If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match.
The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.
Hard copies of all signed, official, C-A Operating Procedures are kept on file in the C-A ESHQ Training Office, Bldg. 911A.

C-A OPERATIONS PROCEDURES MANUAL

ATTACHMENT

7.1.65.q Safety Issues Associated with the 6 O'Clock Blue Valve Box

Text Pages 2 through 13

C-A-OPM Procedures in which this Attachment is used.		
7.1.65		

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Approved:_____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

M. Sardzinski

BROOKHAVEN NATIONAL LABORATORY

SAFETY ISSUES ASSOCIATED WITH THE 6 O'CLOCK BLUE VALVE BOX

Contributors: Bill Dejong, Len Masi, Anthony Nicoletti, Tom Tallerico, Andreas Warkentien, Mark Sardzinski, Dewey Lederle

This document describes the safety issues associated with working on or inside the 6 o'clock BLUE valve box. It is not meant to cover the details of every job. A job specific work permit reviewed by appropriate personnel is still required to complete any work inside the valve box.

MECHANICAL SAFETY ISSUES

Component Details

The 6o'clock blue valve box is part of the RHIC Cryogenic Distribution System. It is comprised of a vacuum tank that houses liquid pots, process piping, heat shield piping, temperature devices and liquid level probes. Also attached to the 6 o'clock blue and yellow valve boxes are the circulating gas compressors.

The following is detailed description of some of the major components, taken from ***Cryogenic System, vii System Components manual***.

Inlet Re-cooler (liquid pots): The Inlet Re-cooler is a heat exchanger assembly located in a valve box. By means of this heat exchanger helium gas which is about to enter the, magnet string at one end (Dipole D0) of a sextant is cooled to a temperature close to the temperature of the boiling liquid helium bath provided on one side of the heat exchanger.[1]

> **Circulating Gas Compressors:** A circulating compressor in each ring will be used to sustain the closed loop flow….These compressors are located at the 6 o'clock valve boxes.[2]
>
> **Process Piping and valves:** The (present) conceptual design envisions that all the piping for a ring will be carried in a common jacket with a heat shield. Pipes will be provided to carry the helium for the following: Magnet coolant, with power leads, Supply header, Return header, Utility header and Heat Shield.

[1] Vii System Components, RHIC Design Manual, pg29
[2] Vii System Components, RHIC Design Manual, pg 32

This connecting piping also contains all the isolation and diverting valves required to meet the RHIC operating scenarios. Groups of these valves have been gather into a single valve box located between each pair of sextants.[3]

Confined Space

The 6 o'clock blue valve box is considered a confined space. Any work inside the box must adhere to the confined space regulations described in the BNL SBMS.

Trapped Helium Volumes

The potential exists for trapped pockets of high pressure helium inside the valve box. Prior to penetrating the box, contact the cryo control room at x3837 to verify no trapped helium volumes exist.

Pressurized Helium Sources

6 o'clock blue valve box is part of the RHIC cryogenic system and has the potential to see pressurized Helium gas and Nitrogen gas sources. Following are a list of potential sources and the valves associated with isolating them (Reference drawing(s) 3A995009, 3A995108, 3A995073, 3A995086, 3A995087, 3A995067, 3A995085, 3A995065, 3A995084 and 3A995088.

3A995009 25Kw Refrigerator

H4644A	**CR Line**
H849A	**CR Line**
H146A	**Supply Line**
H147M	**Return Line**
H25A	**Heat Shield Supply**
H187M	**By-pass Calorimeter**
H9500M	**Cold Box 5 heat shield VJRR line**
H813M	**Calorimeter, Heat Shield**
H9A	**Heat Shield Return**

3A995108 80 Degree Cooler Integration

H9374A	**"S" Line**	
H9355A	**"H" Line**	**Return from Rings**
H9360A	**"M"Line**	
H9359A	**"M"Line**	**Supply to Rings**
H9354A	**"H"Line**	

3A995073 RHIC Helium Storage

N5016M	**Warm Nitrogen Gas Supply**

[3] Vii System Components, RHIC Design Manual, pg 33

3A995086 6:00 Blue Ring P&ID

H6819M	
H4512M	
H4517M	**Warm Return Line**
H4617M	
H4622M	
H6826M	
H4742M	
H4743M	
H4744M	
H4745M	
H4746M	
H4747M	**Lead Flow Return**
H4748M	
H4749M	
H4750M	
H4751M	
H6823M	
H4542M	**Warm Supply Line**
H4626M	
H4559M	**Warm Supply Line**
H6101M	**"R" Line Vacuum Manifold**
H6100M	**"HR" Line Vacuum Manifold**
H4646M	**"M" Line Vacuum Manifold**
H4647M	**"S" Line Vacuum Manifold**
H4648M	**"H" Line Vacuum Manifold**
H4649M	**"U" Line Vacuum Manifold**
H4650M	**"R" Line Vacuum Manifold**
H4651M	**"M" Line Vacuum Manifold**
H4652M	**"S" Line Vacuum Manifold**
H4653M	**"H" Line Vacuum Manifold**
H4654M	**"U" Line Vacuum Manifold**
H4655M	**"R" Line Vacuum Manifold**

Note: Since the Blue and Yellow Ring have a common *Warm Return Manifold,* They share the same isolation valves, which are listed below for convenience. Since they are numerous magnet corrector thermister valves to list, check the valves in the particular sextant that needs isolation. Refer to the sextant P&ID 3A995085 SEXTANT 4/5 Sheets 1-8 Blue

3A995065 SEXTANT 4/5 Sheets 1-8 Yellow

H5380A	**Flow Manifold @ 5Q3 Yellow**
H5381A	**Flow Manifold @ 5Q6 Yellow**
H5382A	**Flow Manifold @ 5Q9 Yellow**
H5383A	**Flow Manifold @ 5Q11 Yellow**
H5384A	**Flow Manifold @ 5Q14 Yellow**
H5385A	**Flow Manifold @ 5Q 16 Yellow**
H5386A	**Flow Manifold @ 5Q19 Yellow**
H5387A	**Flow Manifold @ 5D20 Yellow**
H5386 A	**Flow Manifold @ 4Q19 Yellow**
H5389A	**Flow Manifold @ 4Q16Yellow**
H5390A	**Flow Manifold @ 4Q14 Yellow**
H5391A	**Flow Manifold @ 4Q11 Yellow**
H5392A	**Flow Manifold @ 4Q9 Yellow**
H5393A	**Flow Manifold @ 4Q6 Yellow**
H5394A	**Flow Manifold @ 4Q3 Yellow**

3A995084 4:00 Blue Ring Valve Box

H4483M	
H4484M	
H4485M	**Lead Flow Return to Warm Return Line**
H4486M	**Lead Pot “b”**
H4487M	
H4488M	
H4489M	
H4490M	**Lead Flow Return to Warm Return Line**
H4491M	**Lead Pot “a”**
H4492M	
H4493M	
H4494M	**Lead Flow Return to Warm Return Line**
H4495M	**Lead Pot “a”**
H4407M	**“M” Line Isolation**
H4470M	**“M” Line Vacuum Manifold**
H4471M	**“S” Line Vacuum Manifold**
H4405M	**“S” Line Isolation**
H4472M	**“H” Line Vacuum Manifold**
H4402A	**“H” Line Isolation**
H4473M	**“U” Line Vacuum Manifold**
H4403A	**“U” Line Isolation**
H4404A	**“R” Line Isolation**
H4474M	**“R” Line Vacuum Manifold**
H4412M	**Block and Bleed**
H4417M	**Block and Bleed**

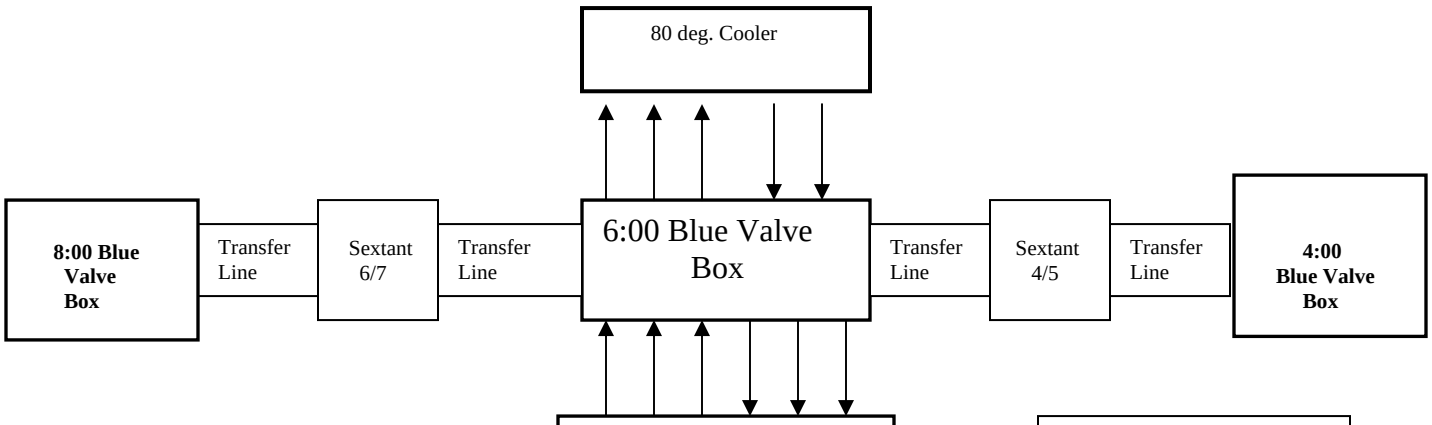
Note: Since the Blue and Yellow Ring have a common *Warm Return Manifold,* They share the same isolation valves, which are listed below for convenience. Since they are numerous magnet corrector thermister valves to list, check the valves in the particular sextant that needs isolation. Refer to the sextant P&ID 3A995087 SEXTANT 6/7 Sheets 1-8 Blue

3A995067 SEXTANT 6/7 Sheets 1-8 Yellow

H7166A	**Flow Manifold @ 7Q3/Spin Yellow**
H7167A	**Flow Manifold @ 7Q6 Yellow**
H7168A	**Flow Manifold @ 7Q9 Yellow**
H7169A	**Flow Manifold @ 7Q11 Yellow**
H7170A	**Flow Manifold @ 7Q14 Yellow**
H7171A	**Flow Manifold @ 7Q16 Yellow**
H7172A	**Flow Manifold @ 7Q19 Yellow**
H7173A	**Flow Manifold @ 7D20 Yellow**
H7174A	**Flow Manifold @ 6Q19 Yellow**
H7175A	**Flow Manifold @ 6Q16 Yellow**
H7176A	**Flow Manifold @ 6Q14 Yellow**
H7177A	**Flow Manifold @ 6Q11 Yellow**
H7178A	**Flow Manifold @ 6Q9 Yellow**
H7179A	**Flow Manifold @ 6Q6 Yellow**
H7180A	**Flow Manifold @ 6Q3/Spin Yellow**

3A995088 8:00 Blue Ring Valve Box

H4872M	**“M” Line Vacuum Manifold**
H4800A	**“M” Line Isolation**
H4873M	**“S” Line Vacuum Manifold**
H4801A	**“S” Line Isolation**
H4874M	**“H” Line Vacuum Manifold**
H4802A	**“H” Line Isolation**
H4875M	**“U” Line Vacuum Manifold**
H4803A	**“U” Line Isolation**
H4876M	**“R” Line Vacuum Manifold**
H4804A	**“R” Line Isolation**
H4817M	**Block and Bleed**
H4833M	**Block and Bleed**



This is a simplified diagram showing all the major cryogenic components of the RHIC blue ring at the 6:00 position between the 8:00 and 4:00 valve boxes. The arrows are in the direction of gas /liquid flow.

1. **Vacuum Systems**

The only possible operations and environmental issues associated with the vacuum system are locking out the turbo vacuum pumps that are used to establish insulating vacuum. Details are in the electrical safety section. Before entering the valve box contact the C-AD vacuum group for assistance in isolating the vacuum system and introducing Air/Nitrogen into the valve box. The main isolation valve for the cold box is V4502A.

2. **Pneumatic Systems**

Valves located on the top of the valve box are supplied with compressed air at approximately 100 psig. Air to valves can be isolated via manifolds located at the 6 0'clock valve box. Reference drawing 3A995100. Exercise extreme caution when working on top of the valve box, not to damage the plastic tubing that feeds the air to the valves.

3. **Tube Trailers**

Occasionally helium tube trailers are used to pressurize the cryo- process lines. These penetrations can be at various locations inside the valve box and may bypass locked out valves. Any person entering the valve box should inspect the area for a tube trailer connection and check with the cryo-control (x3837) room to make sure there are no trailer hazards.

If trailers are stationed at other locations in the RHIC Ring, the potential exists for gas to reach the 6 o'clock blue valve box via cryogenic process lines (Magnet, Heat shield, Utility, Supply and Return). Check with the cryogenic control room to determine if trailers are stationed at other locations in the ring and to insure local LOTO is in place in the area where the trailer connects to the cryo-system. The LOTO list should be covered in the job specific work permit.

4. Piping arrangement.

External

Extreme caution should be exercised when working on or around the valve box , a review of the work plan should be done prior to working on the valve box.

There are numerous hazardous conditions associated with the piping arrangement. For example low hanging piping can cause head injuries. Also work that is outside of the "railed" platform should not be attempted by "climbing" over the rail.

Internal

A detailed plan should be in place before working inside the valve box , the following is a list of hazards inside the valve box.

- The valve box is shaped like a cylindrical tank with no floor built into it, this makes it difficult to move around.
- The piping arrangement is close together and is covered in MLI.
- Care should be taken not to damage small instrument tubing.
- Sharp edges from brackets are a hazard.
- If there is any welding and cutting involved in working inside the valve box a CONFINE SPACE PERMIT is required.

Electrical Safety Issues

In conjunction with the accident in Cold-box 3 in which a technician burned his hand on a heater, we investigated the potential for a similar event in the yellow valve box in service building 6. Careful inspection of the valve box indicates no lethal voltage potentials and no installed heaters internal to the valve box. There are no feed-through(s) externally that contain high voltages that would pass into the cold-box.. The only feed through(s) (cables labeled 6BA, 6BB and 6BC) that exist are for low level instrumentation (temperature sensors). External to the valve box electrical hazards may exists in the form of exposed terminals or wiring that are associated with the solenoids that are attached to pneumatic valves.

Fig.1 Instrumentation cables on the bottom of the valve box.

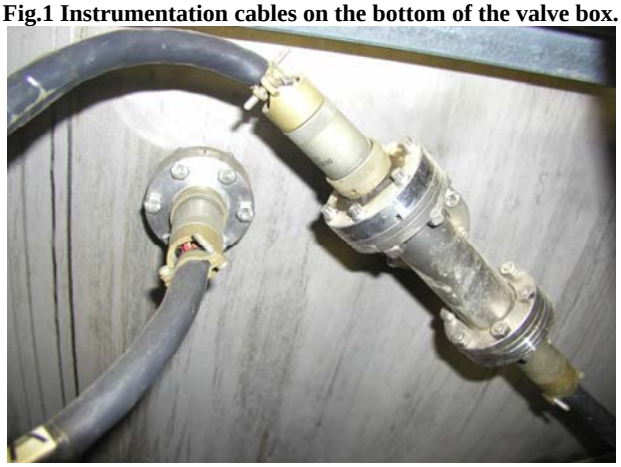
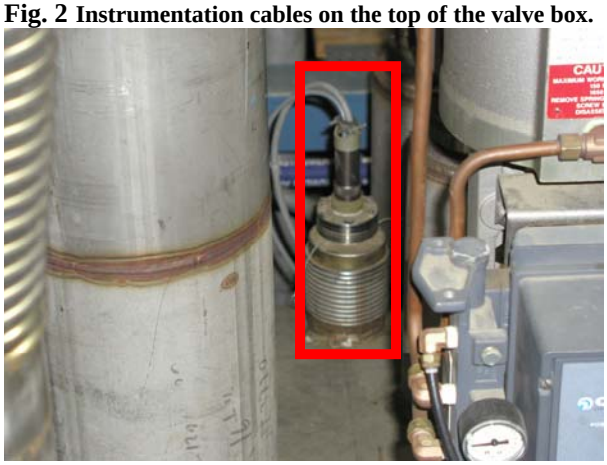


Fig. 2 Instrumentation cables on the top of the valve box.

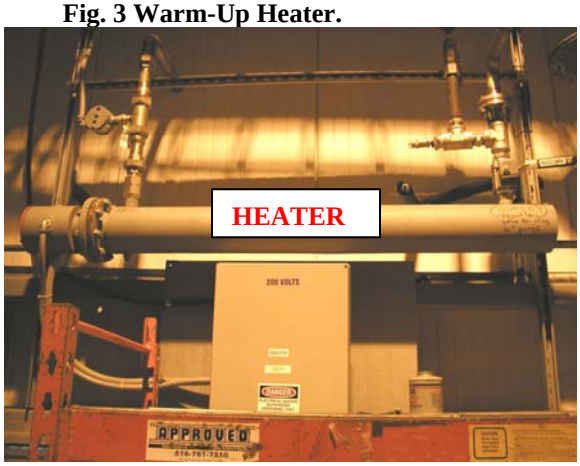


---

1) We identified a safety switch external of the valve box used to disable the circulator speed control that has no identifier and should be given one, so that it appears on the drawing uniquely identified. Presently the drawing (3A985088) identifies the safety switch generically. This is currently being addressed.

2) There is a heater above the ventilation louvers across from the valve box that is not identified as being a heater. In normal use it operates typically at 100F. A label should be added identifying this as a potential hot surface. This is currently being addressed. See the figure below for a view of the heater.

Fig. 3 Warm-Up Heater.



---

2) We identified a safety switch external of the valve box used to disable the circulator speed control. There is no identifier on this switch. An identification label is being installed It is situated next to the blue circulator speed control.

Fig. 4 Speed Control and Power Panel for the Blue Ring Circulator

- 3A985089 - RHIC helium circulating pump motor (blue) wiring diagram.

Normal lockout/tag-out procedures and the use of PPE should be followed when working on these systems.

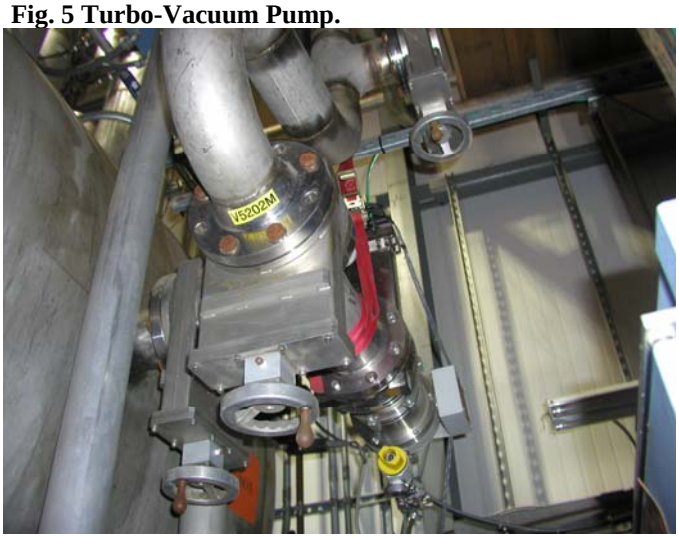
Connector signal lists for the upper and lower feed-through(s) (A, B, C, E) have been located and are on file. The list clearly shows that all signals are low-level instrumentation signals.

Drawings from CVI Incorporated have been located. These drawings go back to the early 90's and were never converted to C_AD format. The drawings reflect both internal and external wiring. The drawings detailing the internal wiring clearly show only instrumentation signals. These drawings should be converted so that they are up to date.

- CVI drawing G771-1400 – RHIC Cryogenic valve boxes elementaries 6 O'clock.
- CVI drawing G771-1440 –6 O'clock Blue ring Skid Wiring Diagram.

The drawing 3A9850XX identifies the detailed voltages of the blue valve box insulating vacuum control system (120Vac – 480Vac). However these voltages are external of the valve box and pose no threat for technicians working inside the valve box.

Fig. 5 Turbo-Vacuum Pump.



Electrical Safety -Power Supply Related

Internal To valve Box

The valve boxes for RHIC have the super-conducting leads from the insertion magnets going through them. These leads are only in the Magnet lines and lead pots. The lead pots have gas cooled leads that allow the insertion shunt power supplies to connect to the magnet circuits. ***The primary electrical hazard is if one was to cut or open one of the lines or lead pot when some type of electrical testing was occurring.*** One could not cut or open a line or lead pot when the magnets are operating. (for apparent reasons) During shut down periods the magnet circuits are connected to ground. Also when ever there are electrical tests there is work a control permit that requires the area be posted and the cryo group to be notified of the test. The insertion power supplies that are connected to the magnet circuits are disabled from turning on during shut down periods, through they can be brought to stand-by state. All these p.s. are low voltage p.s. (20 Volt Max.)

External to Valve Box.

The terminals of the gas cooled leads and the lead heaters are the electrical hazards on the top of the valve boxes. These terminals and lead heaters are in the **orange fenced in** area that is posted. **No personnel** should work in this area **unless a work control permit is issued**. The lead heaters are 120 volt with thermostat control. The same hazard from the power supplies exists on the top of the valve box in the fenced in area only.

Fig. 6 Side view of the blue ring circulator.

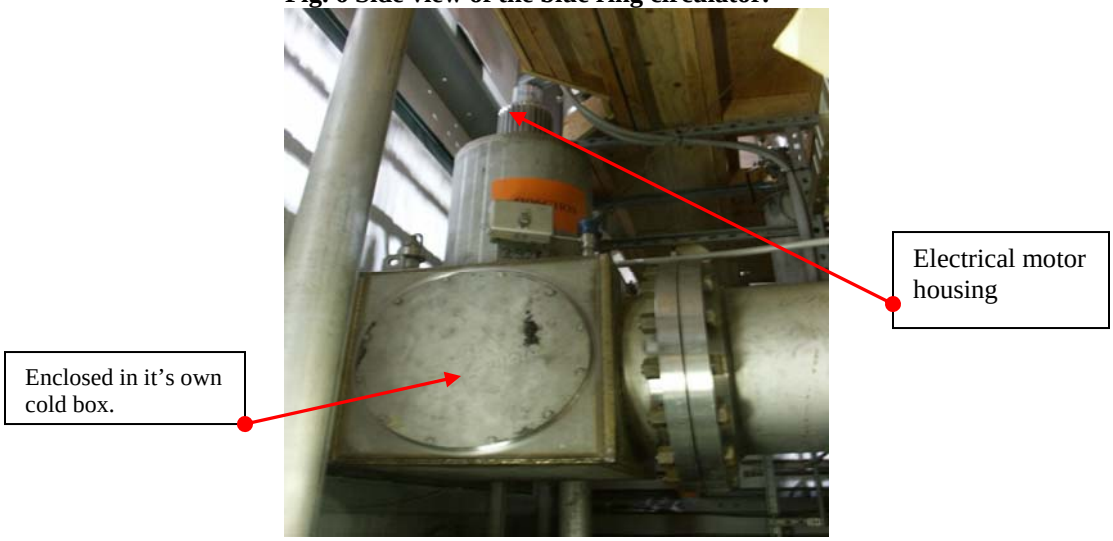


Fig. 7 A partial top view of the 6'oclock blue valve box, showing process piping and valves.

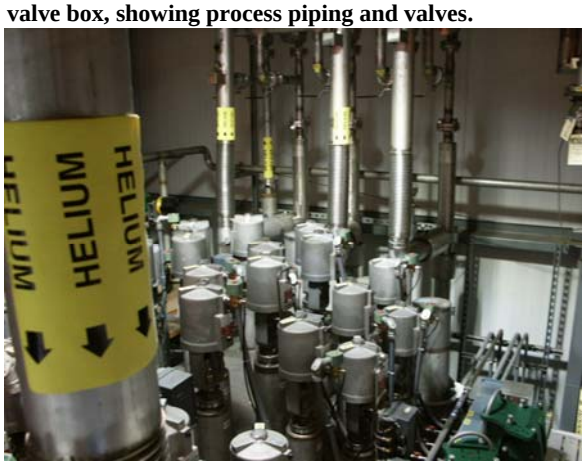


Fig. 8 At the entrance to valve box a CONFINE SPACE sign is posted. This is a typical posting through out the RHIC cryogenic system.

Supporting Documents:

3A995009 25Kw RHIC Refrigerator
3A995108 80Degree Cooler Integration
3A995073 RHIC Helium Storage
3A995086 6:00 Blue Ring P&ID
3A995067 Yellow SEXTANT 4/5 sheets 1-8
3A995085 Blue SEXTANT 4/5 sheets 1-8
3A995084 4:00 Blue Ring P&ID
3A995087 Blue SEXTANT 6/7 sheets 1-8
3A995068 8:00 Yellow Ring P&ID