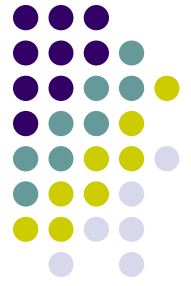


# Rancho Seco Reactor Vessel Segmentation Project & Packaging Large Components



**Michael Snyder**

**Principal Radiological Engineer**

**Rancho Seco Decommissioning Project**

# Rancho Seco History



- 2,480 acre site
- 913-MW B&W design; commercial in 1975
- Shutdown June 1989 by referendum
- SAFSTOR option initially chosen with dismantlement to begin in 2008
- Incremental decommissioning started in 1997
  - IAW CEQA, environmental impact conducted for decommissioning activities – resulted in negative declaration
- Board approved full decommissioning in July 1999
- Scheduled License Termination in 2008

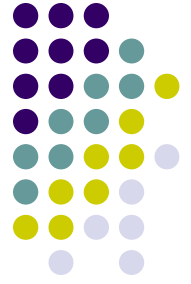
# Spent Fuel and Greater than Class C Waste



- 10 CFR Part 72 License
- Independent Spent Fuel Storage Installation (ISFSI)
  - Dry Fuel Transfer completed in 3<sup>rd</sup> quarter 2002
    - NRC Licensed Cask
      - MP 187
    - 21 canisters
  - Cask and Canisters by Transnuclear
  - Remain in Storage until DOE ships to Yucca Mt



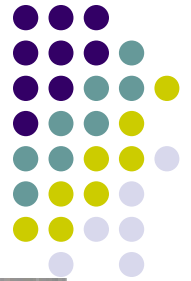
# Reactor Coolant Pumps



- SCO Wraps
- Gondola Rail Car Conveyance
- Blocking and Bracing Plan

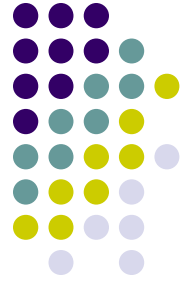


# Spent Fuel Racks



- SCO Wraps & Extended Height Metal Container
- Double Drop Highway Conveyance



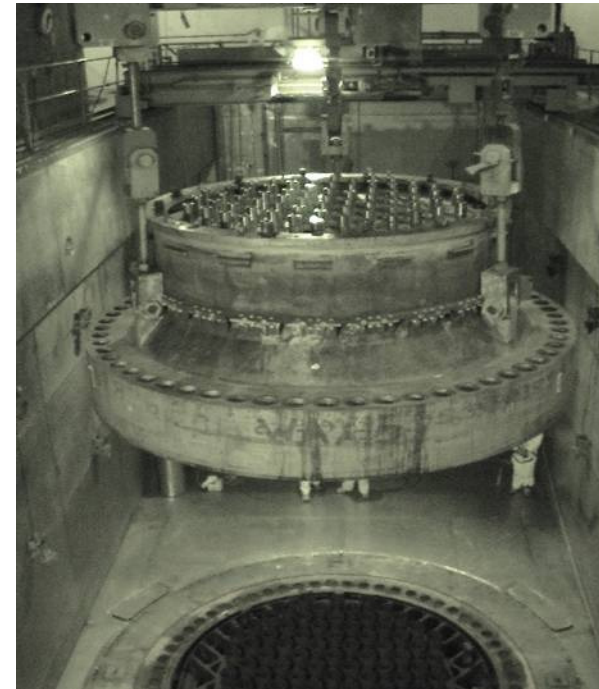


# Reactor Vessel Head

- Segmentation Activities
- Cargo Containers
- Standard Highway Conveyance



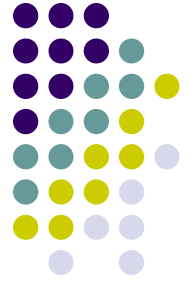
2 sections  
of nozzle  
tops



3 sections  
of flange



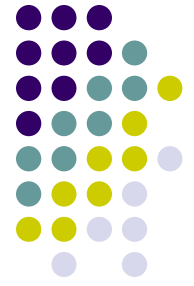
# Pressurizer



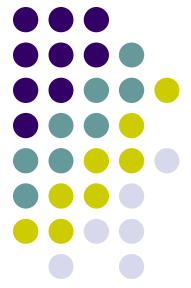
- Soft Sided SCO Wrap
- Heavy Duty Rail Car
- Blocking and Bracing Plan



# Contaminated Concrete and Soil

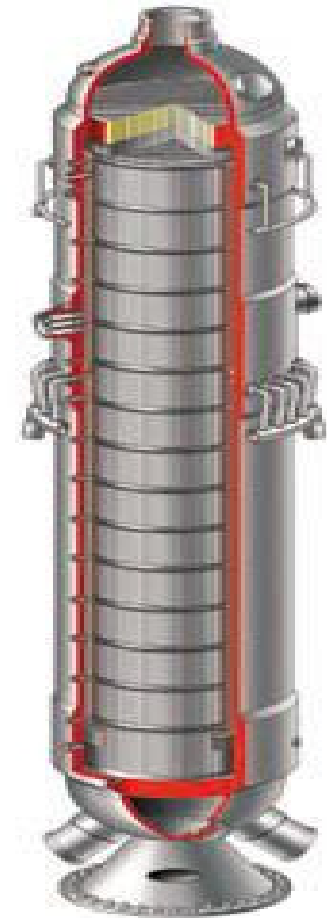




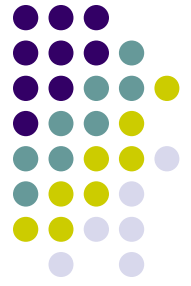


# Once Through Steam Generators (OTSG)

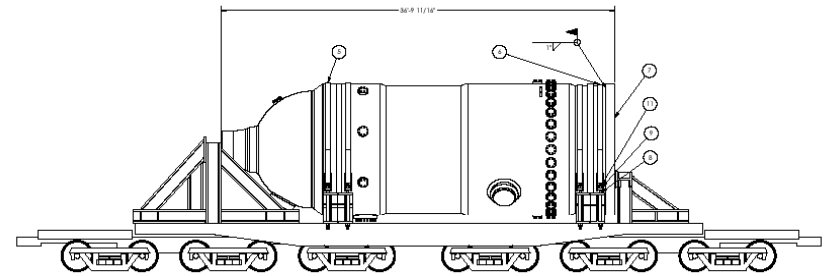
- Each OTSG approximately 1,100,000#
- 80' in length & 12' in diameter
- Transportation Evaluation concluded OTSG were too long to ship intact due to length of OTSG and radii of rail route to disposal site
- Decision made to segment in latitudinal direction and have four sections of OTSG
- Rancho Seco worked with MHF-LS to route & clear the sections to disposal site



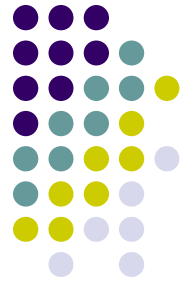
# DOT Exemption Request for OTSG Shipment



- Not unlike other requests however, the generators would be cut in half
  - Necessary for shipment clearance
- Requested exemption for
  - 49CFR173.403 for demonstration of SCO limits
  - 49CFR173.427 for packaging SCO in IP-2
- Request was prepared with guidance from NRC Generic Letter 96-07, Interim Guidance on transportation of Steam Generators

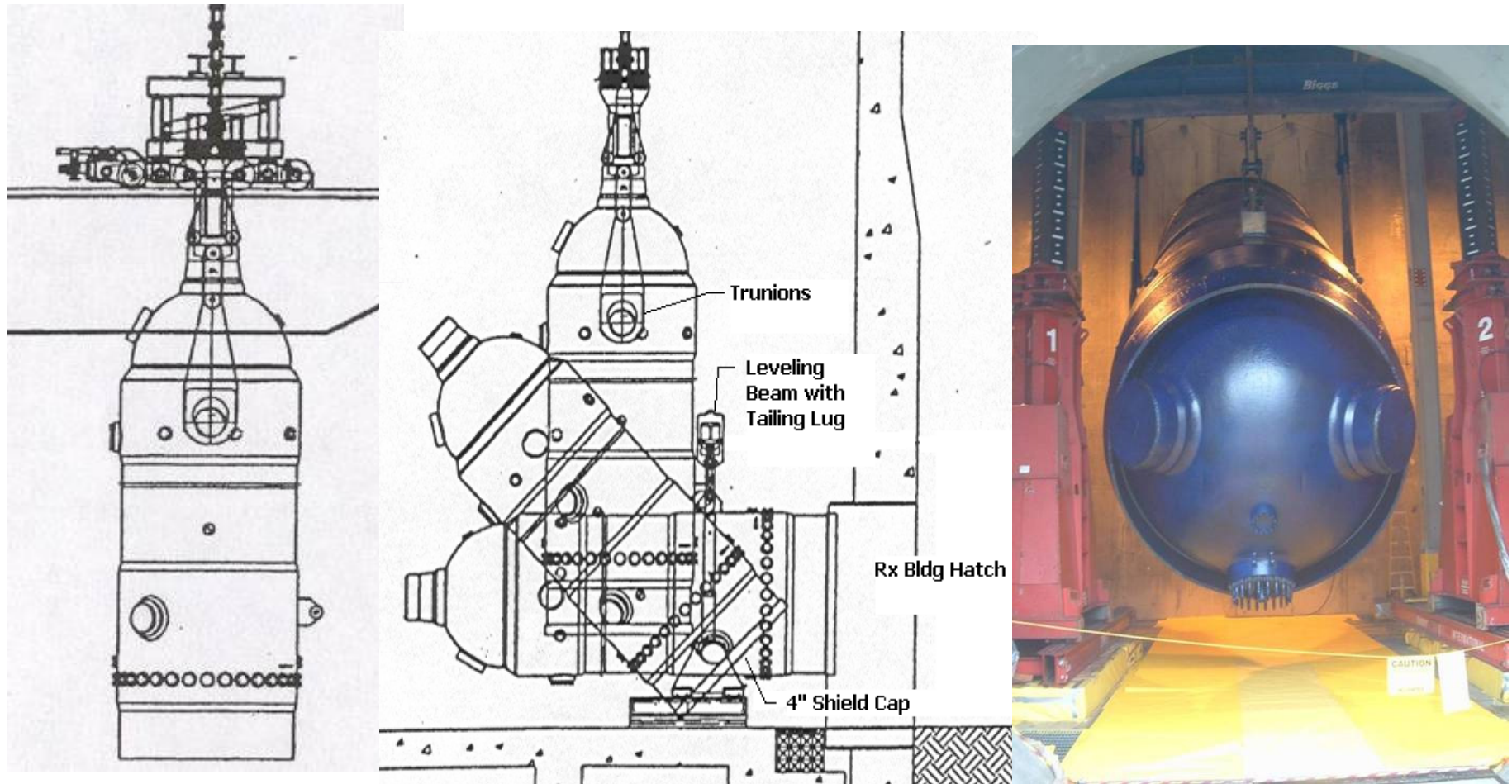
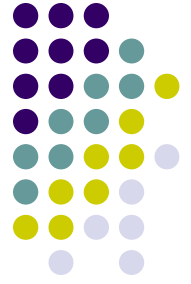


# OTSG Structural Evaluation



- Each OTSG Section required to meet Industrial Package-2 requirements of 49 CFR 173.411
  - IP-2 Packaging Tests per 173.465(c)&(d)
    - 1' drop test & stacking test
  - OTSG sections evaluated per 173.461 for modified mechanical testing
  - Cut sections would be covered with a 4" thick closure cap – for dose rate shielding and included in drop test analysis
  - All other nozzles & openings covered, welded or torqued
  - Evaluation demonstrated OTSG section ability to withstand stresses from 1' drop in horizontal direction

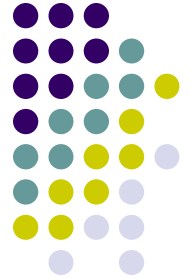
# Removal of OTSG Sections



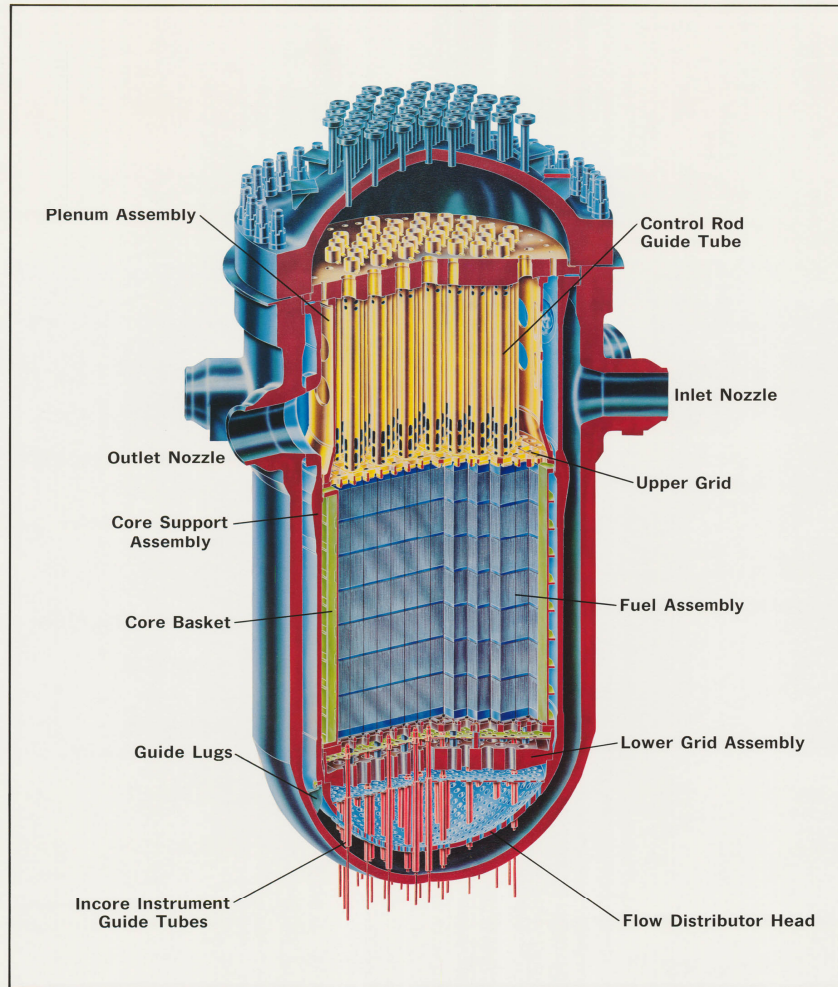
# Onsite Handling of OTSG Sections



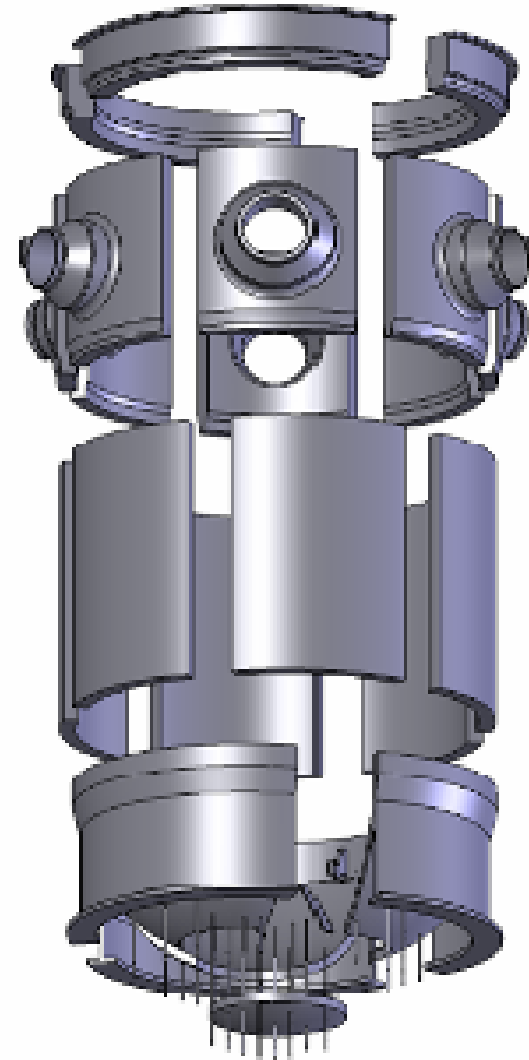
# Reactor Vessel and Internals



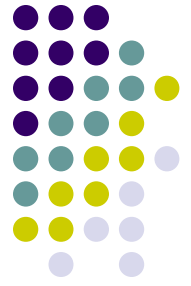
Pressurized Water Reactor



Babcock & Wilcox



# Transportation Evaluation



- Performed in fall of 2001 to assess feasibility of shipping intact Reactor Vessel
- Evaluation assessed rail and barge routes from Rancho Seco to Barnwell, SC or Clive, UT
  - 500 ton canister, 18'-6" OD, 38' in length
    - 1) Road from RS to port of Stockton, barged to SC
    - 2) Rail from RS to Houston, barged to SC
    - 3) Rail from RS to Clive
- Option 1 was determined to be most feasible
- Options 2 & 3 would not clear rail restrictions
  - 36-axle CEBX-800 Schnabel over 270' in length
- Option 1 was subsequently dismissed due to issues barging through Panama Canal or around South America
- Segmentation was chosen



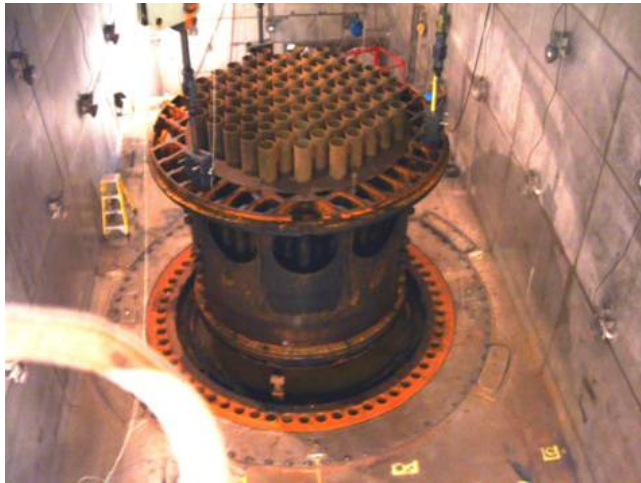
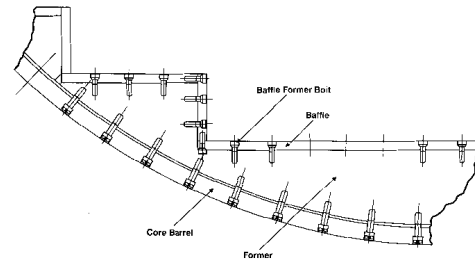
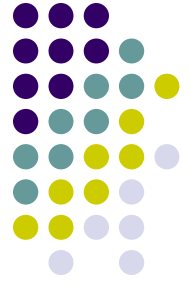
# Rancho Seco Rx Vessel & Internals

- Operated for a total of 2144 effective power days
- Vessel ~ 680,000 lbs, 17'-6" OD, 32' in height & contained ~ 20 Ci of Co60
- Internals ~ 152,000 lbs & contained ~ 41,200 Ci of Co60

<b>Parent Component</b>	<b>Weight (Kg)</b>	<b>Co60 (Curies)</b>
Baffle Plates (GTCC)	8172	22550
Baffle Formers (GTCC)	3464	6030
Plenum Cover (Class A)	24786	0.1
Plenum Cylinder (Class A)	6650	0.15
Control Rod Guide Tubes (Class A)	6892	2.1
Upper Grid (Class B)	6283	200
Core Support Shield (Class A)	28579	27.5
Core Barrel (Class C)	18147	7440
Thermal Shield (Class C)	18799	3010
Lower Internals- Top Section ((Class B)	12643	1910
Lower Internals- Middle Section (Class A)	12697	32.8
Lower Internals- Lower Section (Class A)	5154	6.5

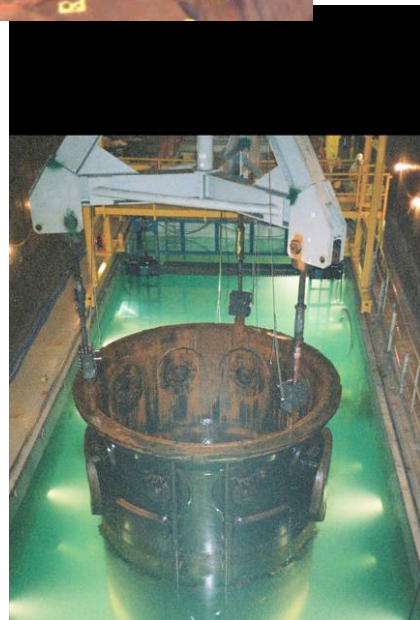
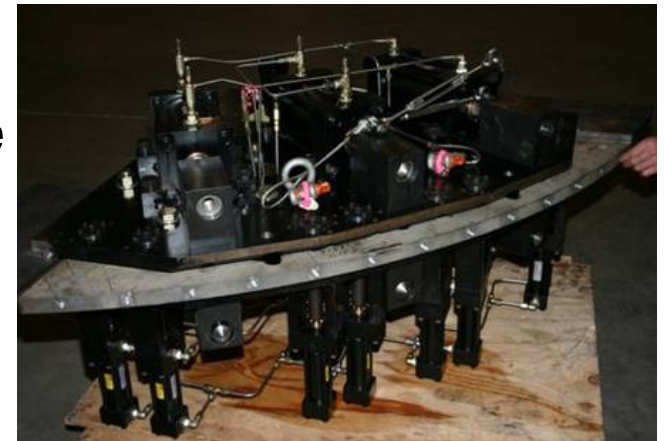


# Reactor Internals Segmentation



Plenum

Bolt Shearing  
Tool for  
removing Baffle  
Formers from  
Core Barrel

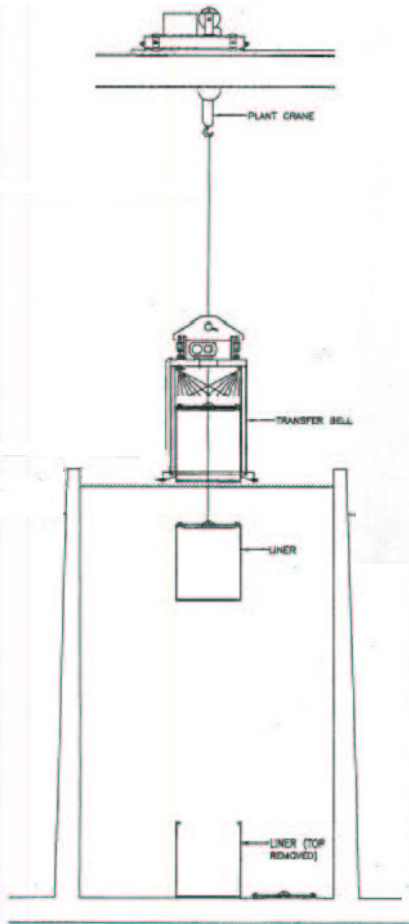
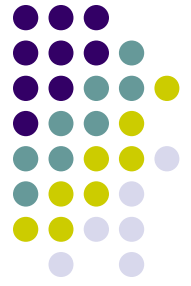


Core  
Support  
Shield

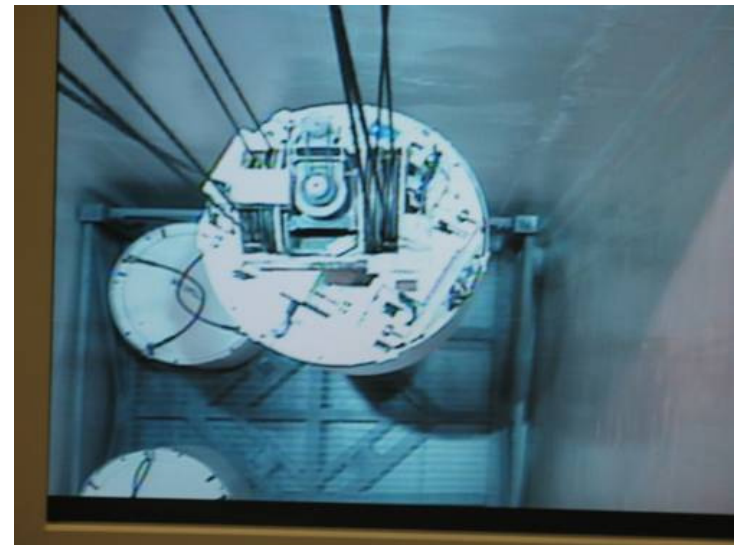
Circular  
saw for  
vertical  
cuts



# Packaging Class B & C Reactor Internals



Transfer of Class B and C waste from Cavity to Storage



# Packaging Class A Reactor Internals



Type A Box with Core Support Shield Sections

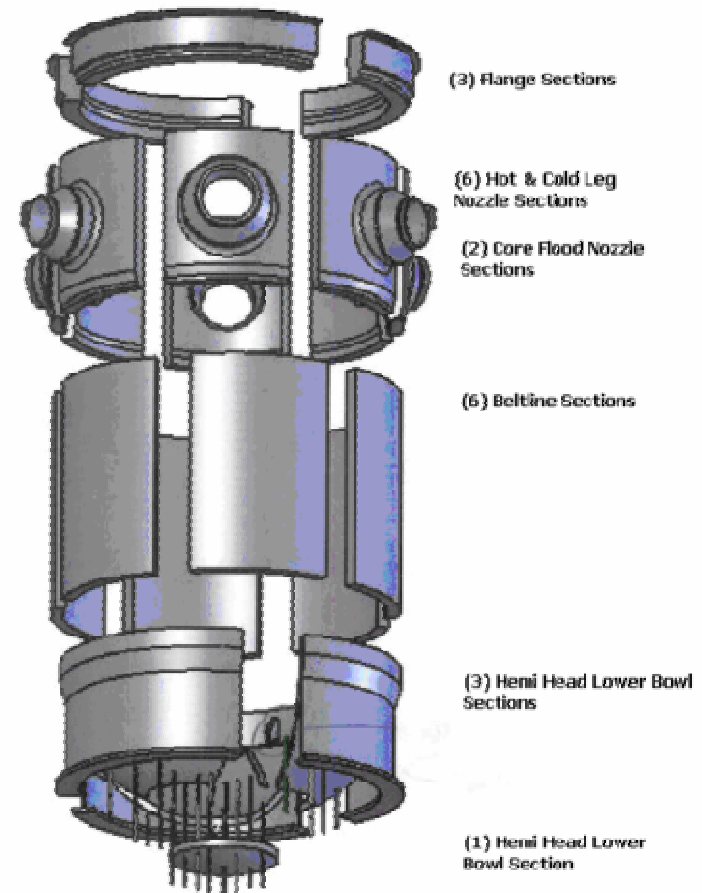
Positioning Shielding around boxes loaded into Gondola car



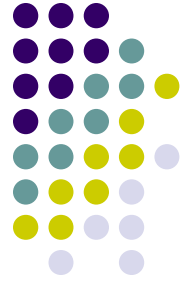
# Reactor Vessel Segmentation Plan



- 3 Flange sections
  - 25,000 lbs each
- 6 Hot & Cold Leg Nozzles
  - 33,400 lbs. each
- 2 Core Flood Nozzles
  - 13,500 lbs. each
- 6 Beltline Sections
- 3 Lower Bowl Hemi Heads
  - 35,000 lbs. each
- 1 Center Bowl
  - 10,000 lbs.

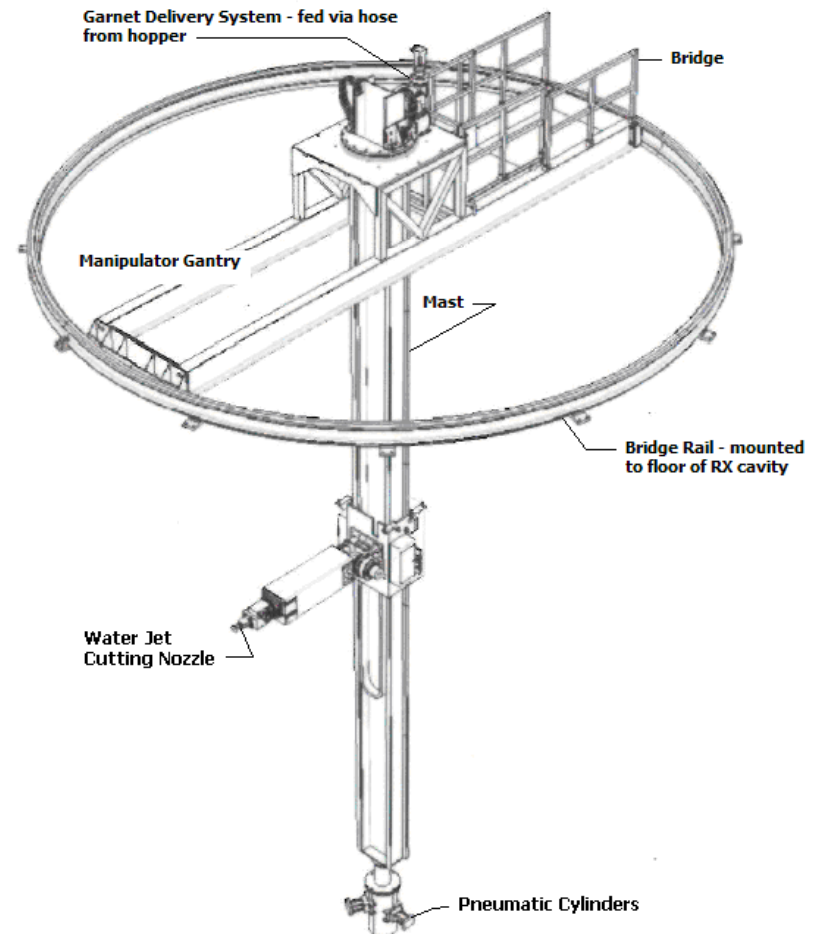


# Reactor Vessel Segmentation Equipment



- Abrasive Water Jet
  - Delivered Garnet Media @ 50,000 psig
  - No generation of vapors
  - Capable of piercing holes
  - Easy collection of secondary waste

## Waterjet Manipulator



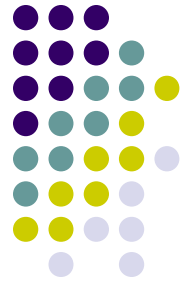
# Reactor Vessel Segmentation



Segmenting a section of Vessel Flange

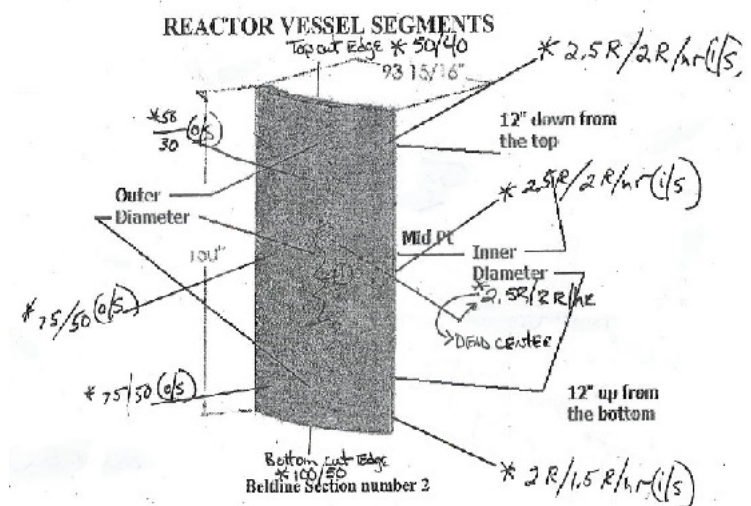


Rigging and removing a beltline section from the vessel



# Dose Rate & Characterization Verification Method

- Contact & 12" dose rates in air were obtained @ multiple locations along inner & exterior diameters
  - All measured readings attributed to activation
  - Average of 12" readings used to determine Co60 activity per section
  - Sections modeled in Microshield v5.05 with iterations of entering Co60 source strengths to infer comparable 12" dose rate
  - Loose contamination contribution assessed for total surface area
  - Results known and calculated
    - Total weight, volume and surface area
    - Total loose contamination
    - Concentration (uCi/cm<sup>3</sup>), Specific Activity (uCi/g) and total activity for Co60
    - A2 SOF and LSA II test results





# Reactor Vessel Packaging

- In all cases, all sections, as packaged for shipment, were verified to
  - Meet waste class A and requirements for LSA II
  - Contain < A2 quantity of radionuclides
  - Be shipped in excepted packaging per 49 CFR 173.427 (b)(4)



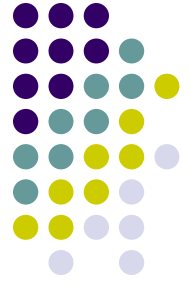
Lower Bowl Hemi Head shipped in 20' Sealand



Beltline section packaged into metal box prior to introduction of grout



# Reactor Vessel Beltline Transportation



Three sections of beltline in each box - shipped - after grouting