

See "Instructions for Filling out the Work Permit" contained in the Work Planning and Control for Experiments and Operations Subject Area.

**1. Work request WCC fills out this section.**  Standing Work Permit

Requester: P. Gianotti	Date: 9/21/2016	Ext.: 3815	Dept/Div/Group: PO/PHENIX
Other Contact person (if different from requester): Carter Biggs			Ext.: 7515
Work Control Coordinator: P. Giannotti		Start Date: 9/7/2016	Est. End Date: 12/31/2016
Brief Description of Work: Remove & Repurpose CM (includes disassembly and disposition of detectors, electronics, utilities and structural components)			
Building: 1008	Room: IR and AH	Equipment: entire MMS	Service Provider: PHENIX and CAD techs and F&O personnel

**2. WCC, Requester/Designee, Service Provider, and ESSH (as necessary) fill out this section or attach analysis**

ESSH ANALYSIS										
<b>Radiation Concerns</b>		<input type="checkbox"/> None	<input checked="" type="checkbox"/> Activation	<input type="checkbox"/> Airborne	<input type="checkbox"/> Contamination	<input type="checkbox"/> Radiation	<input type="checkbox"/> NORM	<input type="checkbox"/> Other		
<input type="checkbox"/> Special nuclear materials involved, notify Isotope Special Materials Group				<input type="checkbox"/> Fissionable/Radiological materials involved, notify Laboratory Nuclear Safety Officer						
<b>Radiation Generating Devices:</b>		<input type="checkbox"/> Radiography	<input type="checkbox"/> Moisture Density Gauges	<input type="checkbox"/> Soil Density Gauges		<input type="checkbox"/> X-ray Equipment				
<b>Safety and Security Concerns</b>		<input type="checkbox"/> None	<input type="checkbox"/> Explosives	<input type="checkbox"/> Transport of Haz/Rad Material		<input type="checkbox"/> Pressurized Systems				
<input type="checkbox"/> Adding/Removing Walls or Roofs	<input type="checkbox"/> Critical Lift	<input type="checkbox"/> Fumes/Mist/Dust*		<input type="checkbox"/> Magnetic Fields*		<input type="checkbox"/> Railroad Work				
<input type="checkbox"/> Asbestos*	<input type="checkbox"/> Cryogenic	<input type="checkbox"/> Heat/Cold Stress		<input type="checkbox"/> Nanomaterials/particles*		<input checked="" type="checkbox"/> Rigging				
<input type="checkbox"/> Beryllium*	<input checked="" type="checkbox"/> Electrical	<input type="checkbox"/> Hydraulic		<input type="checkbox"/> Noise*		<input type="checkbox"/> Silica*				
<input type="checkbox"/> Biohazard*	<input checked="" type="checkbox"/> Elevated Work	<input type="checkbox"/> Lasers*		<input type="checkbox"/> Non-ionizing Radiation*		<input type="checkbox"/> Security Concerns				
<input type="checkbox"/> Chemicals/Corrosives*	<input type="checkbox"/> Excavation	<input checked="" type="checkbox"/> Lead*		<input type="checkbox"/> Oxygen Deficiency*		<input type="checkbox"/> Suspect/Counterfeit Items				
<input type="checkbox"/> Confined Space*	<input type="checkbox"/> Ergonomics*	<input checked="" type="checkbox"/> Material Handling		<input type="checkbox"/> Penetrating Fire Walls		<input type="checkbox"/> Vacuum				
Ladder Access Required: <input checked="" type="checkbox"/> Portable Ladder <input type="checkbox"/> Fixed Ladder- Status/Restrictions:										
* Safety Health Rep. Review Required		<input type="checkbox"/> Haz, Rad, Bio Material Exceed DOE 151.1-C Levels - Contact OEM				<input type="checkbox"/> Other				
Environmental Concerns				<input type="checkbox"/> None		<input type="checkbox"/> Work impacts Environmental Permit No.				
<input type="checkbox"/> Atmospheric Discharges (rad/non-rad/GHG)		<input type="checkbox"/> Land Use Institutional Controls		<input type="checkbox"/> Soil Activation/contamination		<input type="checkbox"/> Waste-Mixed				
<input type="checkbox"/> Chemical or Rad Material Storage or Use		<input type="checkbox"/> Liquid Discharges		<input type="checkbox"/> Waste-Clean		<input checked="" type="checkbox"/> Waste-Radioactive				
<input type="checkbox"/> Cesspools (UIC)		<input type="checkbox"/> PCB Management		<input type="checkbox"/> Waste-Hazardous		<input type="checkbox"/> Waste-Regulated Medical				
<input type="checkbox"/> High water/power consumption		<input type="checkbox"/> Spill potential		<input type="checkbox"/> Waste-Industrial		<input type="checkbox"/> Historical Environmental Hazards				
Waste disposition by: <input type="checkbox"/> Other										
Pollution Prevention (P2)/Waste Minimization Opportunity: <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes				Environmental Preferable Products Available: <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes						
FACILITY CONCERNS		<input checked="" type="checkbox"/> None		<input type="checkbox"/> Intermittent Energy Release						
<input type="checkbox"/> Access/Egress Limitations		<input type="checkbox"/> Electrical Noise		<input type="checkbox"/> Potential to Cause a False Alarm		<input type="checkbox"/> Vibrations				
<input type="checkbox"/> Credited Controls (Use USI Process)		<input type="checkbox"/> Impacts Facility Use Agreement		<input type="checkbox"/> Temperature Change		<input type="checkbox"/> Other				
<input type="checkbox"/> Configuration Management		<input type="checkbox"/> Maintenance Work on Ventilation Systems		<input type="checkbox"/> Utility Interruptions						
WORK CONTROLS										
Work Practices										
<input type="checkbox"/> None		<input type="checkbox"/> Exhaust Ventilation		<input checked="" type="checkbox"/> Lockout/Tagout		<input type="checkbox"/> Spill Containment		<input type="checkbox"/> Security (see Instruction Sheet)		
<input checked="" type="checkbox"/> Back-up Person/Watch		<input checked="" type="checkbox"/> HP Coverage		<input type="checkbox"/> Posting/Warning Signs		<input type="checkbox"/> Time Limitation		<input type="checkbox"/> Other		
<input type="checkbox"/> Barricades		<input type="checkbox"/> IH Survey		<input type="checkbox"/> Scaffolding-requires inspection		<input type="checkbox"/> Warning Alarm (i.e. "high level")		<input type="checkbox"/> Electrical Inspection Required		
Personal Protective Equipment										
<input type="checkbox"/> None		<input type="checkbox"/> Ear Plugs		<input checked="" type="checkbox"/> Gloves, as necessary		<input type="checkbox"/> Lab Coat		<input checked="" type="checkbox"/> Safety Glasses, where req'd		
<input type="checkbox"/> Coveralls		<input type="checkbox"/> Ear Muffs		<input type="checkbox"/> Goggles		<input type="checkbox"/> Respirator*		<input type="checkbox"/> Safety Harness		
<input type="checkbox"/> Disposable Clothing		<input type="checkbox"/> Face Shield		<input checked="" type="checkbox"/> Hard Hat, when Crane used		<input type="checkbox"/> Shoe Covers		<input checked="" type="checkbox"/> Safety Shoes, as req'd	<input type="checkbox"/> High visibility cloths/vest	<input type="checkbox"/> Other
Permits Required (Permits must be valid when job is scheduled.)										
<input checked="" type="checkbox"/> None		<input type="checkbox"/> Cutting/Welding		<input type="checkbox"/> Impair Fire Protection Systems						
<input type="checkbox"/> Concrete/Masonry Penetration		<input type="checkbox"/> Digging/Core Drilling		<input type="checkbox"/> Rad Work Permit-RWP No						
<input type="checkbox"/> Confined Space Entry		<input type="checkbox"/> Electrical Working Hot		<input type="checkbox"/> Other						
Dosimetry/Monitoring										
<input checked="" type="checkbox"/> None		<input type="checkbox"/> Heat Stress Monitor		<input type="checkbox"/> Real Time Monitor		<input type="checkbox"/> TLD				
<input type="checkbox"/> Air Effluent		<input type="checkbox"/> Noise Survey/Dosimeter		<input type="checkbox"/> Self-reading Pencil Dosimeter		<input type="checkbox"/> Waste Characterization				
<input type="checkbox"/> Ground Water		<input type="checkbox"/> O <sub>2</sub> /Combustible Gas		<input type="checkbox"/> Self-reading Digital Dosimeter		<input type="checkbox"/> Other				
<input type="checkbox"/> Liquid Effluent		<input type="checkbox"/> Passive Vapor Monitor		<input type="checkbox"/> Sorbent Tube/Filter Pump						
Training Requirements (List specific training requirements)										
<b>Work screening has identified the following as the reason for permitted work:</b>				<b>When work is categorized as worker planned work and a permit is used only the following signatures are required: ( Although allowed, there is no need to use back of form)</b>						
<input checked="" type="checkbox"/> ESSH				WCC:		Date:				
<input checked="" type="checkbox"/> Complexity				Service Provider:		Date:				
<input type="checkbox"/> Work Coordination				Authorization to start:		Date:				
<input type="checkbox"/> Permit Not Required (Sections 3 through 7 optional)				(Department/Division, or their equivalent, Sup/WCC/Designee)						

**3. Both work requester and service provider contribute to work plan (use attachments for detailed plans)**

**Work Plan** (procedures, timing, equipment, scheduling, coordination, notifications, and personnel availability need to be addressed in adequate detail): See attached documentation for task descriptions and reference to related documentation.

Special Working Conditions Required (e.g., Industrial Hygiene hold points or other monitoring)  
None

Notifications to operations and Operational Limits Requirements:

Post Work Testing, Notification or Documentation Required:

Job Safety Analysis Required:  Yes  No      Review Done:  in series  team

**Reviewed by:** \* Primary Reviewer signature (not required for Worker Planned Work) means that the Review Team members were appropriate for the work that was planned, the Team visited the job site, hazards and risks that could impact ESSH have been considered and controls established according to BNL requirements. In addition, this signature indicates that applicable JRAs, FRAs, as well as other planning documents have been reviewed and training requirements have been identified and recorded on this permit.

Title	Name (print)	Signature	Life #	Date
ES&H Professional				
F&O Facility Project Manager				
Service Provider				
Work Control Coordinator				
Safety Health Representative				
Research Space Manager				
Other				
Other				
Required Walkdown Completed				
*Primary Reviewer				

**4. Job site personnel (Supervisor and workers) fill out this section.**

Note: Signature indicates personnel performing work have read and understand the hazards and permit requirements (including any attachments) and all training required for this permit is current/complete. Job Supervisor/Contractor Supervisor signatures also includes verification that worker training required for this permit is current/complete.

Job Supervisor:		Contractor Supervisor:	
Workers:	Life#:	Workers :	Life#:

Workers are encouraged to provide feedback on ESSH concerns or on ideas for improved job work flow. Use feedback form or space below.

**5. Department/Division, or their equivalent, Line Manager or Designee**

Conditions are appropriate to start work: (Permit has been reviewed, work controls are in place and site is ready for job.)

Name:	Signature:	Life#:	Date:
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**6. Worker provides feedback.**

**Worker Feedback (use attached sheets as necessary)**

a) WCM/WCC: Are there any changes as a result of worker feedback?  Yes  No

Note: See Work Planning and Control for Experiments and Operations Subject Area section 2.6.

**7. Post Job Review/Closeout: Work Control Coordinator (authorizing dept.) checks quality of completed permit and ensures the work site is left in an acceptable condition. (WCC can delegate clean up of job site to work supervisor.)** The WCC ensures that the change process to update drawings, placards, postings, procedures, etc., is initiated, if necessary.

Name:	Signature:	Life#:	Date:
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Comments:

# **Removal and Repurposing (R&R) of the PHENIX Central Magnet (CM), and comprising detector subsystems, support utilities and structural components**

## **Introduction**

The PHENIX Collaboration will remove and repurpose all components comprising the PHENIX Central Magnet (CM) including the magnet structure and flux returns, the magnet coils, all detectors mounted on the M carriage, work platforms, racks, cables, piping, flow distribution services and all other support structures and components attached to the CM carriage during the 2016 PHENIX Removal and Repurposing (R&R) shutdown after run 16. This document describes the work plan to remove and disposition (scrap, repurpose for future use, return to owner, etc.) these components. The disposition of these components will be determined by the PHENIX R&R manager and the disposition of these components will be recorded on the PHENIX R&R data base.

## **Disassembly Procedures**

### **Removal of electronics Racks, detector utilities and small support structures**

CM disassembly of utilities, racks, cables & cable tray, piping, working surfaces, flow distribution devices and small support structures (less than ~50 lbs) will be performed as worker planned work with close coordination between workers, work supervisors and work control coordinators on a daily basis. As each of these components are removed they will be scanned by BNL Health Physics (HP) for activation. Components found to be activated will be appropriately tagged and stored pending final disposition.

### **Removal of detector subsystems**

Removal and repurposing of the following detector subsystems which are mounted on the CM will have separate dedicated work planning/work permits as follows:

F/VTX (east and west) – Work permit # SDD-2016-019

BBC (north and south) - Work permit # SDD-2016-020

RPC1 (north and south) - Work permit # SDD-2016-021

### **Removal of the CM bridge Platform**

Removal and repurposing of the CM upper work platform (bridge platform) will be worker planned work performed by BNL riggers and carpenters in coordination with

PHENIX work control coordinator(s) as generally described in the attached Central Magnet Bridge Assembly Lifting Plan.

After the bridge is removed it will be scanned by BNL Health Physics (HP) for activation. If the bridge is found to be activated will be appropriately tagged. After HP evaluation the bridge platform will be stored for potential future use in an appropriate area as determined by the PHENIX R&R coordinator.

### **Removal of the RPC background shielding (North and South)**

Removal and repurposing of the RPC Background shielding (absorber) will be worker planned work performed by BNL riggers and carpenters in coordination with PHENIX mechanical technicians and work control coordinator(s). The procedure used to successfully install the absorbers during the 2010 summer shutdown is attached to this work permit for reference. In general the steps taken to install the absorbers should be followed in reverse order to remove the absorbers

After each section of absorber is removed it will be scanned by BNL Health Physics (HP) for activation. If the section is found to be activated will be appropriately tagged. After HP evaluation each absorber section will be stored for potential future use in an appropriate area as determined by the PHENIX R&R coordinator.

### **Disassembly of CM structural components**

After all detectors, services, work platforms and RPC Shielding/absorbers have been removed the major massive structural components which comprise the flux return, pole tips and coils of the Central Magnet will be disassembled by a TBD rigging subcontractor. Details of the disassembly procedure will be documented in a formal procedure to be submitted to the CAD ESRC for review and approval prior to commencing disassembly.

### **Work Permit Closeout**

After completion of all work described above, those involved in the coordination and implementation of the work described shall provide appropriate feedback on the effectiveness of the work procedures described herein, any lessons learned during this work effort and any other relevant information that could be useful to refer to when performing similar work in the future. Such feedback will be documented in the closeout section of this work permit and/or on separate sheets attached hereto.

# **Central Magnet Bridge Assembly Lifting Plan**

**Location:** Building 1008

**Total Weight of Lift:** Approx. 2500lbs

**Description of Material Being Lifted:**

Central Magnet Bridge Assembly is composed of:

4"x 4" x .1875" steel Box Beam

2" x 4" x .1875" steel Rectangular Box Beam

Assorted sized Steel Grating

**Dimensions:** See Attached Drawing

**Center of Gravity:** See Attached Drawing

**Equipment List:**

4X 12' Synthetic Slings

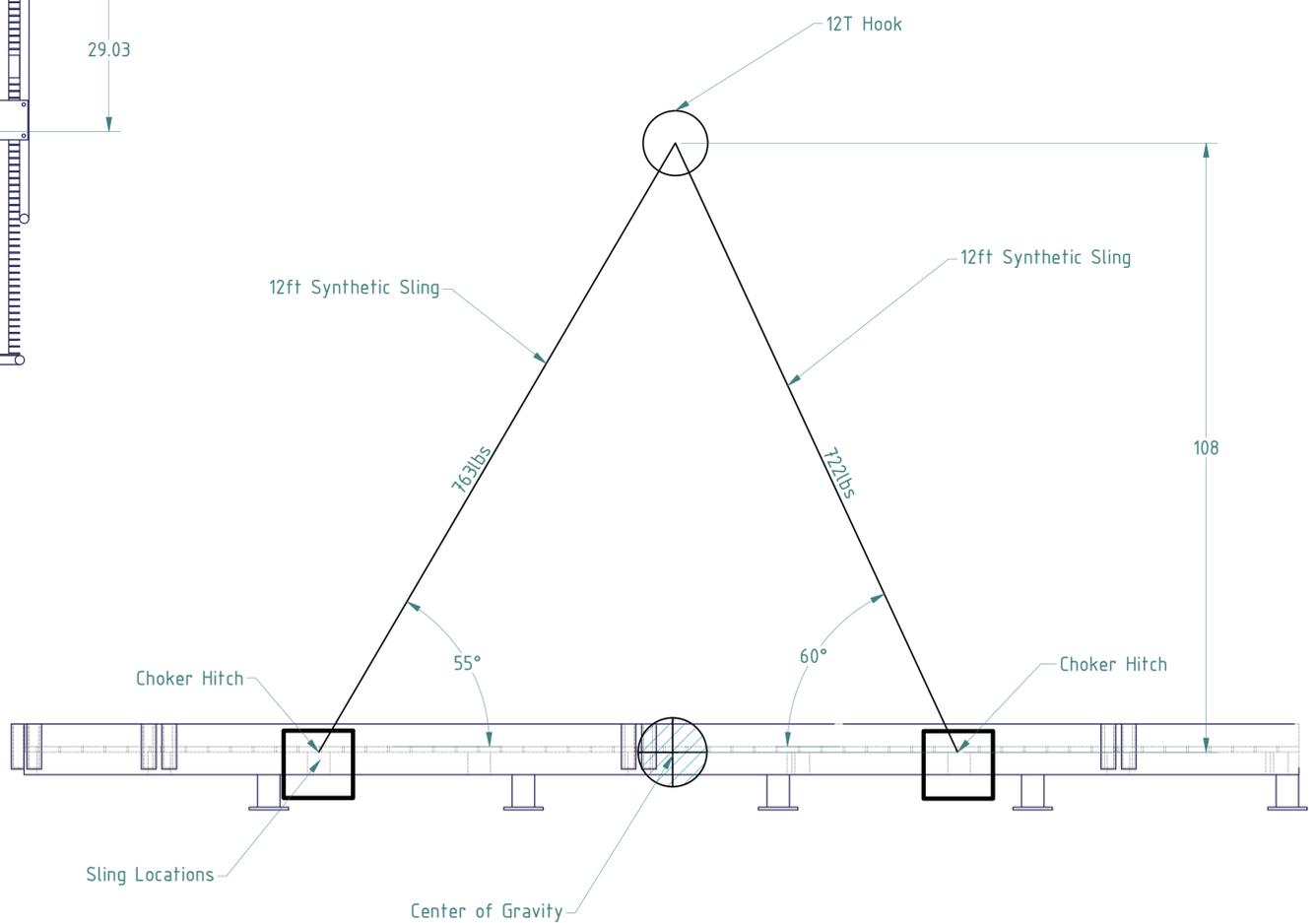
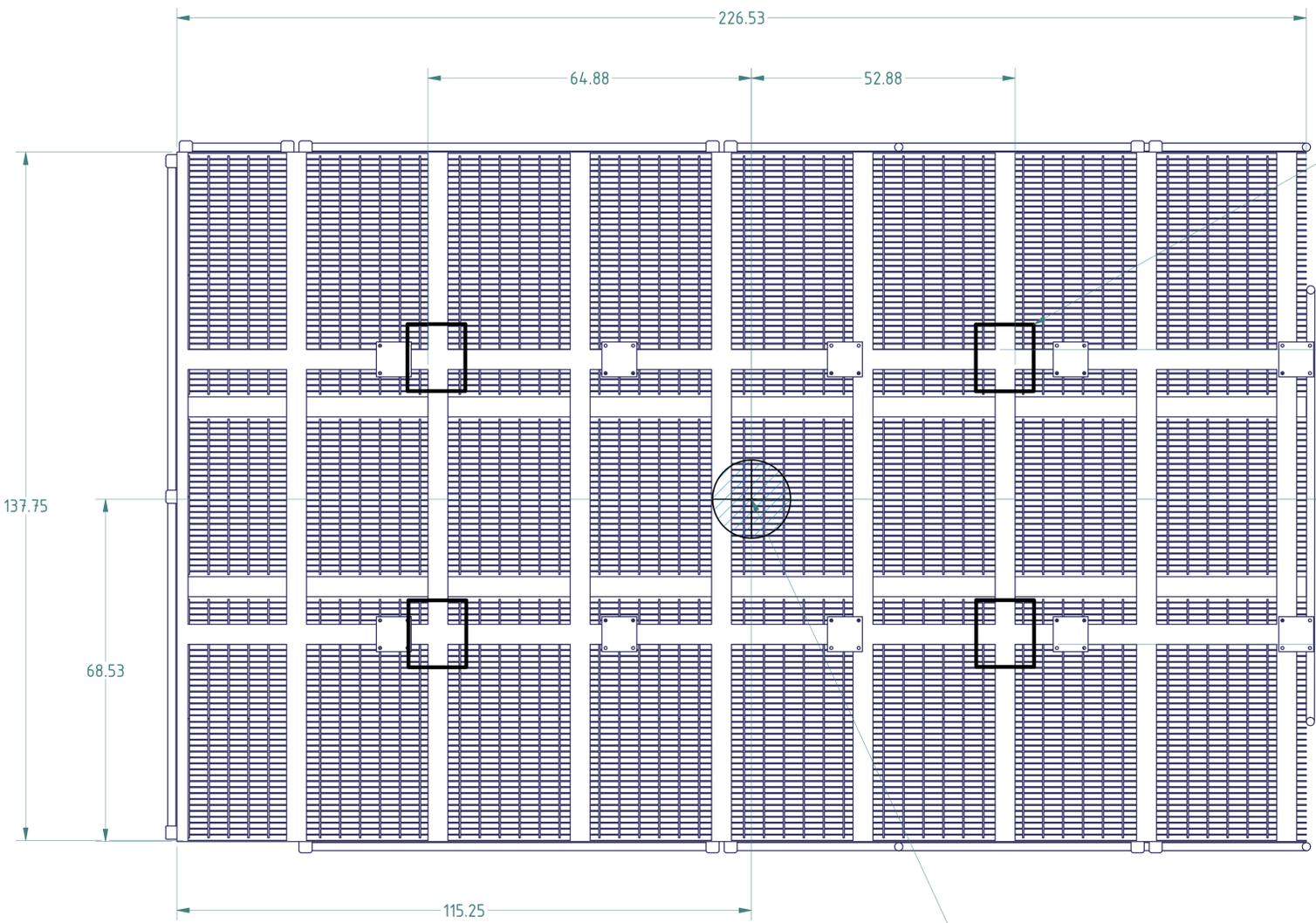
**Description of Lift:**

Four sections of steel grating will be removed above sling locations. 12' slings will be choked around a predetermined intersection of steel box beam. (See attached drawing for locations). Once slings are in place and attached to crane, bolts that attach bridge assembly to central magnet will be removed.

**All lifting operations must be conducted in accordance with ANSI standards and the DOE and OSHA requirements.**

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A		9/21/2016	

NOTES:



		<b>BROOKHAVEN NATIONAL LABORATORY</b> Upton, NY 11973	
<small>THIRD ANGLE PROJECTION          INTERPRET IN GENERAL ACCORDANCE          WITH ASME Y14.5M 1993          UNLESS OTHERWISE SPECIFIED          ALL DIMENSIONS ARE IN MILLIMETERS          DECIMAL TOLERANCES</small>		<b>PHENIX</b> Bridge Assembly Lift Plan	
<small>REVISION STATUS OF SHEETS</small>		<small>PROJECT SYSTEM</small>	
<small>REVISION STATUS OF SHEETS</small>		<small>MODEL/DRAWING NAME</small>	
<small>REVISION STATUS OF SHEETS</small>		<small>SCALE</small>	
<small>REVISION STATUS OF SHEETS</small>		<small>WEIGHT</small>	
<small>REVISION STATUS OF SHEETS</small>		<small>SHEET 1 OF 1</small>	

## **Installation of the RPC Absorbers in the PHENIX Central Magnet**

### **Introduction**

In the 2010 shutdown, the PHENIX experiment plans to install the second station of the new RPC detector subassembly in the RHIC tunnel south of the PHENIX IR. This mirrors the detector subassembly installed during the 2009 shutdown in tunnel north of PHENIX. In order to mask as much background scatter which might otherwise obscure the measurements intended to be made with the new subsystem, the RPC group has determined that a certain mass of material should be inserted between the PHENIX Interaction Point (IP) and the new detectors. RPC experts have calculated that this is best achieved by inserting 35 cm of steel between these points of interest, and furthermore, so as to minimally impact the CM field quality, the steel must be of low permeability. After many tradeoffs, type 310 Stainless steel was chosen.

### **I. Design**

The absorber design requirements call for 35 cm of type 310 stainless steel to be attached to the outer sides of the PHENIX Central Magnet (CM) central poles in the conical cavities surrounding the PHENIX Beam-Beam Counter (BBC) subsystem. The BBC's are housed in lead enclosures commonly referred to as the north and south "flower pots" (due to their shapes). The shape of the cavity is a frustum (truncated cone) within a frustum, the outer frustum formed by the inner walls of the cavity and the inner frustum by the flower pot, both frustums decreasing in diameter at the ends closest to the PHENIX IP. This creates a difficult design, fabrication and installation problem. PHENIX engineering's scheme for maximal coverage and feasible fabrication and installation is to fabricate the absorber in quadrants and 7 layers. This allows the absorber to be fabricated easily with conventional equipment and installed piecemeal so that the installing technicians have sufficient flexibility to maneuver the segments into place and attach the various sections. (Refer to the attached illustrated absorber installation plan for further information.)

The absorbers are supported initially by the shear strength of bolts attaching the segments to first the backplane of the CM pole, then the segments installed prior, and after positioned the vertical load is taken by 12 welded mounting lugs. These lugs will be welded to the CM in-situ by qualified Central Shops welder(s). The lugs have an adjustable bolt which shall be positioned to take the vertical load when the bottom segments are installed and prior to installation to the corresponding upper segments. (Refer to the attached illustrated absorber installation plan for further information.)

The design also requires a special installation tool for lifting and orienting the absorber segments. This tool is completely described in the PHENIX calculation #DRL-2010-3.

This tool lifts 2 or 3 segments at a time so that the lifting load is nearly uniform between lifts enabling the tool to maintain appropriate verticality for the variety of lifts to be performed. The 2 or 3 segments lifted are preassembled then lifted in to place as described in the procedures herein.

## **II. Fabrication**

Fabrication of the segments has been placed with an outside VENDOR thru the University of Illinois, Urbana. The Vendor, Atlas Tool and Die Works has promised a 6 week delivery schedule with partial delivery of the north absorber segments in early August. Mounting lugs, lifting fixture, base shim and welding the lugs to the PHENIX CM will be handled by BNL Central Shops, with assistance and a welding fixture/template to be fabricated by PHENIX technicians. Controlled drawings have been created, reviewed and approved by PHENIX Engineering and are available in the PHENIX/PHYSICS Design Room.

## **III. BBC Cable modifications.**

Installation of the absorbers requires modification of the BBC patch panels adjacent to the BBC's and flowerpots in both the north and south flowerpot vicinity cavities. The modification involves removing the existing patch panel and reworking the panel or the connectors on the panel to route the BBC cables away from the absorbers (which they would otherwise interfere with) and avoid any other interferences with the existing detectors, support structure and utilities. This is worker planned work that will be accomplished by PHENIX mechanical and electrical technicians in close consultation with PHENIX mechanical and electrical engineers. The modifications will be designed in the field at the point of installation after the absorbers have been installed and great care shall be taken to avoid damaging any cables or connectors when closing up the large PHENIX subsystems at the end of these efforts.

## **IV. Procedure**

This work is to be done by fully trained and experienced personnel (PHENIX mechanical technicians) during the 2010 summer shutdown.

(Please see the RPC Absorber Illustrated installation plan which accompanies this Work Permit for more detailed descriptions of each of the following steps.)

### **A. Prior to installation:**

1. Design an appropriate absorber lifting fixture (by PHENIX engineering to BNL lab standards for "below-the-hook" lifting fixtures, with documentation detailing design criteria and stress analysis assumptions), analyze the fixture (stress analysis for BNL Lifting Safety Committee [LSC] Review), obtain fixture approval (by independent CAD engineering), fabricate the fixture (using materials with appropriate

material certification documentation) and qualify the fixture (in accordance with BNL standards, with a lift test observed and approved by BNL LSC.

2. Characterize detail absorber pieces and measure tolerance (this may be done at the absorber segment vendor) and the results are to be used by PHENIX engineering to sort the pieces as best would allow the full assembly to meet assembly tolerance goals.
3. Remove the existing beampipe and move the CM off of the Beamline axis to a location in the IR whereat the north and south flowerpot region of the CM are maximally accessible. [Note: this is actually accomplished as part of the concurrent PHENIX beampipe upgrade project and has been planned with a separate work permit, # SS-2010-189. Refer to that WP for further info concerning this step.]
4. Modify the BBC cables and cable management as described above..
5. Install weld fixture and mounting stubs. (Central Shops in close coordination with PHENIX mechanical technicians per PHENIX controlled drawings).
6. A Central Shops certified welder shall weld the 24 mounting stubs (12 each on the north and south sides).
7. Install the threaded jack screws on each mounting stub, threaded away as much as possible from their nominal final design positions.

## **B. Absorber Installation**

The RPC Absorber is installed in 2 stations, north and south ends of the CM. The north side will be installed first. Each station includes 2 shim pieces and 28 quadrants. The quadrants are installed in preassembled groups of 3 or 2 layers per controlled drawings (105-0224-082 through 105-0224-085 and 105-0224-095). Installing these will require the use of a manlift and the RPC Absorber lifting fixture. The sequence of installation shall be as follows:

### **North Side**

*Note: The CM pole-tip back-planes (inner-most vertical surface in the flower pot cavities) have existing M24 tapped holes at approximately 1/2 the distance between the inner and outer radii of the inner-most absorber segments. These tapped holes are used to attach the inner-most segments to the back-planes and to temporarily hold the shims.*

1. Preassemble the 12 North segment assemblies per the applicable drawings. These assemblies include 4 assemblies of the inner most segments (east and west, upper

- and lower, layers 1 through 3), 4 assemblies of the mid segments (east and west, upper and lower, layers 4 and 5) and 4 assemblies of the outermost segments (east and west, upper and lower, layers 6 and 7). These preassembled segment assemblies are aligned and bolted together using M14 x 40 cap head screws, torqued to 50 ft-lb, max.
2. Attach the lifting fixture extension to the lifting fixture using (4) 1/2-13 x 1.5 inch grade 8 high strength bolts torqued to 35 ft-lb. Attach the 3/4 inch swivel eye to the appropriate lifting hole and torque the lifting eye to its rated value on the eye itself.
  3. Install 2 shims, these are to be positioned in place using M24 x 50 socket head cap screws to attach the shims to the flower pot cavity backplane into the existing M24 tapped holes corresponding to the upper 2 quadrants of the absorber assembly to hold the shim in place until the lower segments are installed. *Do not torque these bolts as they will be removed when the lower segments are installed.*
  4. Install the innermost segment assemblies. These 4 segment assemblies are installed one at a time (in the order: a. west lower, b. east lower, c. west upper and d. east upper). Installation for each segment proceeds as follows:
    - a. Rotated from flat to vertical installed position using the segment rotating fixture.
    - b. Attached the segment to the lifting fixture using (4) 1/2-12 x 1.5 inch grade 8 high strength bolts torqued to 35 ft-lb.
    - c. Install the two edge locating pins in the existing M24 tapped holes corresponding to the vertical and horizontal quadrant edges for the segment being lifted.
    - d. Attach a guide rope/tether to aid in orienting the segment as it is lifted.
    - e. Carefully lift the segment up to its mounting level and move it into mounting position using the locating pins to precisely position the segment assembly into its intended location. (Note: the lift shall involve 3 PHENIX mechanical technicians as follows: one operating the crane, one on a manlift or work platform at installation level, and a third technician as a back-up/watch person to assure that the lift area remains clear of uninvolved personnel, to watch for contact between the load, lifting fixture and or crane hoist and other equipment in the vicinity of the lift and to man the tether line to make sure the load does not turn, spin or otherwise move in an unexpected manner. Each of the 3 technicians shall take care to never position themselves below the load and/or lifting fixture.)
    - f. When the segment is properly positioned fasten it to the backplane using M-24x50 cap head screws, torqued to 150 ft lbs.
    - g. After each lower segment is installed jack the lifting screws in the welded mounting stubs 1/2 turn past initial contact.
    - h. After both lower segments have been installed the M-24 bolts that were holding the shims (see step 2 above) shall be removed.

- i. After the first and second segments have been installed only one additional locating pin need be installed as the other locating pin is shared with the previously installed segment. After the third segment is installed, the fourth segment's locating pins will already be in place from the installation of the first and third segments.
5. Remove the lifting fixture extension from the lifting fixture.
6. Install the 4 mid segments. These 4 segment assemblies are installed one at a time (in the order: a. west lower, b. east lower, c. west upper and d. east upper). Installation for each segment proceeds as follows:
  - a. Rotated from flat to vertical installed position using the segment rotating fixture.
  - b. Attached the segment to the lifting fixture using (4) 1/2-13 x 1.5 inch grade 8 high strength bolts torqued to 35 ft-lb.
  - c. Install the two edge locating pin mid extensions to the existing locating pins corresponding to the vertical and horizontal quadrant edges for the segment being lifted.
  - d. Attach a guide rope/tether to aid in orienting the segment as it is lifted.
  - e. Carefully lift the segment up to its mounting level and move it into mounting position using the locating pins to precisely position the segment assembly into its intended location.
  - f. When the segment is properly positioned fasten it to the corresponding inner-most segment using (4) 1/2-13 x 1-1/2 inch cap screws, torqued to 35 ft-lb
  - g. After each mid segment is installed jack the lifting screws in the welded mounting stubs 1/2 turn past initial contact.
  - h. After the first and second segments have been installed only one additional locating pin extension need be installed as the other locating pin extension is shared with the previously installed segment. After the third segment is installed, the fourth segment's locating pin extensions will already be in place from the installation of the first and third segments.
7. Install the 4 mid segments. These 4 segment assemblies are installed one at a time (in the order: a. west lower, b. east lower, c. west upper and d. east upper). Installation for each segment proceeds as follows:
  - a. Rotated from flat to vertical installed position using the segment rotating fixture.
  - b. Attached the segment to the lifting fixture using (4) 1/2-13 x 1.5 inch grade 8 high strength bolts torqued to 35 ft-lb.
  - c. Install the two edge locating pin mid extensions to the existing locating pins corresponding to the vertical and horizontal quadrant edges for the segment being lifted.

- d. Attach a guide rope/tether to aid in orienting the segment as it is lifted.
- e. Carefully lift the segment up to its mounting level and move it into mounting position using the locating pins to precisely position the segment assembly into its intended location.
- f. When the segment is properly positioned fasten it to the corresponding inner-most segment using (4) 1/2-13 x 1-1/2 inch cap screws, torqued to 35 ft-lb
- g. After each outer segment is installed jack the lifting screws in the welded mounting stubs 1/2 turn past initial contact.
- h. After the first and second segments have been installed only one additional locating pin extension need be installed as the other locating pin extension is shared with the previously installed segment. After the third segment is installed, the fourth segment's locating pin extensions will already be in place from the installation of the first and third segments.

### **South Side**

The installation procedure for the south side is the same as for the north side.

### **V. Work conclusion**

When all work described in this work permit has been completed, the PHENIX work coordinator for this set of tasks shall collect feedback from all parties (BNL trade groups, CAD engineers and technicians, PHENIX engineers and technicians and RPC experts). This feedback shall include critical review of any problems encountered during installation, solutions to such problems, changes to work procedures described herein during the conduct of this work, suggestions for improvements in equipment procedures and techniques and any other information deemed useful and/or relevant by the PHENIX work control coordinator. Such information shall be appropriately disseminated to the various affected/interested parties and a copy of this information shall be attached to this work permit when it is closed out.

## Absorber Installation

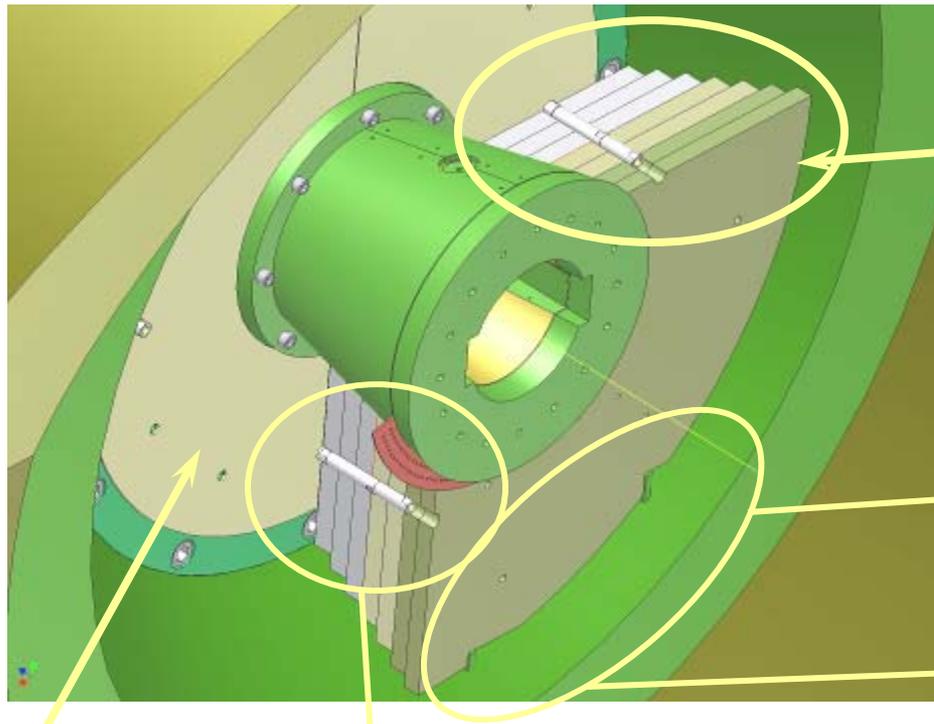
During the summer 2010 shutdown maintenance period PHENIX technicians will install nearly 20 tons of stainless steel in the "flowerpot" cavities on the north and south sides of the PHENIX Central Magnet (CM)

The absorbers will be made of 310 Stainless Steel, chosen for its low permeability and resistance to permeability changes due to thermal and mechanical fabrication processes.

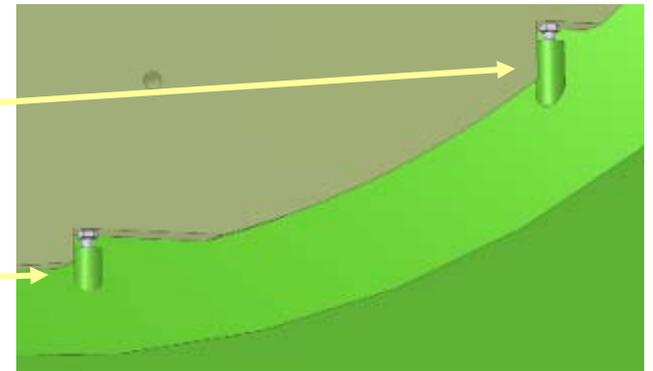
The absorbers will be made of 7 horizontal layers on each the north and south sides of the CM attached by bolts to the back plane of the respective CM poles at the first layer and each subsequent layer to the layer before it. The first 5 layers are each 2 inches thick while the last layer is 1-3/4 inches thick.

The layers are preassembled into 12 quadrant subassemblies with the four innermost quadrants comprised of the first 3 layers, the four middle quadrants comprised of 2 layers and the outermost quadrants comprised also of 2 layers. An additional shim layer is sandwiched between the innermost layers and the pole backplanes.

Additional support is provided from welded stubs on the conical face of the "flowerpot" cavities. These stubs are welded in 2 positions for each of the 6 lower quadrant subassemblies.

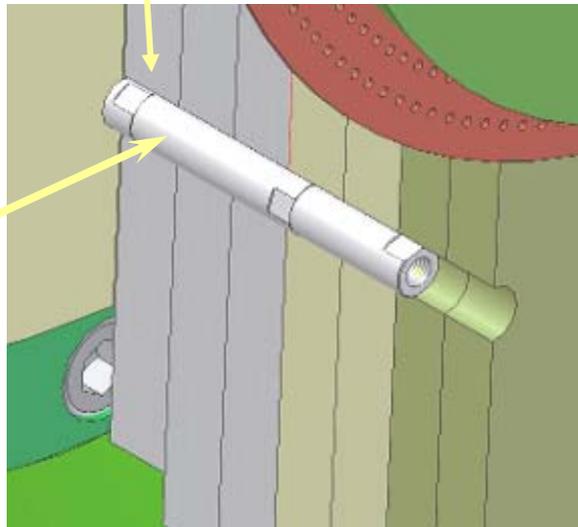


Absorber design concept:  
 7 layers, 4 quadrants per layer + 1  
 Shim layer Each layer indexed and  
 bolted to previous layer. Installed 3  
 in assembled quadrant 2 or 3 layers  
 using a counterbalanced lifting  
 fixture.



Shim layer

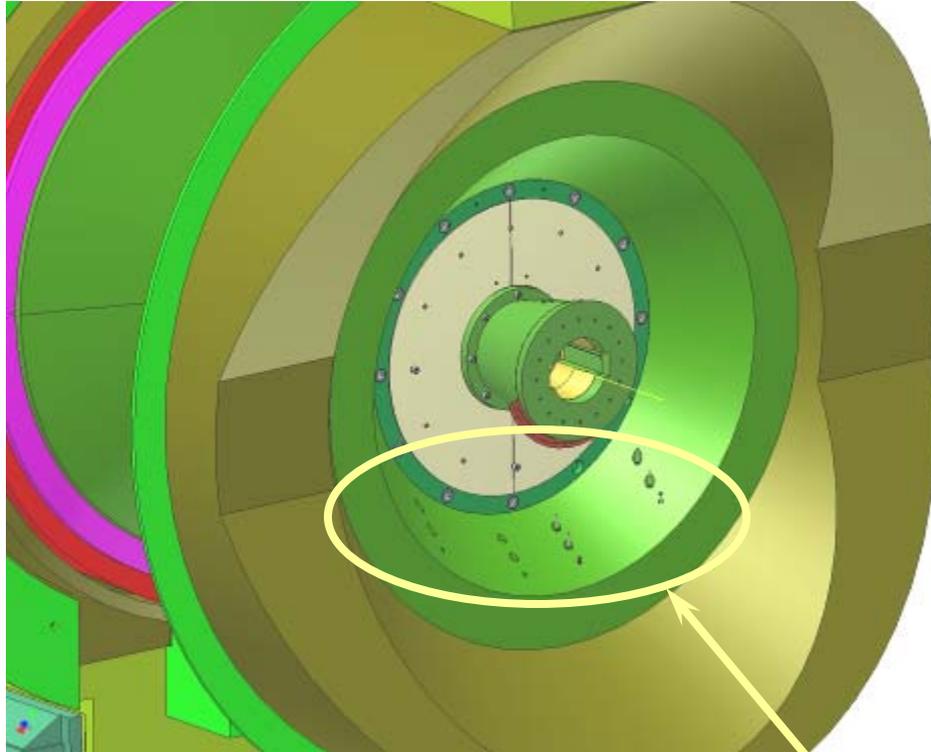
Guide pin and  
 extensions



### RPC Absorber Final Design

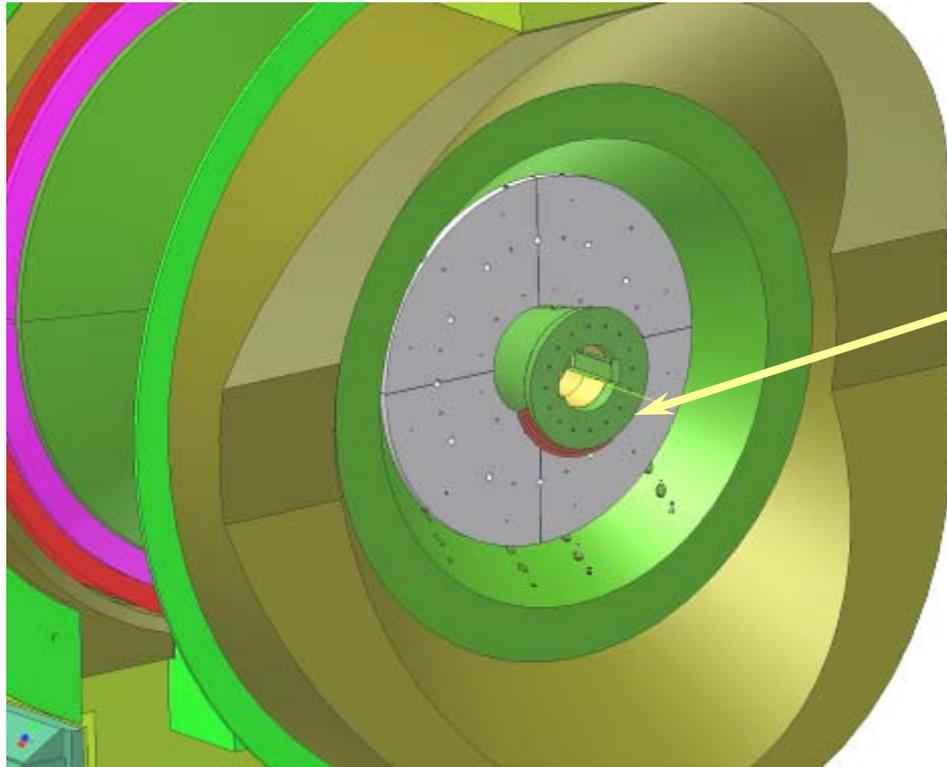
- Welded & tapped vertical support bosses
- 3 stage positioning rod

There are 12 support bosses (on each north and south), each using  $\frac{1}{2}$ -13 bolts for support. Worst case stress analysis 18,000 lbs, evenly distributed on bolts only=  
 $18000/12/.1416 = 10,600$  psi per bolt

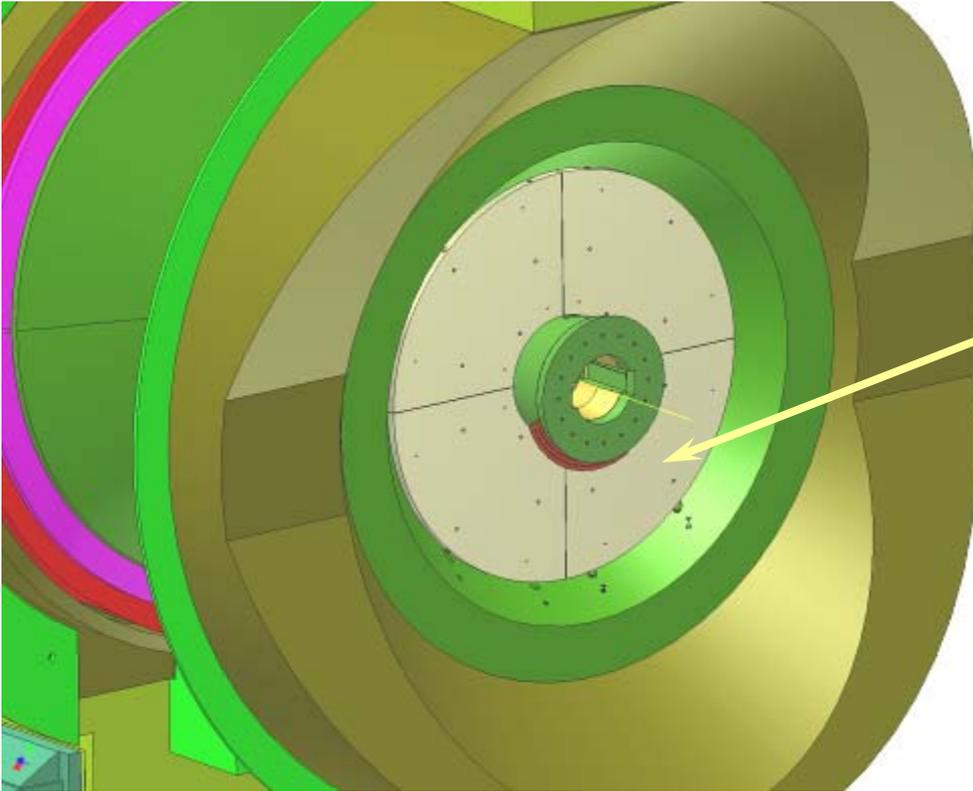


Shim layer installed

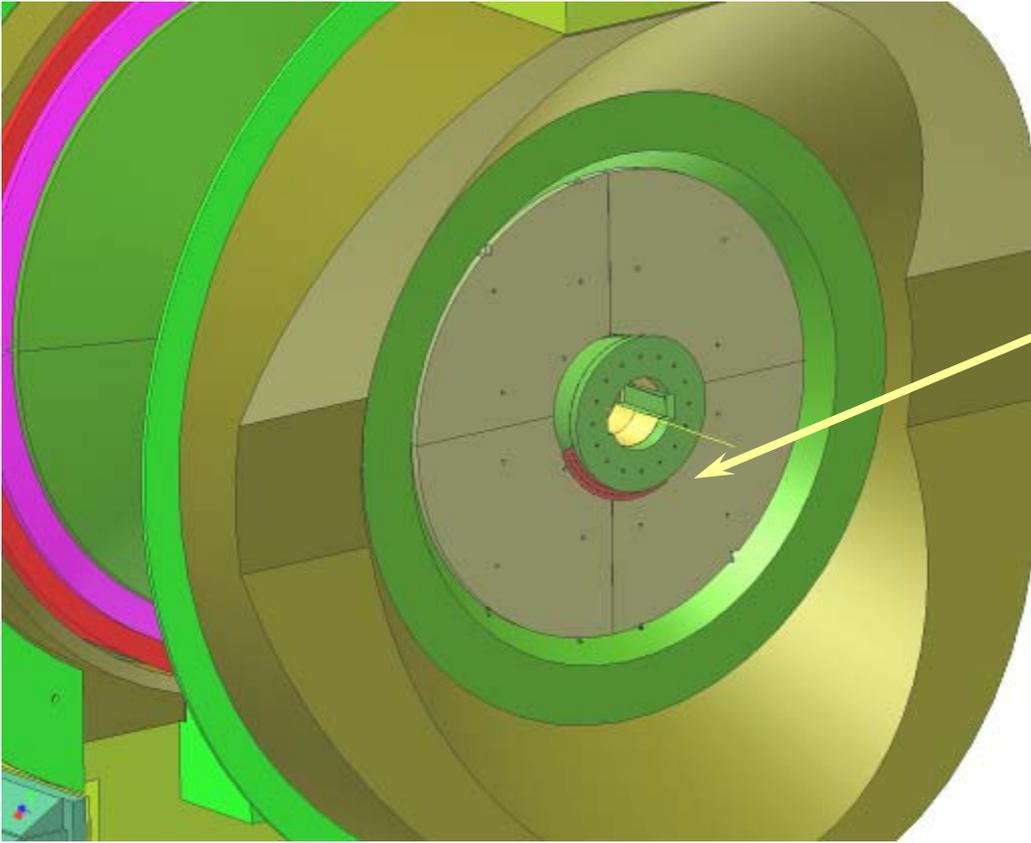
Vertical Support stubs installed



Inner-most quadrant  
subassemblies (layers 1-3)  
installed

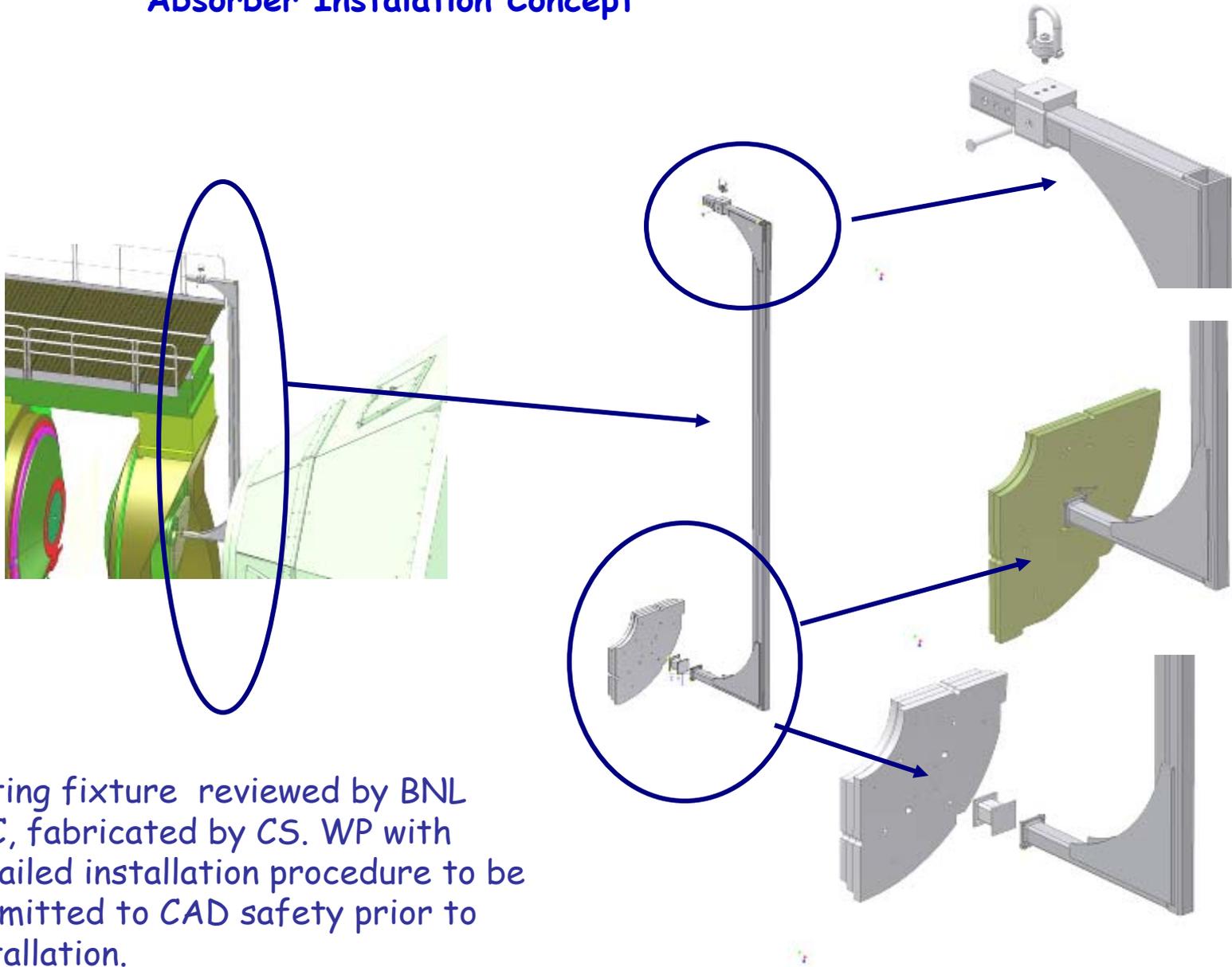


Inner-most quadrant subassemblies (layers 4 & 5) installed

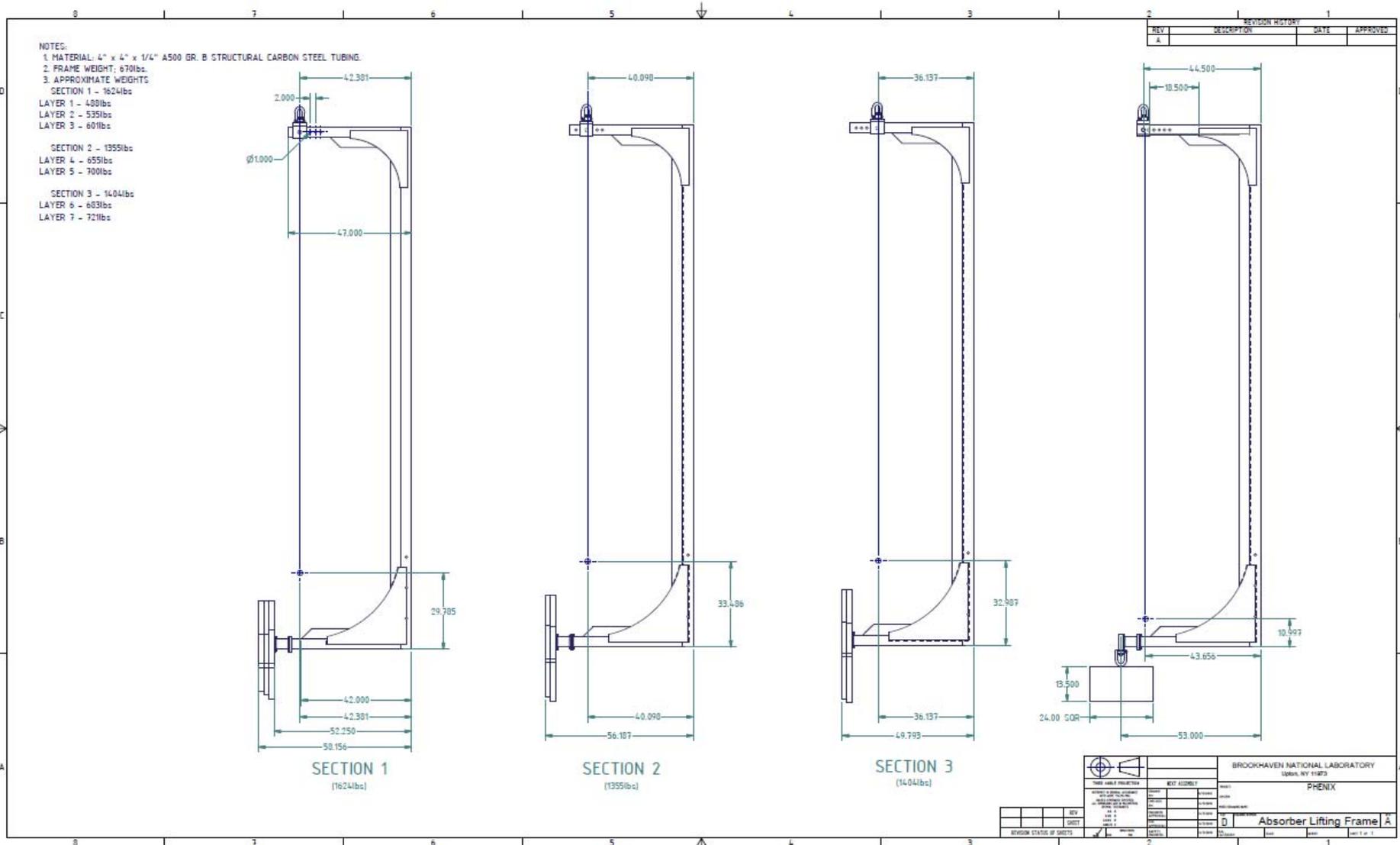


Inner-most quadrant subassemblies (layers 4 & 5) installed

## Absorber Instalation Concept



Lifting fixture reviewed by BNL LSC, fabricated by CS. WP with detailed installation procedure to be submitted to CAD safety prior to installation.



Lift Fixture is designed to work with any quadrant of the 3 subassembly configurations. Also designed for the load test configuration.