Recent Issues Found in a Dual Purpose Metal Cask Design and Operation. Ensa’s Experience in Spain


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Outline

- Introduction
- Applicable Regulations to DPC
- Difficulties when designing a Spent Fuel DPC
- Issues related to the Design. Storage
- Issues related to the Design. Transport
- Issues related to the Operation. Loading
- Conclusions
Introduction

- Dual Purpose Casks are designed to meet both Storage and Transport Regulations
- Each Regulation has its own requirements
- The designer shall assured that the design is in compliance with the requirements of both Regulations using bounding conditions coming from each application
- Gaps, uncertainties and discrepancies in Regulations leave on the designer’s hands the responsibility to make assumptions that sometimes creates difficulties in the design process
Applicable Regulations to DPC

- **Storage:**
  - Spain: IS-20, IS-29 and RPSRI
  - USA: 10 CFR Part 72, NUREG-1536
  - International: IAEA No. SSG-15
  - Other, site-specific requirements

- **Transport:**
  - Spain: ADR, RID, IMDG and Guía de Seguridad 6.4
  - USA: 10 CFR Part 71, NUREG-1617
  - International: IAEA No. SSR-6
  - Other specific regulations
Difficulties when designing a DPC

- Application of several different Regulations
- Specific Design criteria for Storage and Transport
- Find the bounding condition is not always easy
- Current Regulations try to cover most of the issues to be considered in a DPC design & licensing, but...
- As a consequence of the above mentioned, many of the assumptions to be considered by the designer shall be “at it’s own risk” with the uncertainties for licensing acceptance
Issues related to the Design. Storage (I)

- Current regulation provides general statements leaving in hands of the designer the interpretation or assumption that in most cases need to be justified. A few examples here:
  - **Ambient temperatures** to be considered for the cask thermal evaluation: Extreme? Maximum daily/monthly Average?...
  - **Solar Radiation**: Transport requirements acceptable for storage (IAEA SSR-6, 10 CFR 71) or site-specific average? Maximum?
Issues related to the Design. Storage (II)

- Several **accidents considered** in the design of a SF cask during on-site activities and storage (drops and tip over) are based on traditional evaluations. No specific design requirements are provided in the Regulation (height, type, orientations).

- Following to the above issue, the acceptance criteria for these evaluations are also undefined, or at least unclear. **Acceptance criteria** based on stresses is still applicable and for some regulators mandatory. The “pretty new” strain-based criteria included in the latest edition of the ASME Code, Section III, Division 3 (WB/WC-3700), should be identified as an alternative.

- **Retrievability** of the fuel under Normal Condition of Storage and Accident Condition
Issues related to the Design. Storage (III)

- An **aging program** for the different safety class material shall be defined, specially for some specific materials (neutron shielding, neutron absorbers, seals...)

- Definition and acceptance criteria when designing the cask to allow **damage fuel loading**. A definition of the different fuel assembly pathologies shall be established to cover all “damage fuel” types. Requirements that could have an impact on some of the safety functions of the Spent Fuel Cask shall be addressed.
Issues related to the Design. Transport (I)

- Transport Regulations have also similar issues. Gaps and discrepancies create difficulties to decide adequate design requirements for later licensing acceptance. Several examples are presented here:
  - **Burnup Credit.** Application of this methodology is necessary in most of the DPC designs for criticality safety. Several data bases of actinides and FP have been presented (EPRI, ORNL...) to be used in burnup credit calculations, but need to be unified and accepted by Regulators. Bounding scenario should be helpful (Spent Fuel and Plant operating data)
Issues related to the Design. Transport (II)

- **Drop test Temperatures** (cold test).
  - ADR and IAEA SSR-6 define the lowest design ambient temperature at -40 °C. The drop test shall represent the design conditions. Credit to heat load?
  - 10 CFR 71 indicates that the initial condition for cold test shall be at -29 °C
  - Different requirements, so difficult to meet when required to meet both regulations

- **Heat load** to be considered for cold drops (HAC). Only Regulatory Guide 7.8 provides a load combination about this matter.
Issues related to the Design. Transport (III)

- **Fuel Assembly** maximum G load under a drop event (HAC). Regulation does not establish a limit of the G load that the a FA can withstand. Document SAND90-2406 still a reference. Current analytical tools together with a better knowledge and understanding of the irradiated cladding mechanical properties will help the designer to assess new engineering approaches for determining the maximum G load for a fuel type.
Issues related to the Design. Transport (IV)

- As indicated in Regulations, all of the spent fuel that are being loaded in a DP cask should be capable to be transported just after loading or after a storage period. Different fuel assembly pathologies shall be identified to cover all “damage fuel” types (i.e. spalling, hydride effects, mechanical damage) and acceptance criteria to be considered in the cask design need to be developed. Incorporation of the damage fuel types and the acceptance criteria for loading into a safety instruction is required.
Issues related to the Design. Transport (V)

- **Monitoring** of Interlid region pressure under Normal Condition of Transport (NCT) to assure leak tightness: vibration effect on the seals -if any-, especially for transportation after a long period of storage.

- **Aging** material program shall be considered and established based on material engineering assessments, good practices during storage (maintenance & surveillance) and operational experience. A test program when feasible should be considered for any safety related items.
Issues related to the Operation. Loading (I)

- Based on the experience of the Ensa’s personnel during annual loading campaigns since 2002 (first 2 casks loaded in Spain) to date, with a total of 25 spent fuel dual purpose metal casks and 14 concrete modular systems, some observations were found that shall be taken into account for later implementation into a guidance or safety rule.
Issues related to the Operation. Loading (II)

- A guideline to establish the procedures and acceptance criteria for loading activities (other than spent fuel loading verification) shall be develop to consider, but not limited to:
  - The verification of the proper assembly of the different cask items before loading
  - Spare parts availability on time
  - The verification of the functionability of the different loading equipments
Conclusions

- DPC shall comply with both Storage and Transport Regulations, and sometimes even from different Member State countries.
- Because of the above mentioned, requirement may differ from to another. Bounding conditions are not always easy to define.
- Regulations do not address all design requirement so this leave in the designer’s hands the final decision of design assessments with the possibility of licensing issues.
- Due to gaps, uncertainties and discrepancies in the applicable Regulations it should be very helpful to compile clear design requirements into a unique guidance (TECDOC – Safety Case).
- Working Group involving all stake-holders, will allow to cover and address all different stage issues related to DPC and provide with the opportunity to develop a well detailed guidance.
Thanks for your attention!
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