



SAFETY ISSUES ASSOCIATED WITH COLD BOX 5 OF THE RHIC 24 kW REFRIGERATOR

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This document describes the safety issues associated with working on or inside Cold Box 5 of the 24 kW RHIC cryogenic refrigerator. 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 cold box.

MECHANICAL SAFETY ISSUES

Component Details

Cold Box 5 is unique because of its shape, unlike the other cold boxes, cold box 5 has two separate chambers. The first chamber is located outside the main building and the second (smaller in size) is inside the building. Both chambers are attached and share a common vacuum space.

The main cold box houses the three liquid pots (High, Intermediate and Low Pot) and their corresponding heat exchangers HX10, HX11/12, HX13 .Also the main refrigerator calorimeter circuit and HX15. The smaller chamber houses piping that is associated with the cold vacuum pumps and by-pass piping.

Confined Space.

Both chambers are 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 cold box. Prior to penetrating any process lines inside the box, contact the cryo-control room at x3837 to verify no trapped helium volumes exists.

Pressurized Helium Sources

Cold Box 5 is part of the RHIC cryogenic system and has the potential to see pressurized Helium gas sources. Following are a list of potential sources and the valves associated with isolating them (Reference drawing(s) 3A995009, 3A995066, 3A995086 and 3A995073).

H1100A	From Thermax Circuit “X”
H410M	Outlet of 6A
H810M	Outlet of 6B
H49M	Regeneration System/Pure He Source
H9117M	Regeneration System/Pure He Source
H57M	Pure Helium source
H159A	LP side of Hx7M
H406A	LP side of Hx7A
H806A	LP side of Hx7B
H409M	Cool-down return outlet of 6A
H809M	Cool-down return LP side of HX8/18/9
H799M	Cool-down return inlet to HX7B
H399M	Cool-down return inlet to HX7A
H158M	Cool-down return inlet to HX5/6
H26A	Cool-down return line
H449A	Inlet to C2
H437A	Inlet to C1
H450M	Outlet of C2
H200M	Outlet of C2
H9115M	Regeneration System/Pure He Source
H166M	Cold filters CB4
H9114M	Regeneration System (CB4)
H9113M	Regeneration System (CB4)
H25A	Heat Shield (CB3)
H9080M	Heat Shield By-Pass
H813M	Heat Shield Calorimeter circuit
H771A	Absorber B
H371A	Absorber A
H15A	Absorber By-Pass
H426M	Outlet of HX 3A
H826M	Outlet of HX 3B
H6099M	6 o’clock yellow valve box, Supply line to Vacuum manifold
H6608A	6 o’clock yellow valve box, Return from “U”line
H6604A	6 o’clock yellow valve box, Return from “R” line
H6704A	6 o’clock yellow valve box, Return from “R” line

H6708A	6 o'clock yellow valve box, Return from "U" line
H6607A	6 o'clock yellow valve box, "M"line
H6609M	6 o'clock yellow valve box, Supply line
H6625A	6 o'clock yellow valve box, Supply to detector
H6705M	6 o'clock yellow valve box, Supply line
H6605A	6 o'clock yellow valve box, Jt valve re-cooler
H4524A	6 o'clock blue valve box, "M"line
H4558A	6 o'clock blue valve box, Jt valve re-cooler
H4625A	6 o'clock blue valve box, Supply to detector
H4534M	6 o'clock blue valve box, Supply line
H4614M	6 o'clock blue valve box, Supply line
H6010M	6 o'clock blue valve box, Supply line to Vacuum manifold
H4604A	6 o'clock blue valve box, Return from "R" line
H4608A	6 o'clock blue valve box, Return from "U" line
H4504A	6 o'clock blue valve box, Return from "R" line
H4508A	6 o'clock blue valve box, Return from "U" line
H4526A	Supply from Liquid Storage Area.
H4505A	Return from Liquid Storage Area.

Helium Tube Trailers

These are occasionally used to pressurize piping for leak checking or ASME pressure checking. Check with the cryo-control room (x3837) to verify there are no hazards associated with tube trailers prior to working inside the cold box.

Vacuum Systems

The only issues associated with the vacuum system are locking out the vacuum pumps that are used to establish insulating vacuum. Details are in the electrical safety section. Before entering the cold box contact the C-AD vacuum group for assistance in isolating the vacuum system and breaking the vacuum space with air/nitrogen mixture. Vacuum Isolation Valves: (Cold Box 5) 4V554A Vacuum Sys.4

Pneumatic Systems

Valves located on the top of the valve box are supplied with pressurized nitrogen or air at approximately 100 psig. Nitrogen valves can be isolated via manifolds located local to the cold box. Reference drawing RD3A995059.

Heights

Work inside in both chambers of cold box 5 may involve climbing on process piping and working at elevated heights. Use harnessing and temporary scaffolding as necessary. Also care should be taken not to get tangled up in loose instrumentation wiring.

ELECTRICAL SAFETY ISSUES

In conjunction with the accident in Cold box 3 in which a technician burned his hand on a heater, we investigated all potential sources in the cold box that could contribute to another accident occurrence. Careful inspection of the cold box indicates the only electrical related voltage hazards are external of the valve box. There are no feed-through(s) externally that contain high voltages that pass into cold-box 5.. The heater within cold-box 5 is inside a pipe and is fed from the top of the cold-box and into a flange. See the figures below for details.

Fig. 1 : Power cable enclosure for heater.

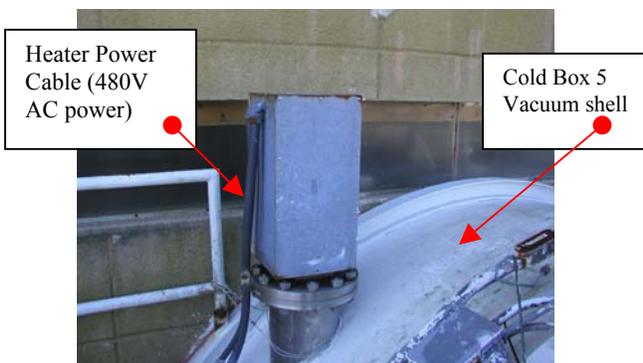


Fig. 2:



Calorimeter Heater cont'd

The heater voltage for cold-box 5 can be removed by locking out the power switch on the calorimeter cabinet as shown in the picture below.

Fig.3: Locking Out Heater Power



An upstream switch and fuse appears below. These switches completely remove power from the Calorimeter cabinets.

Fig.4:



Cold Box 5 Calorimeter Power Shut-off Switch

An additional heater was installed between valves H74A and H83M inside Cold box 5. This heater has since had its source of power disconnected. See the figure below of the heater entrance into Cold box 5 (inside building 1005R) below with power removed.

Fig. 5: Power box for additional heater, conduit removed.



Signal Feed-Through(s) Cold Box 5

The only signal feed-through(s) that exist are for low-level instrumentation (temperature sensors). See pictures below for instrumentation feed-through(s) into cold-box 5.

Fig.6: Instrument feed-through No.1



Fig.7: Instrument feed-through No.2



There is a diffusion vacuum pump external to cold-box 5 that requires 480 volts AC. However it is on a plug and when service is required it can simply be unplugged. No LOTO is required. The 480 volts for this vacuum system does not enter cold-box 5. See figure below of vacuum pumps.

Fig. 8: Cold Box 5 diffusion pump

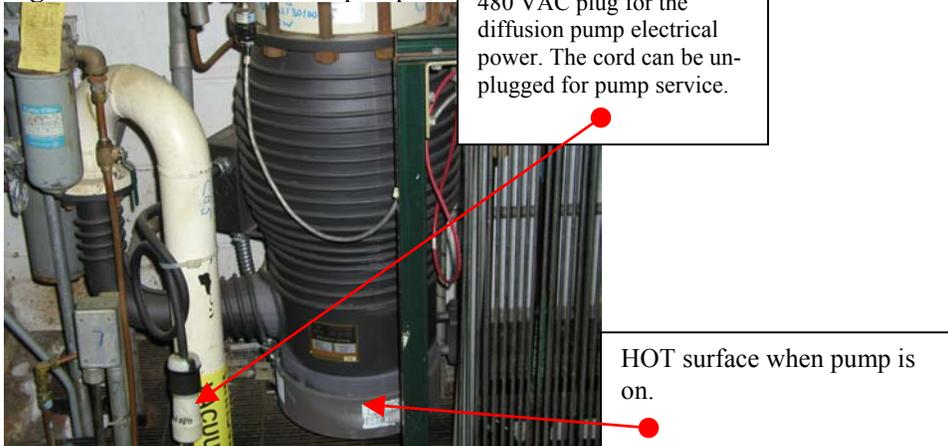
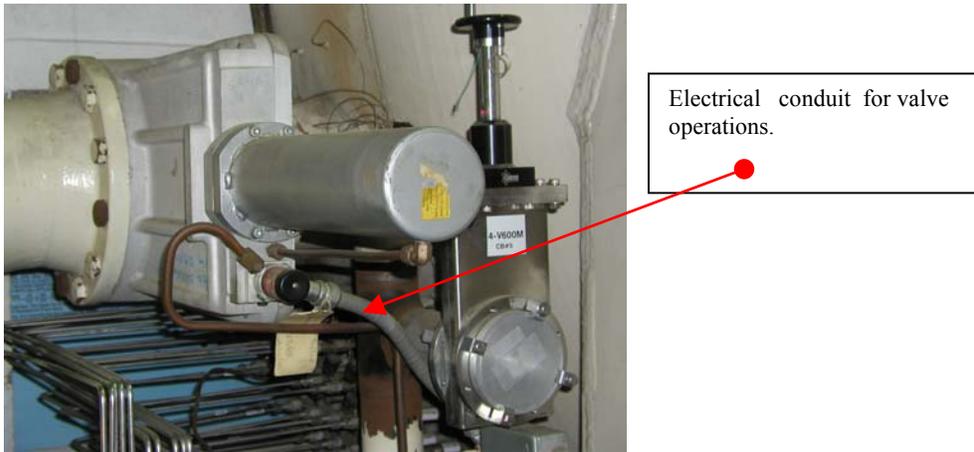


Fig. 8a: Cold Box 5 Vacuum System slide valve



Vacuum Gauges

There are vacuum gauges external of the cold-box as shown in the picture below. None of these gauges have voltages that enter into cold-box 5.

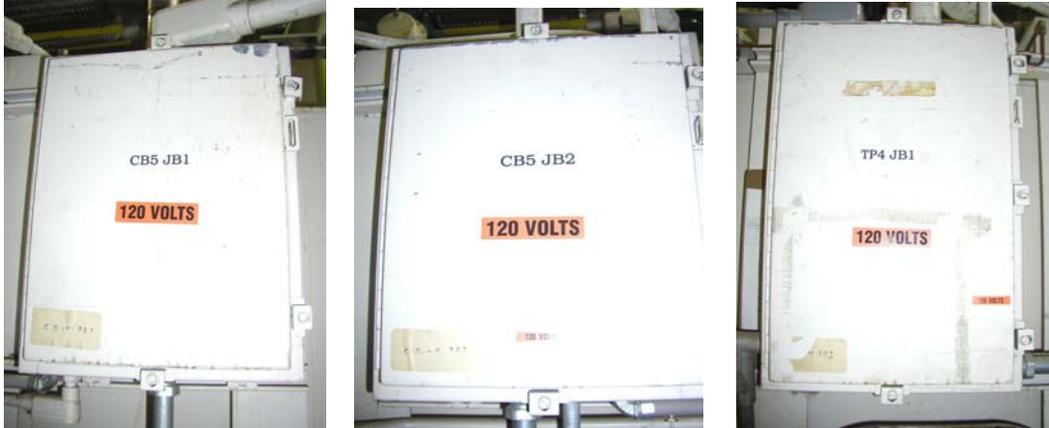
Fig.9 : Cold Box 5 Vacuum gauges



Electrical Safety Issues Continue

Through out the *RHIC Cryogenic* facility the use of electrical junction boxes is plentiful. The pictures below are the electrical junction boxes that are attached to Cold Box 5. All junction boxes have been labeled with the proper voltage.

Fig. 10 : Electrical junction boxes mounted on the side of Cold Box5

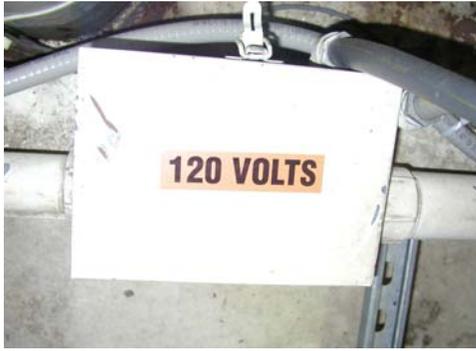


Junction Boxes on top of Cold Box 5

All horizontal junction boxes have been labeled with the proper voltages. See the five pictures below.

Fig.11 a,b,c,d,e





Cold Vacuum Pump Frequency Drives

The junction boxes and the frequency drives for the cold vacuum pumps have all been identified and labeled with the proper voltages.

Fig.12: Cold Vacuum pump power panel.



Frequency Drives

Process Valves of Cold Box 5

Fig.13 : H82M and H34M west side of CB5



Fig.14: H114A North West Corner of CB5



Fig15: H144M North West corner of CB5



Fig16 : H 173A, H147A and H187M South end



Fig.17: H86A and H89A North east corner



Fig.18: H90A and H88M North east corner



Fig.19: H100A east corner of CB 5



Fig.20: Vent stacks, for all liquid pots and CVP ckt.



A vent stack is comprised of two burst discs, if one fails or needs to be service the off-line disc can be brought on-line by means of the selection valve.

Selection valve

Burst disc holder

Fig.: 21 H106A east side of C.B.5



Fig. 22: H100A east side of C.B. 5



Fig.23:H125M,H95A,H122M Southeast corner



Fig. 24: H58A,H146A,H172M and calorimeter enclosure south east corner



Fig.25: H1100A North end of cold box 5



Ladder cage

Fig. 26 H238M and H123A West side of CB5



Inside segment of Cold Box 5

This portion of Cold Box 5 is located inside building 1005R it is attached to the main Cold Box but it shares a common vacuum space. Below are pictures of the process valves which are associated with the inside addition to Cold Box 5.

Fig. 27:H87M (small blue handle),H83M and H74A **Fig. 28:** H130M (large blue handle) and H168M



Fig.29: H33A (green top) and H131A



Fig.30: H38A



Fig.40: H40A



Fig. 41: H69M



Fig. 42: Man-hole cover (for the main Cold Box)



Fig.43: Man-hole cover (for smaller section)



Fig.44: H54A



Fig.45: Cold Vacuum Pump Housing CVP 1

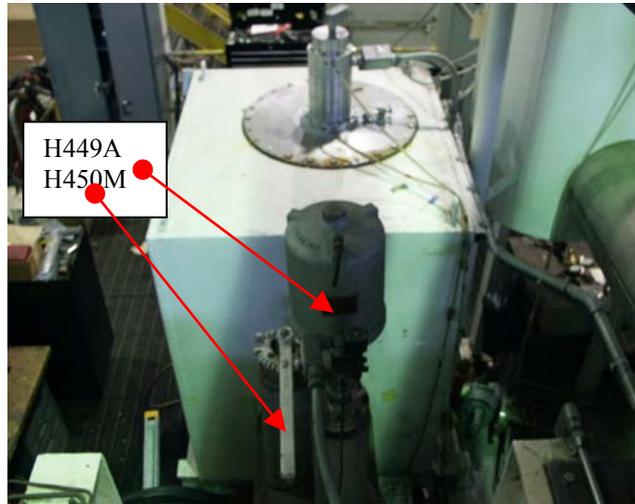
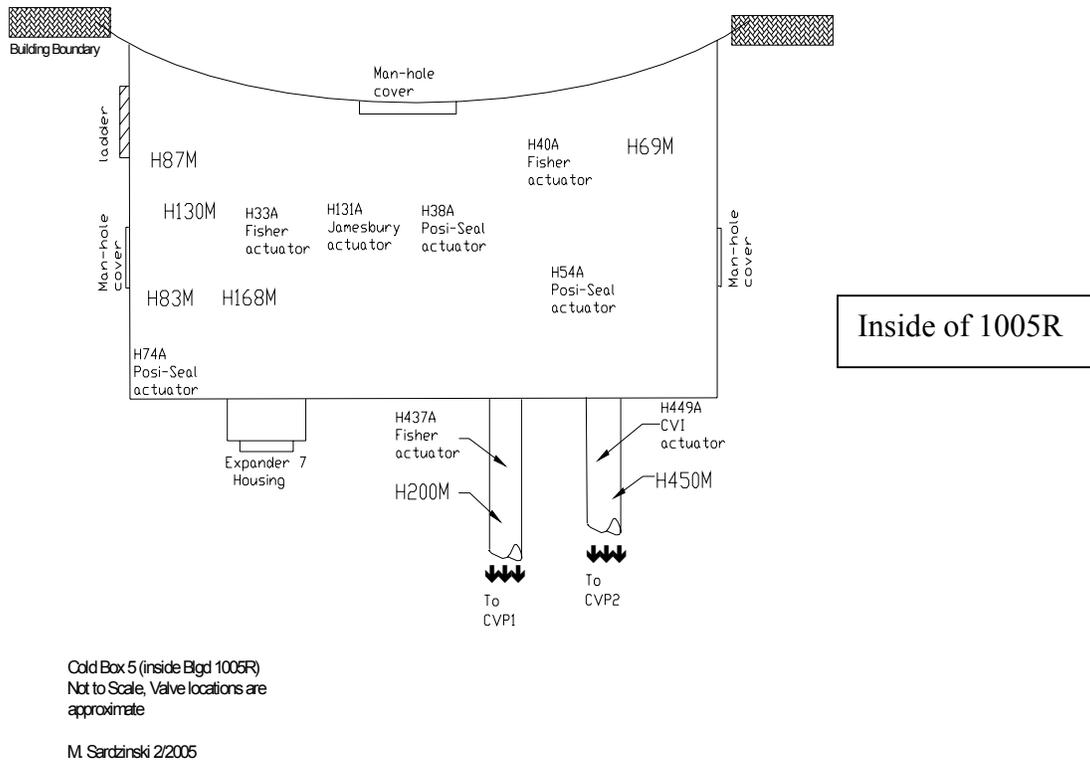


Fig.46: Cold Vacuum Pump Housing CVP 2





Supporting Documents and drawings:

- RD3A995047 Interconnecting Piping Diagram**
- RD3A995051 Cold Box 5 P&ID SHT 1.**
- RD3A995052 Cold Box 5 P&ID SHT 2**
- 3A995009 RHIC 25Kw Helium Refrigerator P&ID**
- 3A985122 rev. B (Helix 7026296) Wiring diagram Calorimeter # 5 Control Panel.**
- 3A985044 rev. B (Helix 7026296) Calorimeter Control Panel Ass'y 3 & 5.**
- DP26-TC Differential meter users Guide**
- P5 Series User's Manual AC Adjustable Speed Drive IDM Controls**