GNS experience in design and licensing of dual purpose casks

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International Workshop on the Development and Application of a Safety Case for Dual Purpose Casks for Spent Nuclear Fuel

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Outline

- Introduction
- Challenges
- Design and Licensing
- Manufacturing and Quality Assurance
- Suggestion Box
- Perspective
Introduction

GNS Gesellschaft für Nuklear-Service mbH

- Disposal of spent fuel as well as low-, intermediate- and high-level radioactive waste for the German Utilities
- Design and licensing of casks for transport and storage of spent fuel and high-level radioactive waste (CASTOR®, CONSTOR®) and low- and intermediate-level radioactive waste (i.e. MOSAIK®)
- Conditioning of radioactive waste
Introduction

- The concept of interim storage of radioactive waste in Germany assumes packagings that also comply with transport regulations.
- The approach are casks designed for both storage and transport, so called Dual Purpose Casks (DPC).
- GNS developed and continually improves its cask family:
  - for high-level radioactive waste the CASTOR® cask family
  - for low- and intermediate-level radioactive waste the MOSAIK® cask family, Yellow Box® and other
Challenges - Requirements

- Inventory Data
- Handling
- Basket
- Cask Body
- Impact Limiter
- Shielding
- Cask Mass
- Lid System
- Thermal
- Containment
- Mechanics
- Release
- Criticality
- Fuel Rod Temperature
- Wall Structure
- Deceleration
- Design Criteria
- Dose Rate
- Moderator Expansion
- Component Temperatures
- Cavity Pressure
Challenges - Methods

Basic safety evaluations, methods, codes, standards, regulations etc. are permanently improved

Example: Shielding, Criticality

Today
three-dimensional
Monte-Carlo-
Calculation Models

dynamical
calculation models
using temperature
and strain rate
dependent material
models

Example: Mechanical Analyses

global analytical approach
quasi-static models

one-dimensional
two-dimensional
Challenges – State of the Art and Aging

- Knowledge
- Application
- Fixed Basis of Evaluation of the Authority
- Safety Margin
- Conservatism under “Aging”
- Terms and Conditions of the Approval
- Real Level of Safety (State of the Art of the Package)
- State of the Art (of the Proofs)
- Safety Requirements (Regulations)
- Evaluation Time of the Authority
- Application
- Issue of Approval/License
- Evaluation Time of the Authority

- Challenges – State of the Art and Aging

- Application
- Fixed Basis of Evaluation of the Authority
Package Design Approval in Germany

- Package approval will be given for 5 years if manufacturing, loading, transportation is regularly performed.
- Package approval will be given for 10 years if each manufactured and loaded cask is stored and if
- an assessment report is part of the application, which address the impact of changed regulations and methods on the design, the operational experience with the casks and an aging management which focuses on the further validity of the safety relevant input parameter of the design and on the stipulations of the inspection plan to be applied before removal of the loaded cask from the storage facility.
Storage Licensing in Germany

- Interim storage of high-level radioactive waste and LWR-fuel assemblies site-specific licensed according to § 6 Atomic Energy Act for 40 years (12 on-site storage facilities as well as 3 centralized storage facilities currently licensed)

- Example CASTOR® V/19: subject to licensing in 9 different storage licensing procedures
CASTOR® Cask Family – Design Features

- Monolithic cask body made from Ductile Cast Iron
- Screwed double lid system with metallic gaskets
- Inner neutron moderator
- Machined cooling fins
- Pressure monitoring
- Radioactive inventory e. g.
  - Spent fuel
  - High-level radioactive waste from reprocessing
CASTOR® Cask Family – DPC Concept

Cask in Storage configuration with additional protection plate

Cask in Transport configuration with impact limiters
Manufacturing – Combined Quality Assurance

- Package Approval
- Transport Configuration
- Acceptance Certificate
- Storage License
- Storage Configuration
- Certificate of Conformity
Manufacturing Surveillance - Transport

Procedure according Transport Regulation

Competent Authority

BAM

3.3

Mandate

Application

Acceptance Certificate

Appointment

Local TÜV (T2)

Surveillance of Manufacturing

Package Approval Holder and Manufacturer

Casks

VORWEG GEHEN

EnBW

E-on

VATTENFALL

GNS
Manufacturing Surveillance - Storage

Procedure according to Storage Regulations

Supervisory Authorities

Application

Certificate of Conformity

Certificate

Mandate

Mandate

BAM
Bundesanstalt für Materialforschung und -prüfung

3.4

TÜVRheinland
Genau. Richtig. Berlin-Brandenburg (T1)

Assignment

Local TÜV (T2)

Surveillance of Manufacturing

Manufacturer

Cask

initiates

VORWEG GEHEN
EnBW e.on

VATTENFAL
GNS

Holder of License for Storage
Quality Assurance Measures

- All manufacturing and test steps of so-called class 1 and 2 components are performed in accordance with pre-assessed “Fabrication and Test Plans”

- Every supplier needs a certified quality management system, which is audited by GNS and BAM

- In total more than 700 test steps are performed per single cask

- Depending on the relevance to safety, additional inspections are performed by GNS (manufacturer) and independent experts

- Approx. 20 kinds of documents have to be taken into account

- More than 1700 pages of documentation per single cask
Manufacturing Shop

Assembly and Preparation for Delivery in the GNS-Cask-Manufacturing Mülheim
After assembly and acceptance tests a comprehensive check of the manufacturing documentation is performed.

The documentation comprises 28 chapters with approximately 1700 pages.

The check of the documentation is performed by GNS as the manufacturer as well as the competent authority.

Acceptance certificate and certificate of conformity granted by the competent authorities form the completion of the manufacturing process.
Different types of CASTOR® casks

CASTOR® HAW28M

CASTOR® THTR/AVR

CASTOR® 1000/19

CASTOR® 440/84
Storage Facilities – Example for a Central Storage

- Pilot-Conditioning Facility PKA
- Storage Facility ALG (low- and intermediate radioactive Waste)
- Storage Facility TBL-G (Burned Fuel and HAW)
Transportation of DPC - Examples
CASTOR® world wide as DPC in use

- Belgium: 7 casks
- Germany: 1000 casks
- Switzerland: 6 casks
- South Africa: 4 casks
- Czech Republic: 98 casks
CASTOR® 1000/19

- On basis of SUJB Decree No. 317/2002 Type Approval shall apply to packagings designed for transport and storage.

- GNS drafted its 1st Integrated Safety Case on basis of detailed SUJB suggestions on such Safety Case in 2008.

- Application to SUJB was performed in November 2008.
Due to Czech rules, licensing/approval procedure duration is limited to one year. However, interruption of the procedure can prescribed by the authority if independent review identifies gaps in the proofs. The applicant has to close the gaps in a prescribed time frame.

Experts for independent review of the SAR are stipulated by the authority and may be also chosen from foreign countries.

Issue of Type Approval by SUJB after one and a half year in June 2010 as Type B(U)F and Type S package.
Suggestion Box

- An Integrated Safety Case for DPCs proves its strengths
  - in national licensing procedures with single authority structures
  - in a type approval procedure for packagings designed for transport and storage
  - in the manufacturing process and quality assurance of such type approved packagings
- Validation of package design approvals of DPCs transfers boundary conditions from one country to another
- International experienced independent experts can support national authorities
- Fixed licensing/evaluation times for authorities and applicants reduce risks and force the concentration on the targets
- Implemented aging management and monitoring procedures in both procedures can bring storage licensing and transport design approval durations in line.
Perspective: Triple Purpose Casks

GNS’s Ductile Cast Iron Containers for low- and intermediate-level active waste

This packages are already licensed for:

- Transport (as Type IP2 Package)
- Interim Storage
- Final storage (for final repository at KONRAD)

For design, licensing and manufacturing three different set of requirements, legal procedures and quality assurance frame works needed to be taken into account!
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