BRAZED AND WELDED CANS FOR TRANSPORT AND STORAGE OF DAMAGED FUEL RODS

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HOTLAB 2016
KARLSRUHE, GERMANY

OCTOBER 04th, 2016
STRUCTURE OF DOCUMENT

1. Context
2. Quality Assurance Requirements
3. Design and Manufacturing of the cans
4. Welding process
5. Brazing process
6. Process qualification
7. Conclusions
1. CONTEXT:

DAHER NT’s type B(U)F-96 package NCS45 is licensed for the transport of:
- undamaged fuel rods,
- uncanned damaged fuel rods, pellets, pellet scraps etc.
- damaged fuel rods or rod sections in welded or brazed cans,
- damaged pellets and pellet scraps in welded or brazed cans

Fuel rods, fuel rod sections, pellets and pellet scraps with burn-up of more than 62 GWd/MgHM must be in any case enclosed in welded or brazed cans

Current status regarding the leak tight encapsulation:
- Dry conditions (Hot-Cell’s laboratories): DAHER NT solution with welded cans.
- Under water (spent fuel pool, power plant): DAHER NT solution with brazed cans
2. QUALITY ASSURANCE REQUIREMENTS-
GENERALITIES

The BAM (Federal Institute for Materials Research and Testing) is the German competent authority for approval and supervision of quality assurance measures:

- for the type B(U)F-96 package NCS 45
- and for the welded and brazed cans to be transported.

According to BAM-GGR 011 Guideline

- the cladding tube,
- the upper and the lower plugs,
- as well as the welding and brazing seams

belong to „Grade 1“ category => highest requirements on Safety (containment)
2. QUALITY ASSURANCE REQUIREMENTS-
DRAWINGS

Safety Assessment (NCS 45’s PDSR)

Manufacturing Specification

Cans’ Template Drawing

Material List
## 2. QUALITY ASSURANCE REQUIREMENTS - MATERIAL LIST

### BRAZED-WELDED CANS FOR TRANSPORT AND STORAGE OF DAMAGED-HIGH BURN-UP FUEL RODS

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**Material Prequalification Controls**

- Material documentation

**Material Prequalification and Certificate Approval**

- NCS/Voith

**Anlagen Teil**

- Essentielle Blöcke: Construction of the building
- Planungs- und Entwurfsplanung

**Zug. Zeichnungs Nr.**

- 0004-WPB-05-03-00: ZL. Rev 2
- 0004-WPB-2015-02-Rev2

**Zug. Prüfungs- u. Prüfplan**

- ZUG.04-FPB-2015-02-Rev5
- ZUG.04-FPB-2015-02-Rev2

**Zug. Hartl/Verkehrstechnische Anweisungen**

- ZUG.04.04.05.01-Rev1
# 2. QUALITY ASSURANCE REQUIREMENTS - MANUFACTURING AND TEST SEQUENCE PLAN (MTSP)

## Prequalification Controls

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### 1. Prüfung vor Beginn der Fertigung
- Überprüfung des Auditierungsstands, ggf. X
- Durchführung eines QS-Audits:
- Überprüfung des QS-Systems gem. BAM-GGR 011

### 2. Kontrolle der Werkstoffnachweise nach X EN 10204 und der Materialkennzeichnung
- der zum Einsatz kommenden Halbzeuge
- den Werkstoffprüflätern und
- der vorgeprüften Werkstoffliste

### 3. Überprüfung des Reinheitszustandes der Fabrikationshallen und Maschinen
(Trennung von ferritischen und austenitischen Werkstoffen)

### 4. Nachweis der Herstellerqualifikation
- gem. AD-Merkblatt HP O und Überprüfung des Vorhandenseins des Großen Schweißbefähigungs-nachweises
- nach DIN 18800 Teil 7 Klasse E

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## Documentation Controls

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### ZUG-KENNR. | 3201/0204-03 |

### ZUG-FABR.KL. | 3201/0204-04 |

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2. QUALITY ASSURANCE REQUIREMENTS - WELDING/BRAZING PLAN
3. DESIGN AND MANUFACTURING OF THE CANS- WELDED CANS

Manufacturing:

1. The tube, upper and lower plugs are machined with final dimensions.

2. The lower plug is welded to the tube. Then a helium leakage test is performed.

3. In the Hot-Cell the tube is loaded with the fuel rod/parts of fuel rod and closed by welding process (circumference welding seam).

4. The can is filled with inert gas through the opening at the extremity of the upper plug and this hole is closed by welding process.
3. DESIGN AND MANUFACTURING OF THE CANS - BRAZED CANS

Manufacturing:

1. The tube is manufactured with final dimensions.

2. Upper and lower plugs are machined with final dimensions of the groove for the brazing material.

3. The brazing material is applied by “cold gas spray” technology.

4. Upper and lower plugs are machined to final dimensions.

5. The lower plug is inserted into the lower part of the tube and secured.
4. ENCAPSULATION PROCESS - WELDING PROCESS

Consists of the following general steps:

1. Loading of the tube with the fuel rod/parts of fuel rods.
2. Welding of upper plug: circumference by an orbital welding.
3. Filling with Helium and spot welding of hole in upper plug.
5. ENCAPSULATION PROCESS - BRAZING PROCESS

Consists of the following general steps:

1. Loading of the tube (lower plug preassembled with it) into the UBE, loading the fuel rod into the tube and closing of the UBE.

2. Draining and drying of the UBE, filling the UBE with Helium.

3. Brazing both plugs.

4. Flooding of the UBE and unloading of the brazed can of the UBE.

5. Helium leakage test in test chamber.
6. PROCESS QUALIFICATION

To qualify each manufacturing and production’s processes, prototype cans with dummy fuel rods were produced.

Non-destructive tests required:
- Visual check of welding / brazing seams.
- Surface crack test of welding / brazing seams.
- Helium leakage test.

Destructive tests required:
- Tensile test of welding / brazing seams.
- Metallographic analysis of heat influenced zones.
- Pressure test for both cans.

A qualification Report which summarizes all the results obtained has to be approved and released by the competent authority.
7. CONCLUSIONS

DAHER NT can provide following two technologies for the production of gas tight cans:
- for damaged fuel rods, fuel rod sections, pellets and pellet scraps,
- and/or material with high burn-up.

Both types of cans
- fulfill the highest QA requirements specified in BAM GGR-011 guideline
- and are already specified in the certificate of package approval of the B(U)F-96 package NCS 45.

DAHER NT supplies technologies that can be easily adapted to any NPP and any Hot-Cell complying with all safety requirements.