

CONDITIONING OF BWR CONTROL – ELEMENTS USING THE NEW MOSAIK® 80T / SWR – SE CASK – CONCEPT

O. Oldiges, H.-J. Blenski, H. Engelage (GNS), W. Behrens (KKB)
J. Majunke (KKP), W. Schwarz (KKI), Dr. Hallfarth (KKK)

ABSTRACT

During the operation of Boiling Water Reactors, Control – Elements are used to control the neutron flux inside the reactor vessel. After the end of the lifetime, the Control – Elements are usually stored in the fuel – elements – pool of the reactor. Up to now, in Germany no conditioning of Control – Elements has been done in a BWR under operation.

NEW CONDITIONING LINE

To treat the Control – Elements outside the BWR, a new conditioning line has been designed using a new type of transport cask to transport 30 BWR Control – Elements from the reactor site to an external plant. GNS is the owner of six casks from the MOSAIK® 80T – Type. To transport the various types of BWR Control – Elements, one of these casks is to be modified as follows:

- Change the inner basket into a special construction to load 30 BWR Control – Elements with various outer dimensions.
- Installation of a 50 mm thick stainless steel shielding tube in the shaft of the cask.
- Installation of a special locking system to adjust the shielding tube inside the shaft to withstand accident demands.
- Design a new shock absorbing system for the top- and bottom shock absorbers.
- Design a new handling equipment in accordance to the rules of the KTA to handle the cask inside the BWR.
- Apply a new transport license for the Typ B (U) cask from the German authorities (BAM, BfS).

Using the new MOSAIK® 80T / SWR – SE – Cask (s. Figure 1), the Control – Elements can be taken from the BWR Fuel – Elements – Pools and loaded into the new cask. After draining, drying and leakage-test, the cask is ready for the transportation to the external conditioning plant. It is intended to transport the Control – Elements to the ILW – Scrapping – Plant at the Research – Center Karlsruhe (FZK / HDB). Inside the ILW – Scrapping Plant the Control – Elements will be cutted and treated in a super – compactor into pellets to minimise the waste volume. After that, the pellets will be stored in a final disposal – cask from MOSAIK® II/15 – type with additional lead shielding inside.

CONDITIONING OF BWR – CONTROL – ELEMENTS OF THE NPP'S PHILLIPSBURG, ISAR, KRÜMMEL AND BRUNSBÜTTEL

Loading the MOSAIK® 80T / SWR – SE – Casks inside the NPP

The handling of the MOSAIK® 80T / SWR – SE inside the NPP is quiet the same like the work to be done, loading Fuel – Elements into a CASTOR® - Cask. So the workers inside the NPP's know the handling very well. The handling inside the NPP can be described in short – from as follows in table I.

Table I: Estimated handling- and operation time in the BWR

Handling – option	Time
Transport of the requested equipment into the NPP	1,5 d
Transport of the cask inside the NPP, prepare for loading	0,75 d
Loading the cask with 30 Control – Elements	1,5 d
Dispatch the cask for Transportation (draining, drying, leakage – test, surface decontamination, dose – rate measure programm)	2,0 d
Transport the cask outside the NPP	0,75 d
Decontamination of the equipment and transport out of the NPP	1,5 d

The total handing time inside the NPP is max. 8 d. All work is done in a so called “3-shift-24 hour” way. On each shift a GNS employee and the employees of the NPP are necessary.

Conditioning of the Control - Elements in the ILW – Scrapping plant of the Research Center Karlsruhe (FZK / HDB)

The loaded cask will be delivered by rail-road to the ILW – Scrapping plant. The cask will be opened with a totally remote-controlled lid – opening device and the basket inside the cask will be pulled on a special transport system inside the ILW – scrapping plant. With the railed transport-system, the basket will be transported inside the processing cell. A installed remote controlled heavy-weight-manipulator is foreseen to unload the Control - Elements from the basked inside a hydraulic cutting device in which the Control - Elements will be cutted into small pieces of a max. length of 200 mm or shorter. After cutting, the pieces gain to a 180 litre drum which is positioned on a vibrator-desk to optimise the waste volume inside the drum. The experience during the cutting of fuel element baskets have shown, that the level of filling is about 30% better than without the vibrator-desk.

After closing the drums with the lid, the filled drums will be transported with the heavy-weight-manipulator to the hydraulic supercompactor. Inside the remote controlled supercompactor the drums are compacted into pellets. The volume reduction factor of the compactor is expected with 4, so that a high waste volume reduction of the Control - Elements will be reachable.

After super-compaction the pellet will be loaded in shielded storage casks from MOSAIK® II-15-type with additional lead shielding inside in dependence to the activity of the Control – Elements.

ACTIVITY INVENTORY OF THE MOSAIK® 80T / SWR – SE – CASK

Different Types of Control Elements

In German BWR – Reactors, several types of Control – Elements are used. The main construction mark of all Control - Elements is the cross – shaped arrangement of the B₄C-filled side parts.

The technical data of one Control – Elements – type is show in the following data-sheet for example.

-	length:	4.450 mm
-	weight:	83 kg (total)
	Head end:	3 kg
	pipes:	18,3 kg
	B ₄ C filling:	4,9 kg
	Side part cladding:	20 kg
	Cross:	13 kg
	Back end:	24 kg
	Structure material:	10 kg

The guide - rollers at the top of the Control - Elements with stellite as basismaterial will be separated in the NPP's in cause of the extremely high activity. The guide - rollers will be loaded in special shielded casks in the fuel-element-pool of the BWR.

Radiological characteristics of the Control – Elements

In accordance, that the neutron flux inside the reactor in the operational area of the Control - Elements is different, the material activation is also very different. So the activation of the Control - Elements reaches its maximum at the top of the elements while the back ends are not activated because they never get into the neutron-flux-zone inside the reactor. 80% of the activity of a Control – Elements will be found at the top (1/3 of the total length) and 20% at the other parts.

To start the conditioning of the Control - Elements using the new MOSAIK® 80T / SWR - SE cask-concept, the Control - Elements have to be stored in the fuell – element pools for min. 5 years. After this storage time the activity is on a level, that it is possible to transport 30 Control - Elements in the MOSAIK® 80T / SWR – SE – cask.

Before starting the conditioning – campagne, the expected activity of each Control - Element is to be pre-calculated using the Origin – code. For every Control – Element, that is to be loaded in the MOSAIK® 80T / SWR – SE – cask, the activity and the dose rate will be calculated. Before loading the Control - Elements into the cask, the calculated dose-rate is to compare with the under water measured dose-rate. With this comparison it is avoid, that the total activity and the surface dose-rate of the MOSAIK® 80T / SWR – SE – cask will not be exceeded.

SUMMARY

With this new technology, GNS is able to offer a new conditioning – line, especially in consideration of minimisation waste – volume and disposal – costs. The first application of this new technologie is sheduled in 2002.

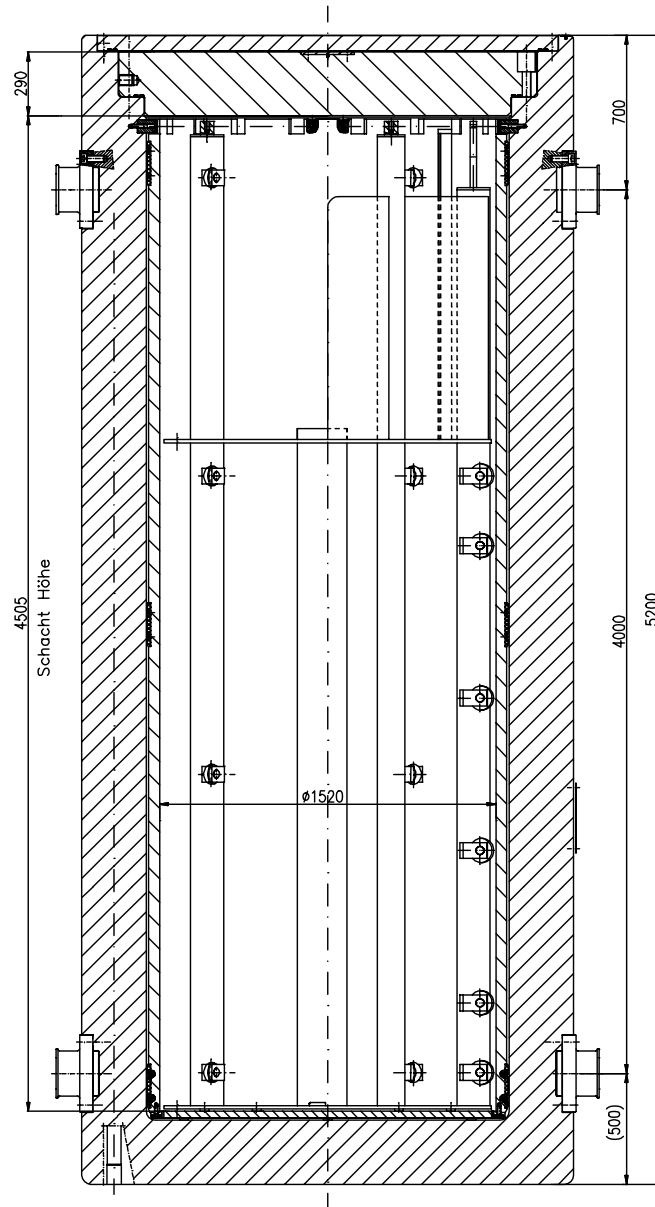


Figure 1: Cross-Section trough the new MOSAIK[®] 80T / SWR – SE – cask