After cleaning and measurement of the dose rates on the surface and at 1 m distance, the container is ready for transportation and storage. A picture of the whole treatment unit with the cast iron container is shown in Figure 4.

Fig. 4. Overview over the treatment unit

EXPERIENCE WITH POWDER RESIN CONDITIONING

Between January and June 2003 eight cast iron containers were successfully loaded in a campaign with a total of 14,826 kg of treated resin. The contents and the final weights of the 8 containers is shown in Table I.

Table I. Weight of the Cast Iron Containers

Container number	Tare mass [kg]	Net mass [kg]	Gross mass [kg]	Percentage of total allowable mass [%]
KKK 8600013	17.540	2.138	19.678	99,39
KKK 8600014	17.860	2.060	19.920	99,60
KKK 8600015	17.800	2.138	19.938	99,69
KKK 8600016	17.780	2.080	19.860	99,30
KKK 8600017	17.820	2.108	19.928	99,64
KKK 8600018	17.980	1.975	19.955	99,78
KKK 8600019	17.860	2.071	19.931	99,66
KKK 8600020	18.040	1.920	19.960	99,80

These loading factors are in good accordance with earlier campaigns where more than 99.5% of the maximum container weight of 20 t was also achieved.

The activity of the treated resin in the containers are listed in Table II.

Table II. Calculation of the Activity Content of the Container

Container number	Calculated Activity from Single Analyses [Bq]	Calculated Activity from Mixed Analyses [Bq]	Deviation from Single Analyses [%]
KKK 8600013	1,63E+10	1,41 E+10	15,57
KKK 8600014	1,06 E+10	1,23 E+10	-14,14
KKK 8600015	1,06 E+10	1,09 E+10	-2,75
KKK 8600016	1,48 E+10	1,54 E+10	-3,90
KKK 8600017	1,09 E+10	1,00 E+10	9,00
KKK 8600018	9,69 E+09	9,70 E+09	-0,10
KKK 8600019	1,33 E+10	1,53 E+10	-13,07
KKK 8600020	1,08 E+10	9,26 E+09	16,63

The table shows that there are no significant deviations of the activity calculation between single analyses and mixed analyses.

CONCLUSIONS

With the waste treatment system consisting of the existing FAFNIR and PUSA units and the cast iron containers (Konrad Type VI), resin conditioning is available in Germany which offers the following advantages for the power plants:

- Safe treatment system with good volume reduction
- Safe transportation and storage even under exigent condition
- conditioning of resin with low radiation exposure
- the resin container fulfills final disposal specifications in Germany