Qualification of Pre-existing Containers According to the Acceptance Criteria of the Repository Konrad-17204

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ABSTRACT

As well as working in the field of waste management, Kerntechnische Entsorgung Karlsruhe GmbH (KBE) is, for historical reasons, one of Germany's three constructors of repository containers for the repository Konrad. The focus of this container production is merely on the side of requalification of the existing legacy containers, which are partly already loaded and grouted.

To a smaller extend, KTE also produces new containers for its own use because the containers exactly match the waste properties present on the Karlsruhe site. There are three major container types in the process of requalification:

- The Type-IV-Drum-Steel-Container FSC-IV-D was successfully licensed in 2014 and regularly produced thereafter. At the same time, the pre-existing containers of this type are requalified on the basis of this license by proof of the compliance with this license.
- The Type-IV-Product-Container PSC-I-D is identical to the FSC-VI-D in terms of steel construction but also contains a liner of concrete for shielding and protection of the steel construction. This container is designed for large components and demolition waste. After a successful drop test, it is currently in the advanced process of licensing.
- Type I cylindrical concrete containers are simple single drum shieldings which were produced in large numbers in the 1970ies and 1980ies. KTE owns 7,000 of those containers, thus making requalification and licensing cheaper than retreatment of the waste after demolition of the containers.

INTRODUCTION

The Central Decontamination Department (HDB) of the Kerntechnische Entsorgung Karlsruhe GmbH (KTE) specializes in handling radioactive waste and residues, from decontamination and recycling to conditioning for final storage. The HDB was founded in the 1960ies to decontaminate materials and instruments used in the nuclear installations of the Karlsruhe site and to dispose of the radioactive waste arising from nuclear research, operation of the research reactors and the reprocessing plant present on site and consequently the decommissioning and dismantling of these installations.
Besides the waste treatment, KTE-HDB has also constructed repository containers since 1986 and is one out of three container manufacturers in Germany.

The container construction has always been secondary to the main process waste management. However, due to the fact that between the 1980ies and 1990ies large amounts of waste were treated and the resulting waste canisters had to be stored safely into an interim storage, the manufacturing of appropriate

containers became necessary. There are three main container types in the process of licensure, which are:

- the Type-IV-Drum-Steel-Container FSC-IV-D designed for the incorporation of 14 200-l-drums,
- the Type-IV-Product-Container designed for large components and demolition waste without internal packaging and
- the old Type I cylindrical concrete containers which are concrete shielding for single drums.

The first two container types are modern designs and are also in production whereas the Type I cylindrical concrete containers were originally designed for the repository Asse and were built and grouted in the 1970ies and early 1980ies. The company which built these containers for HDB no longer exists, which, together with the fact that the container is no longer built, makes it extremely difficult to prove the correct construction and production of the existing 7.000 grouted containers.

CONTAINER LICENSURE AND CONSTRUCTION AT KTE-HDB

HDB has always constructed and built containers for its own needs. In the mid 1980ies the specification of the container types and specification for the repository Konrad started and HDB designed the type IV containers, which were mainly used for interim storage on the Karlsruhe site.

These containers were manufactured by several external companies under the licence of HDB. HDB did the construction and quality control, however the requirements were not as strict as they are today.

The container geometries allowed for Konrad are specified in the acceptance criteria [1, 4] and the proofs needed are listed in the product control [2]. Only special geometries are accepted to allow an effective transport and stacking in the repository, furthermore the weight of the container is limited to 20 tons due to the capacity of the shaft crane. The accepted geometries are listed in Table 1, KTE specialized in type IV containers and Type I cylindrical containers to facilitate the interim storage on site.

Table 1: Container types allowed for the repository Konrad

Cylindrical Containers	Concrete Container		Cast Iron Container			
	Type I	Type II	Type I	Type II	Type III	
Height	1370 mm	1510 mm	1150 mm	1500 mm	1240 mm	
Diameter	1060 mm	1060 mm	900 mm	1060 mm	1000 mm	
Volume (gross)	1.2 m³	1.3 m³	0.7 m³	1.3 m³	1.0 m³	
Cubic Containers	Type I	Type II	Type III	Type IV	Type V	Type VI
Length	1600 mm	1600 mm	3000 mm	3000 mm	3200 mm	1600 mm
Width	1700 mm	1700 mm	1700 mm	1700 mm	2000 mm	2000 mm
Height	1450 mm	1700 mm	1700 mm	1450 mm	1700 mm	1700 mm
Volume (gross)	3.9 m³	4.6 mm³	8.7 m³	7.14 m³	10.9 m³	5.4 m³

The major container types are Type-IV-Drum-Steel-Containers designed to hold 14 lying cylindrical drums of 200 l, concrete containers with a higher shielding holding eight standing drums and Type-IV-Product-Container for large components or concrete rubble. The majority of the Type I cylindrical containers are legacy waste products produced prior to 1985 containing single drums of solidified concentrates, which at the time of production had a high dose rate and had to be stored in concrete shielding.

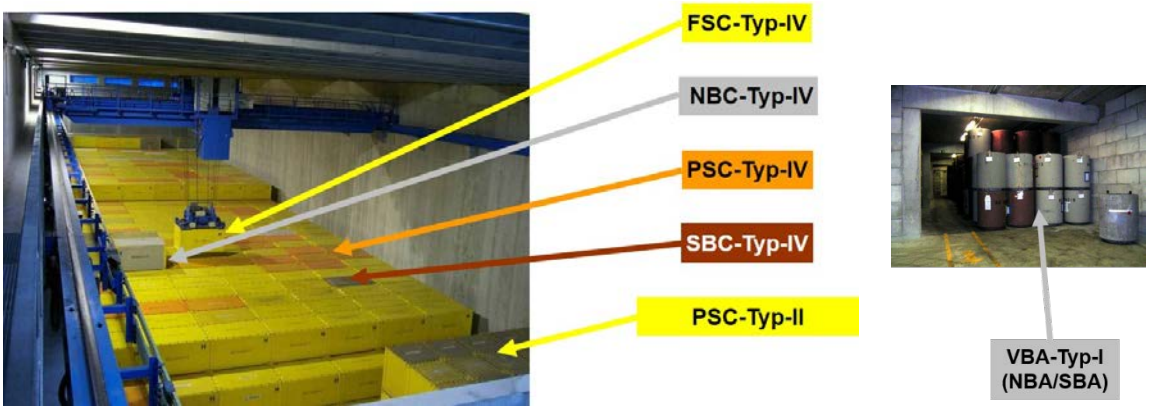

Figure 1: Container Types at HDB

The acceptance criteria of the repository Konrad were finalized in 2010 after the planning approval notice became legally binding in 2007. This means that thereafter all existing containers had to be approved according to these criteria. In this context the existing documentation was questioned and resulted in a complete relaunch of the container licensing procedure at KTE-HDB since 2011.

Type-IV-Drum-Steel-Containers
The first result of this new procedure was the licence for the Type-IV drum-steel-Containers FSC-IV-D in 2014.

Since obtaining this new licence, 160 containers were built in a regular manner. Two audits by the independent expert organization BAM were performed within this timespan.

In parallel to the production of new containers the pre-existing containers, which were constructed according to the same design and specification, are in the process of requalification. This requalification means that the existing documentation is upgraded to the level of the licenced container FSC-IV-D and missing certificates are implemented by results of finite element models [3] or constructive calculations. This requalification process starts with the newest containers and proceeds into the past. To date, 225 old containers of the series FSC2003 and FSC2005 have been licensed for repository Konrad without further requirements. Because now several different construction series of steel drum containers are in use, the quality assurance program and handling of old containers was homogenized for all container series and adjusted to the current criteria. The requalification is designed as a continuous process with a timescale of several years.

Type-IV-Product-Containers
The second major group of type-IV containers are the Type-IV-Product-Containers, which have the same steel construction as the FSC-IV-D but contain a concrete

liner to protect the container from damage by moving components or concrete rubble. The concrete liner also stiffens the entire construction. Due to the identical metal construction the containers were originally built together. In 2011 the Type-IV-Product-Container was separated to facilitate the licensing procedure of the respective container types. After the successful licensing of the FSC-IV-D, the construction and the quality management program of the steel container production of the two container types were reunified. For the Type-IV-Product-Container the construction is followed by the concrete construction part.

In autumn 2015 a drop test of a dummy container was performed successfully at the BAM drop-test facility in Berlin. The licence for the container is expected in 2017. As a shielded container which is suitable for concrete debris of various grain sizes is needed in a decommissioning project, the production of new containers has to start right after the licensing procedure.

Figure 2: Drop-test of Type-IV-Product-Container at the drop-test facility of BAM in Berlin

Type I cylindrical concrete containers

These containers were produced in large numbers in the 1970ies and 1980ies in Germany. Overall approximately 20.000 containers were produced. The majority are in the repository Asse and in the interim storage at KTE-HDB.

The containers have a rather simple design: They consist of a cylindrical reinforcement steel mesh and a base basket, which are bound together, inserted into a form and surrounded with either concrete or hematite concrete. On top two suspension points are tight to the reinforcement for transport, at the base

Due to the large numbers and the fact that they were built as precast concrete component, there are no ID-Numbers on the container and the records of the production data are rather limited. In the 1970ies and 1980ies the data acquisition wasn't at the state of today.
For this reason, in the process of licensing the compliance to all relevant boundary conditions has to be proven. The licence will be stated for a correctly built container and for each container a certificate of compliance will be issued after proof of correct construction.

The fact that the containers are already loaded and grouted make the licensing even a bit more complicated because the requalification measures have to be in concert with the radiological requalification for the documentation of the inventory. Both parts will be incorporated in one quality control plan.
In the process of data acquisition for the licensing procedure the majority of the containers were analysed by g-spectrometry. In this context the physical properties of a large number of containers (diameter, height, hardness, presence

of damages) were also acquired. For about 5 % of the containers NDA techniques like radar and electromagnetic pulse induction technology were used to prove the correct position of the steel armour.

Parameter	Technique
Height	Measurement
Diameter	Measurement
Strength of concrete	Schmidt hammer
Position of suspension points	Measurement
Position of reinforcement	Radar / Eddy current method (electromagnetic pulse induction technology)
Damages / position	Visual

Table 2: Quality control measures in the licensing procedure of Type I cylindrical concrete containers

The methods for the requalification process are already adjusted in consultation with BAM, the quality control plan will be started in 2017.

Figure 3: Product control results of Type I cylindrical concrete containers

Type-IV-Concrete-Containers

In the interim storage of the KTE-HDB there is also a large number of Type-IV-Concrete-Containers, which only take eight standing drums and were designed for the shielding of drums with higher dose rates like solidified concentrates. Today, the majority of the drums have significantly decayed and therefore do not need the shielding anymore. Therefore, they are planned to be packed into Type-IV-Drum-Steel-Containers because the use of volume is far better.

Because of this probable repackaging of the drums, the licensing procedure of the containers was postponed after drop tests and fire tests had already been performed.

CONCLUSIONS

KTE-HDB owns a large number of legacy containers, which were built prior to the final issue of the acceptance criteria Konrad. These containers are in the process

of requalification. This requalification consists of a verification of compliance to all specifications via quality measures, drop tests and verification of existing documentation.

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