SUMMARY OF HIGH EFFICIENCY TRUCK CASK SYSTEMS (GA-4 AND GA-9)

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Nuclear Waste Technical Review Board
Denver, Colorado
July 13, 1994
General Atomics (GA) Legal Weight Truck (LWT) Cask System

TRACTOR

GA-4 or GA-9 CASK

TRAILER

34,000 lb

57.5 ft.

12,000 lb

34,000 lb
Benefit and Importance of GA-4 and GA-9 LWT Cask Systems to CRWMS Program

- Carrying capacity compared to existing legal weight truck casks increased
  - From 1 to 4 PWR assemblies
  - From 2 to 9 BWR assemblies

- Reduction in number of LWT shipments, miles travelled, and potential for accidents

- Reduction in routine radiation exposure to Public
This presentation will present a brief summary of

- Design of GA-4 and GA-9 casks and the design status
- Brief discussion of analysis efforts required in preparation for review by the Nuclear Regulatory Commission (NRC)
- Certification process and activities
- Testing performed and planned to confirm analysis results and cask performance
GA-4 Legal Weight Truck Cask

- LIFTING AND TIEDOWN TRUNNION
- STAINLESS STEEL CLOSURE
- INCONEL 718 CLOSURE BOLTS (12)
- SPENT PWR ELEMENTS (4)
- STAINLESS STEEL LINER
- DEPLETED URANIUM GAMMA SHIELD
- STAINLESS STEEL SKIN
- POLYPROPYLENE NEUTRON SHIELD
- STAINLESS STEEL BODY
- HOLES FOR INCONEL 718 IMPACT LIMITER BOLTS (8)
- REMOVABLE ALUMINUM HONEYCOMB IMPACT LIMITER
GA-9 Legal Weight Truck Cask

- LIFTING AND TIEDOWN TRUNNION
- SPENT BWR ELEMENTS (9)
- STAINLESS STEEL CLOSURE
- INCONEL 718 CLOSURE BOLTS (12)
- STAINLESS STEEL LINER
- DEPLETED URANIUM GAMMA SHIELD
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Cross Sections
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LIFTING HOLES

SMALL B₄C HOLES AT ENDS

LARGE B₄C HOLES IN MID-SPAN

THIS EDGE SHOWN WITHOUT EDGE SUPPORT STRIP

Fuel Support Structure
Key Design Features

- 4 PWR or 9 BWR Spent Fuel Assemblies
- Stainless steel cruciform fuel support structure (FSS)
- Stainless steel liner
- Depleted Uranium (DU) gamma shield
- Stainless steel outer shell
- Polypropylene neutron shield
Key Design Features (Continued)

- Forged bottom head
- Bolted lid closure
- Aluminum honeycomb impact limiters
- Access ports for draining, drying and venting for in-plant operations
Major Design Changes to Address Review Groups’ Comments

- BWR FSS length shortened for channels
- A second set of lifting trunnions
- GA-4 lid closure modified for Non-Fuel Assembly Hardware (NFAH)
- GA-9 lid closure modified and four cell FSS added for NFAH
- Impact limiter tapered
- Paint eliminated
- Welded FSS on GA-4
Table 1 Weights and Dimensions of the GA-4 and GA-9 Casks

<table>
<thead>
<tr>
<th></th>
<th>GA-4</th>
<th>GA-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (loaded)</td>
<td>53,600 lb.</td>
<td>52,900 lb.</td>
</tr>
<tr>
<td>Cask length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>without impact limiters</td>
<td>187.75 in.</td>
<td>198.30 in.</td>
</tr>
<tr>
<td>with impact limiters</td>
<td>233.95 in.</td>
<td>244.50 in.</td>
</tr>
<tr>
<td>Trunnion-to-trunnion width</td>
<td>48.3 in.</td>
<td>46.66 in.</td>
</tr>
<tr>
<td>Impact limiter diameter</td>
<td>90.00 in.</td>
<td>90.00 in.</td>
</tr>
<tr>
<td>Cavity depth</td>
<td>167.25 in.</td>
<td>178.00 in.</td>
</tr>
<tr>
<td>Cavity fuel cell cross section</td>
<td>8.755 in.</td>
<td>5.760 in.</td>
</tr>
</tbody>
</table>
High Capacity Achieved by

- Longer cooled fuel
- Two cask bodies (PWR/BWR)
- Non-circular cross section eliminates unused space
- Efficient gamma shield material (DU)
- High strength materials (XM-19) for cask body components
- Unique FSS; poison contained within structure
- Aluminum honeycomb filled impact limiters
Cask Analyses

- Casks are designed by analysis
- Five major areas or disciplines
- Analyses performed using sophisticated computer codes
- Finite element two and three dimensional models are used
- Analysts can perform highly-detailed analyses of the entire cask, individual components, or specific areas
Cask Analyses (Cont’d)

- Computer programs and models used are typical for cask analysis and are familiar to and accepted by NRC.
- The applied loads result from the conditions defined by Title 10 Part 71 of the Code of Federal Regulations and in-plant operations.
- Mechanical and thermal loads are in terms of:
  - internal and external pressure
  - thermal gradients
  - acceleration and deceleration loads
  - lifting and tiedown loads
  - 30 ft drop
  - Puncture
  - Accident thermal environment (Fire)
- Radiological source terms of spent fuel
Cask Analyses (Continued)

- The analyses produce results, e.g.
  - Stresses
  - Deformations
  - Temperatures
  - Radiation dose levels

- These results are compared to allowable limits

- The allowable limits are established by NRC regulatory guides, the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) codes for Nuclear Components, and the American National Standard Institute (ANSI) standards
Cask Analyses (Continued)

- The allowable limits provide significant safety margins against failure

- Analysis methods, models and results, applied loads, and allowable limits are summarized in the Safety Analysis Report (SAR), which is submitted to NRC for review
Certification Process & Activities

- Cask supplier has NRC approved QA program
- NRC audits cask supplier periodically
- Several presentations to NRC during design and analysis phases
- Last meetings June 2 and July 13, 1993
- Issues raised are resolved prior to SAR submittal
- NRC performs thorough and exhaustive independent review
Certification Process (Cont’d)

- Reviews completed and SARs to be submitted in July 1994 and end of September 1994
- First round questions expected 6-9 months after submittal
- One-half scale model test results spring of 1995
- Test results incorporated into revision of SAR
Cask Testing

- Component, Material, or Subsystem testing
  - During design phase
- Design Verification (Regulatory) testing
  - Part 71 Accident Scenarios
- Performance Verification testing
  - Cask Acceptance testing
  - Periodic Maintenance testing
Cask Testing (Cont’d)

- Component, Material, or Subsystem testing
  - Full scale mockup of a section of cask body
  - Full scale mockup of lid closure area
  - Fire tests of neutron shield materials
  - Several tests on aluminum honeycomb material tests
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Cask Testing (Cont’d)

- Design Verification (Regulatory Testing)
  - Drop tests on 1/2 scale model
  - 30 ft drops and puncture, 3 each
    - side
    - side slapdown
    - Center-of-Gravity (CG) over end corner
Cask Testing (Cont’d)

- Performance Verification Testing
  - After manufacturing prior to acceptance
  - Periodic Maintenance testing