German Approach and Experience Feedback of Transport Ability of SNF Packages after Interim Storage

Frank Wille, Dietmar Wolff, Bernhard Droste, Holger Völzke
BAM Federal Institute for Materials Research and Testing
Berlin, Germany

Manfred Baden
TÜV Rheinland
Industrie Service GmbH
Berlin, Germany

PATRAM 2013
San Francisco, August 18-23
Outline

(1) Introduction

(2) Transport Package Design Approval

(3) Licensing for Dry Interim Storage

(4) Experience on Transport Preparation after Storage

(5) Quo Vadis
Introduction

Concept of Dry Interim Storage for SNF and HLW in Germany

- according to German Reactor Safety Commission (RSK) guidelines 2012

- accident safe dual purpose metal casks
  - Transport Approval Certificate
  - two independent sealed barriere lids
  - permanent monitoring of cask tightness

- storage period up to 40 years
Experience on Cask Storage up to 21 years in Germany

CASTOR® THTR/AVR

Storage Facility Ahaus since 1992
Storage Facility Jülich since 1993

Current German interim storage licenses ending

- Gorleben 2034
- Jülich 2013
- Ahaus 2036 (CASTOR® THTR/AVR: 2032)
- at-site facilities 2042/43

Interim storage periods have to be extended
Approval Certificate

- for transport on public routes
- at time of storage placement
- over storage time

Type B(U) Certificate

Package Design Approval Procedure

according IAEA Regulations (SSR-6)
and
German Guideline R003, PDSR Guide
Design Approval Certificate

Certificate
Validity Period

1985 & 1996 Edition of the IAEA Regulations

up to 5 years

“Loaded and Stored”
✓ exclusion of further manufacturing
✓ cask loaded and placed in storage
✓ intervals of maintenance and updating the SAR determined

10 years

Advantage: Transport Package design well known over storage period
✓ constantly care of the safety cases incl. documents concerning compliance to the regulations
✓ reasonable expense over storage period
Safety Demonstration

- mechanical stability
- shielding
- criticality safety
- thermal design
- attachments for lifting
- activity release
- dose rate

Quality assurance and monitoring program

- design, manufacturing, documentation
- operation
- maintenance & re-inspection
Licensing for Dry Interim Storage

According to §6 of the *German Atomic Energy Act*

- license issued by Federal Office for Radiation Protection
- technical assessment by different expert organizations (BAM, TÜV etc.)

According to Safety Guidelines for *Dry Interim Storage of Irradiated Fuel Assemblies* by the German Reactor Safety Commission

- stored casks have to be *transportable at any time* during storage
- consideration of storage operation condition
- *mechanical accident scenarios* different to transport conditions
  (handling without impact limiters)
- *long term performance* of all components *(up to 40 years)*
- periodic safety inspection and aging management procedure
  is going to be implemented
Long Term Behavior of Components and Material

Research Activities by BAM

Investigation of Metal Seal Resistance

- Long term behavior
- Corrosion Tests (water in the gap between inner and outer seal jacket)

Ageing Effects of Storage Cask Polymer Components

- Neutron shielding components (high temperature, radiation etc.)
- Elastomeric auxiliary seals (low temperature, long term behavior)
Tests and Inspections for Transport after Storage

‘Pure’ Transport Packaging: after unloading, all sections accessible

- system of periodic inspections

Transport after Storage: system of specific tests and inspections

- accessible package sections
- visual inspections,
- load testing,
- replacement of components
- check of the containment system
- check of the pressure monitoring system,
- lid screws (tightening torque),
- leak-tightness
- measurements
- verification of shielding effectiveness
Experience in Transport Preparation after Storage

CASTOR® THTR/ AVR

Interim Storage of SNF of decommissioned gas cooled high temperature research reactor in Jülich, Germany

- Loaded between 1993 - 2009
- Monolithic ductile cast iron cask body
- Double lid closure system (permanent pressure monitoring)
- Metallic seals
- Upper & lower pair of trunnions
- Bottom & top impact limiters (steel sheeted, wood filled)
Experience in Transport Preparation after Storage

CASTOR® THTR/ AVR Research Centre Jülich → Storage Facility Ahaus

USA

Transport preparation of 152 casks is ongoing

Example Leak-Tightness Test

Example Repair & Testing of Trunnions

© FZJ
# Test and Inspection Plan

1. Check of documentation of pressure monitoring system

2. Visual check of surfaces

3. Block-Position measurement of all lids

4. Examination of bolting torque of primary lid bolts

5. Leak-tightness tests of lid systems (30 primary lids)

6. All seals of 45 reassembled secondary lids renewed and leak-tight tested

7. Inspections of bolts and threaded holes (one hole repaired)

8. Check of trunnions, refurbished and replaced. 45 casks load tested
Results of Inspections and Tests

CASTOR© THTR/AVR **fulfills** current regulatory requirements

45 packages were inspected and tested

Transport ability was retained after 20 years of storage!
Summary & Quo Vadis

Package has to fulfill regulatory requirements incl. approval certificate after storage period

- Keep Approval Certificate over storage period alive
- Keep knowledge of the transport package

Apply conservative assumptions for safety cases or get knowledge in detail about conditions after storage period

- Challenge: Non-accessible areas (basket, spent fuel)

R&D Aging (long term behavior) of material and components

gaskets, package under regulatory tests, spent fuel assembly behavior

Regulatory Work

IAEA Working Group – Safety Case for Dual Purpose Casks