

Transport Aspects of Spent Fuel Management

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– Bundesamt für Strahlenschutz –

International Conference on Management of Spent Fuel from Nuclear Power Reactors -
An Integrated Approach to the Back-End of the Fuel Cycle

Vienna, 15-19 June 2015

Contents

- Motivation for ageing management for all transport packages
- Approaches for different kinds of packages
- Overview over the German concept for package design approval for packages for storage and transport of spent fuel
- Way to improve the IAEA regulations for the safe transport of radioactive material
- Conclusions

General requirement

During shipment any transport package must meet the requirements of the transport regulations that are valid at that time.

This means: the demonstration of compliance with the regulations for any package design shall be related to

- The transport regulations at the time of shipment, and
- The condition of the packaging and contents during shipment .

OK, but what if...

Challenge

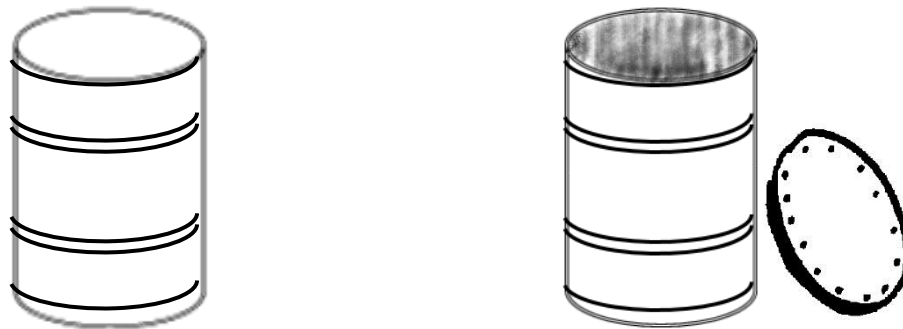
What if

- The transport regulations or the state of the technical knowledge change between the time of designing and the time of shipment, or
- The conditions of the packaging and contents change before or during shipment?

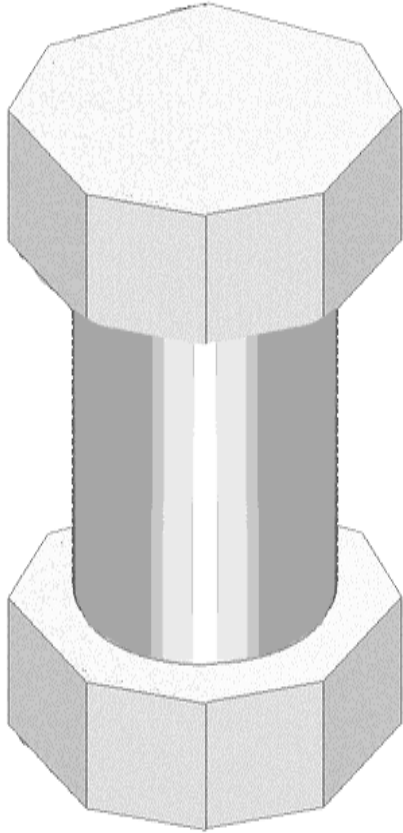
**Ageing management
(graded approach!)**

Package used for frequent loading and transport

- Compliance demonstration for the package consisting of the packaging as built and the contents at the time of loading
- Periodic inspection of the packaging when empty including maintenance or replacement of parts
- Changes in the properties of the contents during transport accounted for in the design or in the handling instructions
- Changes in the regulations or technical knowledge taken into account during periodical renewal of the design approval



Packages intended to be transported after long storage



Compliance with the regulations for such packages

- should not depend on inspection of the interior of the package during storage
- may take into account well known storage conditions including monitoring

Packages intended to be transported after long storage

- The ageing of the packaging and the contents during the planned storage time should be taken into account from the very beginning in the design and in the demonstration of compliance with the regulations.
- During storage the effect of changes to the transport regulations and to the technical knowledge should be monitored and assessed (“gap analysis”), potentially leading to measure to be applied before shipment.
- Before shipment after storage an inspection of the package (including review of the storage records and gap analyses) and maintenance, if required, should be carried out to ensure compliance with the regulations during shipment.

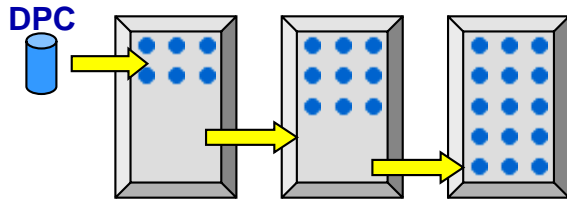
German concept of package design approval for DPCs



In Germany spent fuel is stored in dual purpose casks (DPCs). The transport package design approval is maintained over the whole storage period.

German concept of package design approval for DPCs

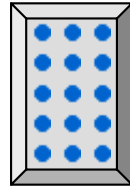
DPCs manufactured, loaded and transported to storage facility



D/1234/B(U)F-96 (Rev.0)

- Issue of package design approval for transport, normal revision and renewal procedure
- Design shall meet transport and storage requirements
- Safety related long term aspects to be considered
- Issue of instructions for pre-shipment inspection before transport after storage

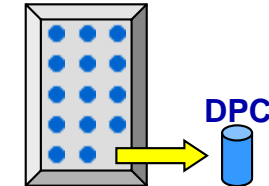
Interim storage up to 40 years



D/1234/B(U)F-96 (Rev.X)

- Certificate renewal procedure every 10 years
- Within this period impact assessment of changes in regulations, state of the art of safety demonstrations, operational experiences, ageing effects
- Update of instructions for pre-shipment inspection

Transport from the storage facility



D/1234/B(U)F-96 (Rev.Z)

- Valid package design approval
- Before transport: performance of all measures as specified in the instructions for pre-shipment inspection or in the certificate
- Transport in compliance with regulations

Way to improve the transport regulations (SSR-6)

- It should be required that the design of any package shall take into account ageing processes.
- Regarding the need for an ageing management packages intended to be used for shipment after storage should be directly mentioned to clarify that ageing considerations are especially important for these package designs.

Way to improve the transport regulations (SSR-6)

- It should be explicitly stated that for a package intended to be used for shipment after storage already the application for package design approval should consider ageing of the packaging and the contents in terms of safety demonstration.
- The management system for such a package should account for ageing, including a periodic gap analysis program and appropriate instructions for operation and maintenance with the inspection before shipment after storage as a key element.
- Detailed guidance should be given.

Conclusions

The key to transport after several years of storage:

- Ageing management (for all packages)
- Consideration of ageing processes in the design phase and application for transport package design approval
- Periodical assessment of changes in regulations, state of the art of safety demonstrations, operational experiences, ageing effects (“gap analysis”)
- Pre-shipment inspection accounting for results of gap analyses

Design

**Management
system**

Thank you for your attention!