

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

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- (1) Introduction**
- (2) Transport Package Design Approval**
- (3) Licensing for Dry Interim Storage**
- (4) Experience on Transport Preparation after Storage**
- (5) Quo Vadis**

Concept of Dry Interim Storage for SNF and HLW in Germany

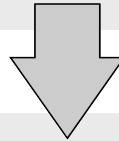
- according to German Reactor Safety Commission (RSK) guidelines 2012
- accident safe dual purpose metal casks with
 - ➔ Transport Approval Certificate
 - ➔ two independent sealed barrier lids
 - ➔ permanent monitoring of cask tightness
- storage period up to 40 years



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CASTOR® THTR/AVR

Storage Facility Ahaus since 1992
Storage Facility Jülich since 1993



Experience on Cask Storage up to 21 years in Germany

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**

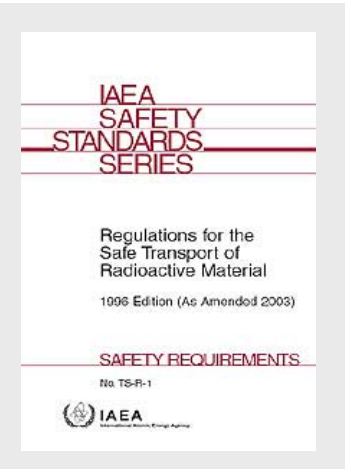
Type B(U)
Certificate

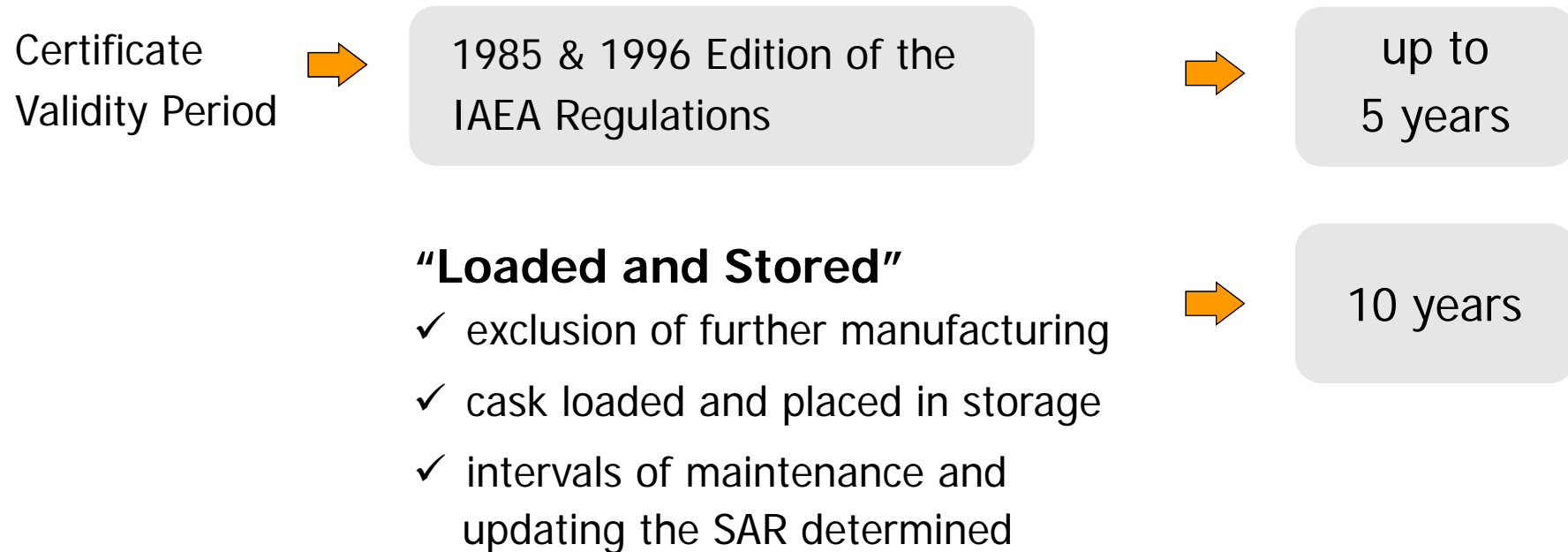


Package Design
Approval Procedure



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





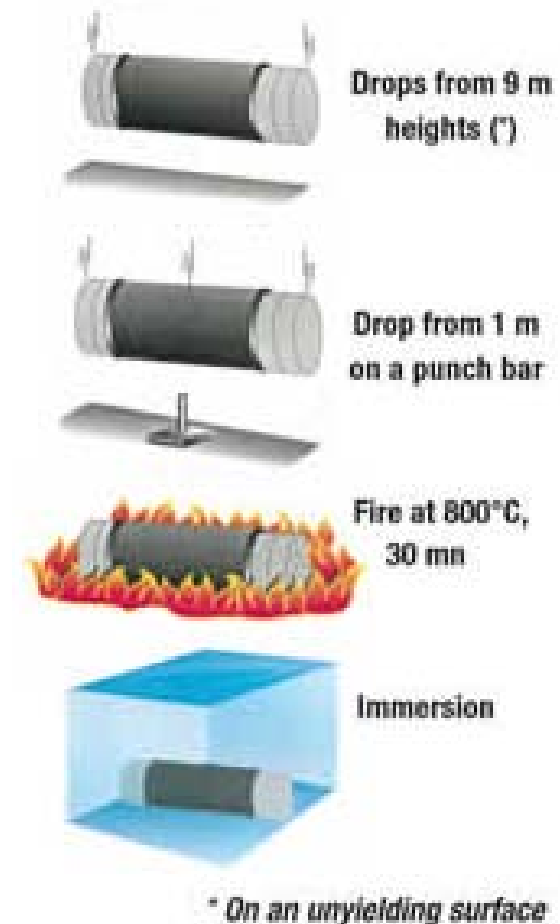
- **Advantage:** *Transport Package design well known* over storage period
- ✓ *constantly care* of the safety cases incl. documents concerning compliance to the regulations
 - ✓ reasonable expense over storage period

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



test scenarios according to IAEA TS-R-1 (SSR-6)

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.)

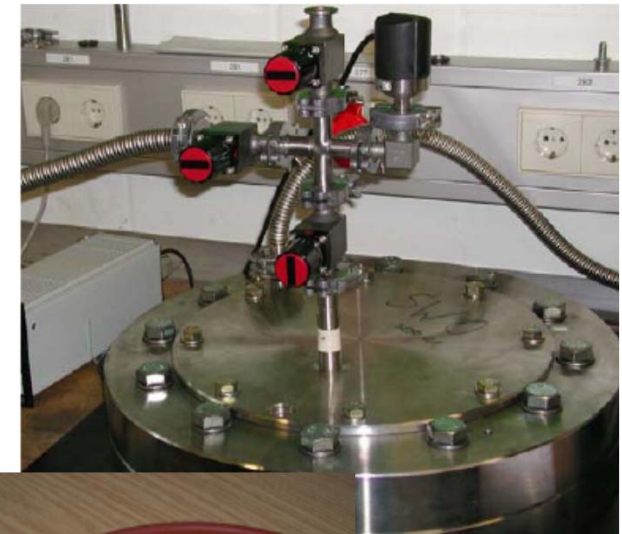
According to Safety Guidelines for *Dry Interim Storage of Irradiated Fuel Assemblies* by the German Reactor Safety Commission

- ➔ 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

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)



'Pure' Transport Packaging:

after unloading, all sections accessible



system of periodic inspections

Transport after Storage:

system of specific tests and inspections



accessible package sections

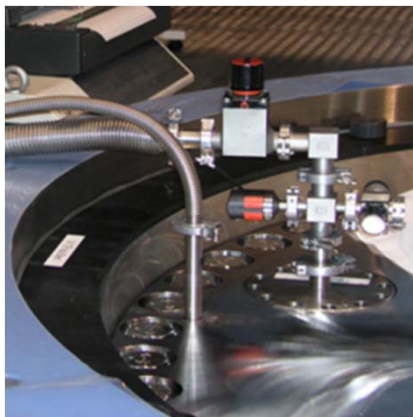
- visual inspections,
- load testing,
- replacement of components



check of the containment system

- check of the pressure monitoring system,
- lid screws (tightening torque),
- leak-tightness

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measurements

- verification of shielding effectiveness

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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)



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Experience in Transport Preparation after Storage



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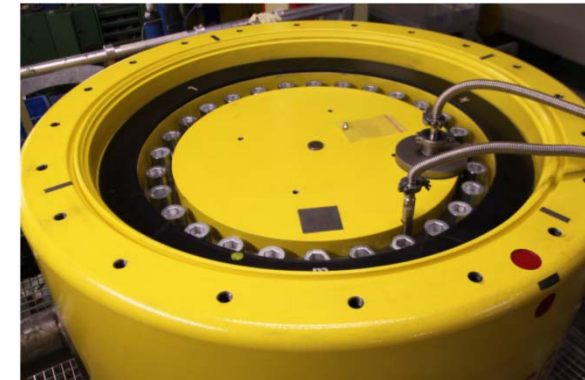
Research Centre Jülich →

Storage Facility Ahaus ?

→ USA



Example
Leak-Tightness Test



Transport preparation of
152 casks is ongoing









Example
Repair & Testing
of Trunnions



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- (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 

CASTOR[®] THTR/AVR **fulfills** current regulatory requirements



45 packages were inspected and tested



Transport ability was retained after 20 years of storage !

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