STURGIS MH-1A DECOMMISSIONING UPDATE AND LESSONS LEARNED

WM2018
Session 097b US Army Corps of Engineers - Deactivated NPP Program D&D Contracting Opportunities

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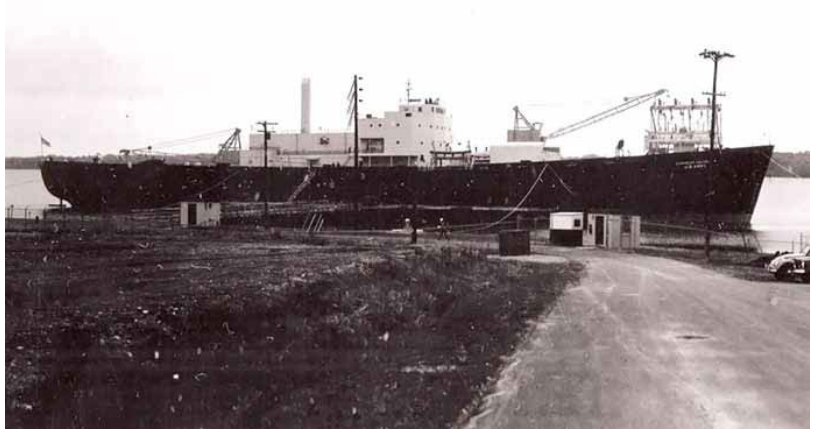
STURGIS DECOMMISSIONING TOPICS

- History
- D&D Planning
- Operational Update
- MARSAME
- Waste
- Radiation Safety

FIRST BARGE MOUNTED NUCLEAR POWER PLANT



- The former World War II Liberty Ship, *SS Charles H. Cugle*, was converted into a floating nuclear power plant in 1966
- STURGIS was the first barge mounted nuclear plant to regularly supply power to a shore station
- The STURGIS' nuclear reactor, MH-1A, was used to generate electricity for military and civilian use in the Panama Canal Zone from 1968-1976

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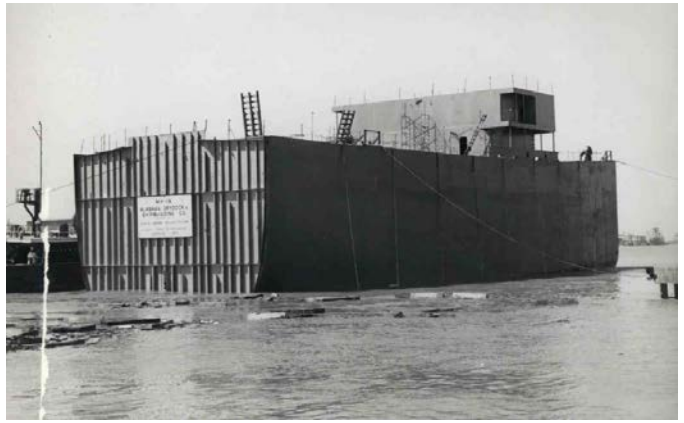
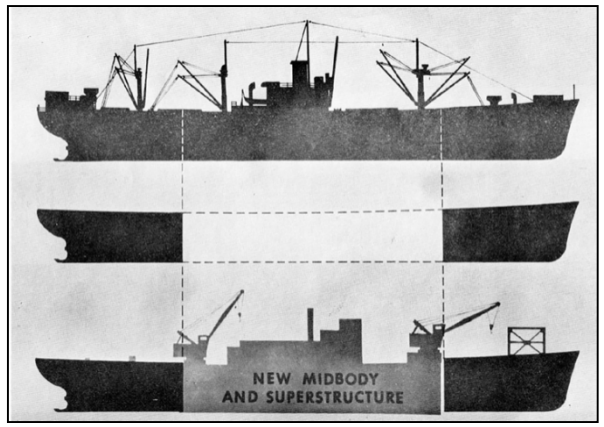


THE STURGIS IS A HISTORIC PROPERTY



Design schematic from 1959

- During decommissioning, USACE will preserve items of historic interest, including an electronic repository of documents
- During the Decommissioning Planning phase, USACE entered into Memorandum of Agreement with the Virginia State Historic Preservation Office to mitigate the adverse effects of the decommissioning

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FUEL REMOVAL AND PREPARED FOR LONG-TERM STORAGE

- In 1977 after completing its mission, the STURGIS returned to Fort Belvoir where the nuclear fuel was removed, and the vessel was prepared for safe long-term storage
- The STURGIS was maintained in James River Reserve Fleet at Joint Base Langley-Eustis, VA from 1978 - 2015
- USACE performed quarterly monitoring in the James River until 2015 when the STURGIS was moved to Galveston, TX for Final Decommissioning

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STURGIS – MH-1A CHARACTERIZATION CONFIRMS VERY LOW RADIATION LEVELS

- The vessel's radiological and chemical contaminants were evaluated in 2001
- The extensive characterization confirmed that radiation levels had decayed within the reactor access compartment to safe working levels
- Data collected supported cost estimating for decommissioning funding requests

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MH-1A STURGIS DECOMMISSIONING PLANNING

- Decommissioning Plan Final (Rev1) – 14 March 2014
- NEPA
  - EA – 15 April 2014
  - FONSI Final – 21 April 2014
  - Section 106, MOA – 2 May 2014
- Decommissioning Permit issued – 9 May 2014
- Contract Actions
  - Initial award 27 March 2014 - $34.6M
  - GAO Protest Filed 14 April 2014 and subsequently withdrawn 21 May 2014
  - Contract modification in Aug 2016 for the amount of $17.3M
  - Contract modification in July 2017 for the amount of $14.5M

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EXECUTION OF WORK

Planning Documents

- Decommissioning Plan
- MCSRP and Survey Unit Packages
- UFP/QAPP
- APP/RPP
- Waste Management Plan
- Physical Security Plan
- Environmental Monitoring Plan
- Technical Work Documents
- Work Instructions
- Radiation Work Permits
- AHA/JSA
- Critical Lift Plans
- ALARA Assessments
- Field Work Variances
- Daily Quality Control Reports

Implementation

- Experienced Supervision
  - Crew Supervision
  - Site Management
  - Safety and Radiation Safety
  - Rigging Expert
- Trained Labor Force
  - Rad Worker 2
  - HAZWOPER and HAZMAT
  - Containment/Glove Bag Training
- Oversight
  - Radiological Controls
  - Quality
  - Safety
  - Critical Lifts
- Project SharePoint Site for document control and repository

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ROLES AND RESPONSIBILITIES

- Overall Project Management – USACE – Baltimore District
- APTIM (formerly CB&I): Project Management
  - Includes Site Manager, Safety, RSO, Quality
  - Engineering of Work Packages
- Atkins (formerly Energy Solutions): Waste Management and Radiological Controls
  - RCTs
  - Waste Characterization and Packaging
- Waste Control Specialists: Waste Transportation and Disposal
  - Transport and disposal at facility in Andrews, Texas
- Malin International Shipyard: Shipyard Support
  - Dockside Support (Crane and Equipment Operators, Electrician, Welders, Naval Architect)

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MH-1A STURGIS ACCOMPLISHMENTS

- All major reactor components have been successfully removed
- Ongoing waste shipments;
  - Debris – 68 radiological shipments to WCS, ~1,375,000 lbs.
  - Water – 33 shipments to US Ecology TX ~1,150,000 lbs.
  - Lead recycled to date ~600,000 lbs.
- 42 MARSAME Survey Unit Package/Plans finalized (100% complete)
  - Surveys implemented – 36
  - ORISE completed IV and/or side by side measurements in 16 survey units
  - Reports finalized – 26
- Radiation dose to date – 4,081 mrem total which is ~30% of projected dose budget; highest individuals (2) 600-700 mrem
- Risk mitigation is ongoing and providing positive results

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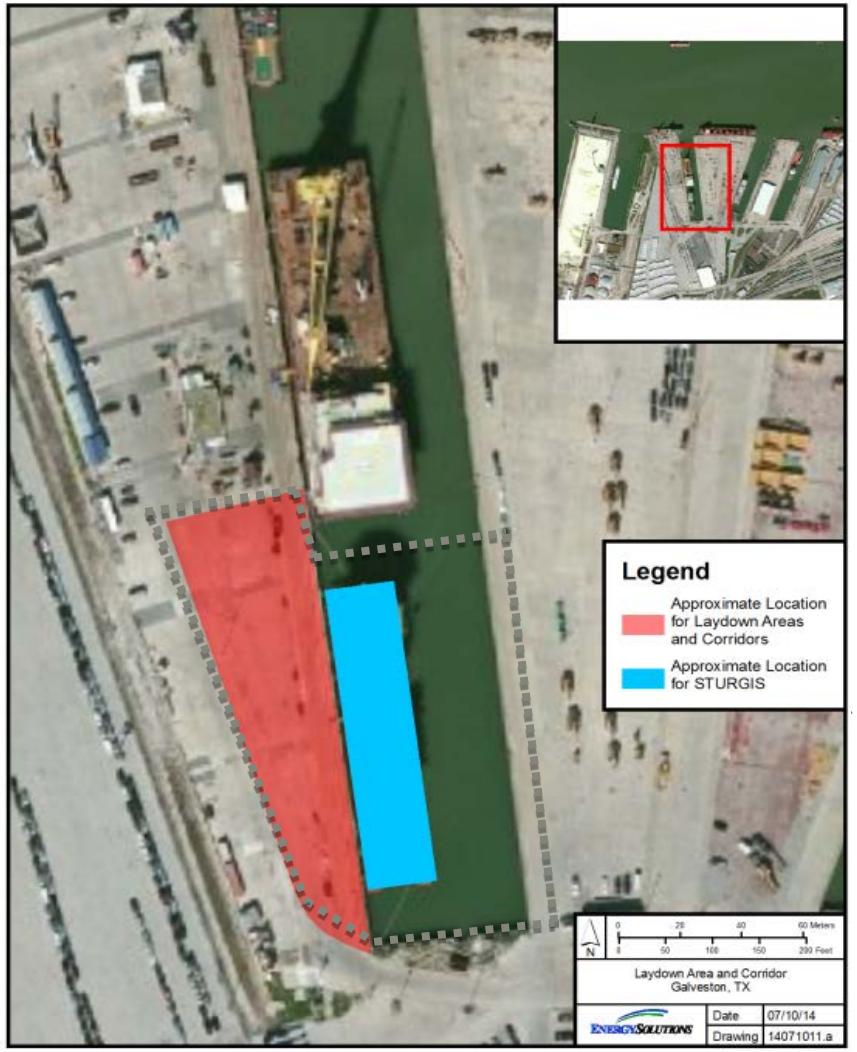
SITE MOBILIZATION AND TRAINING

Initial activities that established the shipyard infrastructure

- Site security
- Environmental Baseline and Monitoring established
- Staging areas for the planned work including ship access, industrial hygiene preparation, and decontamination areas
- Materials storage areas and project offices/crew facilities
- Work crews hired and trained
  - Rad Worker
  - Rigging
  - HAZWOPER/Hazmat
  - Containments



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RELOCATION OF STURGIS FROM JAMES RIVER RESERVE FLEET, VA TO GALVESTON, TX

Towing delayed 6 months due to concerns raised by Galveston City Council

- The STURGIS tow was initiated on April 16 and it arrived at the Malin Shipyard (Pier 40/41 at the Port of Galveston) on April 29 - 6 days ahead of schedule
- Hull was scamped in the JRRF prior to tow
- Towing was by a licensed towing contractor in accordance with the requirements of the U.S. Navy Towing Manual
- Towing Plan approved by USACE and USCG
- Licensed pilots were used in port areas
- Ballast remained on board and for processing Galveston

Lesson Learned: 80% of the ballast water was RCRA hazardous waste (D008) from lead paint and required stabilization prior to disposal

STURGIS DECOMMISSIONING PREPARATIONS

Established the shipboard infrastructure on the STURGIS

- Boarding ramps
- Safety upgrades
- Hurricane Plan
- Controlled areas/zones established within the existing superstructure
- Radiological support area/laboratory
- Power infrastructure including emergency power installed
- HVAC systems installed
- Onboard crane refurbished

Lesson Learned: Shipboard infrastructure took significantly longer than planned due to complexity of installation, temperatures in Galveston, lead based paints, and understanding of shipboard systems

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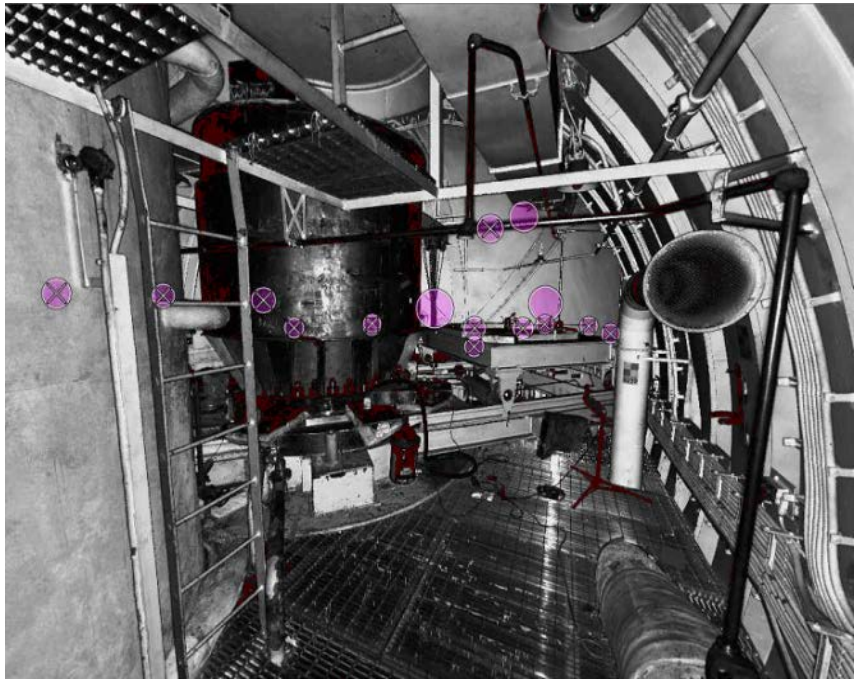
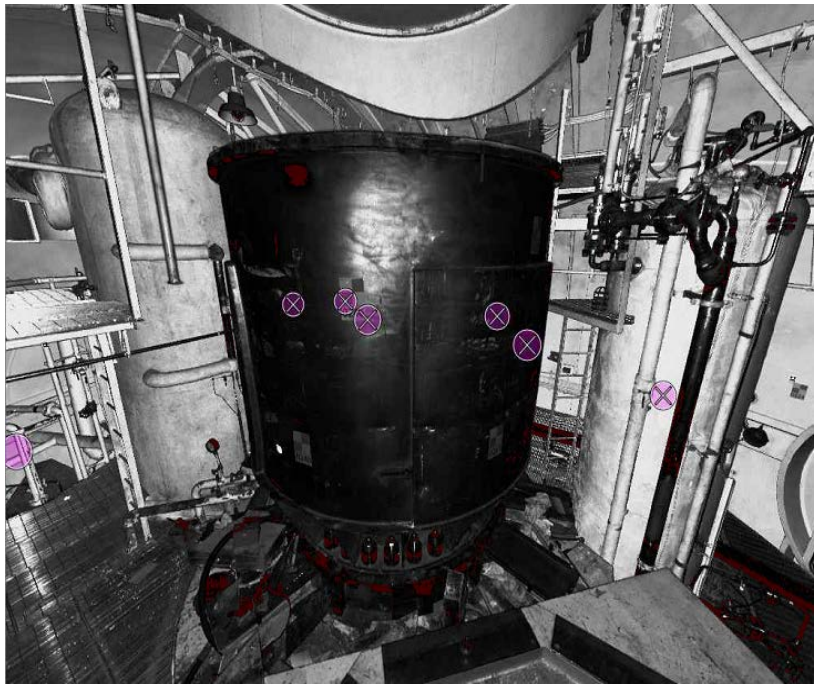
PREPARATION FOR DECOMMISSIONING

- Accessed and inspected Reactor Access Compartment (RAC) and the Reactor Containment Vessel (RCV) – repeat of USACE activity of 1999.
  - Determined the overall condition, material present, and to confirm radiological conditions/dose rates
  - Determined dose rate from Reactor Pressure Vessel (RPV)
  - Used Laser Scanners to develop Point Cloud of RAC and RCV





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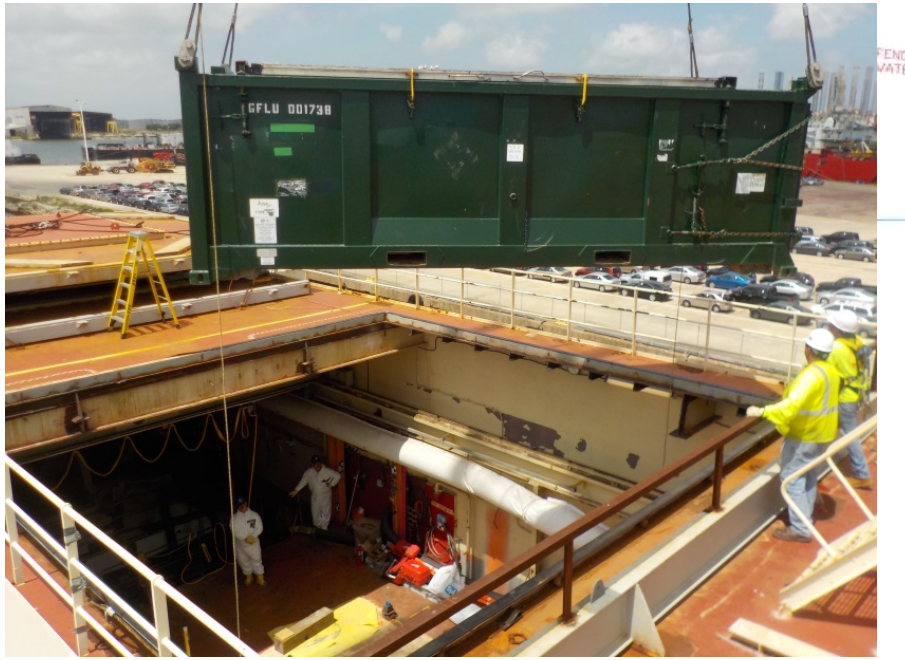
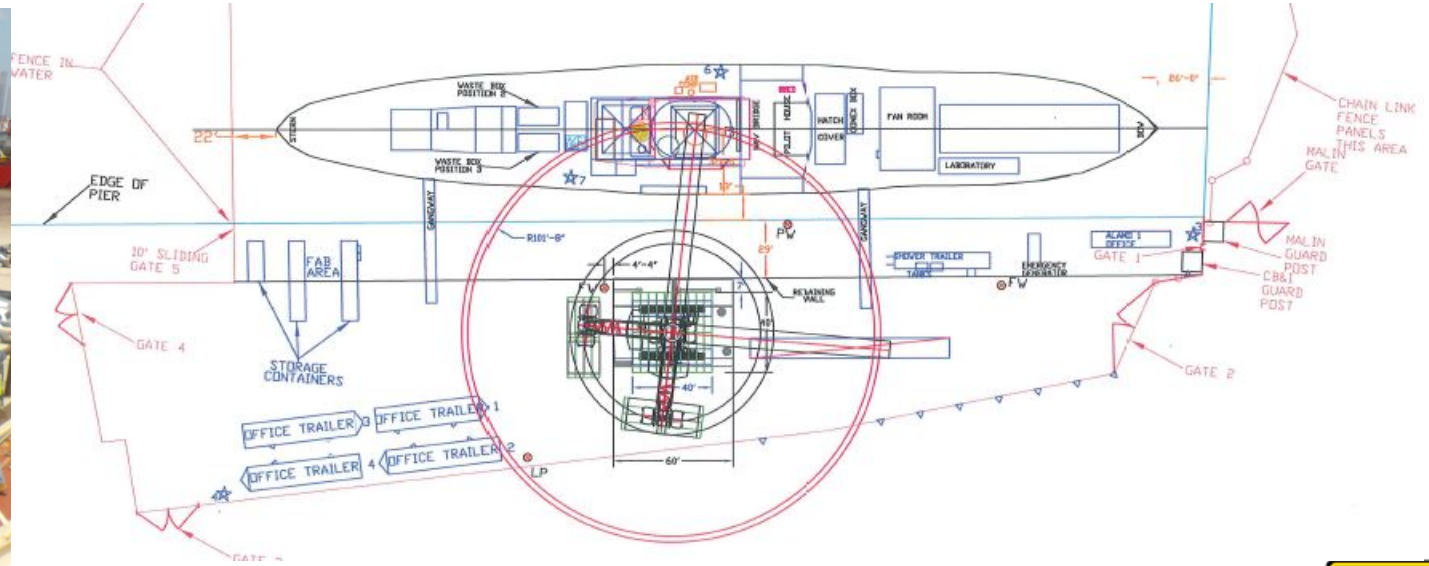
ESTABLISH ACCESS TO REFUELING ROOM

- Design and install roof penetrations to remain in place (providing containment) and be removed only for lifting operations
- The covers are weather tight and designed for severe weather conditions that can occur in the Galveston area





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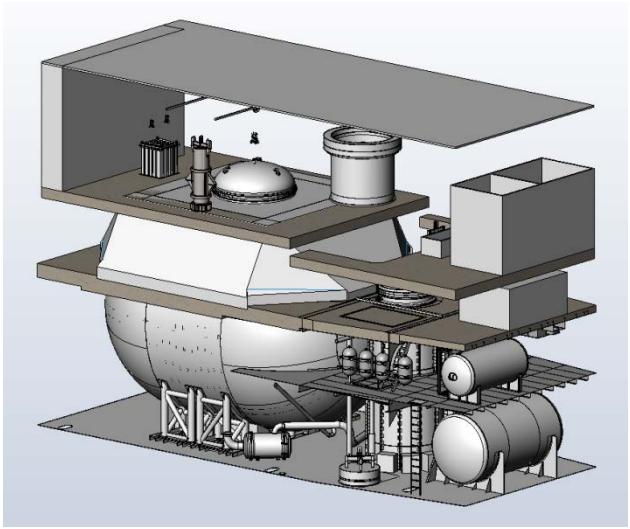
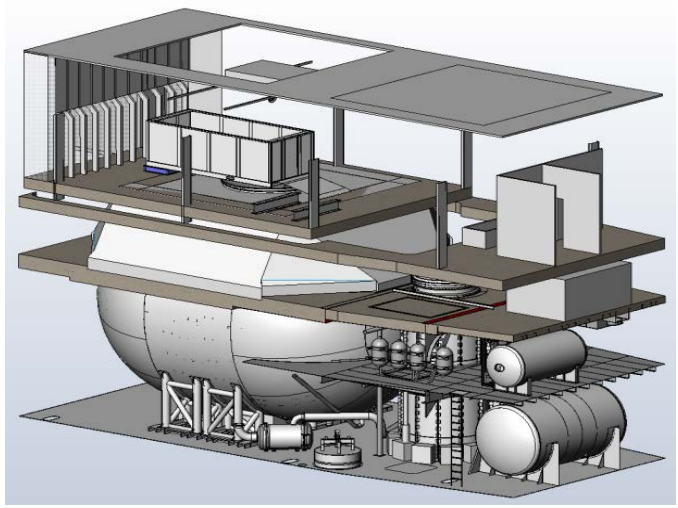
REMOVAL OF MATERIALS FROM REFUELING ROOM

- All items were assumed to be impacted, and were disposed





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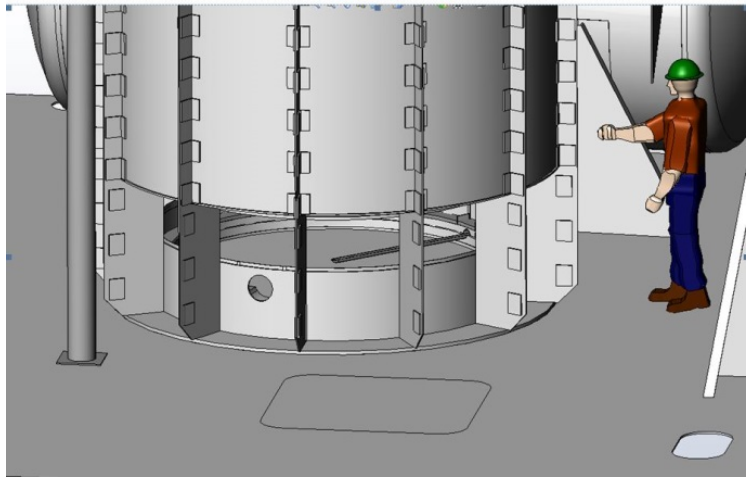
REMOVE SPENT FUEL STORAGE TANK

- The SFST was sealed in 1977 and contained an assortment of contaminated materials and equipment
- 27 feet tall X 8 feet diameter, ~ 55k pounds
- SFST was prepared, characterized, filled and bagged as removed from the STURGIS



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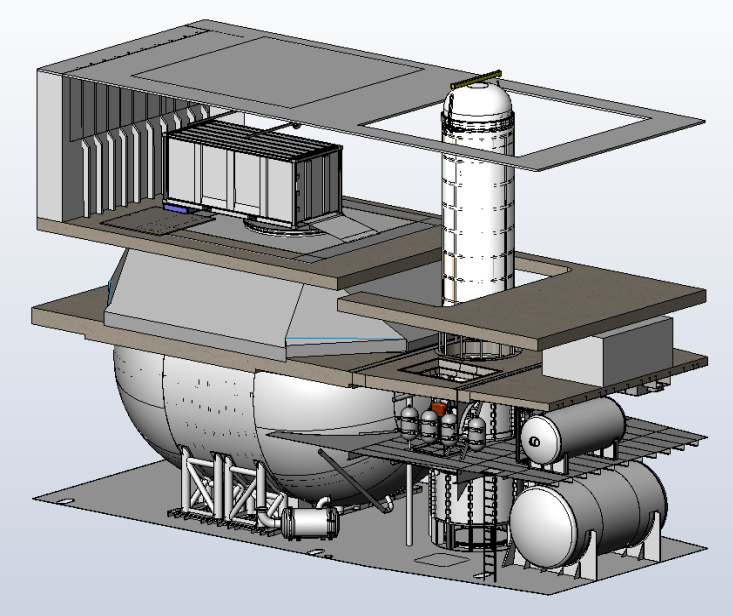
REMOVAL OF SPENT FUEL STORAGE TANK



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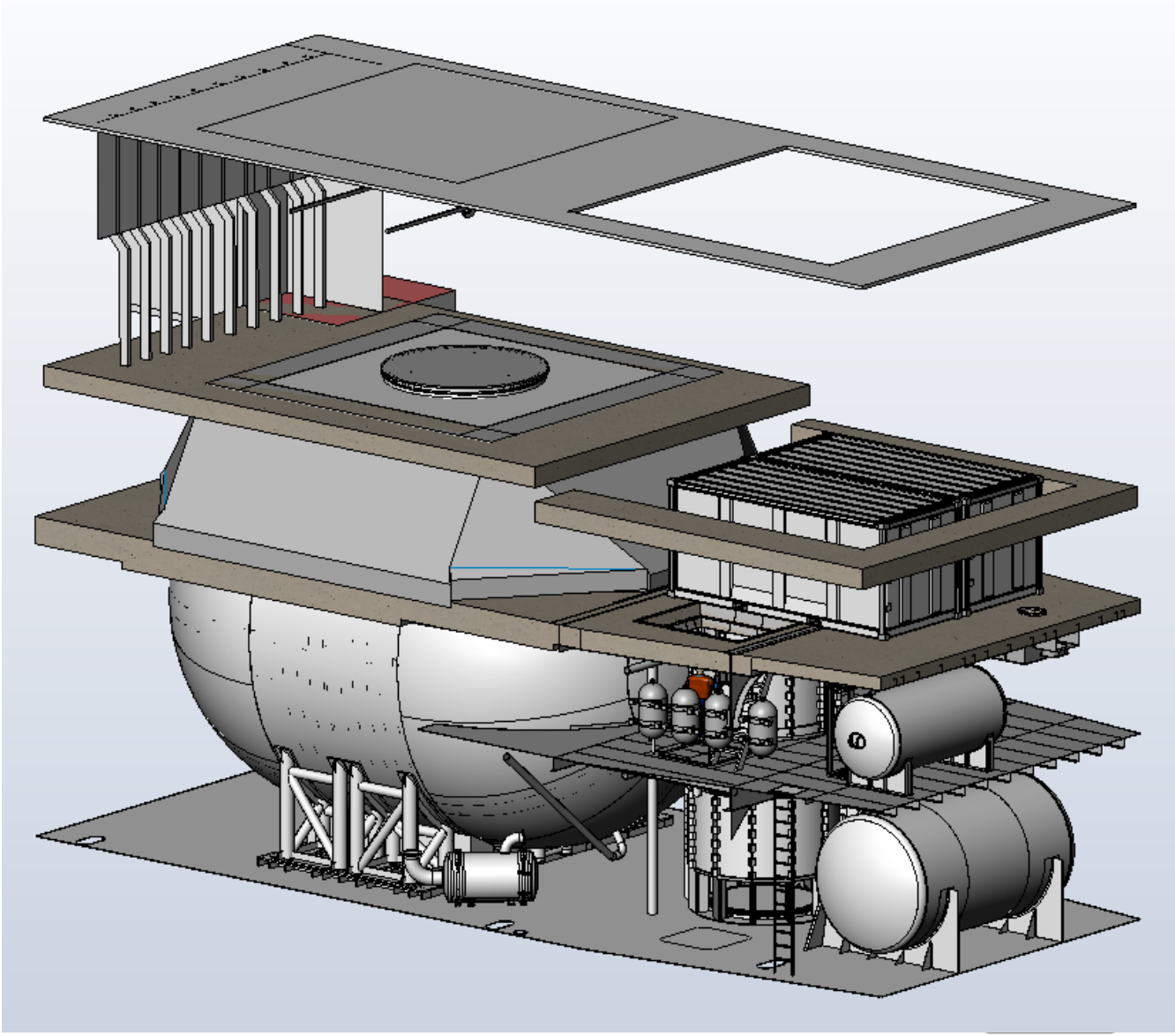
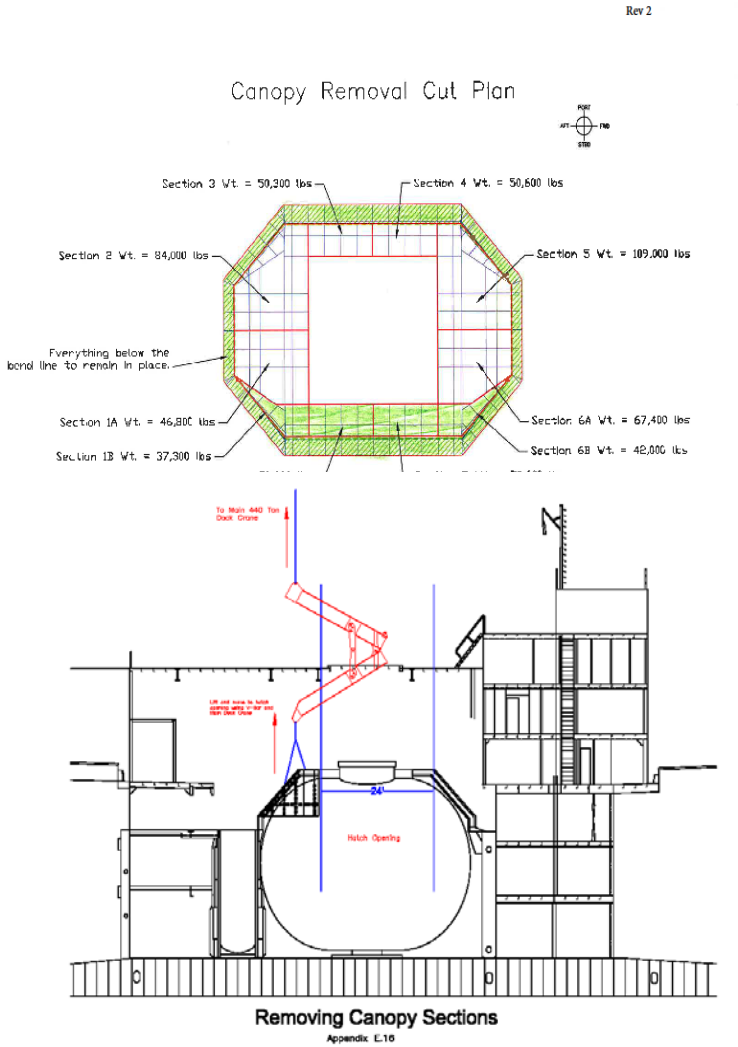
DECOMMISSIONING ACTIVITIES

- Removed Materials from Refueling Room
  - Following removal of SFST
  - Removal of remaining items in Refueling Room including Mezzanine Deck
  - Allowed placement of IMCs

Lessons Learned: Engineering Costs were significantly underestimated

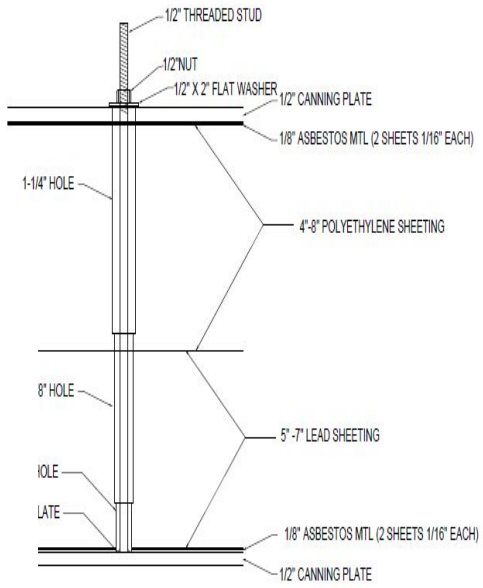


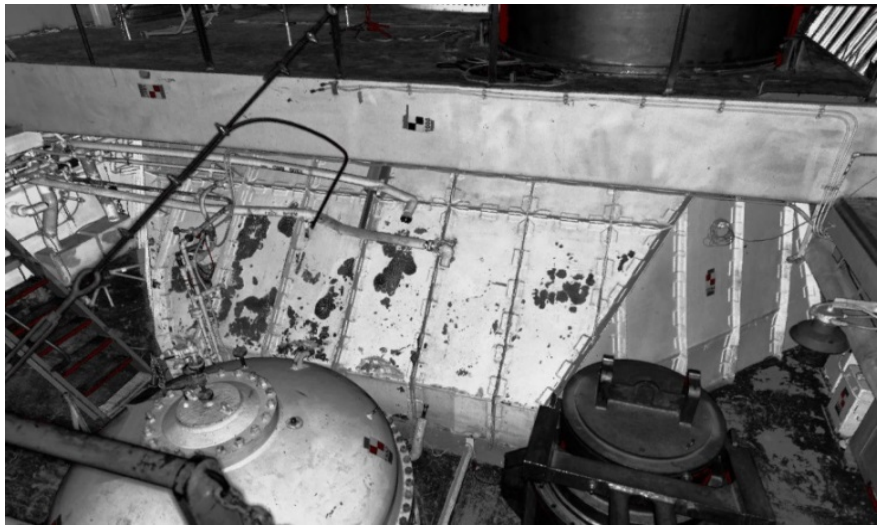
REMOVAL OF CANOPY SECTIONS TO OBTAIN ACCESS TO REACTOR CONTAINMENT VESSEL



Lifts using the V-Bar

Securing items for lift





Historical photo of the canopy

Photo of the reactor containment vessel with the canopy being removed

CANOPY REMOVAL ACTIVITIES

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CANOPY REMOVAL ACTIVITIES

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CANOPY REMOVAL ENCOUNTERED SIGNIFICANT DELAYS

- Heat stress – work rest cycles
- Lead/asbestos dust generated from cutting operations required safety precautions (Respirators, Containment)
- Review of engineering drawings did not adequately identify the design of the Canopy and additional drilling/tapping/epoxy holes for lifting and stability of canopy pieces were required
- Prep work for wire saw cut including lead paint removal, pulley mounting, wire saw 2" cut holes, containment set up, post-cut cleanup and containment breakdown requires approximately 2 days for each cut

Lesson Learned: Initial schedule did not include sufficient time for set up of containment and other precautions necessary to complete tasks safely

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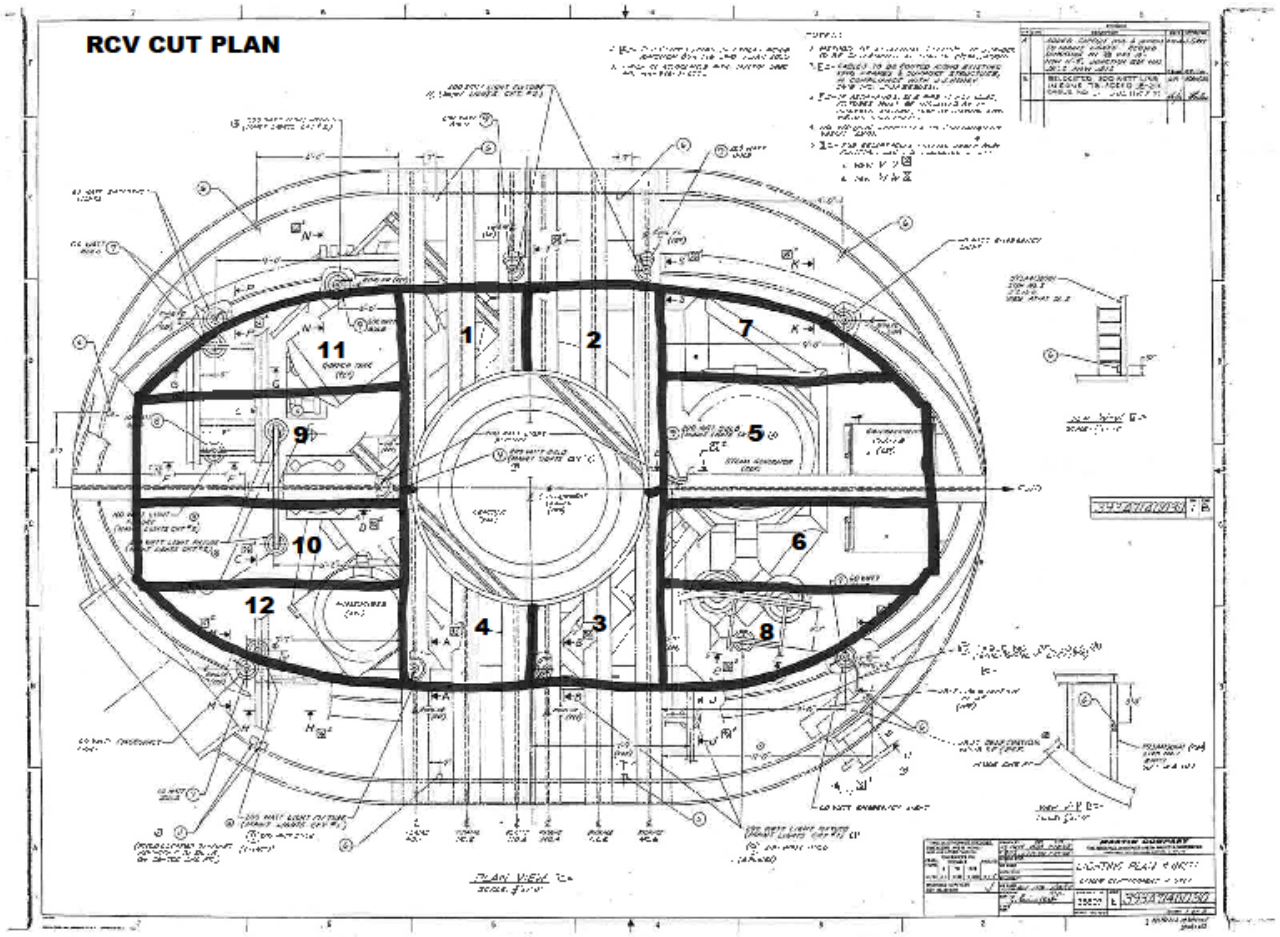
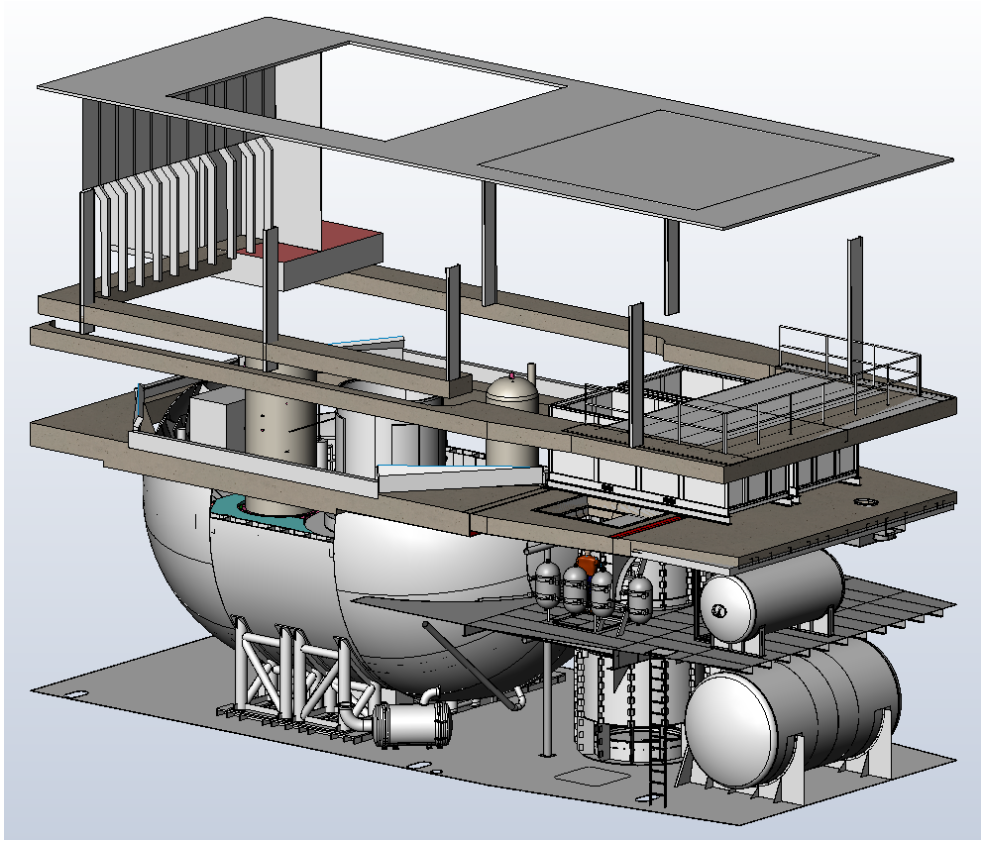
PREPARE OVERHEAD ACCESS TO REACTOR CONTAINMENT VESSEL

Top View – 12 specific cuts



Opens access to the large components



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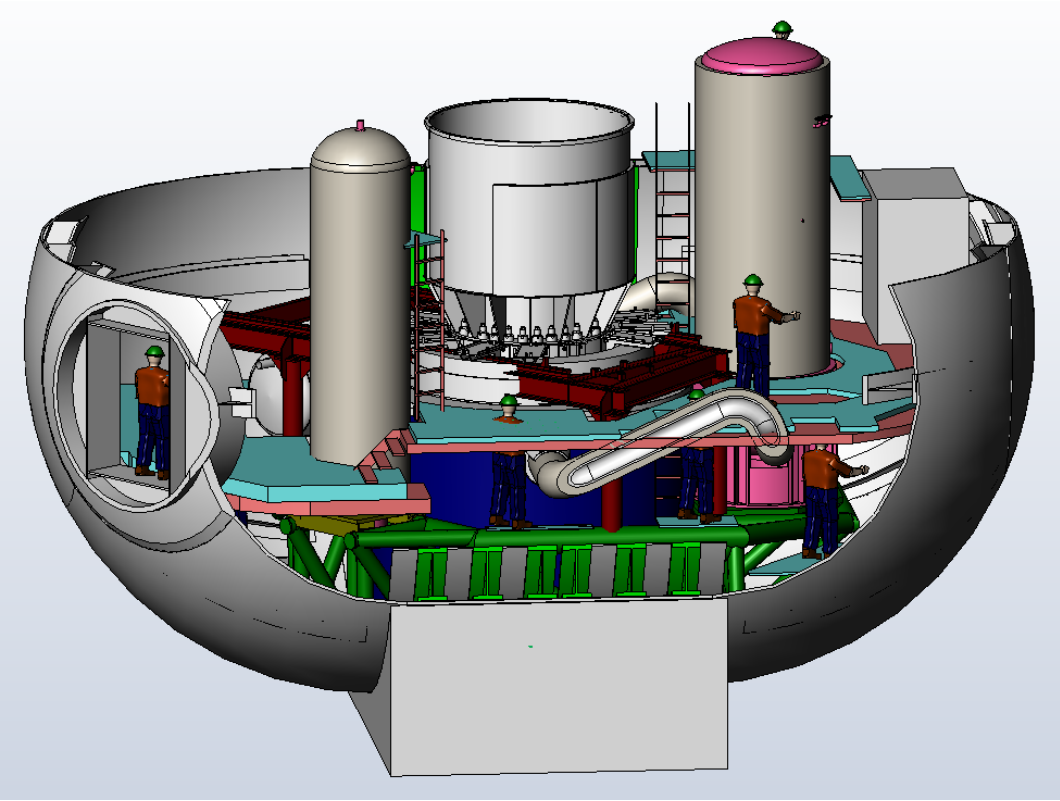
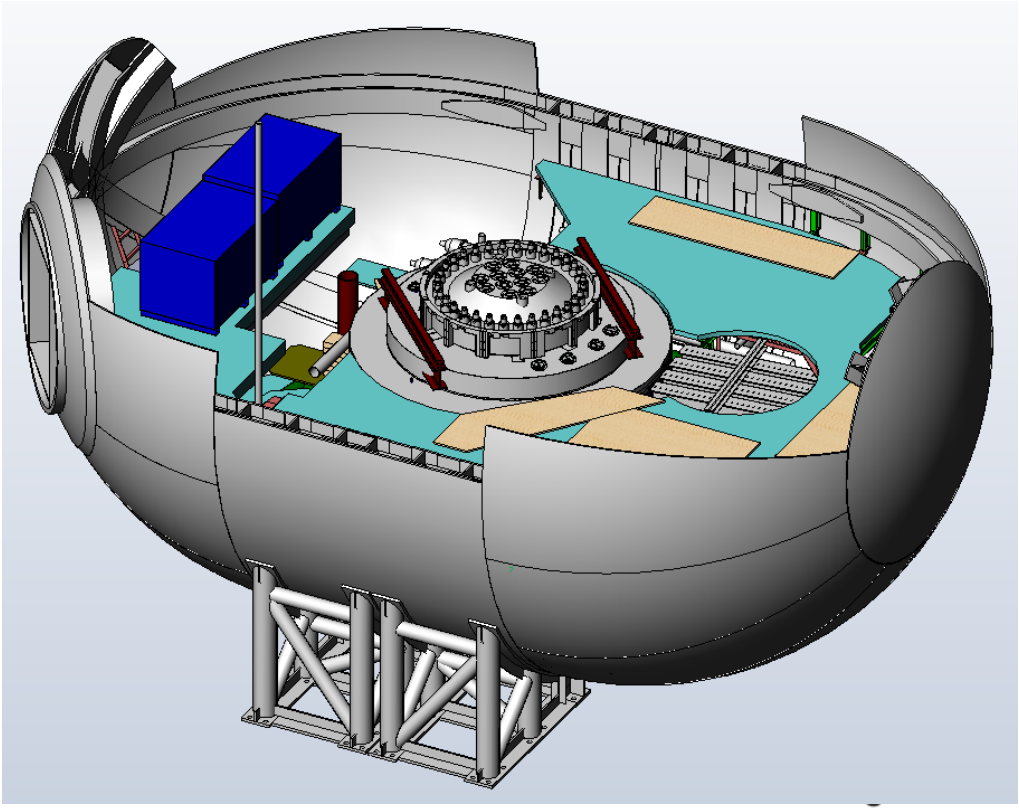
REMOVAL OF LARGE COMPONENTS

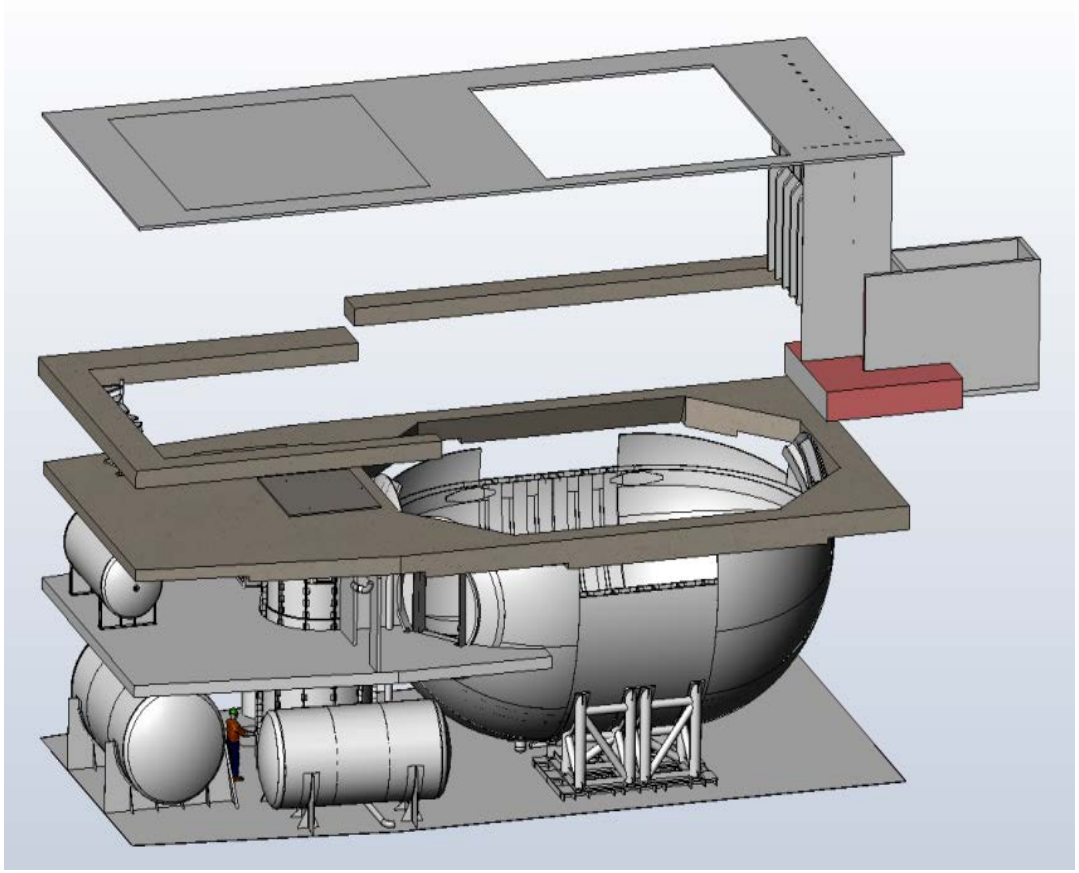
- Removed to make room of RPV removal
- Items included steam generator, pressurizer, coolant pumps, refueling shield tank, ductwork, and reactor head dolly
- Items were removed for direct disposal

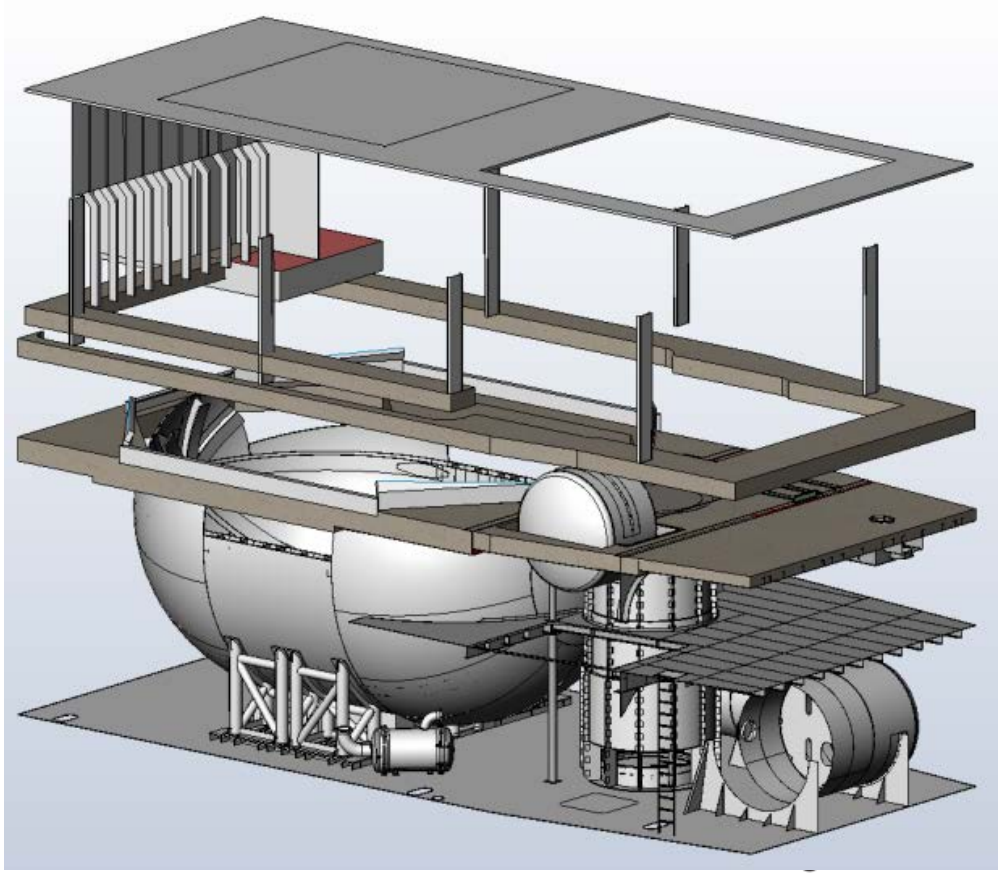




REMOVE COMPONENTS FROM REACTOR ACCESS COMPARTMENT

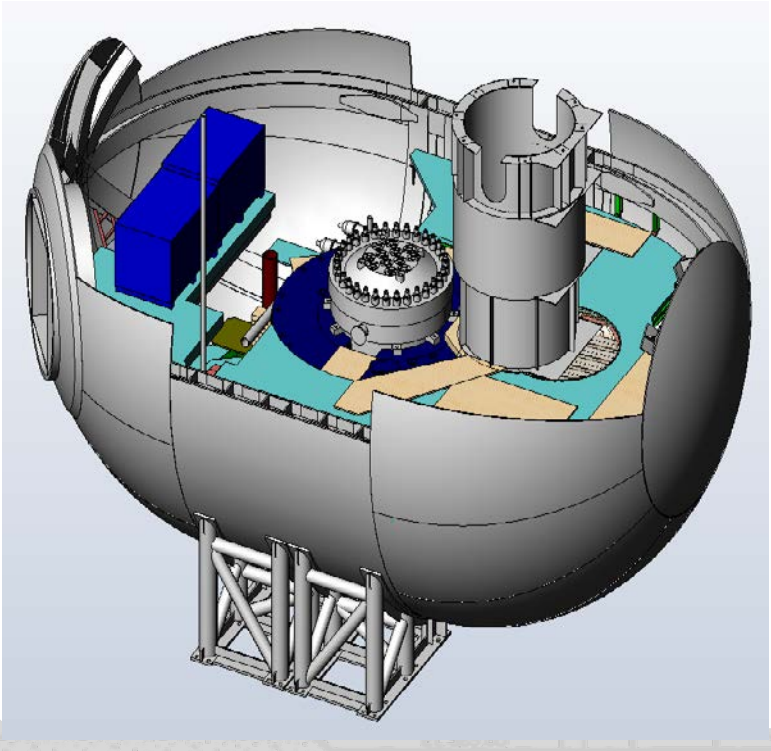
- Numerous smaller reactor components, most related to waste processing including tanks, pumps, valves, and piping
- Materials located on Platform and Tank Top Deck

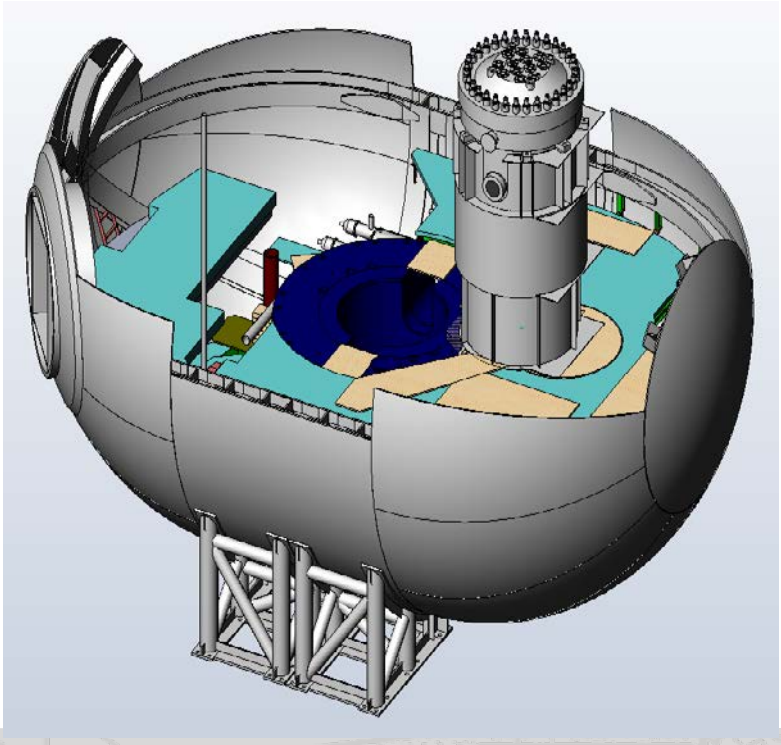




REMOVAL OF THE REACTOR PRESSURE VESSEL

- RPV was activated and expected to have significant dose rate
- A shielded transport container was built to comply with transportation requirements. It was staged inside the RCV as shown below to allow the RPV to be placed inside the container within containment.
- Shielded shipping container and RPV were removed from STURGIS for transport on 20 May 2017





Title to the RPV was transferred to the Department of Energy for disposal purposes at WCS – DOE and USACE signed agreement on 5 May 2017

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CRITICAL LIFT PLAN TO REMOVE RPV

Lift Notes for Rotating the RPV and Shield Assembly to Horizontal - Initial Main Crane

Demag CC1800

Main Boom Length =196.9 ft.
SL-Mast Length = 98.4 ft.
Track Width = 23.8 ft.
Counterweight =264,500 lbs
Central Ballast= 66,100 lbs
SL-Mast Radius = 44.3 ft.

Capacity = 233,700 lbs @ Maximum Radius = 72'-6"
Superlift Counterweight = 176,400 lbs

Lifting Notes

Rooster Sheave	=	1,654 lbs
Headache Ball	=	1,700 lbs
Main Load Block (no cheek weights)	=	11,023 lbs
(2) EN600X30' Roundslings	=	168 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/ Link plates	=	1,548 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 2"Ø X 29'-2" Wire Rope Slings	=	626 lbs
Total Additions	=	17,225 lbs
Max Initial Load RPV + Shield	=	162,100 lbs
Total Load	=	179,325 lbs

76.7% of Chart Capacity
*82.4% of Line Capacity

Lift Notes for Rotating the RPV Shield Assembly to Horizontal- Initial Tailing

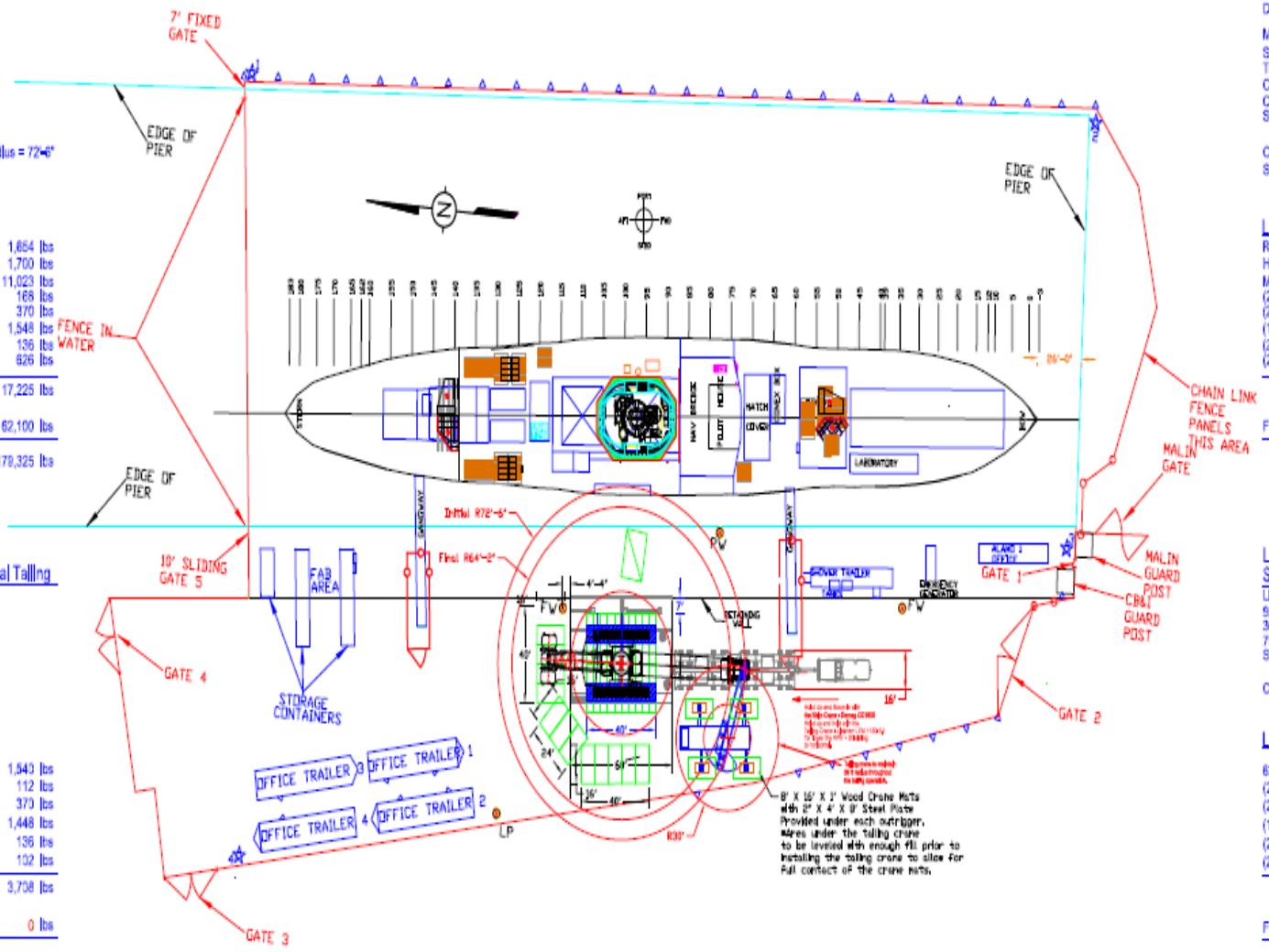
Liebherr LTM 1130-5.1
92,600 lb Crane Counterweight
360° Chart
75.1 ft of Main Boom
Swing-Away Removed

Capacity = 99,500 lbs @ Radius =30'

Lifting Notes

63 Ton Load Block	=	1,540 lbs
(2) EN600X20' Roundslings	=	112 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/Link Plates	=	1,448 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 1"Ø X 20' Wire Rope Slings	=	102 lbs
Total Additions	=	3,708 lbs
Initial Load RPV + Shield	=	0 lbs
Total Load	=	3,708 lbs

3.7% of Chart Capacity
*4.7% of Line Capacity



Lift Notes for Rotating the RPV and Shield Assembly to Horizontal - Final Main Crane

Demag CC1800

Main Boom Length =196.9 ft.
SL-Mast Length = 98.4 ft.
Track Width = 23.8 ft.
Counterweight =264,500 lbs
Central Ballast= 66,100 lbs
SL-Mast Radius = 44.3 ft.

Capacity = 275,267 lbs @ Maximum Radius = 64'-2"
Superlift Counterweight = 176,400 lbs

Lifting Notes

Rooster Sheave	=	1,654 lbs
Headache Ball	=	1,700 lbs
Main Load Block (no cheek weights)	=	11,023 lbs
(2) EN600X30' Roundslings	=	168 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/ Link plates	=	1,548 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 2"Ø X 29'-2" Wire Rope Slings	=	626 lbs
Total Additions	=	17,225 lbs
Final Load RPV + Shield	=	121,077 lbs
Total Load	=	138,302 lbs

50.1% of Chart Capacity
*63.6% of Line Capacity

Lift Notes for Rotating the RPV Shield Assembly to Horizontal- Final Tailing

Liebherr LTM 1130-5.1
92,600 lb Crane Counterweight
360° Chart
75.1 ft of Main Boom
Swing-Away Removed

Capacity = 99,500 lbs @ Radius =30'

Lifting Notes

63 Ton Load Block	=	1,540 lbs
(2) EN600X20' Roundslings	=	112 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/Link Plates	=	1,448 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 1"Ø X 20' Wire Rope Slings	=	102 lbs
Total Additions	=	3,708 lbs
Final Load RPV + Shield	=	41,023 lbs
Total Load	=	44,731 lbs

45.0% of Chart Capacity
*56.5% of Line Capacity

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CRITICAL LIFT PLAN TO REMOVE (TAILING)

Lift Notes for Rotating the RPV and Shield Assembly to Horizontal - Initial Main Crane

Demag CC1800

Main Boom Length =196.9 ft.
SL-Mast Length = 98.4 ft.
Track Width = 23.8 ft.
Counterweight =264,500 lbs
Central Ballast= 66,100 lbs
SL-Mast Radius = 44.3 ft.

Capacity = 233,700 lbs @ Maximum Radius = 72'-6"
Superlift Counterweight = 176,400 lbs

Lifting Notes

Rooster Sheave	=	1,654 lbs
Headache Ball	=	1,700 lbs
Main Load Block (no cheek weights)	=	11,023 lbs
(2) EN600X30' Roundslings	=	168 lbs
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(1) 8XL MaxBar w/ Link plates	=	1,548 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 2"Ø X 29'-2" Wire Rope Slings	=	626 lbs
Total Additions	=	17,225 lbs
Max Initial Load RPV + Shield	=	162,100 lbs
Total Load	=	179,325 lbs

76.7% of Chart Capacity
*82.4% of Line Capacity

Lift Notes for Rotating the RPV Shield Assembly to Horizontal- Initial Tailing

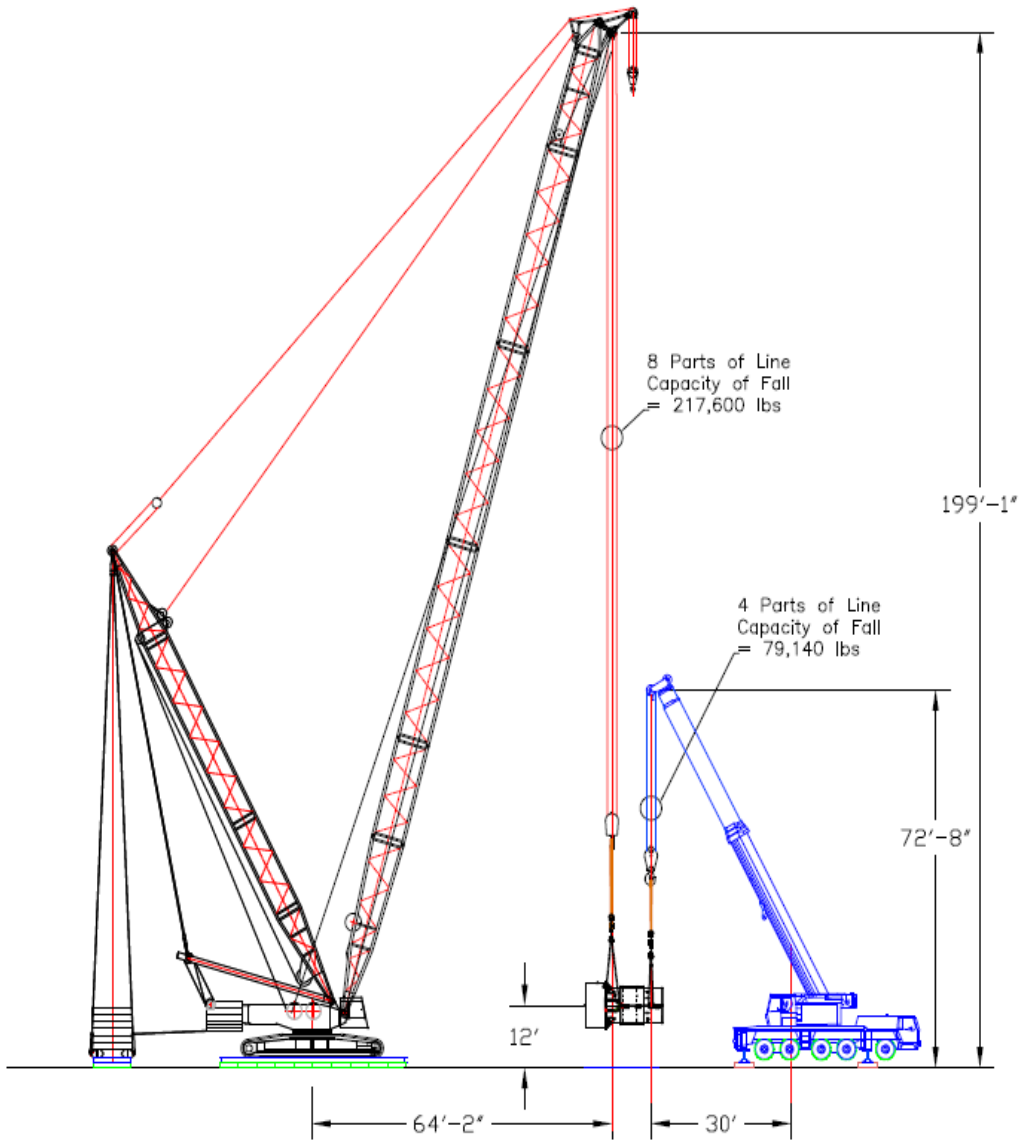
Liebherr LTM 1130-5.1
92,600 lb Crane Counterweight
360° Chart
70.1 ft of Main Boom
Swing-Away Removed

Capacity = 99,500 lbs @ Radius =30'

Lifting Notes

63 Ton Load Block	=	1,540 lbs
(2) EN600X20' Roundslings	=	112 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/Link Plates	=	1,448 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 1"Ø X 20' Wire Rope Slings	=	102 lbs
Total Additions	=	3,708 lbs
Initial Load RPV + Shield	=	0 lbs
Total Load	=	3,708 lbs

3.7% of Chart Capacity
*4.7% of Line Capacity



Lift Notes for Rotating the RPV and Shield Assembly to Horizontal - Final Main Crane

Demag CC1800

Main Boom Length =196.9 ft.
SL-Mast Length = 98.4 ft.
Track Width = 23.8 ft.
Counterweight =264,500 lbs
Central Ballast= 66,100 lbs
SL-Mast Radius = 44.3 ft.

Capacity = 275,287 lbs @ Maximum Radius = 64'-2"
Superlift Counterweight = 176,400 lbs

Lifting Notes

Rooster Sheave	=	1,654 lbs
Headache Ball	=	1,700 lbs
Main Load Block (no cheek weights)	=	11,023 lbs
(2) EN600X30' Roundslings	=	168 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/ Link plates	=	1,548 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 2"Ø X 29'-2" Wire Rope Slings	=	626 lbs
Total Additions	=	17,225 lbs
Final Load RPV + Shield	=	121,077 lbs
Total Load	=	138,302 lbs

50.1% of Chart Capacity
*63.6% of Line Capacity

Lift Notes for Rotating the RPV Shield Assembly to Horizontal- Final Tailing

Liebherr LTM 1130-5.1
92,600 lb Crane Counterweight
360° Chart
70.1 ft of Main Boom
Swing-Away Removed

Capacity = 99,500 lbs @ Radius =30'

Lifting Notes

63 Ton Load Block	=	1,540 lbs
(2) EN600X20' Roundslings	=	112 lbs
(2) 125 Ton Widebody Shackles	=	370 lbs
(1) 8XL MaxBar w/Link Plates	=	1,448 lbs
(2) 55 Ton Widebody Shackles	=	136 lbs
(2) 1"Ø X 20' Wire Rope Slings	=	102 lbs
Total Additions	=	3,708 lbs
Final Load RPV + Shield	=	41,023 lbs
Total Load	=	44,731 lbs

45.0% of Chart Capacity
*56.5% of Line Capacity

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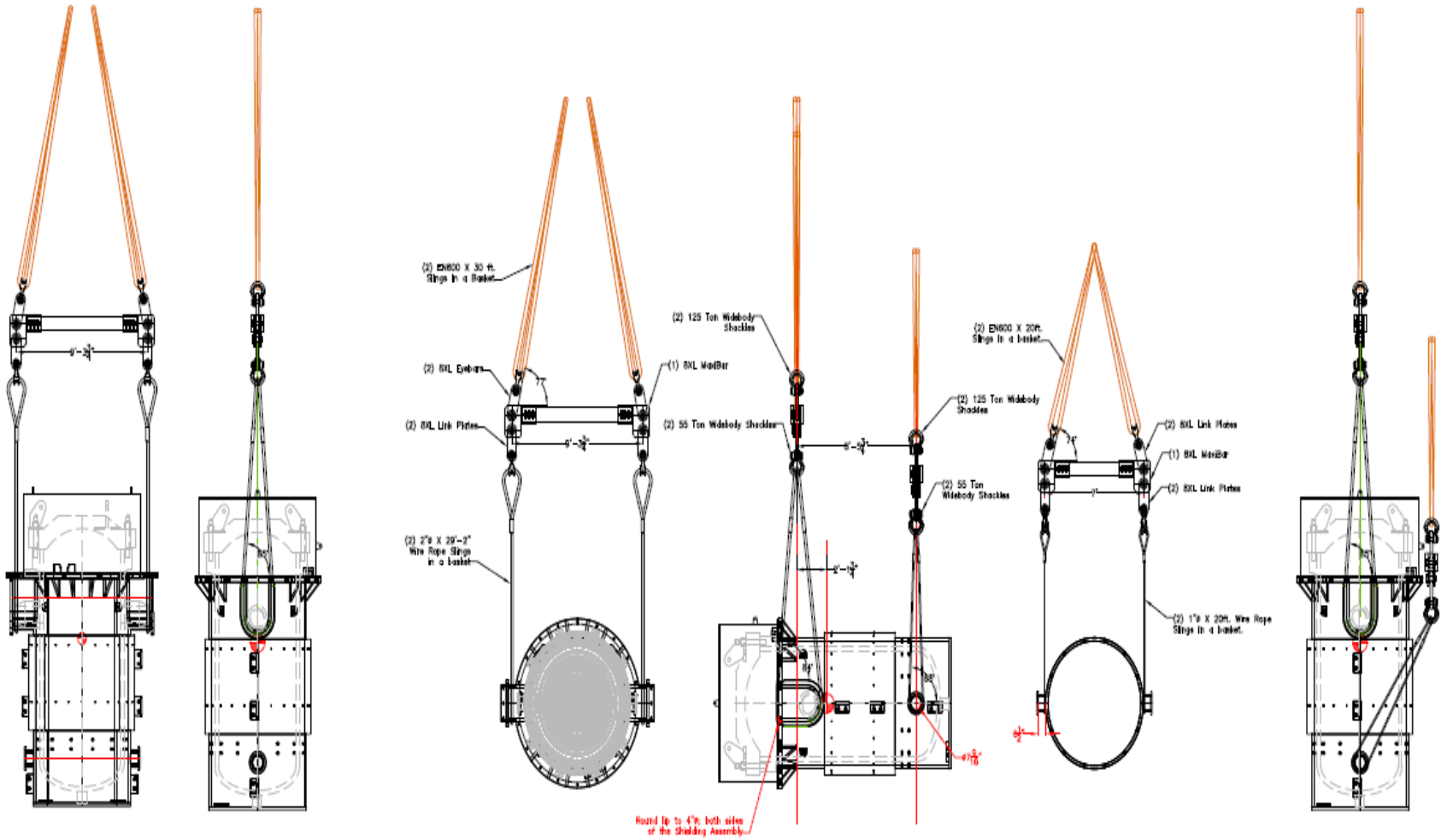
CRITICAL LIFT PLAN TO REMOVE RPV (RIGGING)



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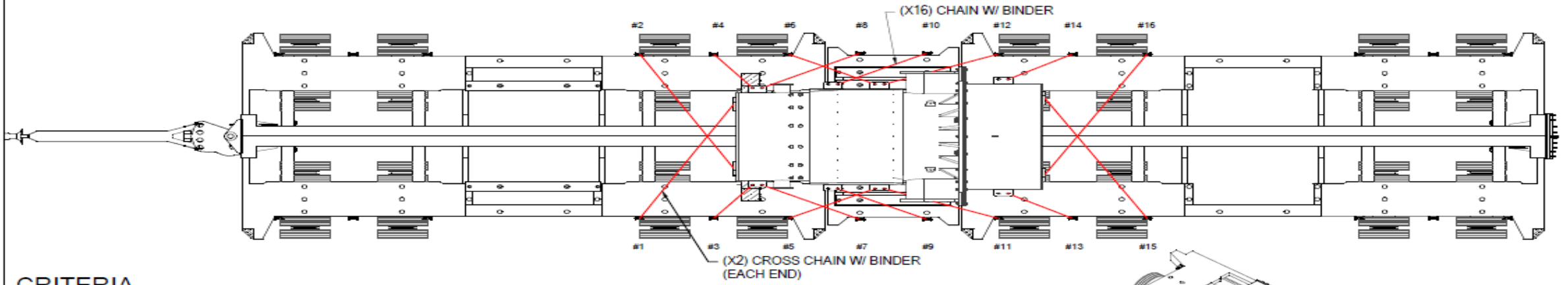
RPV TRANSPORT AND SECUREMENT

TRAVEL DIRECTION

PERKINS SPECIALIZED TRANSPORTATION LAYOUT



CRITERIA

U.S. DEPT OF TRANSPORTATION FEDERAL MOTOR CARRIER SAFETY REGULATIONS PART 393 - PARTS & ACCESSORIES NECESSARY FOR SAFE OPERATION 393.102(a)(2)/.102(b)
PERFORMANCE CRITERIA:

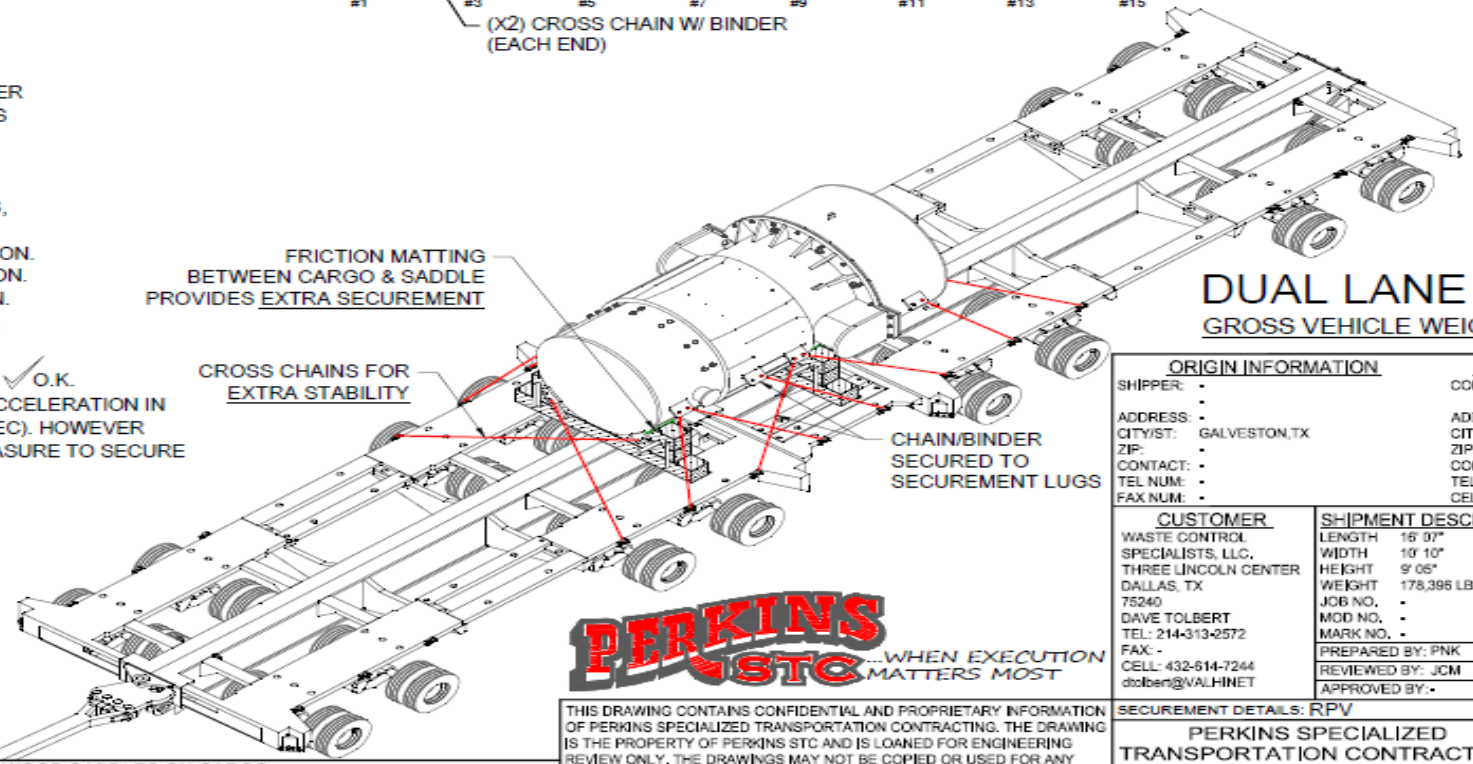
CARGO SECUREMENT DEVICES & SYSTEMS MUST BE CAPABLE OF WITHSTANDING THE FOLLOWING FORCES, APPLIED SEPARATELY:

1) 0.435g DECELERATION IN THE FORWARD DIRECTION.
2) 0.5g ACCELERATION IN THE REARWARD DIRECTION.
3) 0.25g ACCELERATION IN THE LATERAL DIRECTION.
4) 0.2g ACCELERATION IN THE UPWARD DIRECTION.

DESIGN CRITERIA TO SATISFY ✓O.K.

FRICTION MATTING UNDER CARGO ARRESTS 1.012g OF ACCELERATION IN FORWARD, REARWARD, & LATERAL DIRECTIONS (SEE SPEC). HOWEVER FRICTION MATTING SHALL BE USED FOR ADDITIONAL MEASURE TO SECURE LOAD.

½" RATCHETING BINDER = 9,200 LB RATING (WLL)
SEE SHEET "G" FOR SECUREMENT CALCULATIONS.



DUAL LANE LOADING

GROSS VEHICLE WEIGHT = 348,000 LBS

ORIGIN INFORMATION		DESTINATION INFORMATION	
SHIPPER:	-	CONSIGNEE:	WASTE CONTROL SPECIALISTS, LLC.
ADDRESS:	-	ADDRESS:	-
CITY/ST:	GALVESTON,TX	CITY/ST:	ANDREWS, TX
ZIP:	-	ZIP:	-
CONTACT:	-	CONTACT:	-
TEL NUM:	-	TEL NUM:	-
FAX NUM:	-	CELL NUM:	-

CUSTOMER	SHIPMENT DESCRIPTION		PERMIT INFORMATION	
WASTE CONTROL SPECIALISTS, LLC.	LENGTH	16' 07"	LENGTH	115' 10"
THREE LINCOLN CENTER	WIDTH	10' 10"	WIDTH	16' 00"
DALLAS, TX	HEIGHT	9' 05"	HEIGHT	13' 02"
75240	WEIGHT	178,395 LBS	REAR O.H.	00' 00"
DAVE TOLBERT	JOB NO.	-	WEIGHT	SEE ABOVE
TEL: 214-313-2572	MOD NO.	-		
FAX: -	MARK NO.	-		
CELL: 432-614-7244	PREPARED BY: PNK	DATE: 03/16/17	SCALE: NONE	
dtolbert@VALHINET	REVIEWED BY: JCM	DATE: 03/16/17		
	APPROVED BY: -	DATE: -		

PERKINS STC ...WHEN EXECUTION MATTERS MOST

SECUREMENT DETAILS: RPV

PERKINS SPECIALIZED TRANSPORTATION CONTRACTING
NORTHFIELD, MN
1-877-PERKINS
www.heavyhaul.com

QUOTE #	110586
PROJECT #	550
WORK ORDER #	3495
DRAWING #	5503495-06-f

REV 1	PNK	DATE: 03/21/17	REPLACED STEEL SADDLES WITH WOOD SADDLES ON CARGO
REV 2	PNK	DATE: 05/10/17	1) ADDED SECUREMENT PAGES; 2) ADDED CHAINS
REV 3		DATE: -	-

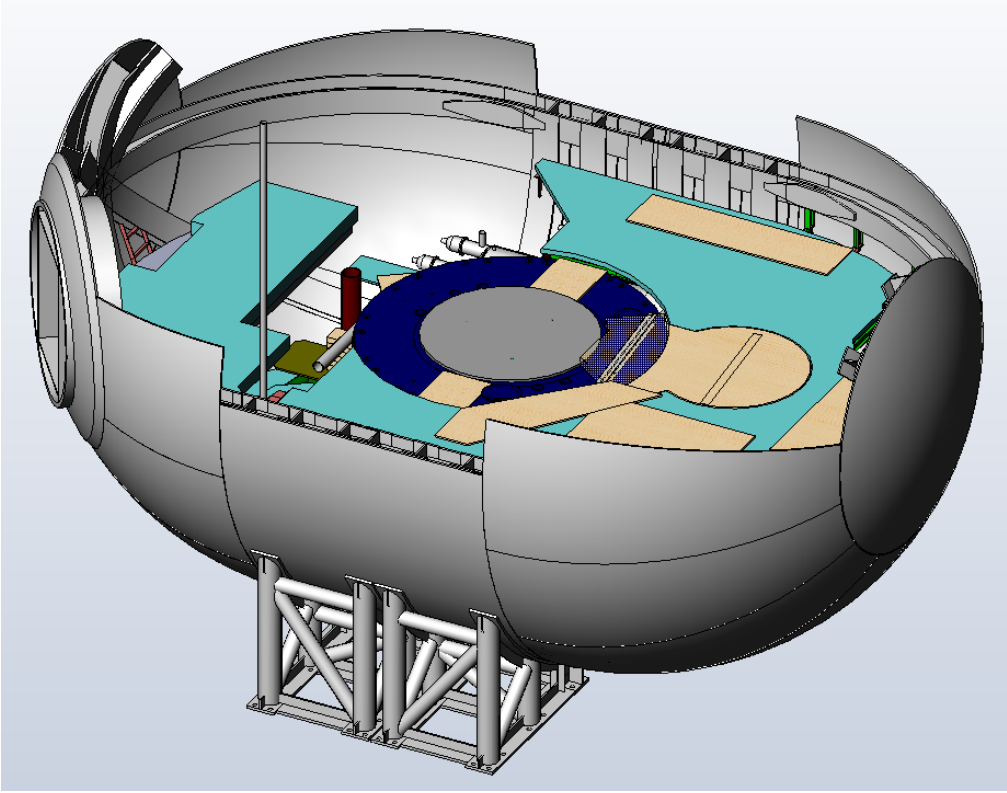
STURGIS RPV DISPOSAL STORYBOARD MAY - JULY 2017

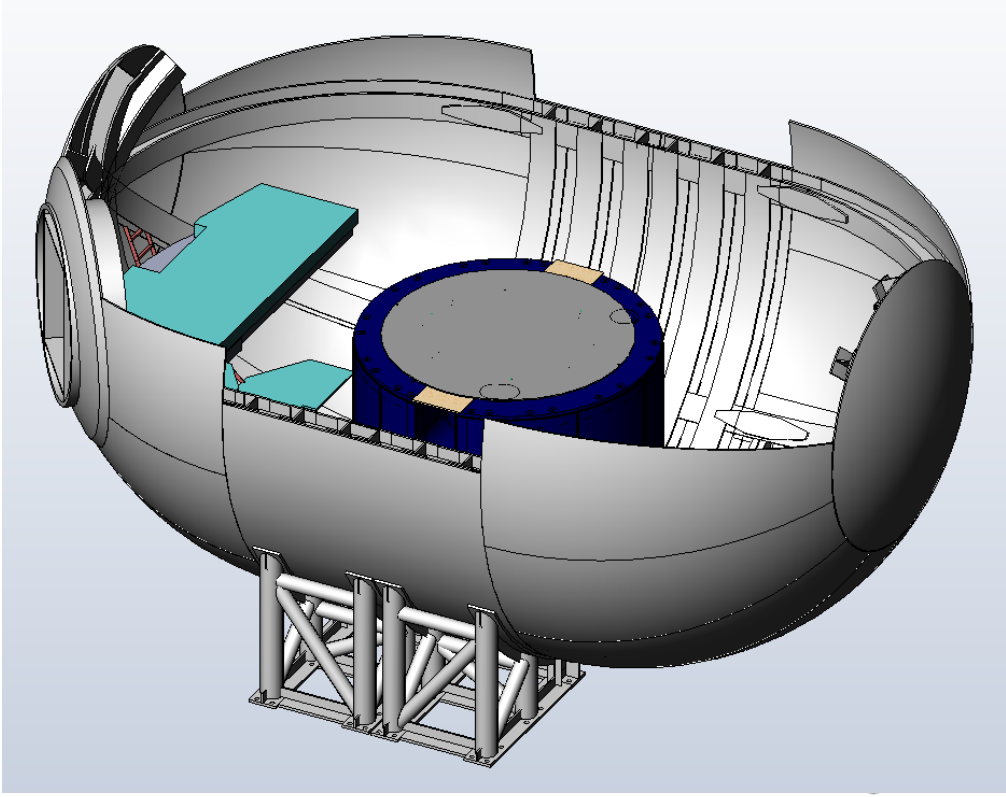
Reactor Pressure Vessel (RPV) Removed from Primary Shield Tank, Sealed in the Shielded Container, Secured onto the Transport Vehicle

RPV and Shielded Container are Moved into the Waste Control Specialists Federal Waste Facility Disposal Cell and Encased in Concrete

REMOVE REMAINING ITEMS FROM RCV

- Smaller components including surge tanks, instrumentation, cabling, ventilation systems, as well as floor gratings, ladders, etc.
- Material will be disposed of as Low Level Waste
- Only remaining item were PST



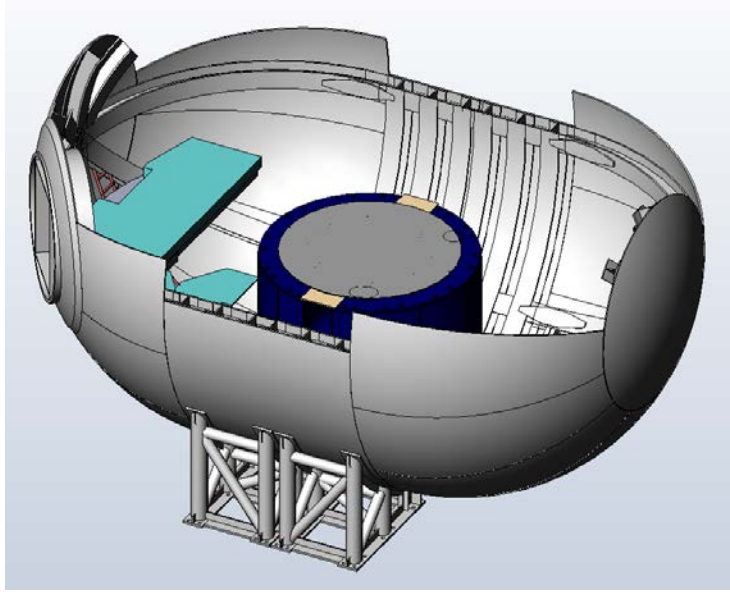


REMOVAL OF THE PRIMARY SHIELD TANK

- PST Inner wall was activated and had significant dose rate (~4 R/hr)
- Shielded transport container was fabricated and is being used for shipments
- Inner wall and ion detectors were removed first to reduce dose
- Balance of unit was sectioned for disposal

Overall Approach

▪ Cut the top flange and plate. ▪ Access and removal of lead shot in selected compartments of the outer wall.	Phase 1
▪ Access and removal of gravel in water jacket. ▪ Cutting of coolant channels adjacent to inner wall. ▪ Removal of temporary shielding in PST inner chamber. ▪ Locating and drilling pilot holes for wire saw. ▪ Installation of wire saw and sectioning and removal of the inner wall, including the Ion Detector Housings.	Phase 2
▪ Removal of the balance of lead shot ▪ Removal of the outer and middle wall. ▪ Removal of the remaining bottom portion of the PST, including lead sheeting and shielding. ▪ Removal of any remaining activated or contaminated material below the PST. Note this may involve removing portions of the bottom of the Reactor Containment Vessel (RCV).	Phase 3



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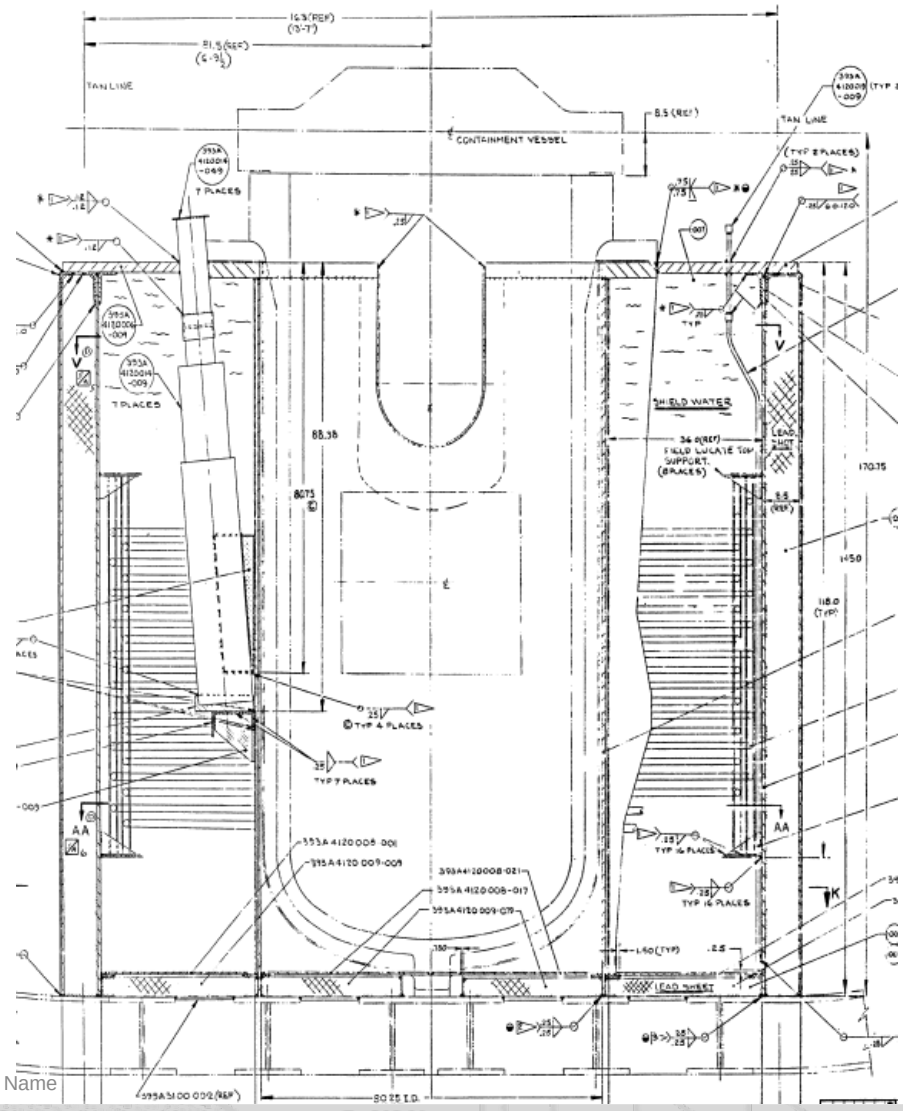
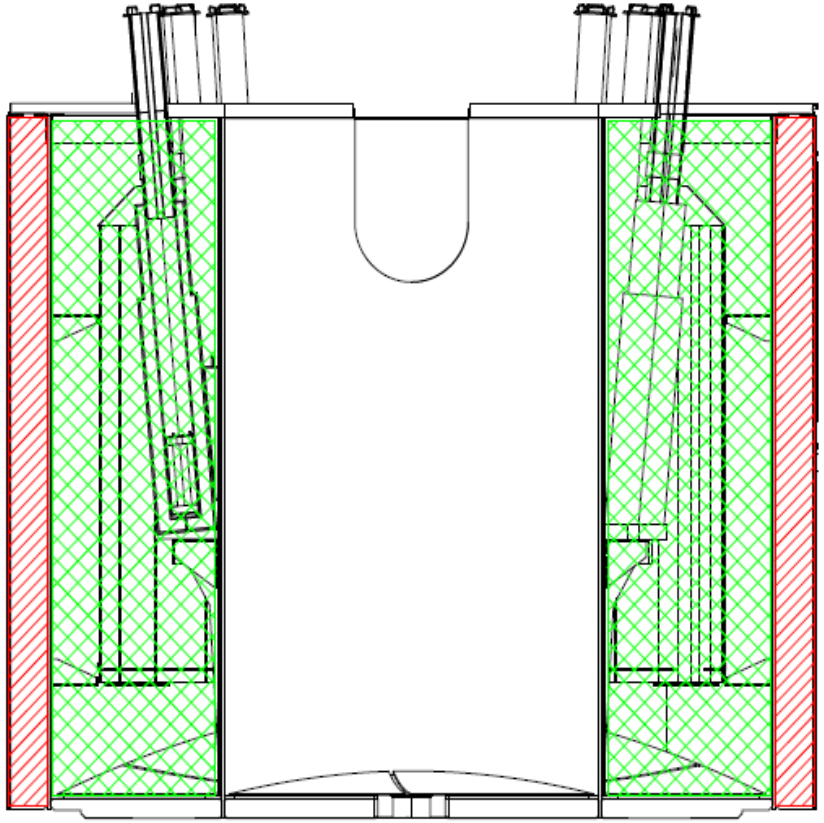
PRIMARY SHIELD TANK

PST – From As Built Drawings



PST D&D Planning Documents



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PRIMARY SHIELD TANK

- Crews sized inner wall of PST with Diamond Wire to fit into off the shelf bags sized for placement into a WCS Federal Waste Facility Modular Concrete Container
  - Drill holes for rigging and wire saw cutting
  - Remove gravel from middle section of PST
  - Remove Pb from outer section compartments to allow holes to be drilled for wire saw
  - Design and construct shielded IP-1 shipping container
  - Lift and place section into bag within shielded container
- Inner wall of PST to be cut into 6 sections and placed in 3 bags
- Outer and Middle wall sized to fit into IMC
- Removed remaining Lead below PST

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MH1-A STURGIS – DECOMMISSIONING COMPLETION

- Upon completion of decommissioning activities in Galveston, the STURGIS will be radiologically released for future dismantlement

- After release, the STURGIS will be towed to Brownsville for shipbreaking at a commercial facility

- Port of Galveston, Pier 41 will be surveyed and released allowing for the ARO permit to be terminated

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MATERIALS CATEGORIZATION, SURVEY, AND RELEASE PLAN

- Based on:
  - Sturgis Decommissioning Plan
  - NUREG-1575 MARSAME (supplement to MARSSIM)
  - NUREG-1640 Radiological Assessments for Clearance of Materials from Nuclear Facilities

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STURGIS DECOMMISSIONING PLAN

- The DP provides a detailed description of the approach that the USACE intends to use to assess the radiological status of STURGIS, to remove the MH-1A reactor and other radioactive materials attributable to the permitted past operations, to disposition all onboard components, equipment and structural materials on the barge, and terminate the reactor permit

- Assumptions related to our use and interpretation of MARSAME and NUREG-1640 were presented within this DP

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MARSAME

- MARSAME was used as guidance for survey and release of M&E associated with decommissioning STURGIS

- Our use of MARSAME is similar to MARSSIM because we chose to use mostly MARSSIM-type, method-based survey designs. There are also differences such as the use of sentinel surveys in “unknown” areas

- We also designed scan only method-based survey designs to survey and release lead-based painted surfaces prior to removal of paint material for disposal as RCRA hazardous waste

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NUREG-1640

- NUREG-1640 (Vol 1) provides probabilistic estimates of annual dose to an individual following the clearance of specific materials (iron and steel, copper, aluminum, and concrete rubble) from licensed nuclear facilities

- One of the pathways addressed is the recycling of steel scrap. This scenario was analyzed with the 115 radionuclides considered most likely to be associated with materials from licensed nuclear facilities

- 1640's design basis enables the conversion of a dose criterion to a concentration

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PROCESS

- Step 1- We incorporated a 1mrem/yr release criterion for our critical receptor. This was intended to correspond to the conservative release criterion used for the clearance of items and materials from rad controlled areas, as presented in ANSI N13.12

- Step 2- We identified in 1640 (Table 3.22) the most limiting result for our ROCs from the 95th percentile data column. We converted that result in mrem/y per pCi/m^2 to dpm/100 cm^2. Our gross beta DCGL for 1mrem/yr, based on most limiting Co-60, was calculated to be 1,590 dpm/100 cm^2. Co-60 dose is caused to “scrap yard” critical receptor

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Table 4-2
Action Levels Based on 1 mrem/yr Dose Limit (Table 8 of the DP)

Nuclide	Recycled Copper (pCi/g per mrem/yr)	Recycled Steel (dpm/100 cm^2 per mrem/yr)	Recycled Concrete (pCi/g per mrem/yr)
Detectable Radionuclides			
^{60}Co	108.7	1,590	0.50
^{94}Nb	142.9	2,780	0.83
^{152}Eu	N/A	N/A	1.1
^{154}Eu	N/A	N/A	1.0
Hard to Detect Radionuclides			
^{3}H	6.25.E+05	4.27.E+06	900
^{14}C	4.35.E+05	6.37.E+06	1,000
^{55}Fe	2.63.E+06	1.85.E+08	66,000
^{59}Ni	4.35.E+06	1.85.E+08	83,000
^{63}Ni	2.13.E+06	1.71E.+08	66,000

Sum of Fractions = $\frac{Detectable\ \beta-\gamma\ dpm/100cm^2}{1{,}590\ dpm/100cm^2}+\frac{HTD\ dpm/100cm^2}{4.27x10^5\ dpm/100cm^2}<1$

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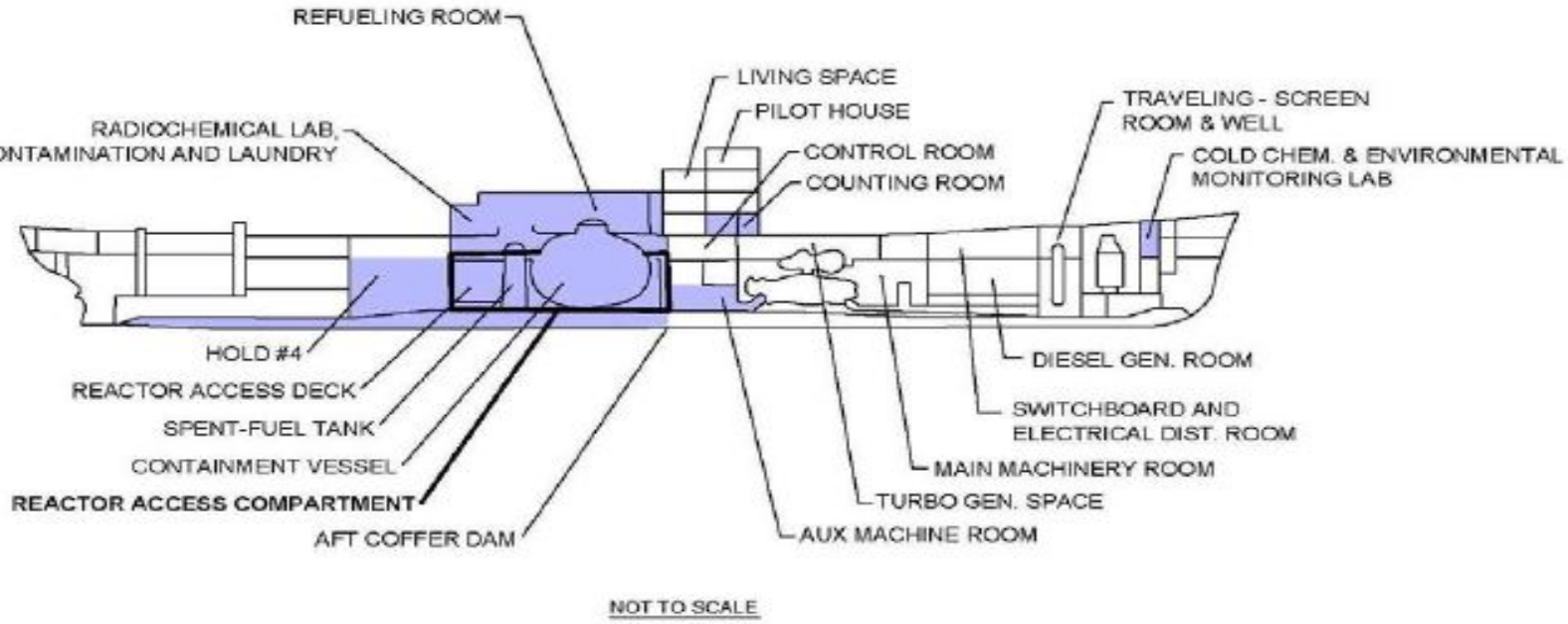
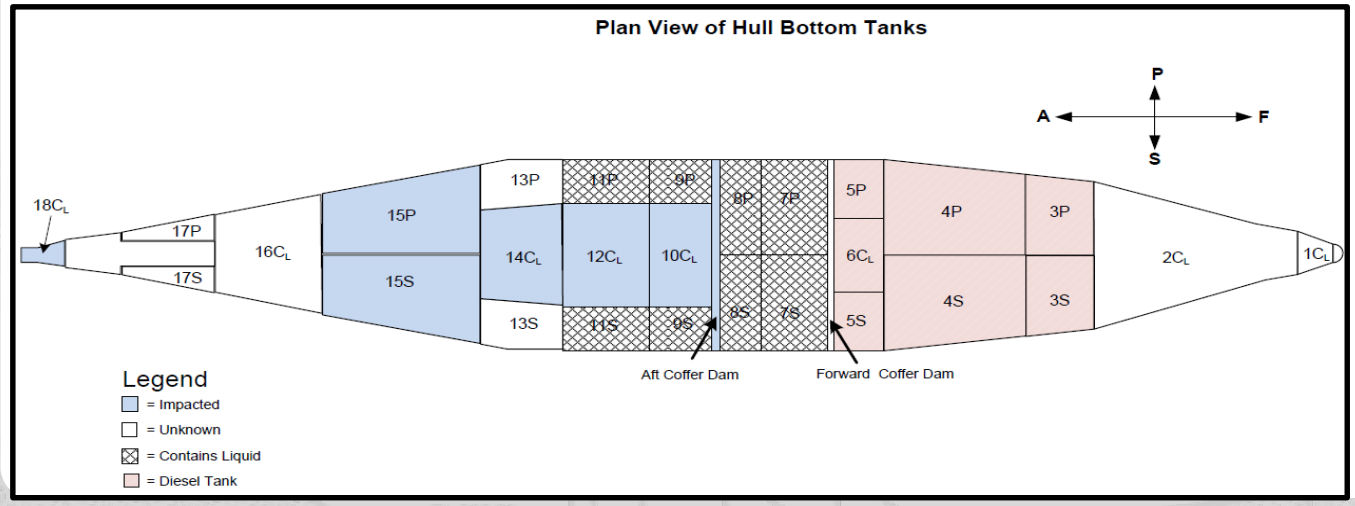
Impacted Areas- Class 1, 2, or 3
Unknown Areas- Sentinel Surveys

Figure 3-1
Impacted Areas





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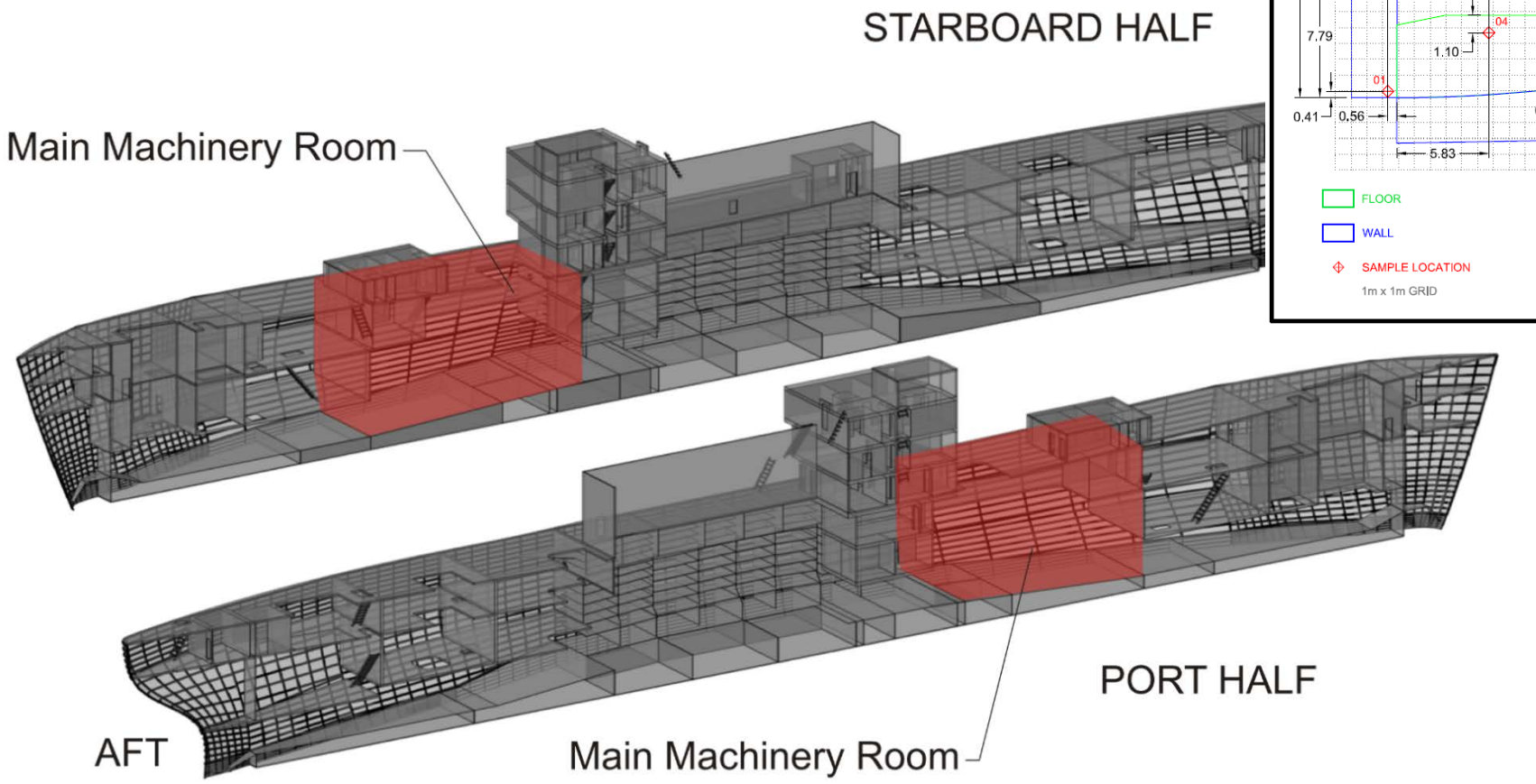
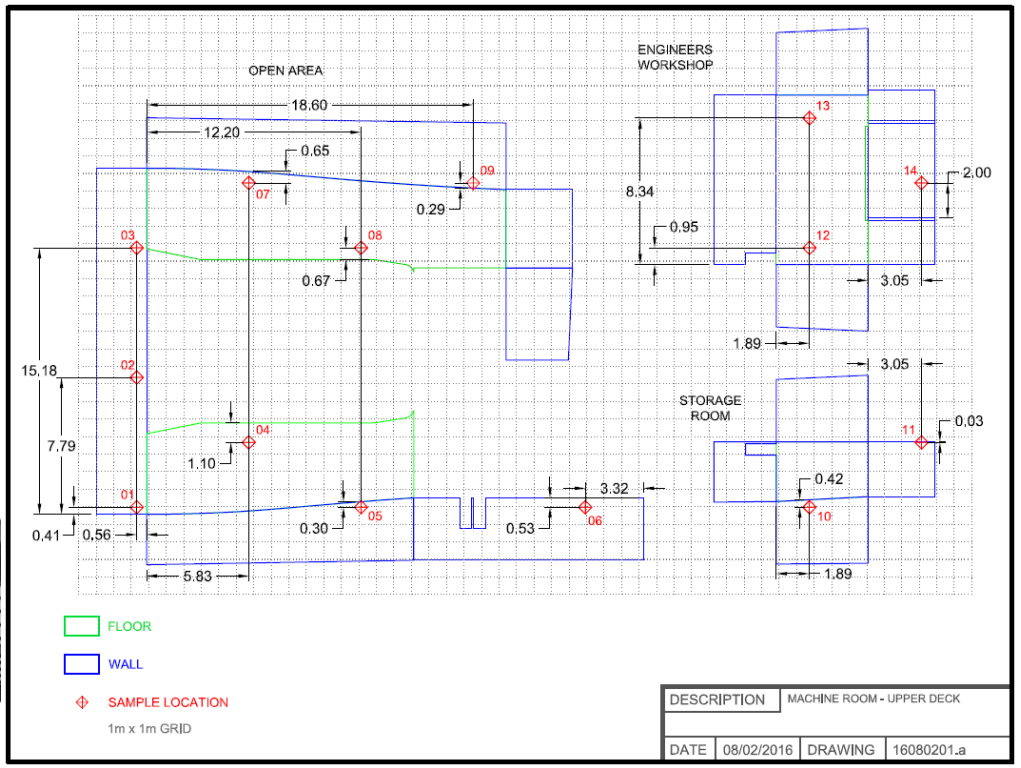
MARSAME SURVEY UNIT
MAIN MACHINERY ROOM





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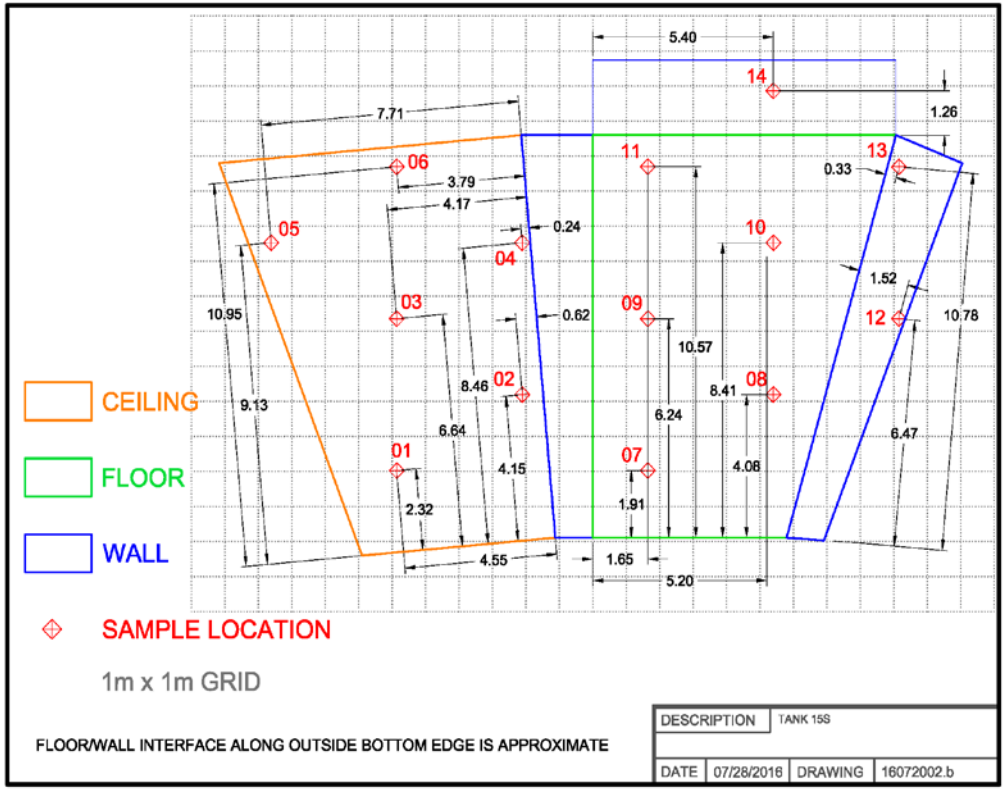
MARSAME SURVEY UNIT FOR TANK 15S



STURGIS DECOMMISSIONING WASTES

- Waste is LLRW/LLMW Federal Waste not subject to compact requirements
- DOE determined the waste is eligible for disposal at WCS (FWF) or NNSS and the DOE would need to take title of waste for disposal at either location
- Options considered
  - NNSS (Class A/B/C LLRW/LLMW)
  - WCS (Class A/B/C LLRW/LLMW)
  - Energy Solutions (Class A LLRW/LLMW)
- Disposal to date
  - WCS RCRA Cell (Tier 2) – 1,200,000 pounds
  - WCS FWF Class A & C LLRW – 172,000 pounds
  - US Ecology Texas - Ballast Water – 1,150,000 pounds
  - US Ecology Texas - Small volume of universal waste
- Recycle to date
  - Approximately 600,000 pounds of lead

Lesson Learned: Over 90% of waste was low activity and meet the exemptions for disposal in the RCRA disposal cell

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RADIATION SAFETY

- Dosimetry
  - Army OSL with onsite reader
  - Electronic dosimeter (DMC 3000) – allows for remote monitoring

RADIATION SAFETY

- Personnel Dose – OSL Readings - cumulative through end of 2017:

Estimated Whole Body Exposure Range (Rem)	# of Staff	% of Total	Total Dose
No Measurable Exposure	73	74.5	0.0
Exposure Less Than 0.1	15	15.3	0.59
0.1 thru 0.249	3	3.1	0.403
0.250 thru 0.499	5	5.1	1.772
0.50 thru 0.749	2	2.0	1.316

- Official Army Dosimetry Center Results vs. Onsite Reader results vs. Electronic Dosimeter Readings

Comparison of Dosimetry Results			
Individual	**ADC Results**	**On Site Reader Results**	**ED Results**
#1	670	530	660
#2	646	548	667
#3	472	441	395
#4	380	321	393

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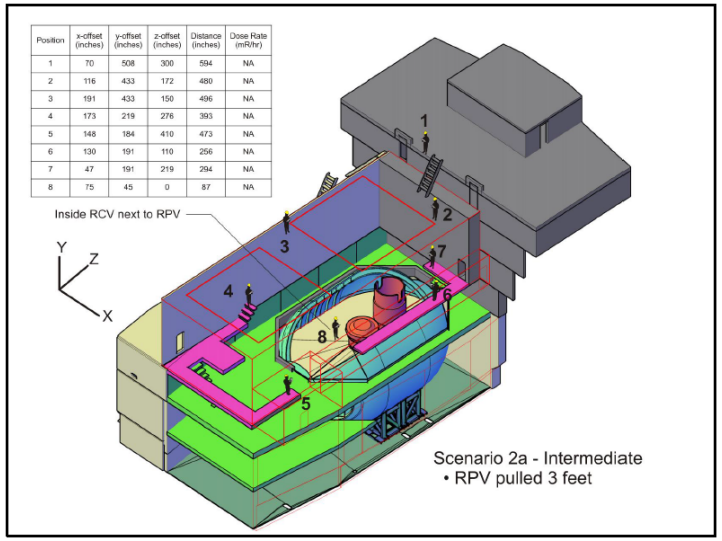
RADIATION SAFETY

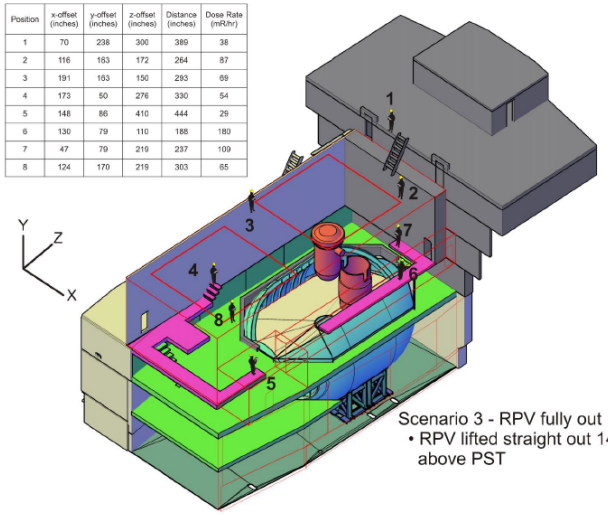
- ALARA Analysis and Dose Assessment

Position	x-offset (inches)	y-offset (inches)	z-offset (inches)	Distance (inches)	Dose Rate (mR/hr)
1	70	508	300	594	NA
2	116	433	172	480	NA
3	191	433	150	496	NA
4	173	219	276	393	NA
5	148	184	410	473	NA
6	130	191	110	256	NA
7	47	191	219	294	NA
8	75	45	0	87	NA



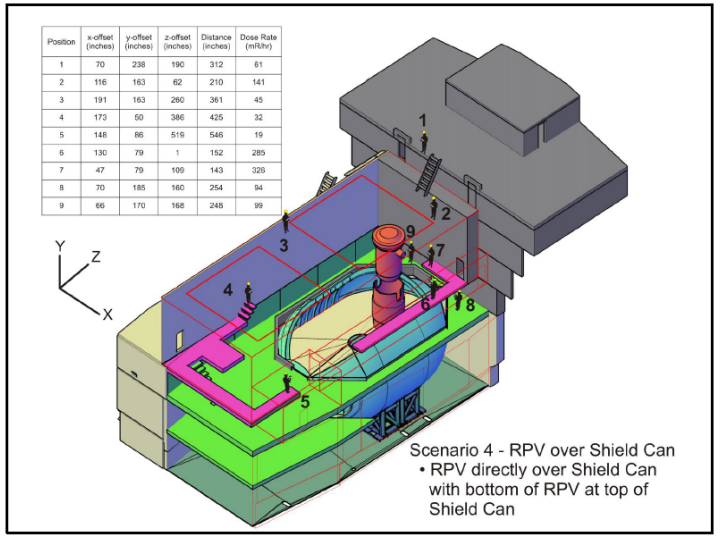
Scenario 2a - Intermediate
• RPV pulled 3 feet

Position	x-offset (inches)	y-offset (inches)	z-offset (inches)	Distance (inches)	Dose Rate (mR/hr)
1	70	238	300	389	38
2	116	163	172	264	87
3	191	163	150	283	69
4	173	50	276	330	54
5	148	86	410	444	29
6	130	79	110	188	180
7	47	79	219	237	109
8	124	170	219	303	65



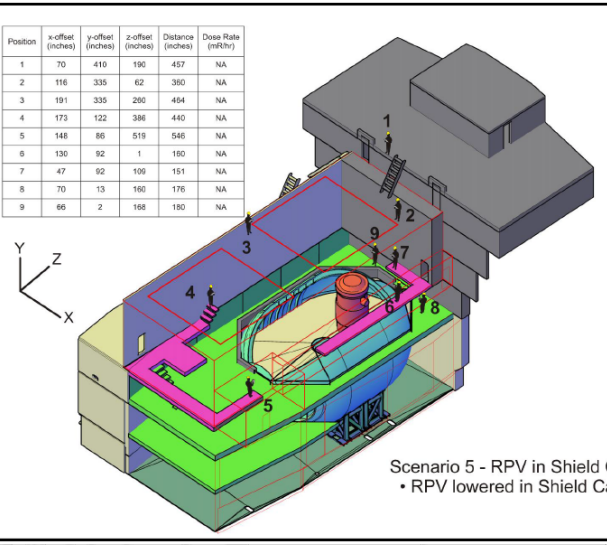
Scenario 3 - RPV fully out
• RPV lifted straight out 14 feet above PST

Position	x-offset (inches)	y-offset (inches)	z-offset (inches)	Distance (inches)	Dose Rate (mR/hr)
1	70	238	190	312	61
2	116	163	62	210	141
3	191	163	260	361	45
4	173	50	386	425	32
5	148	86	519	546	19
6	130	79	1	152	285
7	47	79	109	143	326
8	70	185	160	254	94
9	66	170	168	248	99



Scenario 4 - RPV over Shield Can
• RPV directly over Shield Can with bottom of RPV at top of Shield Can

Position	x-offset (inches)	y-offset (inches)	z-offset (inches)	Distance (inches)	Dose Rate (mR/hr)
1	70	410	190	457	NA
2	116	335	62	360	NA
3	191	335	260	454	NA
4	173	122	386	440	NA
5	148	86	519	546	NA
6	130	92	1	180	NA
7	47	92	109	151	NA
8	70	13	160	176	NA
9	66	2	168	180	NA



Scenario 5 - RPV in Shield Can
• RPV lowered in Shield Can

SIGNIFICANT LESSONS LEARNED

- Local government officials and stakeholders
- Collaboration between Gov’t and Contractor is a must
- Proactive and transparent communications
- Shipyard Infrastructure
- Dock load bearing pressure
- Health and Safety Requirements
- Engineering Design
- Qualified Staff – training; ramp up; ramp down
- Subcontractors/Teaming Partners
- SharePoint site for project documents
- Disposal/Disposition Method
- Contract Administration and team oversight by Gov’t

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Questions?

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