

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: Don Lynch	Date: 8/4/2016	Ext.: 2253	Dept/Div/Group: PO/PHENIX
Other Contact person (if different from requester): Carter Biggs			Ext.: 7515
Work Control Coordinator: Don Lynch		Start Date: 8/5/2016	Est. End Date: 10/15/2016
Brief Description of Work: Remove and Disposition north and south RPC1 detector subsystems			
Building: 1008	Room: IR	Equipment: RPC1 north & south	Service Provider: PHENIX and CAD techs

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

<b>ESSH ANALYSIS</b>							
<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 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 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	
<b>Environmental Concerns</b>				<input checked="" 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 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			
<b>FACILITY CONCERNS</b>				<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				
<b>WORK CONTROLS</b>							
<b>Work Practices</b>							
<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 checked="" type="checkbox"/> Scaffolding-requires inspection		<input type="checkbox"/> Warning Alarm (i.e. "high level")	<input type="checkbox"/> Electrical Inspection Required		
<b>Personal Protective Equipment</b>							
<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 type="checkbox"/> Hard Hat	<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	
<b>Permits Required</b> (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				
<b>Dosimetry/Monitoring</b>							
<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				
<b>Training Requirements</b> (List specific training requirements)							
CAD Access or User training, PHENIX Awareness, Working at heights where applicable, LOTO aware							
<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 type="checkbox"/> ESSH				WCC:		Date:	
<input type="checkbox"/> Complexity				Service Provider:		Date:	
<input type="checkbox"/> Work Coordination				Authorization to start:		Date:	
<input checked="" 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 procedure description.

Special Working Conditions Required (e.g., Industrial Hygiene hold points or other monitoring)

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:

## **Installation of RPC1 Detector Subsystems and Supporting Services in the North and South "Flowerpot" Cavities of the PHENIX Central Magnet**

### **Introduction**

After completion of the 2016 RHIC/PHENIX, the PHENIX experiment has completed its experimental mission and it is proposed to replace the PHENIX experiment with a new experiment that repurposes some components, utilities and infrastructure for a new experiment called sPHENIX. As part of this process the RPC1 detectors in the north and south Muon Magnets will be removed and repurposed. This effort will be worker planned work, essentially reversing the installation process, aided by the description of the design and installation of the RPC1 north and south which took place between 2010 and 2012, as excerpted and adapted in the remainder of this attachment.

### **I. Design**

The new RPC1 detectors are arranged in 360 degree array around the beampipe in both the north and south station 1 areas of PHENIX as described above. The north and south subsystems are identical and each is comprised of 8 octant independently mounted and aligned detector modules. Each module contains 2 gas moderated active detectors known as "gaps", which are sealed modules which generate precise signals as the tracked particles pass through. The signals are processed electronically by local electronics on each module and the signal routed first to identical north and south rack mounted processing electronics located on the CM bridge platform. From there the processed signals are routed via fiber optic cables to data processing and analyses in rack mounted electronics in the PHENIX rack room and to the PHENIX data acquisition system (DAQ).

High voltage support for the detector modules, low voltage for module level electronics are routed from the bridge racks to the detector and managed in cable trays. Gas services to the detector modules are provided via a gas distribution manifolds, flow meters and polyflow distribution tubing, sourced from the existing RPC gas system control rack (already in place in the PHENIX gas mixing house. The details of the support structure and services design are documented in PHENIX controlled drawings. The design is illustrated in the RPC1 illustrated installation plan (attached). Each module octant weighs less than 50 lbs. and will be installed by PHENIX technicians accessing the area with scaffolding. (Note: the scaffolding used has been designed for general purpose use in the station 1 areas of PHENIX, and will already be in place due to Muon Tracker subsystem maintenance also taking place this shutdown. The scaffolding is fully described in the work permit for that project and which is referenced herein.)

## **II. Removal Procedure**

This work is to be done by fully trained and experienced personnel (PHENIX mechanical technicians) during the 2016 maintenance shutdown subsequent to RHIC run 16 or later, as convenient to the overall PHENIX removal and repurposing (R&R) project .

### **Prior to removal:**

1. Read and understand all components of the work permit and attachments for this installation effort.
2. Scaffolding will either be already installed or be reinstalled in the appropriate station 1 gap between the appropriate muon magnet (north or south) and the CM, erected at the height appropriate for removal of the upper RPC1 modules. The scaffolding will have been erected in per separate work permit (MPC-Ex removal, see WP SDD-2016-011 for further information including postings and approvals required for scaffold assembly and use)
3. Cover the exposed section of beampipe on the north side of the CM flowerpot area with thick foam insulation. In conjunction with the scaffolding erected for other work. A rigid mechanical barrier is to be erected around the foam covered beampipe. Verify that the rigid barrier (beampipe protection) is in place before proceeding with the removal of MPC-Ex components. This barrier shall remain in place during the entire removal process or until the beampipe is removed. (Note: overall work coordination for the PHENIX R&R project may decide it is more convenient to remove the beampipe before removing the RPC1's, in which case the barrier will not be necessary.)
4. Remove all cables, cooling lines, front end modules, etc. by hand, until only the RPC1 modules remain.

### **RPC1 Detector Removal**

1. One at a time beginning with the upper most octant, remove the outer and inner mechanical support and alignment bracketry and lift the module by hand (2 technicians required) to the work platform.
2. Using appropriate slings, lift the octant from the work platform to the IR floor.
3. Technicians shall lift the octant by hand and position it in its respective position, aligned by the inner support ring.

4. Each module will be surveyed for activation after removal then dispositioned (scrapped or moved to temporary storage) as determined by the PHENIX R&R manager.
5. After the top three octants have been removed, the scaffolding shall be re-configured to the lower work platform configuration. (Refer to the scaffolding portion of the MPC-Ex work permit referenced above for details.)

*Note: The Illustrated installation plan for the RPCI's utilized in the PHENIX 2011 shutdown is attached for reference purposes.*

## **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 (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. Any lessons learned shall be applied to future installations and/or maintenance/upgrades for this and similar projects.

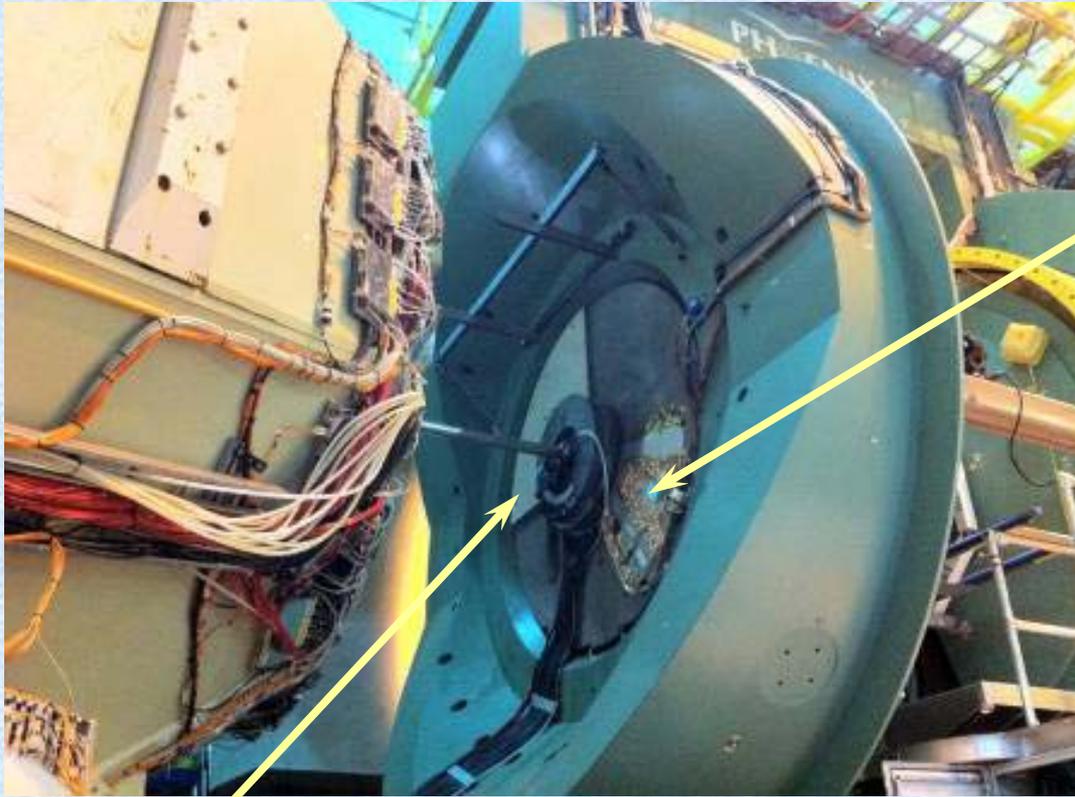
**Illustrated Installation Plan  
For  
RPC1 PHENIX Detector Subsystem**

RPC1 detectors are fabricated as 8 identical octants and are the same on both the north and south.

Steel absorbers installed during shutdown 2010 proved to be beneficial during run 11 and will remain in place unchanged. PE and Pb absorber testing of prototype during run 11 indicated negligible benefit of absorbers as originally planned. Therefore no PE nor Pb absorbers are to be installed.

Individual octants weigh less than 50 lbs each and shall be individually installed and mounted by hand. IR Crane and appropriate slings may be utilized to stage the individual octants.

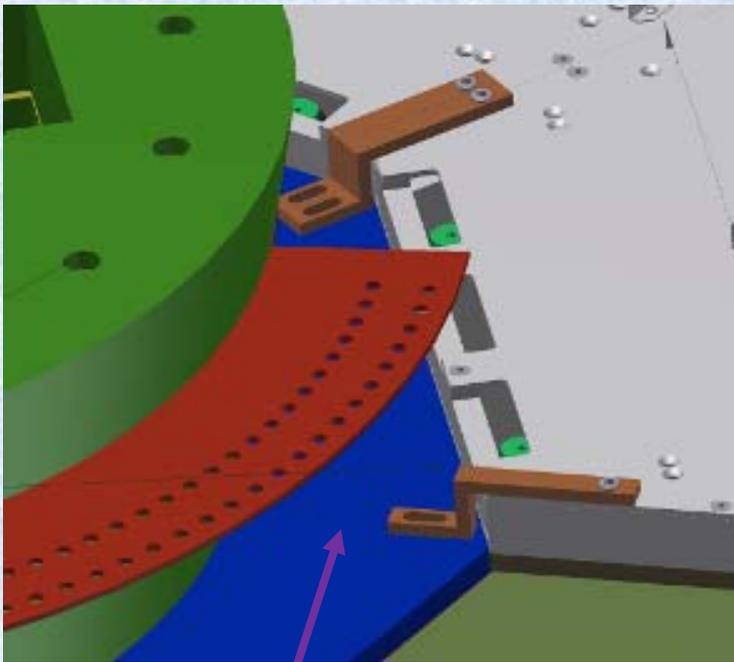
Work platforms installed for MuTr work will be utilized for RPC1 Installation.



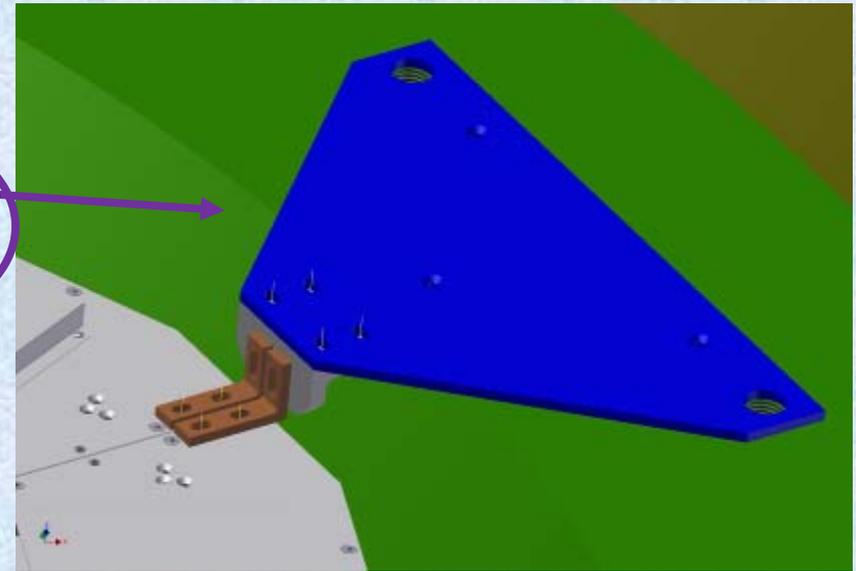
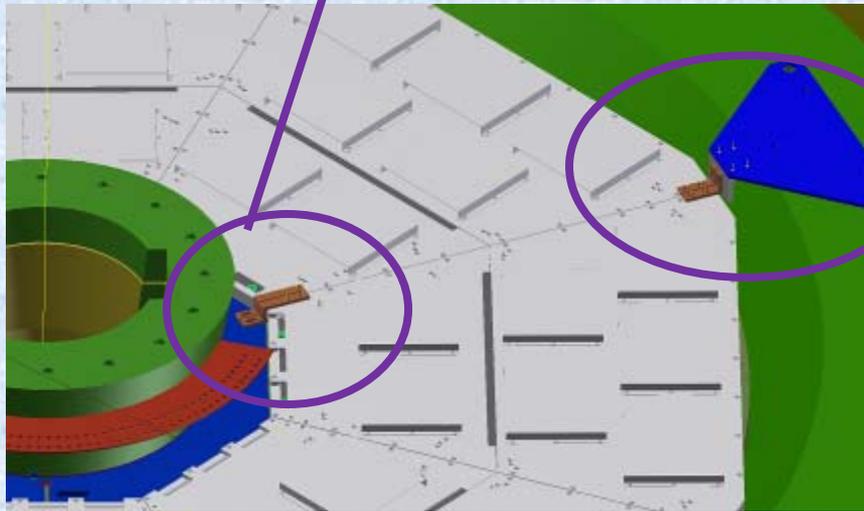
RPC1 prototype installed in the south CM station 1 flowerpot area. The prototype and its services have been removed from this area. The RPC1 south detector octants will be installed in this area. The RPC1 north detector octants will be stored in the similar location on the north side of the CM.

RPC1 prototype PB and borated PE absorbers installed in the south CM station 1 flowerpot area. These absorbers and supporting hardware have been removed from this area. Absorbers of this type have been determined to be unnecessary for the new RPC1 .

## RPC1 Mounting Concept



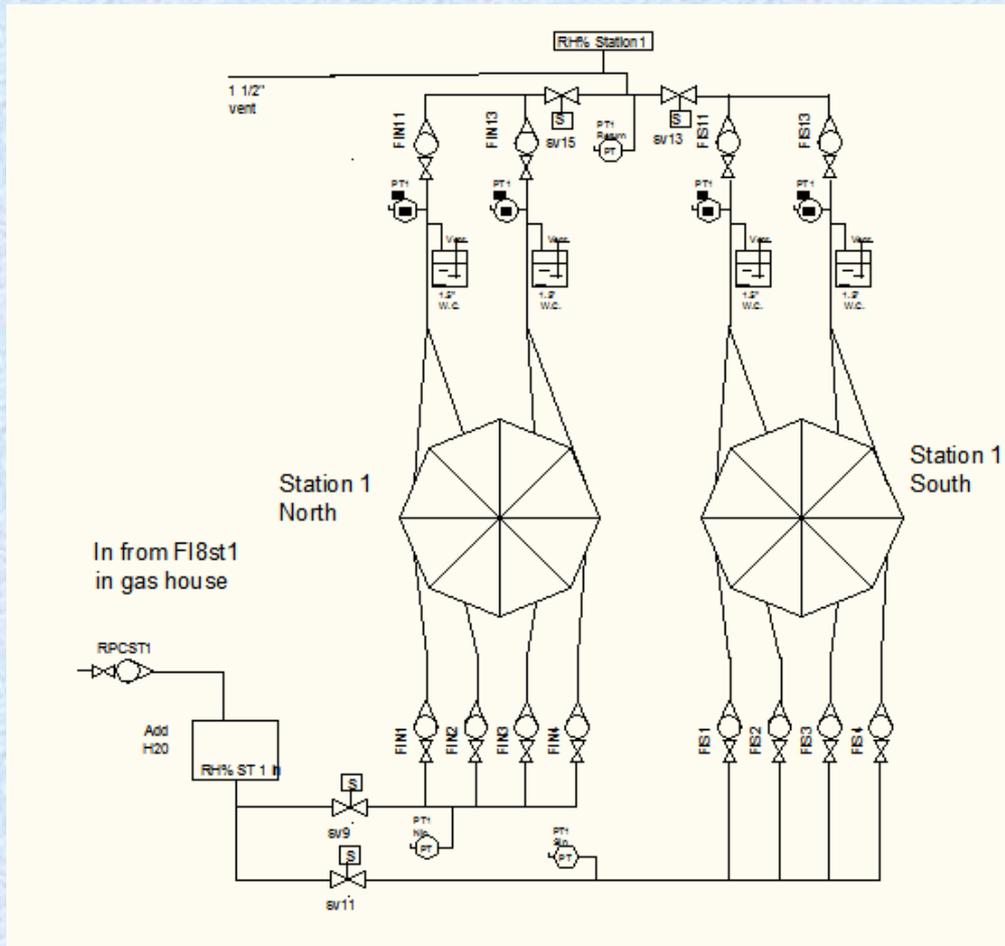
Octants are individually mounted then tied together and supported at the outer octant boundaries by brackets mounted on existing tapped holes, and on inner edges by rings which wedge against the flower pot lead liner. Tapped holes in 8 places on each octant are used both to mount the absorber section and to attach the mounting brackets.



# RPC1 Electronics

- Add one PHENIX electronics rack to bridge - CMT6.
- Add three more FEE crates, one for south (CMT1) and two for north (CMT6) .
- Four FEE boards per octant. Total: 16 FEE boards in each of 4 crates.
- Install 16 LV cables: 8 south and 8 north.
- Install 256 signal cables: 16 per octant per side.
- All new components are the same as previously approved RP3 installations.

# RPC1 Distribution System



RPC1 channel in the gas house and gas lines to the Central Magnet already exists (old HBD lines). They were already used to run the RPC1 prototype for Run 11

Current RPC1 Prototype rack



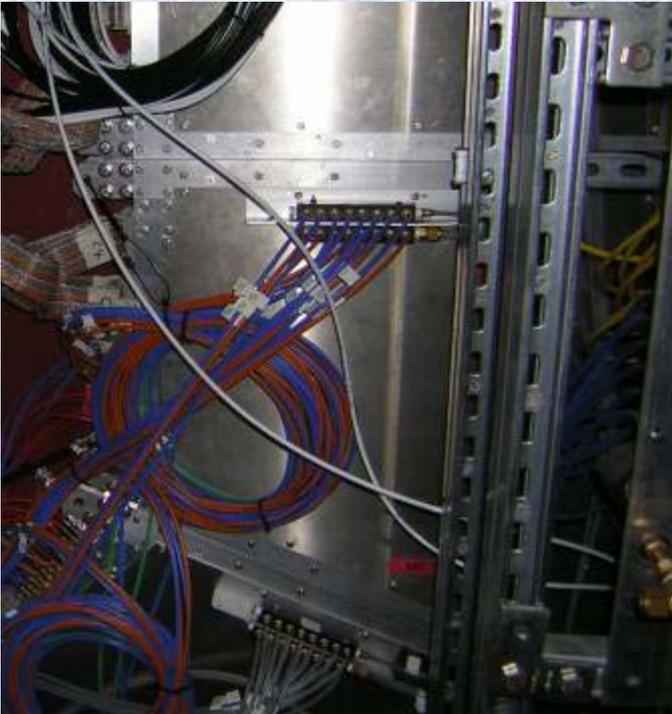


RPC1 South Panel

RPC1 North Panel

Cooling System

# RPC3 Distribution Upgrade



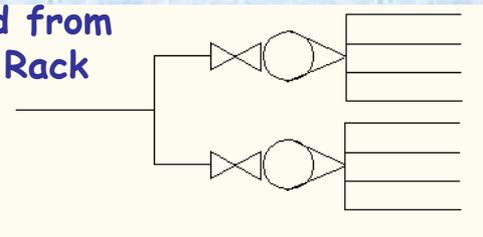
Currently each manifold feeds 4 modules  
Plan is to add 2 flometers to the manifold to feed 2 modules each

Feed from  
Gas Rack

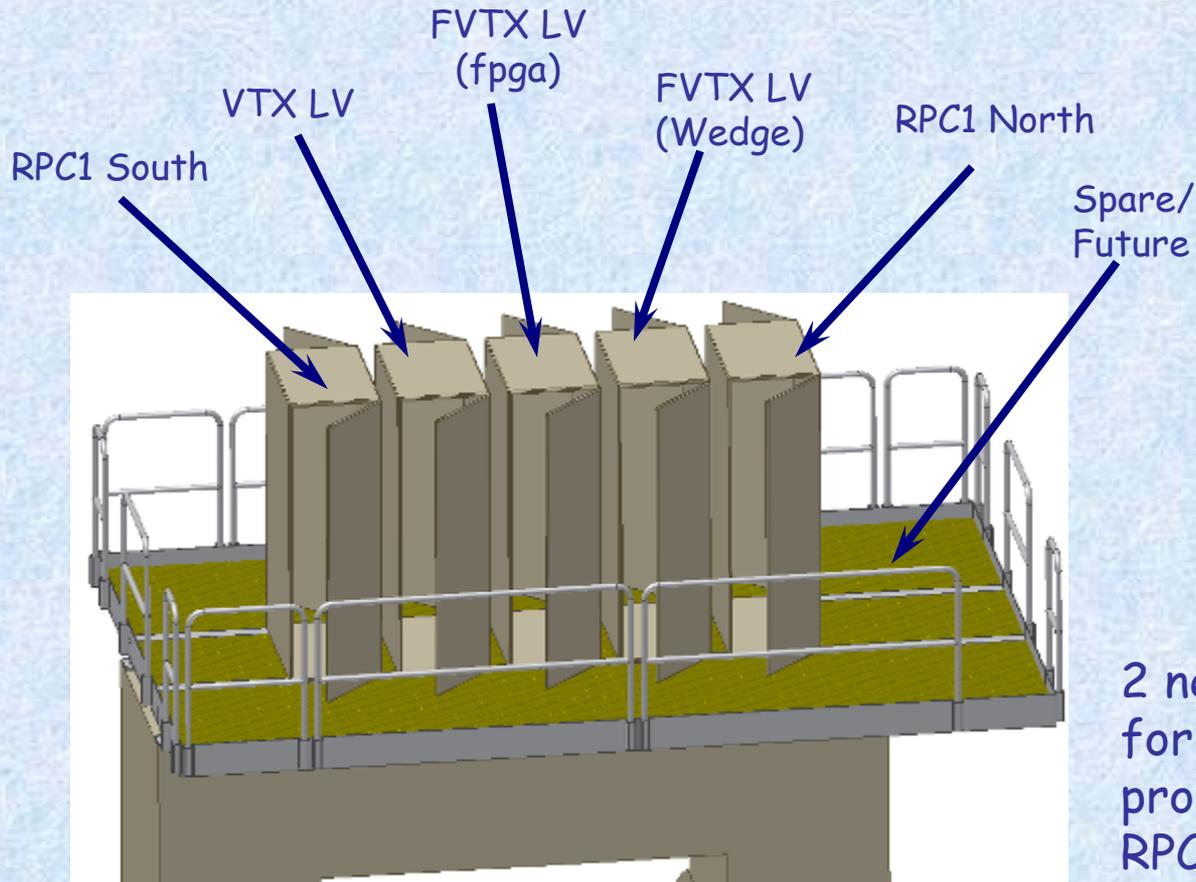


Before

Feed from  
Gas Rack

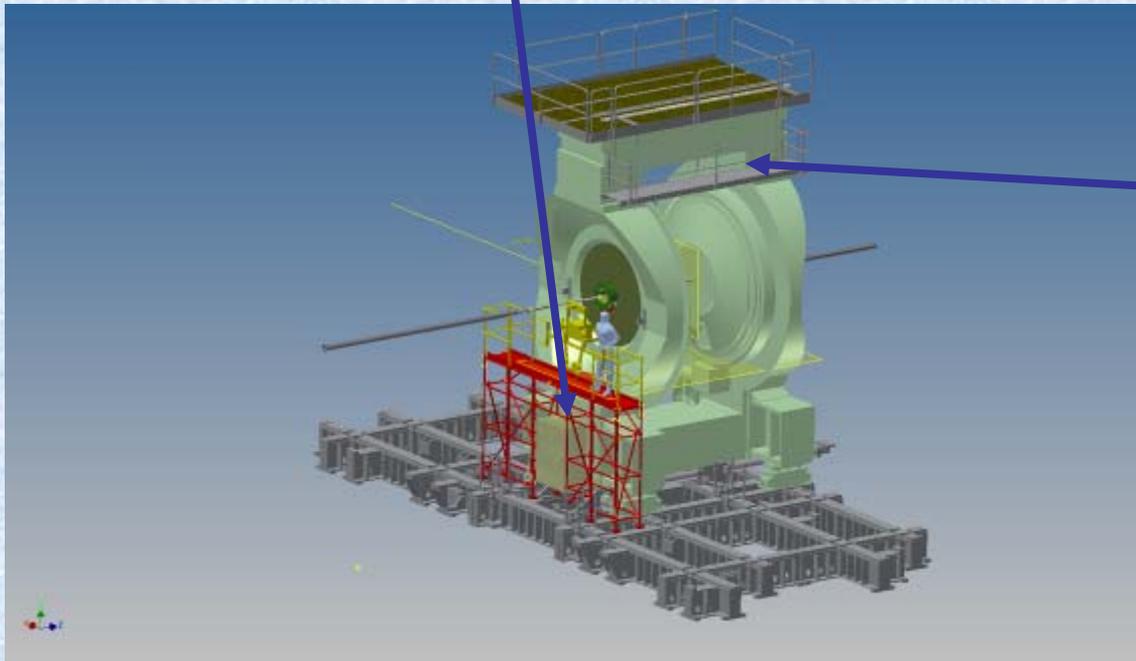
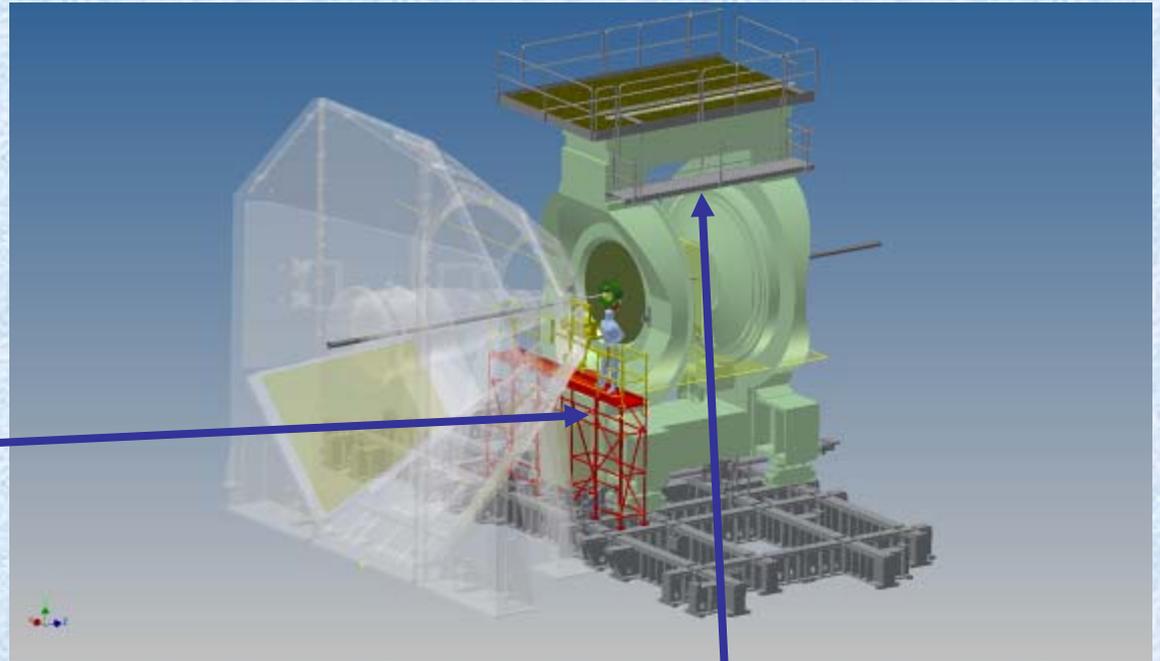


After



2 new racks to be added for FVTX, 1 new and prototype upgraded for RPC1. All racks will be equipped with standard PHENIX heat, smoke and water leak detection.

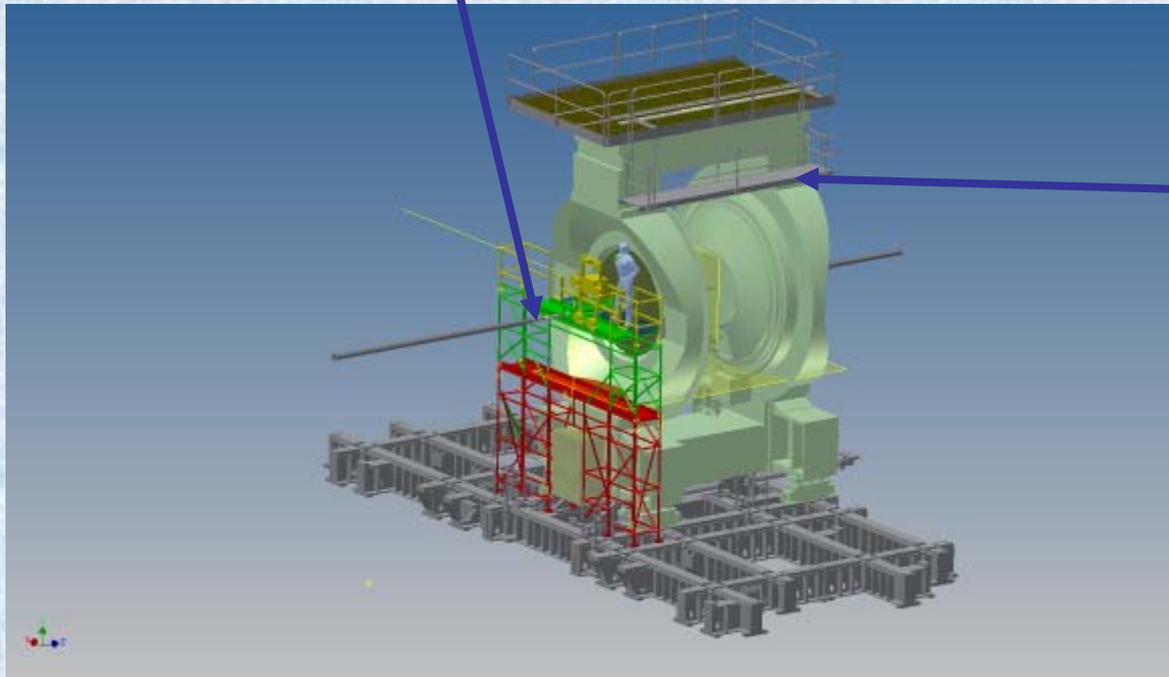
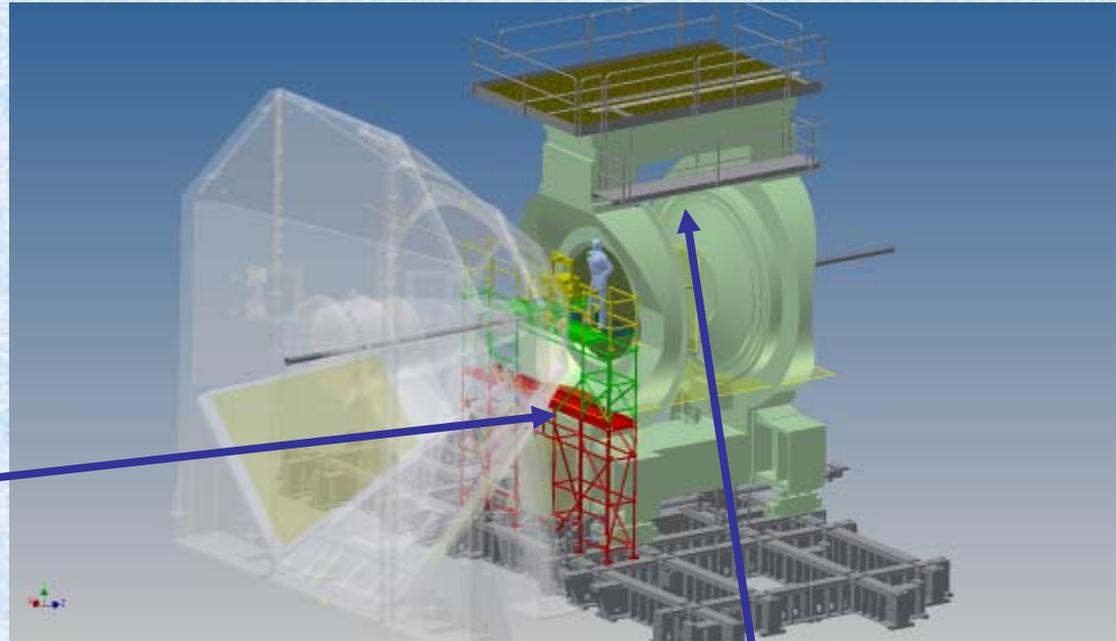
Station 1 platform configured for lower level access shown with North Muon Magnet in phantom for reference and invisible for clarity.



Central Magnet suspended work platform also shown in both models.

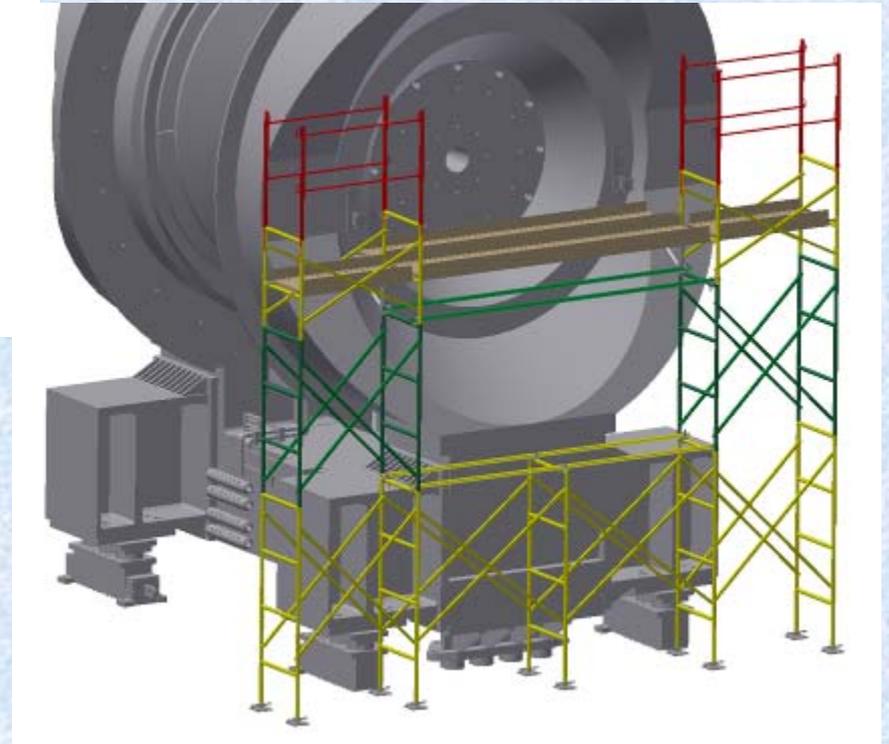
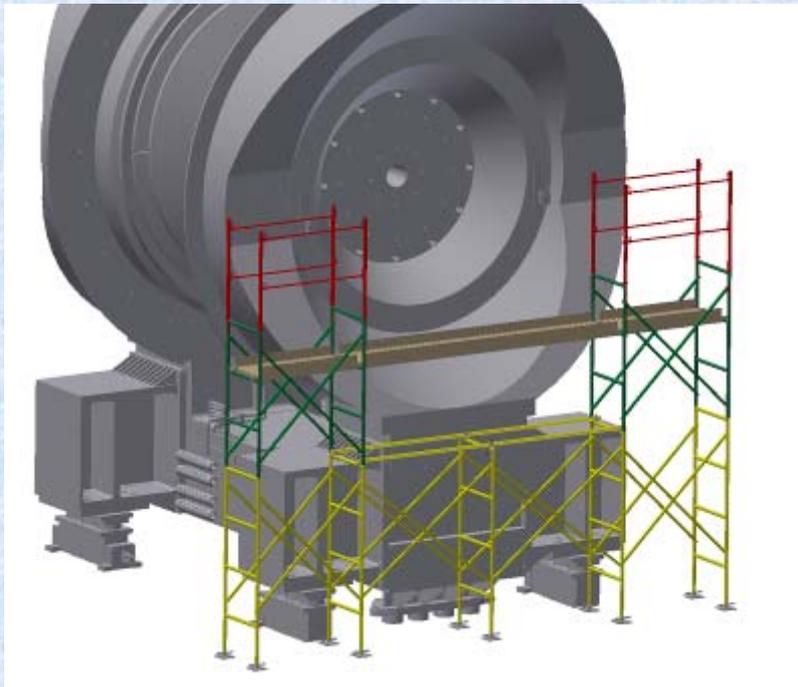
down

Station 1 platform configured for upper level access shown with North Muon Magnet in phantom for reference and invisible for clarity.



Central Magnet suspended work platform also shown in both models.

down



# Station 1 scaffolding: redesigned to use SAFWAY pre-engineered free standing scaffold.

