U. S. Department of Energy
Office of Civilian Radioactive Waste Management

Presentation To
The Nuclear Waste Technical Review Board

Subject: Cask Development/Fabrication

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Presenter's Title
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August 21-23, 1989
CASK DEVELOPMENT

0 REQUIREMENTS

0 FABRICATION

0 CASK CARRIAGE DEVELOPMENT
Design Process

- Requirements
  - Preliminary Design
    - Review
      - Final Design
        - Review
          - Technical Review Group (TRG)
            - Design Package Drawings and Specifications
             - Model Tests
             - Engineering Tests
CASK REQUIREMENTS

0 Safety
0 Quality
0 Interfaces
0 Design
0 Operational
CASK SAFETY REQUIREMENTS

0 SAFETY CONSIDERATIONS
   - CASK CONTRACTOR STATEMENT OF WORK
     PROVIDES BASE REQUIREMENTS

0 SAFETY ADDRESSED AS PART OF CERTIFICATION
   - MEET 10CFR71 REQUIREMENTS
   - MEETINGS WITH NRC
   - SAFETY ANALYSIS REPORT FOR PACKAGING (SARP)

0 THE DESIGN PROCESS ENSURES A SAFE DESIGN
   - PERIODIC PROJECT REVIEWS
   - PRELIMINARY AND FINAL DESIGN REVIEWS

0 DESIGN SPECIFIC
   - LOW CENTER OF GRAVITY
   - EASE OF INSPECTION
   - LEAK TEST CAPABILITY
CASK SAFETY REQUIREMENTS (CONT'D)

0 Safeguards
   (Physical Protection From Theft And Sabotage)
   - General Design Requirement
     - Compliance with 10CFR73, "Physical Protection of Plants and Materials"

   - Specific Design Requirements
     - Ease of Safeguards Inspections
     - Avoidance of Areas for Concealed Explosives
     - Tamper-Indicating Seals
CASK QUALITY REQUIREMENTS

- QUALITY ASSURANCE
  - PROGRAM PHILOSOPHY
  - NRC/DOE-APPROVED PROGRAM
  - DOE-APPROVED IMPLEMENTATION PLAN
  - ANSI/ASME NQA-1

- QUALITY CONTROL
  - AUDITS
  - TESTS

- GRADED QUALITY LEVELS
CASK INTERFACE REQUIREMENTS

0 Facility Interface Capability Assessment (FICA) Study Available - November 1989

0 Preliminary data indicate three facilities have physical restrictions difficult to remedy

0 Specialty casks may be required for these facilities
CASK INTERFACE REQUIREMENTS

0 STANDARD FUEL (FROM 10CFR961—STANDARD CONTRACT)

- PRESSURIZED WATER REACTOR (PWR)
  - 9 IN. X 9 IN. X 178 IN.

- BOILING WATER REACTOR (BWR)
  - 6 IN. X 6 IN. X 179 IN.

- NONFUEL BEARING COMPONENTS (NFBC)
  - UNFAILED

- > FIVE-YEAR COOLING
CASK INTERFACE REQUIREMENTS (CONT’D)

- DOE FACILITIES
  - COORDINATING WITH REPOSITORY ON CASK DESIGN
CASK DESIGN REQUIREMENTS

- Design Goals for OCRWM Casks
  - Maximum Payload Within:
    - Weight Constraints
    - Safety Considerations
  - Subcriticality
  - Shielding
  - Dissipate Fuel Heat
  - Maintain Containment
  - Minimize Handling Requirements (ALARA)
  - Life - 25 years, 1,000,000 Miles
CASK OPERATIONAL REQUIREMENTS

- Impact Limiter Removal and Storage
- Worker Platforms
- Personnel Barriers
- Bar Codes
- Tiedowns
- Contamination Control
- Cask Loading
- Standardization
Cask Operational Requirements (Cont'd)

- Component Interchangeability
- Fuel Protection
- Intermodal Considerations
- Robotics
- Lifting Devices
- Cask Penetrations
Cask Operational Requirements (Cont'd)

0 Cask Lifting Devices

- Trunnions to be Circular, Replaceable
- Four Trunnions Near Closure End
- Consider Offset Rear Trunnions
- Require Only One Lifting Device
- Lifting Device Self-Guiding, Remotely Activated
- Consider Operator Visibility
- Consider Accident Retrieval - Any Orientation
CASK OPERATIONAL REQUIREMENTS (CONT’D)

CASK PENETRATIONS

- CASK DRAINING, DRYING, SAMPLING, PURGING
  - MINIMUM PENETRATIONS, DOUBLE CLOSURES
  - LIMIT PARTICULATE ACCUMULATION
  - DISSIMILAR FITTINGS
  - REMOTE CAVITY DRAINING VERIFICATION
  - VACUUM DRYING
  - CAVITY SAMPLING, TOP END
  - NO HYDRAULIC LOCKS
CASK CONTRACTOR DESIGNS
Design Process

- Requirements
- Preliminary Design
  - Review
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  - Final Design
    - Review
    - Design Package Drawings and Specifications
  - Engineering Tests
    - Model Tests
<table>
<thead>
<tr>
<th>COMPANY</th>
<th>GA</th>
<th>W</th>
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<tbody>
<tr>
<td>CASK DESIGNATION</td>
<td>GA4/GA9</td>
<td>TITAN</td>
</tr>
<tr>
<td>PAYLOAD</td>
<td>4/9</td>
<td>3/7</td>
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<tr>
<td>STRUCTURAL MATERIAL</td>
<td>SS</td>
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<td>BASKET MATERIAL</td>
<td>SS</td>
<td>SS</td>
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<tr>
<td>IMPACT LIMITER MATERIAL</td>
<td>Al Honeycomb</td>
<td>Al Honeycomb w/SS Skin</td>
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<tr>
<td>NEUTRON SHIELDING</td>
<td>Borated Silicone</td>
<td>Borated Silicone</td>
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<tr>
<td>GAMMA SHIELDING</td>
<td>DU</td>
<td>DU</td>
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</table>
NAC - CTC
100 TON COMBINED TRANSPORT CASK
RAIL/BARGE

- SOLID NEUTRON SHIELD (WITH 24 COPPER/StAINLESS STEEL FINNS)
- STAINLESS STEEL OUTER SKIN
- SPACER
- DEPLETED URANIUM GAMMA SHIELD
- IMPACT LIMITER
- REMOVABLE FUEL BASKET (PWR SHOWN)
- HY-85 INNER SHELL
- HY-85 OUTER SHELL
- LIFTING TRUNMIION
- FUEL ASSEMBLY (25 PWR/52 BWR CAPACITY)
- WEDGE-LOC CLOSURE MECHANISM
Stainless steel
Cask body
Boro-silicone
Fuel basket
(21 PWR/48 BWR)
Lead
Impact limiter
Vertical restraint
Cradle/tiedown assembly
Special railcar

NUPAC 140B Rail/Barge
Spent Fuel Shipping Cask
BABCOCK & WILCOX BR-100
100 TON RAIL/BARGE CASK

- Stainless Steel Inner Shell
- Removable Fuel Basket
- Gamma Shield (Lead)
- Cavities for 21 PWR or 52 BWR Fuel Assemblies
- Fuel Assemblies
- Plugs (Alternate Trunnion Location)
- Removable Trunnions
- Stainless Steel Outer Shell
- Neutron/THERMAL SHIELD (Borated Concrete with Integral Copper Fins)
- Removable Skid Suitable for Rail or Barge Shipment (Personnel Barrier Not Shown for Clarity)
- Impact Limiter
- Shear Pads
- Shield Plug
- Closure Lid

*PATENTED BY ROBATEL SA

DEPARTMENT OF ENERGY
CONTRACT NO. DE-AC07-88ID12701

APRIL 1989
## R/B Casks

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<tr>
<th></th>
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<tr>
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<tr>
<td><strong>Payload</strong></td>
<td>26/52</td>
<td>21/48</td>
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<tr>
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<td>Hy 85</td>
<td>SS</td>
<td>SS</td>
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<tr>
<td><strong>Basket Material</strong></td>
<td>Al</td>
<td>SS</td>
<td>Al</td>
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<tr>
<td><strong>Impact Limiter Material</strong></td>
<td>Al Honeycomb</td>
<td>Foam</td>
<td>Balsa Wood Kevlar Reinforced</td>
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<td>NUPAC</td>
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<tr>
<td>NEUTRON SHIELDING</td>
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<td>Borated Silicone</td>
<td>Borated Concrete</td>
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<tr>
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<td>Pb</td>
<td>Pb</td>
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<tr>
<td>CLOSURE TYPE</td>
<td>Wedge Lock</td>
<td>Bolted</td>
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# Loaded Cask Weight (With Impact Limiters)

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<tr>
<th></th>
<th>Cask Weight (Lb)</th>
<th>GVW (Lb)</th>
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<tbody>
<tr>
<td><strong>LWT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GA</td>
<td>53,800</td>
<td>80,000</td>
</tr>
<tr>
<td>W</td>
<td>53,200</td>
<td>80,000</td>
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<tr>
<td><strong>R/B</strong></td>
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<tr>
<td>B&amp;W</td>
<td>204,000</td>
<td>263,000</td>
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<tr>
<td>NAC</td>
<td>207,000</td>
<td>263,000</td>
</tr>
<tr>
<td>NuPAC</td>
<td>205,600</td>
<td>263,000</td>
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</table>
INNOVATIVE DESIGN FEATURES

0 ROUNDED-SQUARE CROSS-SECTION
0 TITANIUM STRUCTURE
0 WEDGE-LOC LID CLOSURE
0 Balsa Wood/Kevlar Impact Limiters
0 Concrete/Neutron/Thermal Shield
CASK FABRICATION
Design Process

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USE OF CODES AND STANDARDS IN FABRICATION

- Ensures uniform and widely accepted practices
- Facilitates NRC approval
- Code of Federal Regulation (CFR) Documents
  - 10CFR20, "Standards for Protection Against Radiation"
  - 10CFR71, "Packaging and Transportation of Radioactive Material"
  - 10CFR73, "Physical Protection of Plants and Materials"
U. S. Department of Energy (DOE) Documents

- Order 1540.2, "Administrative Procedures for Hazardous Material Packaging for Transport"

- Order 5480.3, "Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes"
NON-GOVERNMENT CODES AND STANDARDS

0 ASME Boiler and Pressure Vessel Code, 1985 Edition (Applicable Parts)
0 American Iron and Steel Institute (AISI) Specifications
0 International Atomic Energy Agency - Safety Series 6, Regulations for the Safe Transport of Radioactive Materials
0 Association of American Railroads (AAR)
  - Field Manual of the AAR - Interchange Rules
  - Office Manual of the AAR - Interchange Rules
  - Manual of Standards and Recommended Practices, Section C - Part II, M-1001
0 American Welding Society
  - AWS D1.1-80 "Structural Welding Code"
0 COPPERS Railway Bridge Ratings (E Ratings)
CODES AND STANDARDS ADDRESSING QUALITY ASSURANCE/QUALITY CONTROL

- Quality Assurance Requirements (DOE/RW-214)
- DOE Order 4700.1, Section III Part D "Quality Assurance"
- DOE Order 5700.6B "Quality Assurance"
- DOE-ID CSDP Quality Management Plan
- ANSI/ASME NQA-1 Quality Assurance Program Requirements for Nuclear Facilities
- 10CFR71, subpart H, "Packaging and Transportation of Radioactive Materials, Quality Assurance" and Regulatory Guidance
OCWRM QA REQUIREMENTS

- Quality List (Grouped by Importance)
- Graded Approach to Quality Assurance
- Quality Information Reporting
- Indoctrination and Training
- Annual Management Appraisal
CASK FABRICATION -
VERIFICATION OF FABRICABILITY

- CASK DESIGN CONTRACTORS
  - INTERNAL PERSONNEL
  - FABRICATORS
- TECHNICAL REVIEW GROUP (TRG)
- QUALITY ASSURANCE PERSONNEL
CASK CARRIAGE DEVELOPMENT
LEGAL WEIGHT TRUCK LIMITS

0 Axle Loading
- Steering 12,000 LB
- Single 20,000 LB
- Tandem 34,000 LB

0 Gross Vehicle Weight (GVW) 80,000 LB

0 Length Regulated by States

0 Width (Federal Standard) 102 IN.
Semi-Trailer Requirements

0 No Consensus Standard for Design
0 ANSI N14.30 in Review Process
   - Performance Standards
   - Acceptance Criteria
0 Truck Trailer Manufacturers Association (TTMA)
   - Recommended Practices and Guidelines for Construction
GA/W are collaborating to develop LWT Trailers

- No off-the-shelf trailer exists
  - Light weight
  - Sufficiently strong

- Both LWT cask contractors are striving to utilize a minimum-weight common design trailer
  - Workshop
  - Operations review and input
GA/W LWT Trailer Development (cont’d)

• Reasonable weight values have been allowed for the LWT designs

<table>
<thead>
<tr>
<th></th>
<th>GA</th>
<th>W</th>
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</thead>
<tbody>
<tr>
<td>Tractor with drivers and fuel</td>
<td>16,000</td>
<td>16,000</td>
</tr>
<tr>
<td>Trailer with tie downs and personnel barrier</td>
<td>9,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Cask (loaded)</td>
<td>55,000</td>
<td>54,000</td>
</tr>
<tr>
<td>GVW</td>
<td>80,000</td>
<td>80,000</td>
</tr>
</tbody>
</table>
TRACTOR REQUIREMENTS

0 NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (NHTSA)
   - SAFETY STANDARDS

0 INDIVIDUAL MANUFACTURING GUIDELINES FOR FABRICATION
RAILCAR REQUIREMENTS

0 Free Interchange

0 263,000 lbs GVW
   - Maximum Axle Loading - 65,750 lbs

0 Maximum Length - 48 ft

0 Maximum CG Above Rails - 98 in.

0 Design and Testing
   - Regulated by Association of American Railroads (AAR)* Manual of Standards and Recommended Practices

0 Operator Safety Equipment Standards
   - Regulated by Federal Railroad Administration (FRA)

*Not a Government Agency
RAILCAR DEVELOPMENT

- DOE has Contract with AAR for Support
- 100-Ton "Hook Limit" is Cask Weight Restraint
- ~63,000 lb for Railcar, Tiedowns, and Personnel Barrier
- All Cask Contractors Have Employed Railcar Specialists
- Conceptual Designs in Progress