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TGC36 A DUAL PURPOSE CASK FOR THE TRANSPORT AND INTERIM STORAGE OF COMPACTED WASTE (CSD-C) - 8349

Olaf Oldiges
GNS Gesellschaft für Nuklear-Service mbH
D-45127 Essen, Germany

Jean Michel Boniface
TN International, AREVA Group,
Paris, France

ABSTRACT

According to contractual and international obligations, the German Utilities have to return the residues resulting from the reprocessing of nuclear fuel assemblies (compacted hulls and ends) to Germany. The new dual purpose cask TGC36 is a joint product from the two leading companies in the field development and manufactory of nuclear casks in Europe, GNS and TN International, is intended for the transport to the interim storage facility Ahaus and to be stored there for up several years.

For the development and the delivery of the TGC36 cask, GNS and TN International formed the AGC Consortium based on German law to combine the special know how of both partners in the most efficient way.

The design and the licensing strategy of the TGC36 are introduced in this paper.

INTRODUCTION

Up to the completion of the delivery of spent fuel from German nuclear power plants at the end of June 2005, 5309 t HM of spent fuel had been transported to France and 777 t HM to England for reprocessing. Residues from reprocessing (canisters with vitrified waste and canisters with compacted solid waste) are to be returned to Germany according to contractual and international obligations and are to be stored in the interim storage facilities in Ahaus and Gorleben until emplacement in the final repository.

For the return transport and interim storage of compacted hulls and structural parts from the reprocessing of fuel assemblies from German nuclear power plants (CSD-C canister -Colis Standard des Déchets – Compactés) to the Ahaus interim storage facility, the cask TGC36 described below is to be developed by the AGC Consortium.

The TGC36 (shown in Figure. 1) as well as the contents are presented in this description. Furthermore, the overall schedule for the project to develop, license and manufacture the TGC36 based on the target to return of the first CSD-C canisters in 2011 is also presented. The initial investigative results for the safety analyses of various design features are presented.

The cask is made of forged steel and accommodates 36 CSD-C canisters with a transport mass of approximately 116 Mg. The design used for the cask concept is based on well-established technologies and experience which have been gained by GNS and TN International during the production and approval of type B(U) packages for radioactive waste.

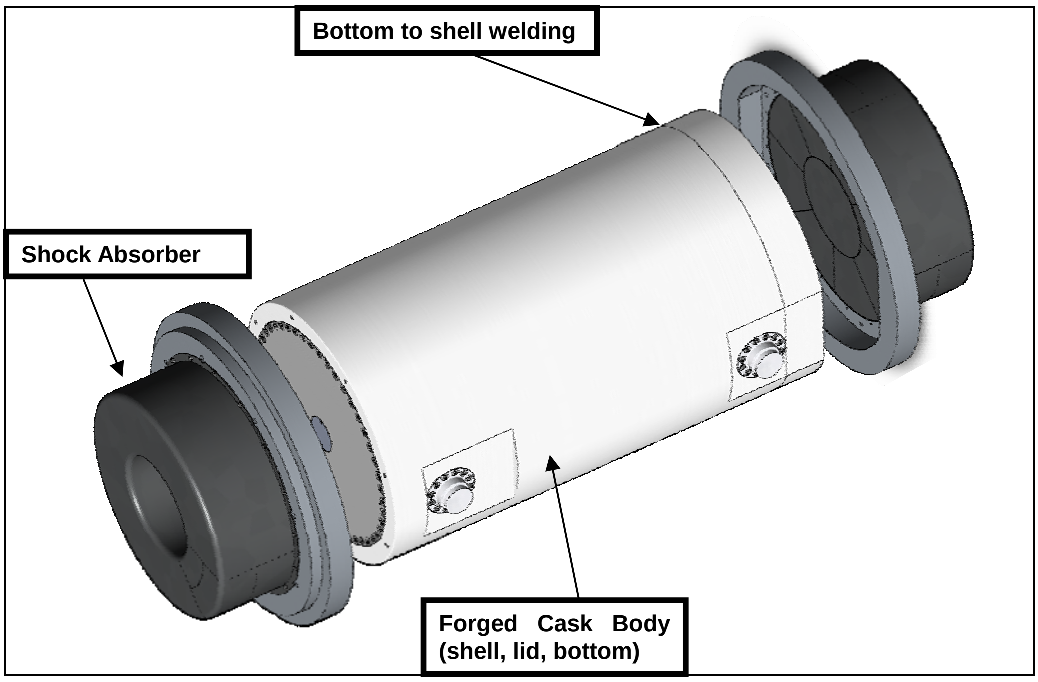

Figure 1: TGC36 in transport configuration

DESCRIPTION OF THE INVENTORY

The CSD-C canisters to be loaded into the TGC36 are shown in Figures 2 and 3. In the stainless steel shell of the CSD-C canister, the compacted hulls and structural parts as well as compacted so-called technological waste from the operation of the reprocessing facility will be loaded. The compacted parts (discs) are fixed in a horizontal position by spring elements fitted laterally in the shell of the CSD-C canister.

The CSD-C canister mainly consists of:

- the outer stainless steel shell
- an inner closure with handling connections
- the outer lid with mushroom-shaped handling adapter

The outer dimensions of the CSD-C canister (Ø430 mm, height 1335 mm) are identical to those of the canisters with vitrified waste. The average mass of a CSD-C canister is 750 kg at a capacity of approx. 180 liters.

The two closure lids of the CSD-C canister have so-called Poral filters welded in; these are sintered metal filters with a pore size of approx. 0.3 µm.

The radioactive content related to a CSD-C canister is specified in basic data for the initial design of the cask. For 95% of all CSC-C the inventory is 42 TBq of cobalt 60 and 0.6 TBq of curium 244. For the remaining 5% of the CSC-C the inventory is specified with 210 TBq of Co-60 and 2 TBq Cm-244.

The heat generated in a CSD-C canister by the radioactive decay of the inventory stated above is 40 W for 95% and 90 W for the remaining 5% of the CSD-C's.

The CSD-C canisters are loaded in a basket in the TGC36. The basket serves only for the positioning of the canisters during loading.

Figure 2: CSD-C canister

Figure 3: Compacted Discs in the CSD-C canister

DESCRIPTION OF THE TGC36 CASK

General

The TGC36 serves to accommodate 36 CSD-C canisters arranged in three layers of 12 canisters each. The design of the TGC36 is based on qualified cask technologies and takes into account the combination of specific knowledge and experience gained by GNS and TN International in the production and approval of packages. Figure 4 shows the cask in a longitudinal section with the main dimensions.

The TGC36 consists of the cask body with welded-on bottom, the bolted lid with double gasket, the basket, four trunnions and one bottom and one lid shock absorber.

The materials used for all the main components of the TGC36 are summarized in Table 1. This table contains a reference to TN International and GNS cask types already approved for each selected material .

Table 1: Materials for the containment of the TGC36

Component	Material	Reference Cask / Manufacturer	
Cask shell	Forged steel A 508 Gr. 4N, Class 3	TN85 Cask	TNI
Cask bottom	Forged steel A 508 Gr. 4N, Class 3	TN85 Cask	TNI
Cask lid	Forged steel A 508 Gr. 4N, Class 3	TN85 Cask	TNI
Gaskets	Elastomeric (FKM)	MOSAIK® Cask	GNS
Shock absorbers	Aluminum and Wood (red cedar / balsa)	TN24 Cask CASTOR® HAW28M	TNI GNS

Description of the TGC36 Cask

The TGC36 is described below with its main features and properties. The main technical data is summarized in Table 2. The figures 3 and 4 show the cask in different sectional diagrams.

Table 2: Technical data of the TGC36

Cask diameter	2880 mm (transport) / 2416 mm (storage)
Trunnion distance over Cask diameter	2561 mm
Trunnion distance over Cask longitudinal axis	3223 mm
Length of Cask body	4493 mm
Total length with shock absorbers	6147 mm
Inner cavity diameter	1840 mm
Length of inner cavity	3899 mm
Shielding thickness	288 mm (sidewall) / 296 mm (bottom & lid)

All information is preliminary

- The **cask body** consists of a cylindrical forged steel shell (288 mm wall thickness) with a welded-on forged steel bottom (296 mm thick). The cask body outer diameter is 2416 mm and the overall length is 4495 mm. The cask body has four machined flattened areas to accommodate the trunnions. The inner cavity has bolted shielding steel elements located at these areas.
- The **cask lid** is a disk-shaped steel forging (296 mm thick) and is bolted onto the top of the cask. The lid is equipped with **double elastomeric gaskets** to ensure the leak tightness. Together with the sealed test opening in the lid, the gasket configuration allows

the performance of the leak test according to transport regulations (vacuum maintenance test).

- The cask body and lid have a multi-layered **decontamination coating**. The cask cavity has a **corrosion coating**.
- A **mushroom-shaped adapter** is bolted to the top of the lid for handling in the La Hague plant. This handling device will be removed for transport.
- There are four trunnions (two each in the top and bottom) bolted to the cask body. These are for cask handling (horizontal and vertical) with correspondingly designed crossheads as well as for placing the cask on the transport frame.
- The basket in the cask cavity is to hold the CSD-C canisters. It is composed of 12 tubes which are linked together using gusset (stiffening) plates.
- A set of shock absorbers made of aluminum for the horizontal impact and wood for the lateral and oblique impacts each are bolted to the two ends of the cask body for transport.

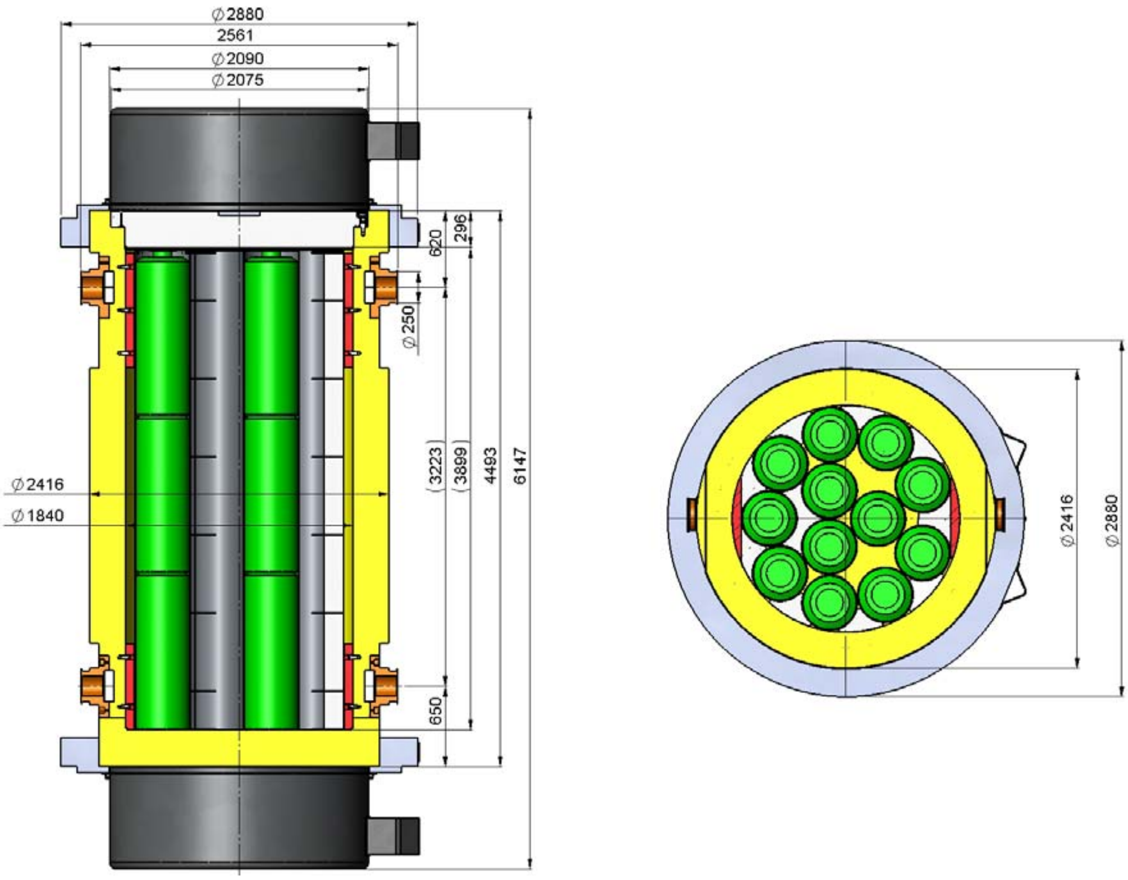

Figure 4: Cross-section through the TGC36

DESIGN VERIFICATION

Shielding

The shielding performance of the TGC36, loaded with 36 CSD-C's as described in the previous chapter will be verified by numerical calculations with validated computer codes (MCMP) using the maximum inventory data.
Calculations performed during the verification of the conceptual design showed that there are still margins between the calculated results to the limitation values from the IAEA regulations.

Thermal behavior

The thermal behavior of the loaded TGC36 has been investigated for transport and storage conditions with the max. heat load inside the cavity under normal and accidental conditions. The results are used as input data for the release calculations in both configurations.
Already performed calculations with the computer code ANSYS have shown that the design is incompliant with the accidental conditions.

Mechanical behavior

The mechanical behavior of the TGC36 under normal conditions of transport will be verified in accordance with requirements of the International standards by using validated computer codes (LS-DYNA, ANSYS for example).
The mechanical behavior under accidental conditions of transport will be demonstrated with drop tests using a scale 1:1 model. The drop test will show the leak tightness of the cask in compliance with the IAEA regulations. The drop test program is currently in a clearing phase with the German competent authorities.
The beginning of the drop test campaign is scheduled for autumn 2008. The manufacture of the drop test cask is currently in progress at different companies in Europe. The test cask will be made of a different type of material which has the same mechanical properties at room temperature than the material for the serial casks have at low temperatures. This strategy simplifies the performance of the drop tests in a significant manner.
The drop tests will be performed by the German Bundesanstalt für Materialforschung und –prüfung (BAM) at their drop test facility in Horstwalde nearby Berlin. The values taken form the instrumentation of the drop tests will be used for additional mechanical calculations to justify the design if necessary.

PROJECT TIME SCHEDULE

Figure 5 gives an overview on the project time schedule. Due to the very limited time available for the complete project, parallel actions will be necessary. This includes the preparation of the Safety Analysis Report as well as the manufacture of the first serial cask in parallel to the licensing procedure.

Nr.	Vorgangsname	Dauer
1	**Flask Development and SAR**	**43,44 M**
2	Final design phase (including validation)	35 M
3	Delivery SAR (Final Version)	0 M
4	**Flask Approval Procedure**	**60,54 M**
5	Application for flask approval	0 M
6	**Drop Test Program (1:1)**	**38,5 M**
7	Presentation Drop Test Program to BAM/BfS	0 M
8	Discussions with BAM	4,5 M
9	Mechanical Pre-Calculations	6 M
10	Final Agreement Phase with BAM	5 M
11	Manufacturing of the drop test flask	17 M
12	Preparation of drop tests	6 M
13	Drop Test Performance	12 M
14	Evaluation of the results	5 M
15	Evaluation of the SAR by BAM	11 M
16	Approval Certificate	0 t
17	Validation of the Flask Approval in France	6 M
18	**Storage Licensing Procedure**	**56,31 M**
19	Application for Storage License	0 t
20	Licensing Procedure	53 M
21	Storage License	0 t
22	**Flask Manufacturing**	**16,71 M**
23	Green light by the authorities	0 M
24	Flask Manufacturing Process (advanced)	16 M
25	Delivery of the 1st flask	0 t

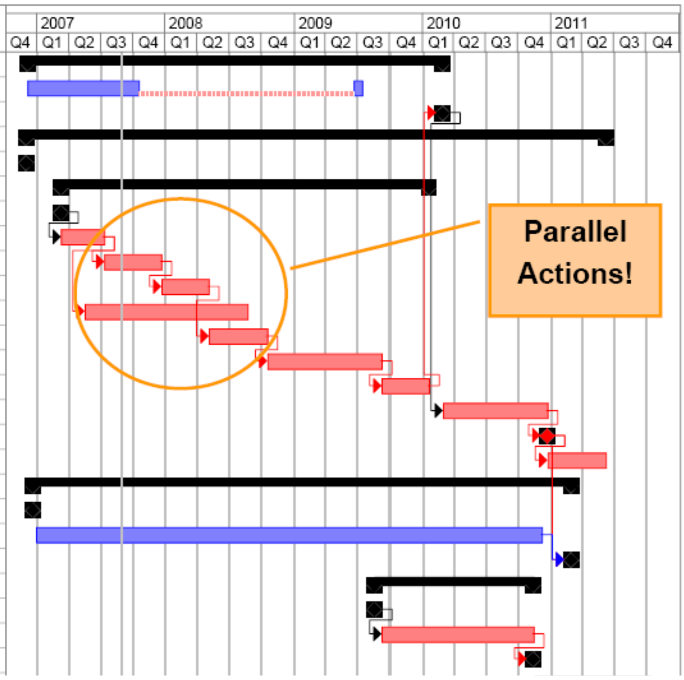

Figure 5: Project time schedule

CONCLUSIONS

GNS and TNI have formed a consortium named AGC to design, license and manufacture an innovative cask for the transport and the interim storage of the compacted wastes resulting from the reprocessing of the German spent fuel.

This cask has been optimized in order to offer a high capacity of loading, and allows a payload of 36 canisters, leading to a total mass of approximately 116 Mg in transport configuration.

The success of this project requires a special effort from both partner companies, members of the consortium, and implies also an efficient management of simultaneous tasks during the licensing period and the manufacturing time of the first items of the cask.