

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: 7/9/2012	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: 7/16/2012		Est. End Date: 10/1/2012
Brief Description of Work: Repairs and Upgrades to MuTr Station 1 South and north side of Station 2 South			
Building: 1008 & RPC Factory	Room: IR, AH & RPC Tent	Equipment: MuTr Station1 & 2 S	Service Provider MuTr Experts & PHENIX Techs

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

<b>ESS&amp;H ANALYSIS</b>							
<b>Radiation Concerns</b>	<input checked="" type="checkbox"/> None	<input 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 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	
* 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)			<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"/> Oil/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"/> Underground Duct/Piping
Waste disposition by: <input type="checkbox"/> Other							
<b>Pollution Prevention (P2)/Waste Minimization Opportunity:</b>			<input 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"/> Configuration Management			<input type="checkbox"/> Impacts Facility Use Agreement		<input type="checkbox"/> Temperature Change		<input type="checkbox"/> Other
<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 checked="" type="checkbox"/> Back-up Person/Watch		<input type="checkbox"/> HP Coverage		<input type="checkbox"/> Posting/Warning Signs		<input type="checkbox"/> Time Limitation	
<input type="checkbox"/> Security (see Instruction Sheet)		<input type="checkbox"/> Other		<input type="checkbox"/> Warning Alarm (i.e. "high level")		<input type="checkbox"/> Electrical Inspection Required	
<input type="checkbox"/> Barricades		<input type="checkbox"/> IH Survey		<input checked="" type="checkbox"/> Scaffolding-requires inspection		<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 appropriate		<input type="checkbox"/> Lab Coat	
<input checked="" type="checkbox"/> Safety Glasses as appropriate		<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		<input type="checkbox"/> High visibility cloths/vest		<input type="checkbox"/> Other	
<b>Permits Required (Permits must be valid when job is scheduled.)</b>							
<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 (List specific training requirements)</b>							
Based on analysis above, the Review Team determines the risk, complexity, and coordination ratings below:							
<b>ESS&amp;H Risk Level:</b>				If using the permit when all hazard ratings are low, only the following need to sign: (Although allowed, there is no need to use back of form)			
<input checked="" type="checkbox"/> Low		<input type="checkbox"/> Moderate		<input type="checkbox"/> High		WCC: _____ Date: _____	
<input checked="" type="checkbox"/> Low		<input type="checkbox"/> Moderate		<input type="checkbox"/> High		Service Provider: _____ Date: _____	
<input checked="" type="checkbox"/> Low		<input type="checkbox"/> Moderate		<input type="checkbox"/> High		Authorization to start _____ Date: _____	
(Department/Division, or their equivalent, Sup/WCC/Designee)							

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

<b>Work Plan</b> (procedures, timing, equipment, scheduling, coordination, notifications, and personnel availability need to be addressed in adequate detail):				
See Attached				
Special Working Conditions Required (e.g., Industrial Hygiene hold points or other monitoring)				
None				
Notifications to operations and Operational Limits Requirements: None				
Post Work Testing, Notification or Documentation Required:				
Job Safety Analysis Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			Review Done: <input checked="" type="checkbox"/> in series <input type="checkbox"/> team	
<b>Reviewed by:</b> * Primary Reviewer signature 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 ESS&H 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	Don Lynch		20146	
Safety Health Representative				
Research Space Manager				
Other				
Other (PHENIX Escort)				
Required Walkdown Completed				
*Primary Reviewer				

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

<b>Note:</b> 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 ESS&H 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:

**6. Worker provides feedback.**

<b>Worker Feedback (use attached sheets as necessary)</b>
a) WCM/WCC: Are there any changes as a result of worker feedback? <input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Note:</b> 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:
Comments:			

**MuTr Station 1 & 2 South Re-Capacitation, Upgrade and Overhaul****INTRODUCTION**

In the 2011 shutdown and into the 2012 shutdown, the PHENIX experiment has been performing overhaul maintenance on the Muon Tracker (MuTr) detector stations 1 North and South. The MuTr is an important component of the PHENIX experiment which has served well over the first decade of PHENIX running but has been experiencing high voltage (HV) problems of late due to systematic failures of grounding/capacitance circuits which protect the detector circuits against sensitivity to various environmental conditions (high humidity) and reduces noise problems. The original capacitance/grounding issues were corrected by removing failed capacitors. While this addresses the problem under normal environmental conditions it does not protect against all conditions. These now need to be replaced with new more robust capacitors to fix the remaining HV problems.

In order to install the new capacitors, the station 1 MuTr detectors need to be unmounted from their current installed position on the north and south sides of the PHENIX Central Magnet (CM) and worked on in a controlled environment. During the summer 2011 maintenance shutdown, Station 1 North was demounted, transported to the RPC factory (in the AGS building) for upgrade in the relatively clean environment of the factory, and re-installed into the PHENIX detector in the same location after they were serviced. The removal and reinstallation of the MuTr station 1 detector subsystems required the use of a vacuum lifting device. This device was purchased by the Los Alamos Lab group for the PHENIX experiment approximately 10 years ago specifically for the original installation of the MuTr station 1 detector subsystem. The lifting fixture has been re-analyzed and re-certified for the current intended utilization. For more information on this lift fixture refer to PHENIX Document # DRL-ECD-2011-002 "MuTr Vacuum Lifting Fixture".

In addition, MuTr experts performed repairs on the station 2 North MuTr detectors from the station 1 side access created by removing station 1. This required additional access features which were devised and implemented by PHENIX engineering utilizing existing features of the MMN magnet and the station 1 scaffolding

Access to the station 1 MuTr equipment was achieved using scaffolding as designed by PHENIX engineering from standard steel scaffolding parts. For more information on this scaffolding refer to PHENIX Document # DRL-ECD- 2011-001" "PHENIX MuTr Station 1 Work Platforms".

During the 2012 shutdown these same techniques and equipment will be used to affect the same upgrades and repairs on the Station 1 South and the north side of Station 2 South.

**1. MuTr station 1 (north and south) removal/re-installation procedure.**

(The MuTr Station 1 North and South Upgrade and Overhaul Project Plan is attached to this report. It has illustrations and descriptive discussion of the various tasks involved including the removal and installation of the MuTr station 1 components. This plan provides useful illustrations for some of the steps in the procedure described in the next few sections of this report.) The removal/installation procedure for the MuTr station 1 components has been designed by PHENIX engineers in the following subsections. **(Please note that the procedure to be used is essentially the same for the north and south stations 1.)**

The weight of each MuTr station 1 quadrant is 125 lbs.  
The weight of each MuTr station 1 FEE plate is 675 lbs.

## **1.1 Equipment List**

- 1.1.1** ANVER vacuum lifting fixture, model # ET-100M8-MR-SP, Serial # 974808, rated load capacity 1000 lbs.
- 1.1.2** Guide ropes, as required
- 1.1.3** Shackles rated for a minimum of 1000 lb
- 1.1.4** Two swivel hoist rings rated for a minimum 800 lb load
- 1.1.5** Nylon slings rated for a minimum of 1000 lb load.

## **1.2 Preparations**

- 1.2.1** Prior to commencing the installation all equipment is to be checked for current inspection tags, and visually inspected in accordance with BNL lifting safety requirements.
- 1.2.2** Access, work platforms and scaffolding shall be in place, inspected and approved by a competent person (in scaffold erection) prior to commencing removal of the MuTr station 1 detector subsystems and related hardware.
- 1.2.3** Beam protection shall be in place prior to commencing removal of station 1 MuTr components. Protection shall include both a soft foam tube cover and a rigid protective cage to prevent damage to the beampipe from falling and/or moving objects and personnel.
- 1.2.4** This procedure, access, work platforms and/or scaffolding to be used in relation with this procedure and all related work planning shall have been reviewed and approved by the CAD Experimental safety review committee (ESRC). *(Note: At various times during this procedure the scaffolding will need to be reconfigured to achieve optimal access. After each such*

*reconfiguration, the scaffolding shall be re-inspected and re-approved by a competent person (in scaffold erection) before work may proceed. A copy of the approval checkoff sheet is attached.)*

- 1.2.5** Use of the vacuum lifting fixture shall be practiced to simulate the removal of MuTr station 1 chambers, so that the PHENIX technicians involved in this task are thoroughly familiar with the proper and safe operation of this equipment. This lift shall simulate the MuTr installation using mockup equipment in an open area of the PHENIX Assembly Hall after the lifting fixture has been re-certified. The purpose of the practice lift is so that the technicians are familiar with the operation of the lift fixture in a safe an open area before attempting to use it in the tight spaces associated with the actual removal and re-installation of the MuTr chambers.
- 1.2.6** All persons involved in the tasks described herein shall be appropriately trained for the tasks they will be performing. All persons involved shall have, as a minimum, CA Access training, PHENIX awareness, scaffold use training, working at heights training and beryllium use training. Persons operating the crane and lifting fixtures shall be fully trained in rigging and use of the IR cranes. Electrical work, LOTO and other training appropriate to the actual work each individual will be performing shall also be verified by the person in charge for this procedure. Appropriate PPE shall be used in accordance with BNL SBMS. As a minimum this would be safety glasses, closed toed shoes long pants. When using the crane the shoes must be steel toed and hard hats must be worn.

### **1.3 Removal of MuTr components**

(Full scaffold in place)

- 1.3.1** Carefully label all cables, tubing etc that will need to be removed, disconnected and/or relocated in order to remove the MuTr station 1 FEE plates and the MuTr station 1 subsystem chambers.
- 1.3.2** Disconnect all cables, water cooling, air tubing, etc. from the MPC detector, the MuTr station 1 FEE's and the MuTr station 1 chambers, and carefully coil up the cables, hoses, tubes, etc. and secure them with cable ties or equivalent in a convenient location on the MMN until the maintenance, overhaul and upgrade of the station 1 MuTr components is completed and they have been re-installed.

- 1.3.3** Insert two swivel hooks into the front of each of the FEE plate halves, and attach guide ropes. The attachment position for each FEE plate has been designed to lift the FEE plates directly off of their mounts without rotation..
- 1.3.4** Position the 1 ton crane above the upper-most half FEE plate and attach the FEE plate by the swivel hook to the crane hook using 2nylon slings.
- 1.3.5** Remove the slack from the slings, and then remove the fasteners which attach the FEE plate to its mounting support, except the lower most fastener which should only be loosened enough at this time to allow the FEE plate half to assure it does not rotate as it is lifted.
- 1.3.6** Slowly lift the FEE plate half making sure the center of gravity (cg) is directly below the swivel hook.
- 1.3.7** Remove the last fastener and using the crane move the half FEE plate up and away from the beam pipe, then bring it down to the 20 ton cart to transport it out of the IR and into the assembly hall for safekeeping until the upgrade and overhaul of the MuTr chambers is complete.

(Remove upper section of scaffold.)

- 1.3.8** Similarly, attach the crane to the lower half of the FEE plate, remove slack, remove all but the lowermost fasteners, loosen the lower most fastener and lower the crane to assure the plate's cg balance point is aligned with the crane hook..
- 1.3.9** Remove the last fastener then use the crane and guide ropes to move the FEE plate down and away from the beampipe, and then transport it out of the IR for safekeeping during the MuTr chamber upgrade and overhaul.

(Re-install upper section of scaffold)

(Note: MuTr station 1 chamber quadrants are located so that the centers of the quadrants are roughly at clock index positions 1:00, 4:00, 7:00 and 10:00. The quadrants are mounted using kinematic mounts. Care shall be taken during removal and re-installation not to disturb the kinematic mount settings.)

- 1.3.10** Attach the ANVER lifting fixture to the crane hook then move it with the crane to the upper (1:00) chamber quadrant, position the suction cups to surround the chamber cg and start the vacuum pump. When the pump stops pumping the fixture is secure. Lift the chamber quadrant off the kinematic mounts and away from the beam pipe. Move the quadrant using the crane away from the MMN and place it on the 20 ton cart for transport

out of the IR to the AH and then onto its overhaul and upgrade station at the RPC factory.

**1.3.11** Follow the same procedure for the next quadrant (10:00).

(The scaffolding is now reconfigured to the lower level work configuration and removal of the upper level)

**1.3.12** Follow the same procedure to remove the lower 2 chamber quadrants.

#### **1.4 Station 2 Maintenance and Repairs**

After the station 1 chambers have been removed, PHENIX engineering will evaluate access to the station 2 chambers from the station 1 side.

Insufficient detail drawings currently exist to allow appropriate work planning for this section of the work. PHENIX engineers shall perform appropriate work planning and review at that time.

#### **1.5 Station 1 Maintenance and Repair**

The station 1 chambers shall be transported to the RPC Factory in the BNL AGS building after removal. The maintenance and repair work on these chambers is described in the attached work plan.

#### **1.6 Re-installation of MuTr components**

At this point in time upgrade and overhaul of MuTr station 1 chambers has been completed and the chamber quadrants are in the PHENIX AH ready for re-installation.

(The scaffolding is now reconfigured to the lower level work configuration with removal of the upper level)

**1.6.1** Place the 7:00 chamber quadrant on the 20 ton cart in the horizontal position with the kinematic mounts facing down and transport the quadrant on the cart from the AH to the IR.

**1.6.2** Attach the vacuum lifting fixture to the crane and position it above the chamber quadrant with the suction cups surrounding the cg. Turn on the vacuum pump. When the pump stops the load is secure. Attach guide ropes as appropriate.

**1.6.3** Carefully lift the chamber, rotate it to the vertical position and position it on the kinematic mounts for the 7:00 chamber. Fasten the chamber in place then relieve the suction and separate the lifting fixture.

**1.6.4** Repeat for the 4:00 chamber.

(Reconfigure scaffolding to the full scaffold by restoring the upper level.)

**1.6.5** Repeat the chamber lifting procedure for the 10:00 and 1:00 chambers.

(Reconfigure the scaffolding to the lower level work configuration.)

**1.6.6** Move the FEE plate halves from their temporary storage spot to the IR.

**1.6.7** Insert a swivel hook into the lower FEE plate and attach it to the crane using slings. Attach guide ropes.

**1.6.8** Lift the lower FEE plate to its approximate install position and position it so that the lower most fastener can be loosely attached. Using the crane lift and rotate the FEE plate to its final position.

**1.6.9** Attach and tighten all fasteners.

(Reconfigure scaffolding to the full scaffold by restoring the upper level.)

**1.6.10** Insert a swivel hook into the upper FEE plate and attach it to the crane using slings. Attach guide ropes.

**1.6.11** Lift the upper FEE plate to its approximate install position and position it so that the lower most fastener can be loosely attached. Using the crane lift and rotate the FEE plate to its final position.

**1.6.12** Attach and tighten all fasteners.

**1.6.13** Check all MuTr station 1 cables, hoses and tubing. Replace damaged or worn parts with identical new components.

**1.6.14** Restore/replace all MuTr station 1 cables/hoses/tubing to the pre-upgrade configuration, taking care to route all cables/hoses/tubing as neatly/compactly, efficiently as possible.

## **2.0 Installation Closeout**

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 MuTr 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.

# MuTr Station1 Removal, Maintenance, Overhaul and Re-installation During Shutdown 2012



6/20/2012

Slide # 1

# Removing, Repairing and Replacing Muon Tracking Station-1 (South)

Purpose - to install new coupling caps and terminators for anodes

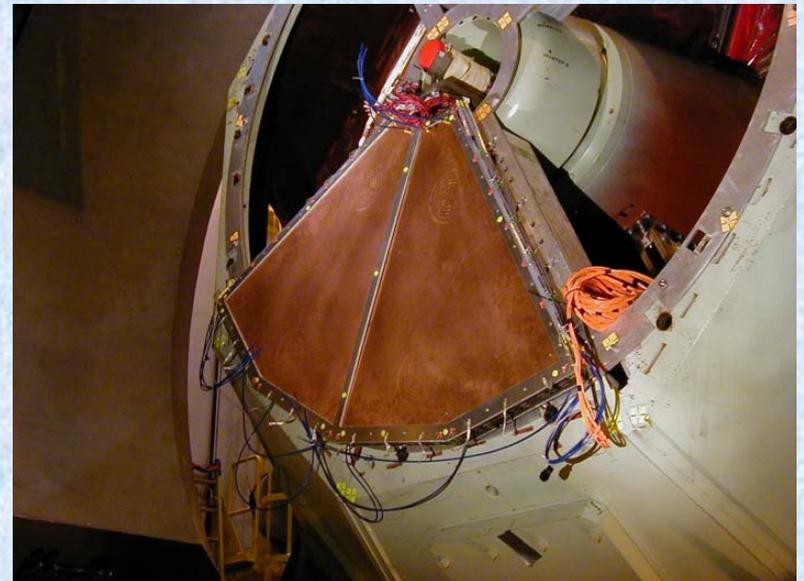
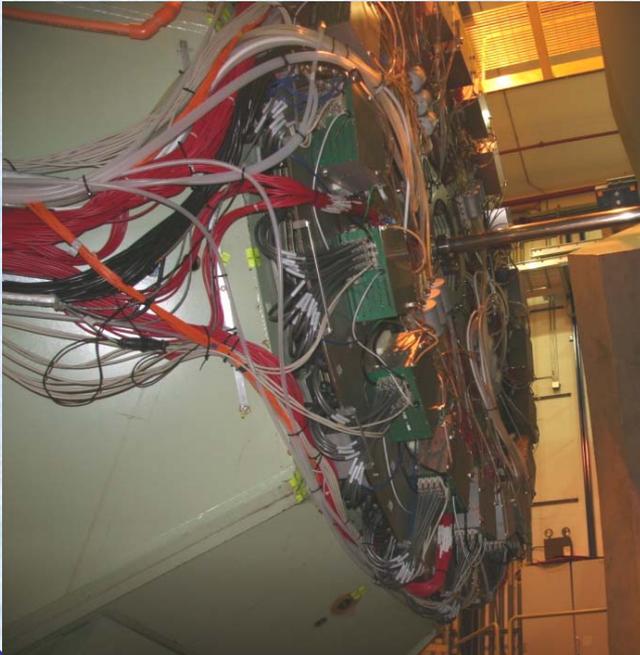
- reduces cross-talk problems by about 1/3
- fixes any remaining HV problems

Steps:

- Preparation of needed parts & procedures
- Documentation of present connections
- Disconnect cables, water cooling, etc.
- Remove FEE plate & chambers; take chambers to lab
- Clean & install new caps and terminators
- Reinstall chambers & FEE plates
- Re-cable & test

## Disconnect cables, water cooling, etc. (1 week, 3 people):

- drain water cooling system & disconnect ( $\sim 20$  chassis  $\times$   $2+(?)$  tubes each)
- disconnect chamber gas and seal chambers
- arcnet ( $\sim 20$ ); calibration (8)
- Clink (60)
- **Analog cables** ( $6/\text{chassis} \times 3 \text{ gaps} \times 8 \text{ octs} = 144$  + **muTrg cables** ( $\sim 70?$ ))
- light sources ( $7/\text{oct} \times 8 \text{ octs} = 56$ ); MPC cables
- HV cables (24)
- grounding cables (numerous) - chamber to FEE plate, chassis-to-chassis, etc.



6/20/2012

Remove FEE plate & chambers; take chambers to lab (1 week, 2 techs):

- FEE plates comes off in 2 halves using crane
- chambers in 4 quadrants on kinematic mounts, labeled for reinstallation in same positions
- Need existing vacuum lifting fixtures (test before use) for chambers
- take chambers to lab (RPC Factory, old burn in test tent)
- chamber gas lines sealed; gentle transport to/from lab
- while sta-1 out, could install terminators on upstream sta-2 anodes (or even recap sta-2)?



## MuTr Work in the RPC Factory Area

Soldering on new capacitors to station-1 chambers, adding plug-on terminators, & testing at HV

- Cleaning of pads with scraping tools and occasionally with soldering iron and solder wick (most are pretty clean already) - no solvents needed
- Use soldering irons and small amounts of solder to put capacitors onto existing pads
  - use "smoke eater" aspiration unit while soldering
- Add plug-on terminators at existing connectors on chamber edges
- Flow Ar/CO<sup>2</sup>/CF<sup>4</sup> gas (non-flammable) for HV testing at full (< 2000V) voltage
- Once HV is verified ok; paint on conformal coating with brush over capacitors and pads (Print Kote, toluene based) - existing small bottles should be more than enough for this job
- No readout tests are needed until chambers/FEE are reinstalled at 1008
- Workers to read RPC Factory Work Plan and sign before starting work

before



after



- Station-1 South re-capacitation and termination



vacuum lifting fixture

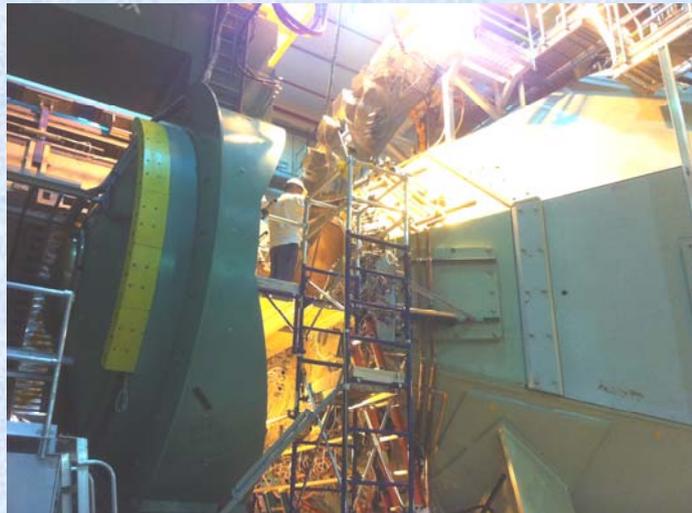


view when sta-1 removed (south)



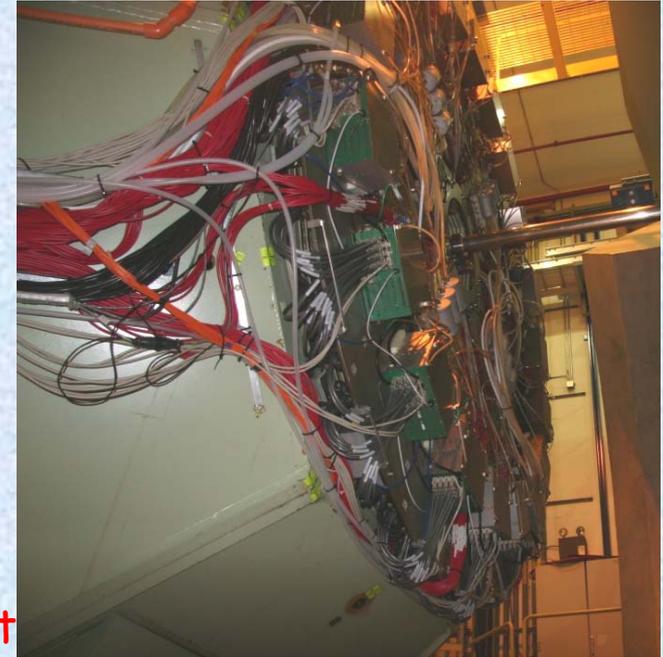
## Reinstall chambers & FEE plates (1 week, 2 techs):

- 4 quadrants, can be installed one at a time as they are ready
- alignment ok because of precision kinematic mounts
- hook up gas & flow (Ar/CO<sub>2</sub>)
- reinstall FEE plates

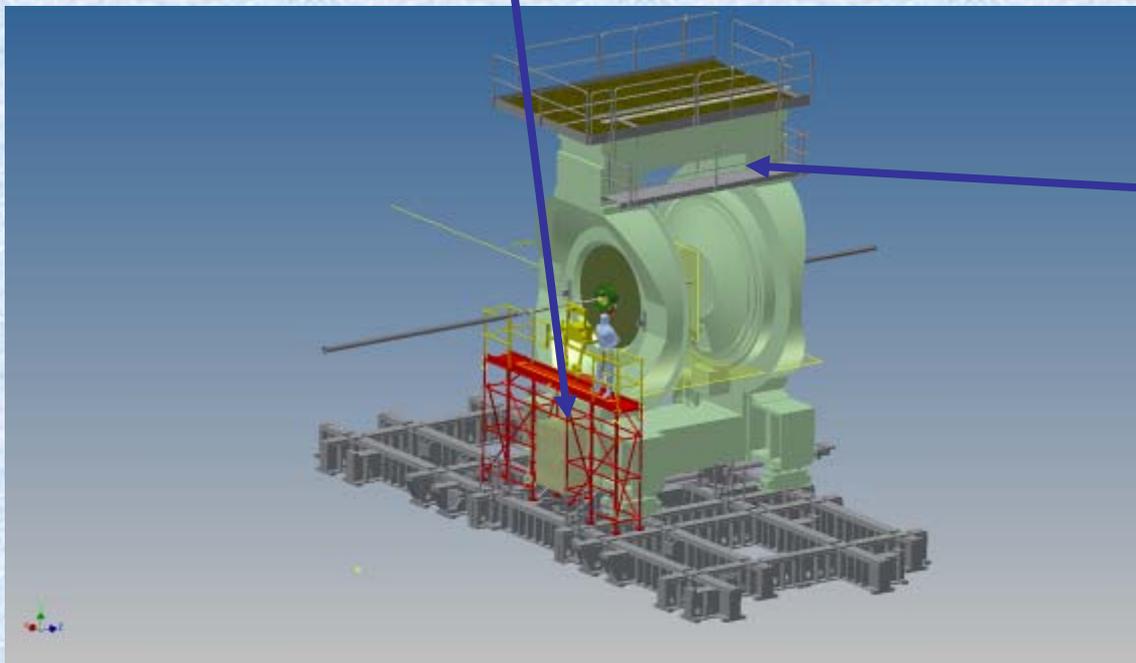
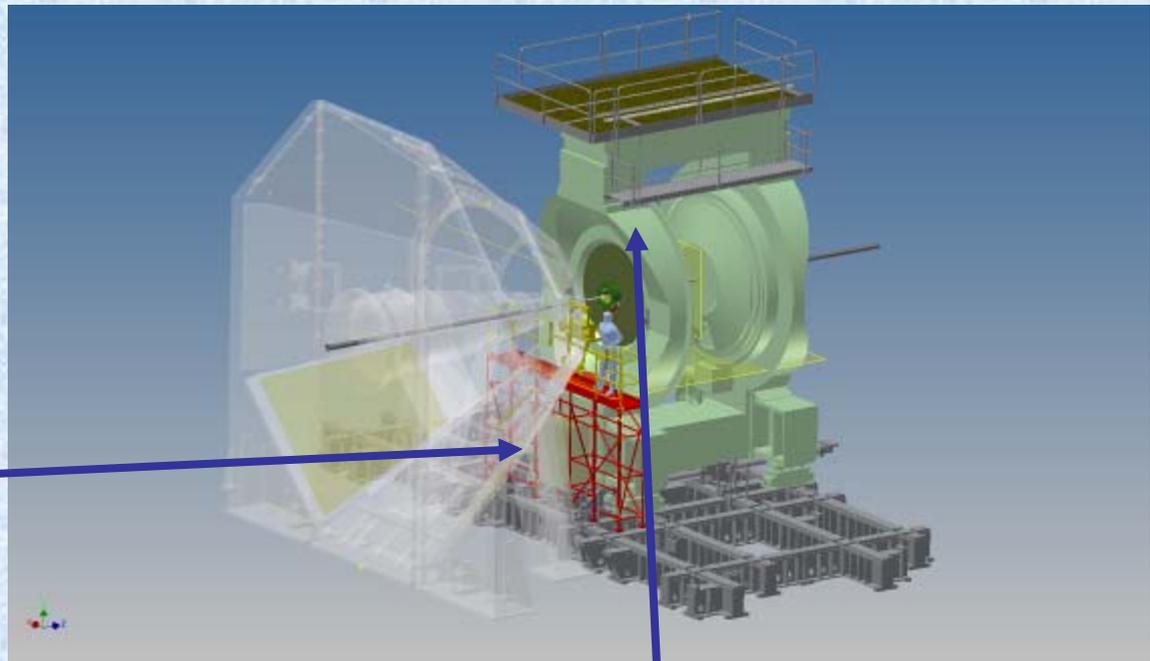


## Recable & test (3-4 weeks, assuming continuous manpower, 3+ people):

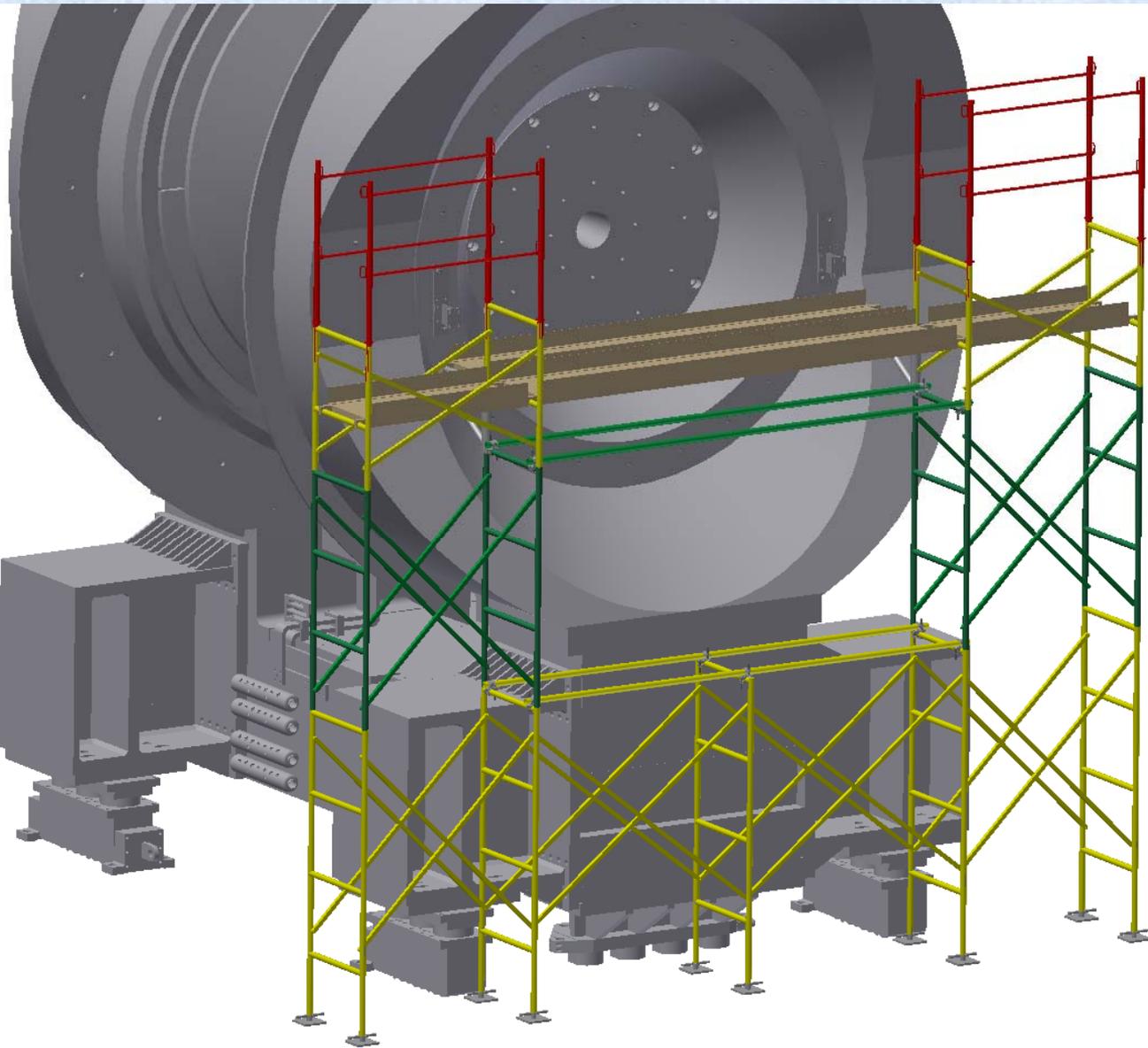
- restore readout 1<sup>st</sup> so can test other connections as they are made
  - LV, Clink, Arcnet, calibration
  - cooling
- grounding cables
- analog cables
  - test with calibration system as you go
- HV cables
- light sources
- MPC cables
- Neaten/pack cabling to fit in required space envelope
- testing:
  - individual gap/oct calibration tests to detect swapped or poorly connected cables & fix
  - noise chasing
  - HV testing at operating voltages with Ar/CO<sub>2</sub> gas
  - optical alignment tests
  - MPC tests



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, but not needed for 2012 shutdown.

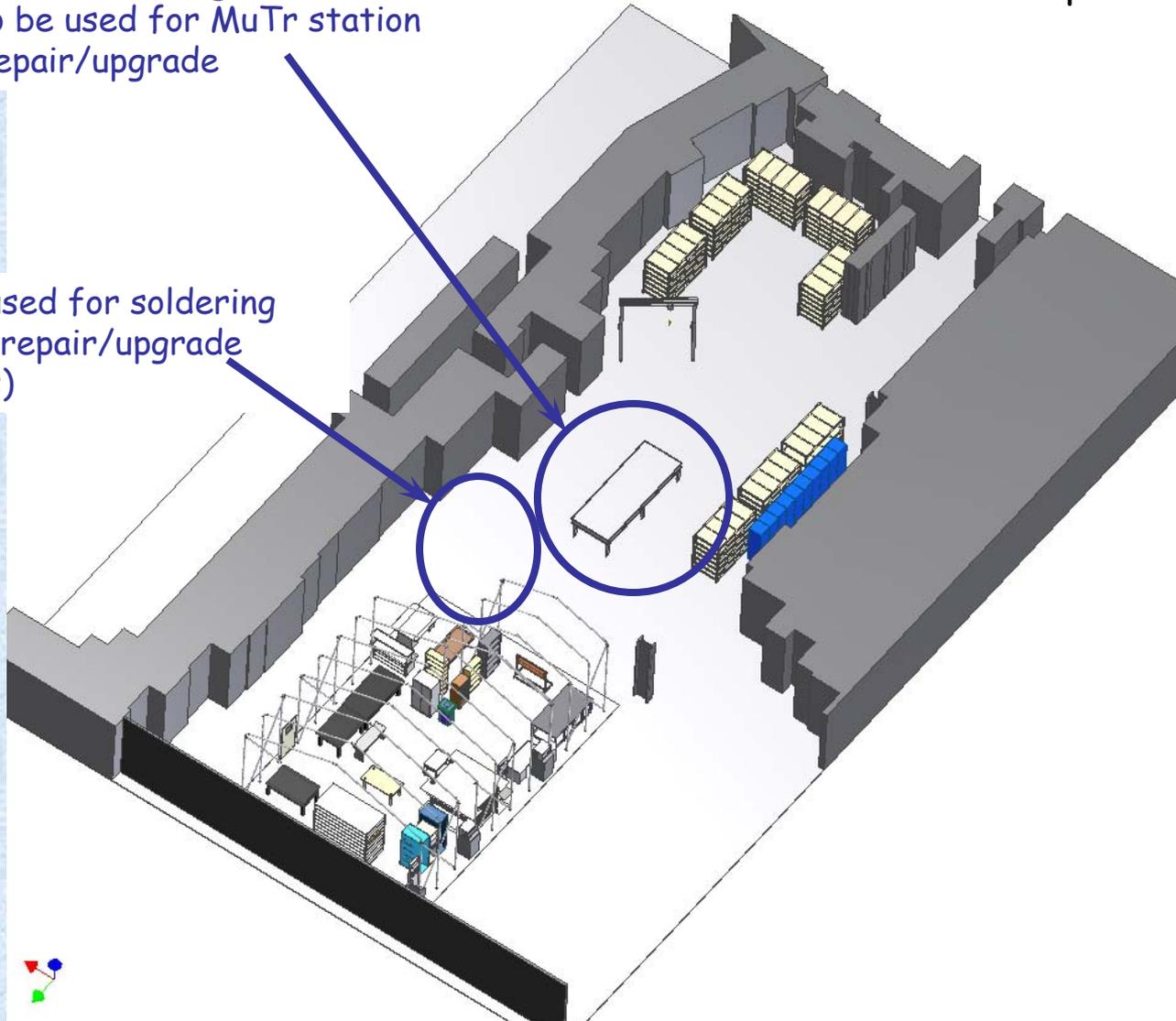


SAFWAY  
Scaffolding  
arrangement  
for upper access.  
Ladder and MMN  
not shown for  
clarity

This area (previously occupied by burn-in test stand and enclosing tent, now just tent) to be used for MuTr station 1 chamber repair/upgrade

RPC Factory site to be utilized by both RPC1 fabrication/testing and MuTr station 1 chamber repair/upgrade

This area to be used for soldering station chamber repair/upgrade (outside of tents)



## 2012 Shutdown Schedule

Run 12 Ends	6/25/2012
Shutdown Standard Tasks	6/25-7/20/2012
• Open wall, disassemble wall, Remove MuID Collars,	
• Move EC to AH, etc.	
VTX Strip-pixel post run tests	6/25-6/30/2012
FVTX post run tests	7/1-7/8/2012
Disassemble VTX/FVTX services	7/9-7/27/2012
July 4 <sup>th</sup> Holiday	7/4/2012
Open Station 1 North, remove MPC North for repairs	7/9-13/2012
RPC1 North Cooling Upgrade	7/9-13/2012
Temporary power patch for IR and AH lights and cranes	7/16-7/20
AH electrical power panel upgrades	7/16-9/15
Remove VTX/FVTX and transport to Chemistry Lab	7/30/2012
Remove MMS & MMN vertical East lampshades	7/23-7/27/2012
Summer Sunday (8/5) Prep and teardown	8/1-8/7/2012
Summer Sunday (RHIC)	8/5/12

## 2012 Shutdown Schedule (Continued)

### MuTr South Station 1 work

Install access (Sta. 1 work platforms)	7/30-8/3/2012
Disconnect Cables, hoses etc, ID/label all	8/6-8/10/2012
Remove FEE plates and chambers	8/13-8/17/2012
Station 2 Terminators and manifold upgrade through access opened by station 1 removal	8/20/-8/31/2012

MPC South repairs	8/20-9/15/2012
RPC 1 South cooling upgrade	8/20-9/15/2012
Labor Day Holiday	9/3/2012

### MuTr South Station 1 work (Cont'd)

Clean/install new MuTr Sta. 1 chamber parts and upgrades (concurrent At RPC Factory)	8/20/-9/7/2012
Re-install chambers and FEE plates	9/10-9/14/2012
Re-cable, re-hose and test re-capacitation and air manifold upgrades	9/10-9/28/2012

Station 3 North and South (upper half)	7/23-9/30/2012
Repair upgrade, reassemble VTX/FVTX	7/23-10/5/2012
Test, survey (at Chemistry and IR) and re-install VTX/FVTX	10/8-11/9/2012
Substation breaker upgrade/test (CAD)	8/20-9/30
AH utility power distribution upgrade	8/20-9/30
DC West maintenance (replace window)	9/15-10/15
RPC stations 1 and 3, north and south maintenance	As required
Other detector maintenance as required	As required
Infrastructure maintenance as required	As required
TBD prototype tasks	As required
Open Station 1 North, re-install MPC North	10/16-10/26/2012
RPC1 North Cooling upgrade (if not completed earlier)	10/16-10/26/2012

6/20/2012

## 2012 Shutdown Schedule (Continued)

Veterans Day Holiday	11/12/2012
Pre-run commissioning and prep for run 13	11/1-12/31/2012
Prep for EC roll in	11/12-11/16/2012
Roll in EC	11/19-11/21/2012
Thanksgiving Holidays	11/22-23/2012
Prep IR for run	11/26-12/3/2010
Pink/Blue/White sheets	12/3-12/21/201
Christmas Holidays	12/24-25/2012
Start run 13	1/1/2013

