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HALL D PROCEDURE NO.:
D00000-01-08-P001 Rev -

TITLE: DIRC Operations Procedure

DATE: 1/18/2019

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REV.	DESCRIPTION	BY	CHK.	APP.	APP.	DATE

1. Background

The DIRC Detector consists of 4 fused silica Bar Boxes previously used at SLAC and 2 new Optical Boxes supplied by MIT. The purpose of the Hall D GlueX DIRC is to utilize Cherenkov radiation to provide supplemental particle identification information for charged particles reconstructed by the GlueX detector. In particular, the DIRC will enhance the ability to separate pions from kaons. The radiator for the DIRC uses four five-meter long ``bar boxes,'' (BB) each containing twelve fused silica bars. These bar boxes are recycled from the BaBar DIRC detector that was built at SLAC. The role of the optical boxes (OB) is to transport the light from the "bar boxes" to the photon-detector plane. This light will then be utilized to image the Cherenkov radiation emitted from the bar boxes.

The complete detector consists of an Upper Detector (OB coupled to 2 BBs, PMTs etc) on the north side of the hall and a Lower Detector on the south side of the hall. The ability to move the detector in and out of beam is required.
There is significant infrastructure required to support this detector. Infrastructure includes mechanical supports and motors, electronic equipment and cables, pure water for optical coupling and transmission, pure nitrogen purge to prevent contamination and air cooling for the electronics.

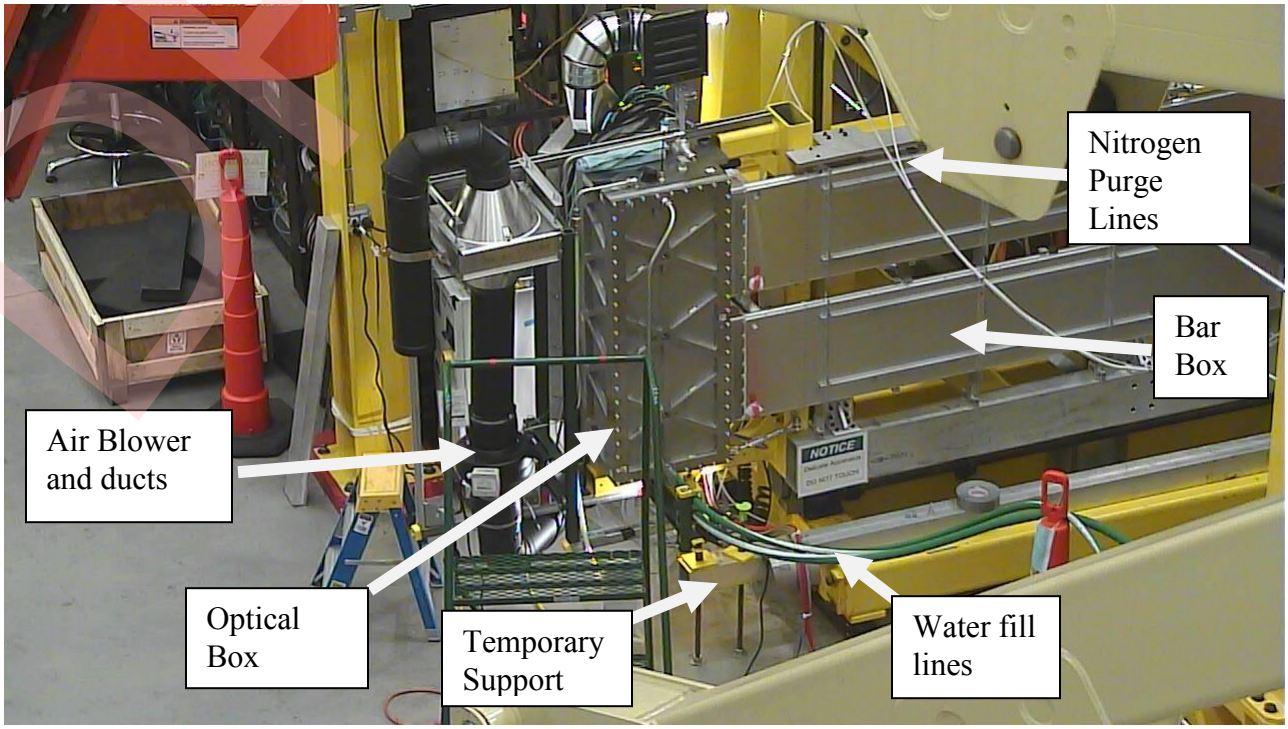


Fig 1 Lower DIRC Detector Installed but separated from FCAL Platform

2. Scope - Hall D DIRC Detector Operation, Maintenance and Installation and Removal from beamline position

These procedures can only be performed by trained individuals authorized by the Hall D Work Coordinator!
The purpose of this procedure is to define how to safely operate and install the DIRC detector into operational position and move back out. Hazards to personnel and equipment along with the actions to mitigate the hazards are addressed in each section. Required maintenance is also addressed. The DIRC Detector installation drawing is D000000000-1019.

3. Operations and Controls

Under normal operations, the DIRC Optical Box (OB) is filled with circulating purified water (see D000000108S003 Water System Skid SOW and D000000108-5000 P&ID) at a rate of approximately 3 change outs per day. The capacity of the OB is approximately 43 gallons. The holding tank is initially filled with JLAB Low Conductivity Water (LCW) then kept clean by circulating through a series of filters, UV lights and oxygen and CO2 removal system. The water is recirculated through a skid filtering system at a rate of approximately 2 gpm. Most of the water bypasses the OBs. Only about 0.1 gpm of water flows into each OB (fig 7). Details of the operation of the skid controls are found in the User manual located at: O:\halld_engineering\Technical_Library\DIRC Pureflow waterskid. The water skid parameters are controlled by an Allen Bradley PLC.
Internal interlocks for water flow and temperature will shut down the pumps when the assigned values are exceeded. The skid can be reset from the EPICS screen (see fig. 1). Underneath each optical box is a catch pan with a water sensor in it. This will set off an alarm if any water leaks out of the OB and into the pan.

In addition, there is a constant clean nitrogen gas purge on the Bar Boxes (BB) and OBs (See D000001002-5001P&ID and fig 8). The flow is controlled manually using a flow meter with a readout that is visible on EPICS (see fig 2). The North BBs are

currently sharing 1 flow meter and nominally flows at 2.5 – 2.7 l/h. The south BBs are separate and flow at 0.8-1.0 l/h each. The OBs flow at 6 l/h. Pressure transducers are used to monitor the pressure in the systems. A 1 psi relief valve is used for the OB N2 system and 1 psi check valves are used for relieving if there is a water overflow. The BB supply pressure is set at 4 in H2O and there is nominally a 2.5 in H2O drop in pressure through the filter bank at the current flow rate. Alarms are set at appropriate values for each component to let us know if there is a fault condition.

There is also air cooling for the PMT electronics. This system has a duct pressure sensor that will alarm and trip the high voltage to the PMTs when the fan is off (ie. no air flow). Over temperature and humidity inside the dark box as well as the light sensor and cover switch will trip off the low and high voltage. These discrepancies must be corrected before the high voltage can be turned back on to the readout modules.

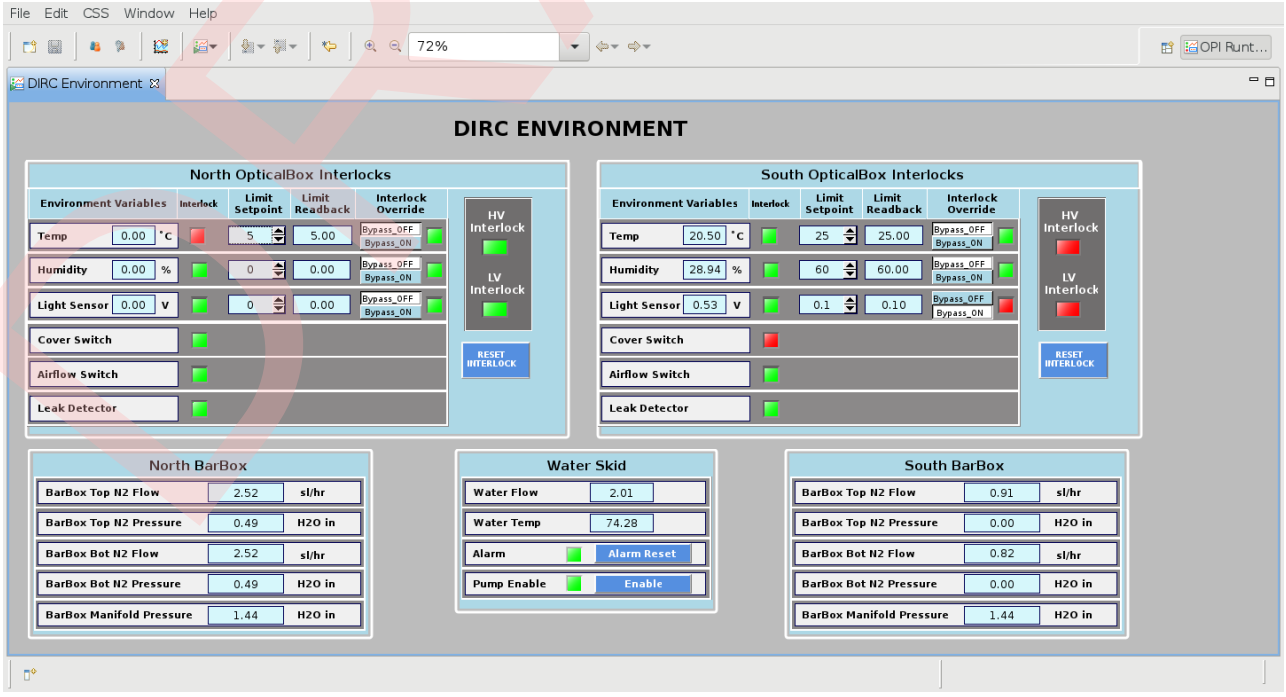


Fig 2 DIRC EPICS Control Screen

4. Installing and Removing the Detectors from Beam Position

Electronic Signature in progress.

In order to move the detectors in and out of beam position, a series of motors, gear boxes, drive shafts and ACME screws are used. The motors can only be operated locally and a trained person must be present when moving the detectors. Care must be taken when moving the detector as there are obstacles that would interfere with this motion. The entire DIRC detector assembly must be separated from the FCAL platform to move in or out of beam. A minimum of 3 trained people must be present when the platform is decoupled and the detectors are moved in or out of beam. The following steps are to be taken;

a. Check to see if the Solenoid magnet is powered on. If so, ensure safeguards are in place to keep falling magnetic objects getting into the marked 600 gauss boundary. Restrictions on crane use are in affect (See Hall D Crane operations OSP)
b. Ensure the upstream lock down angles are installed and bolted to the ground
c. Uncouple the FCAL platform and DIRC support structure by removing the 2 upper and 2 lower tie plates (see figs 3 and 4). The overhead crane and man lifts are to be used.
d. Lock out the crane to ensure there are no mishaps when the structures are separated and the 2nd (downstream) FCAL support is not installed.
e. Use a come-along to move the FCAL platform downstream a minimum of 30 inches (see drawing D000000000-1012 FCAL towing fixture install). All obstructions should be moved and body parts shall be clear of moving mechanical parts. Pay close attention to the cable, fibers, hoses etc.. to ensure nothing gets caught or pinched.
f. Unlock the motor control on the DIRC support
g. Operate the upper and lower motors separately (either up or down) until the limit switch is reached. The motor control must be constantly manned when moving in case the limit switches fail. Keep a close eye to make sure there are no obstructions. Ensure all cabling, water lines and nitrogen lines are free to move.
h. Administratively lock out the motor controls.

i. Install the come along on the upstream end of the FCAL platform and bring it back to the DIRC support until they touch. 2 people should be observing to ensure there are no obstructions.
j. Re-install the upper tie plates using the crane and man lifts.
k. Turn on the water skid and set flow to 0.1 gpm to each box.
l. Ensure nitrogen is flowing to each component at proper levels.
m. Check CSS screen to ensure all interlocks are still functioning

Note: If the structures are to remain separated for an extended length of time (ie more than just the time needed to re-position the detectors), the downstream support bar shall be installed over the downstream bottom tube of the DIRC support structure (shown in fig. 1 & 4).

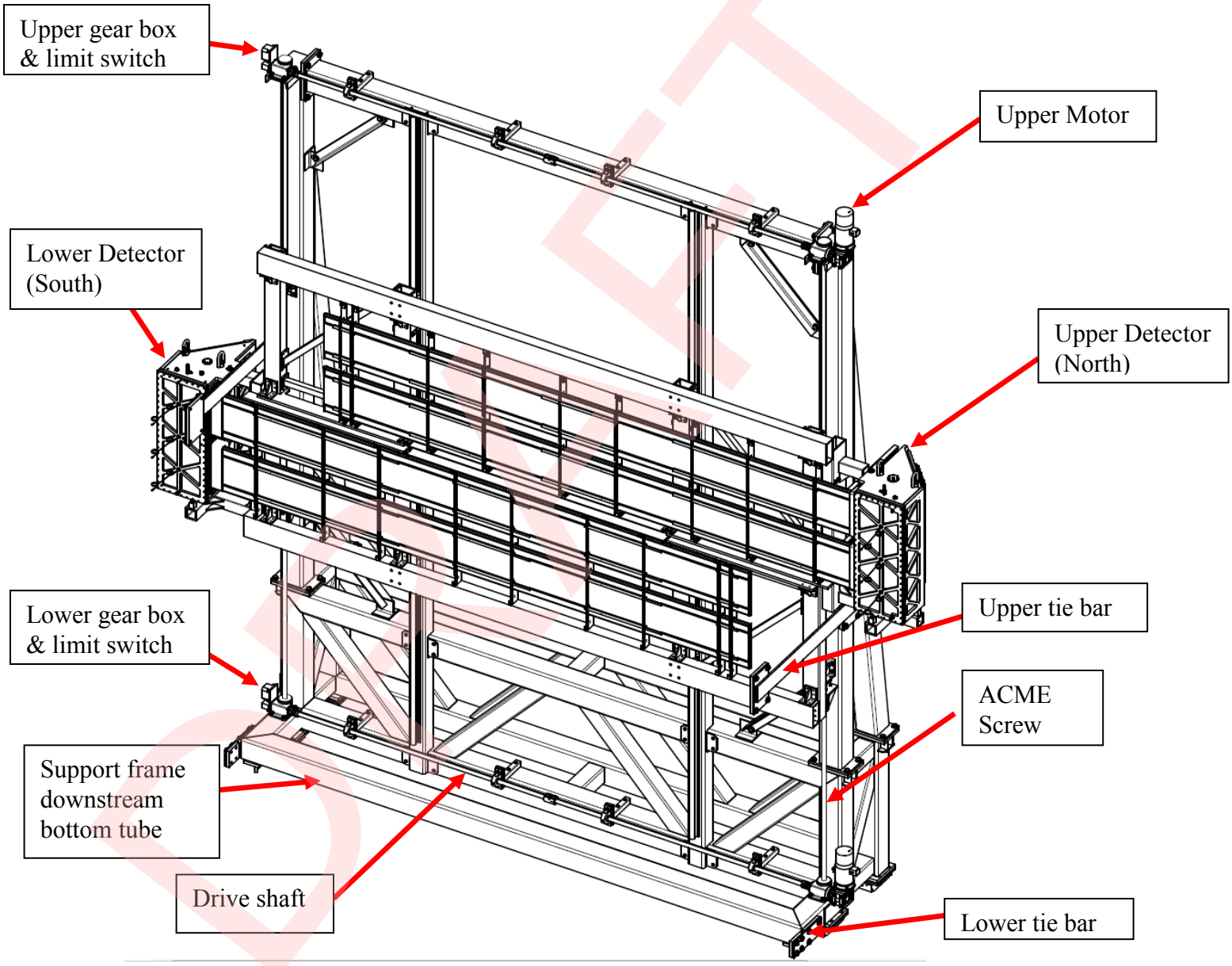


Fig 3 DIRC in Operational Position

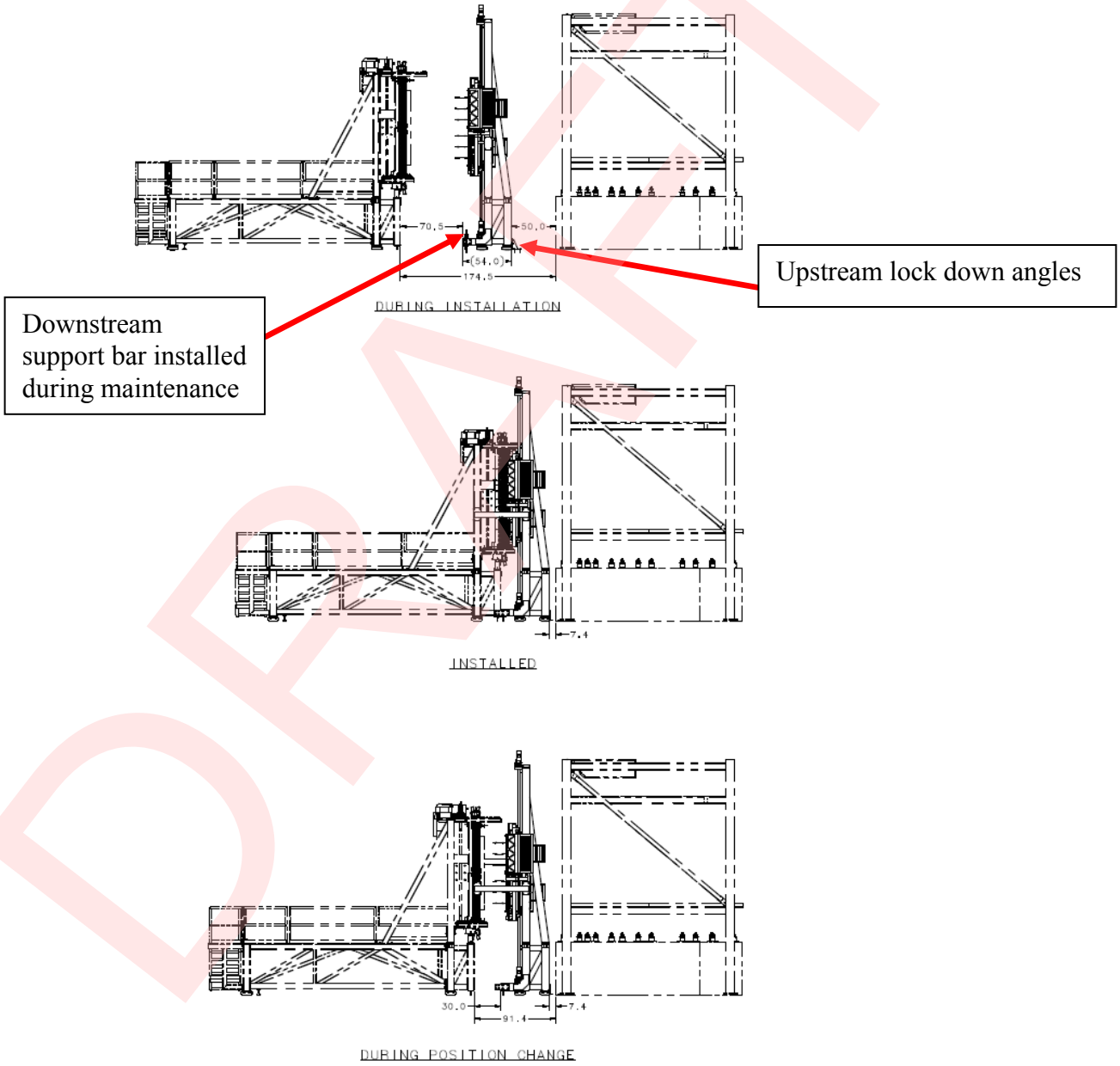


Fig 4 Side View of DIRC Support and FCAL Platform

Fig 5 DIRC in Maintenance Set up

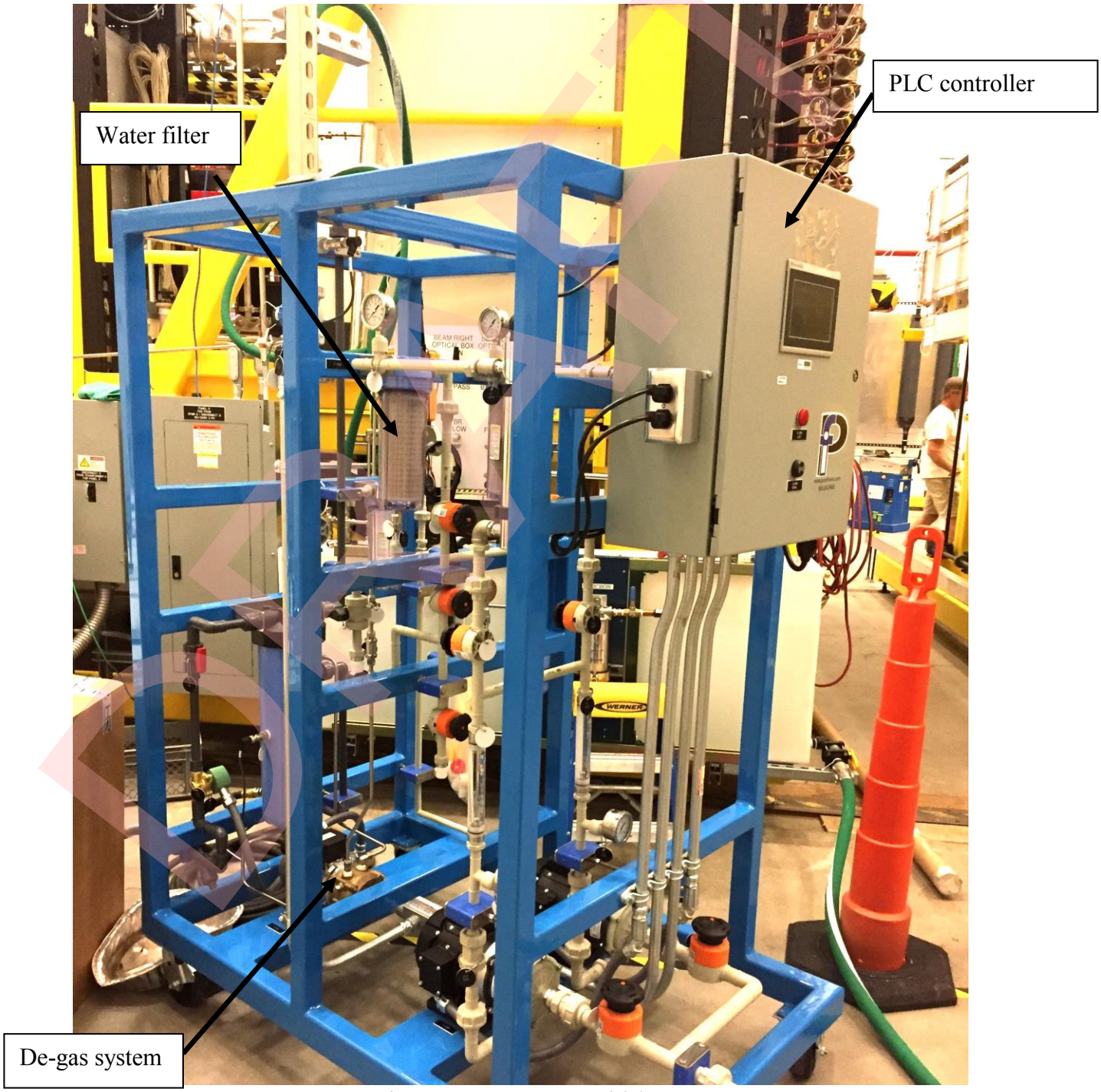


Fig 6 DIRC Water Skid

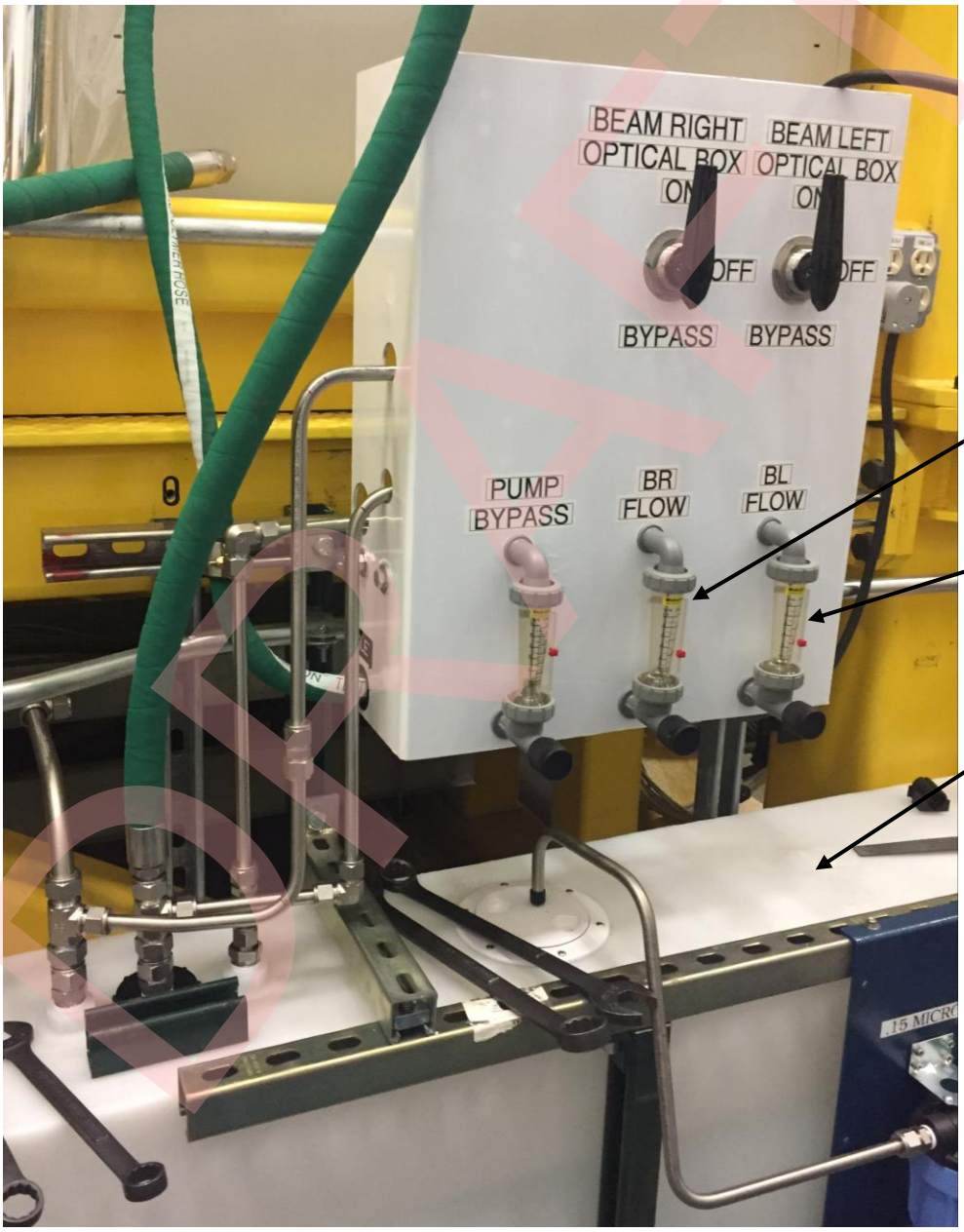
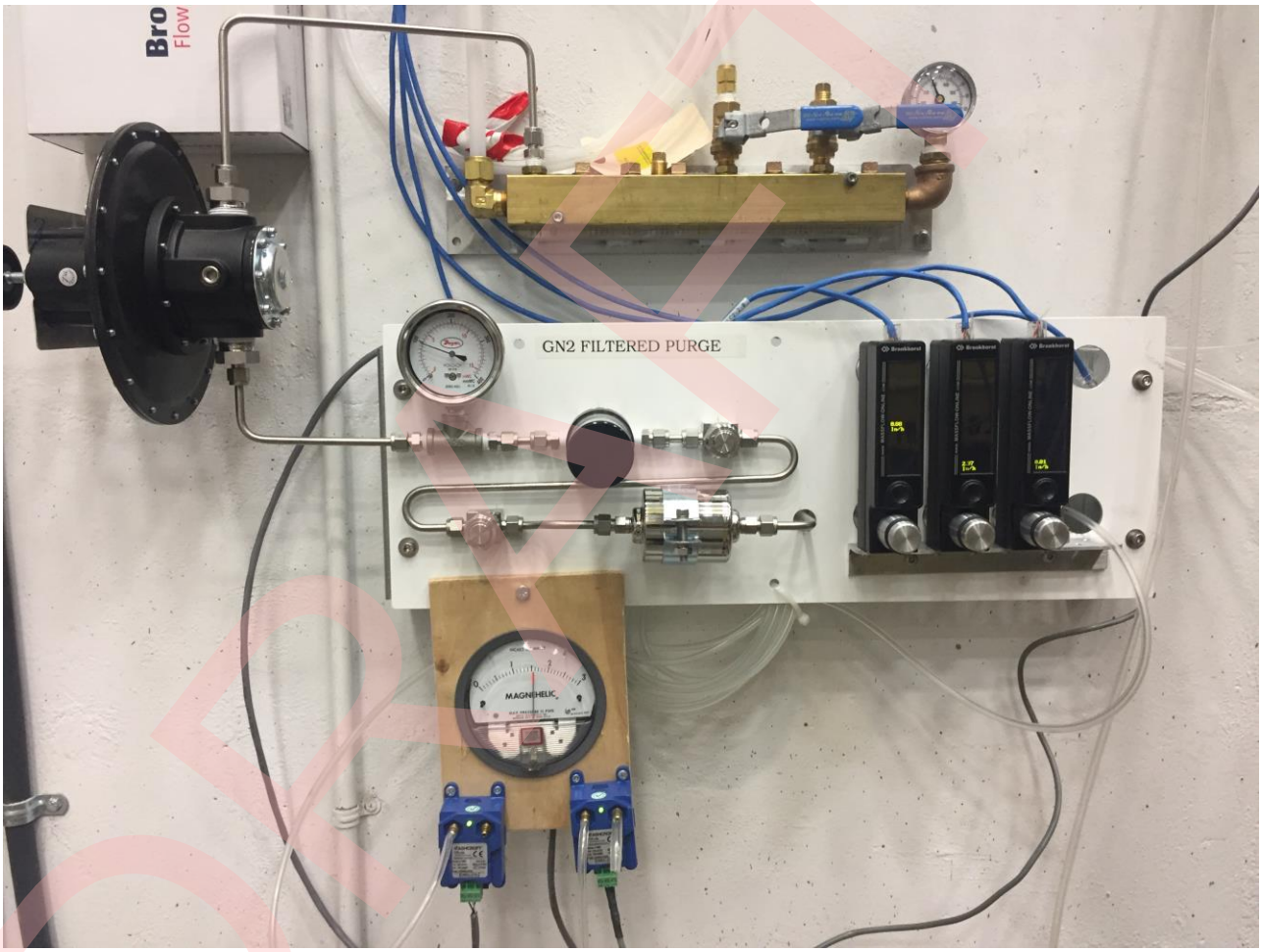


Fig 7 DIRC Water Flow Panel



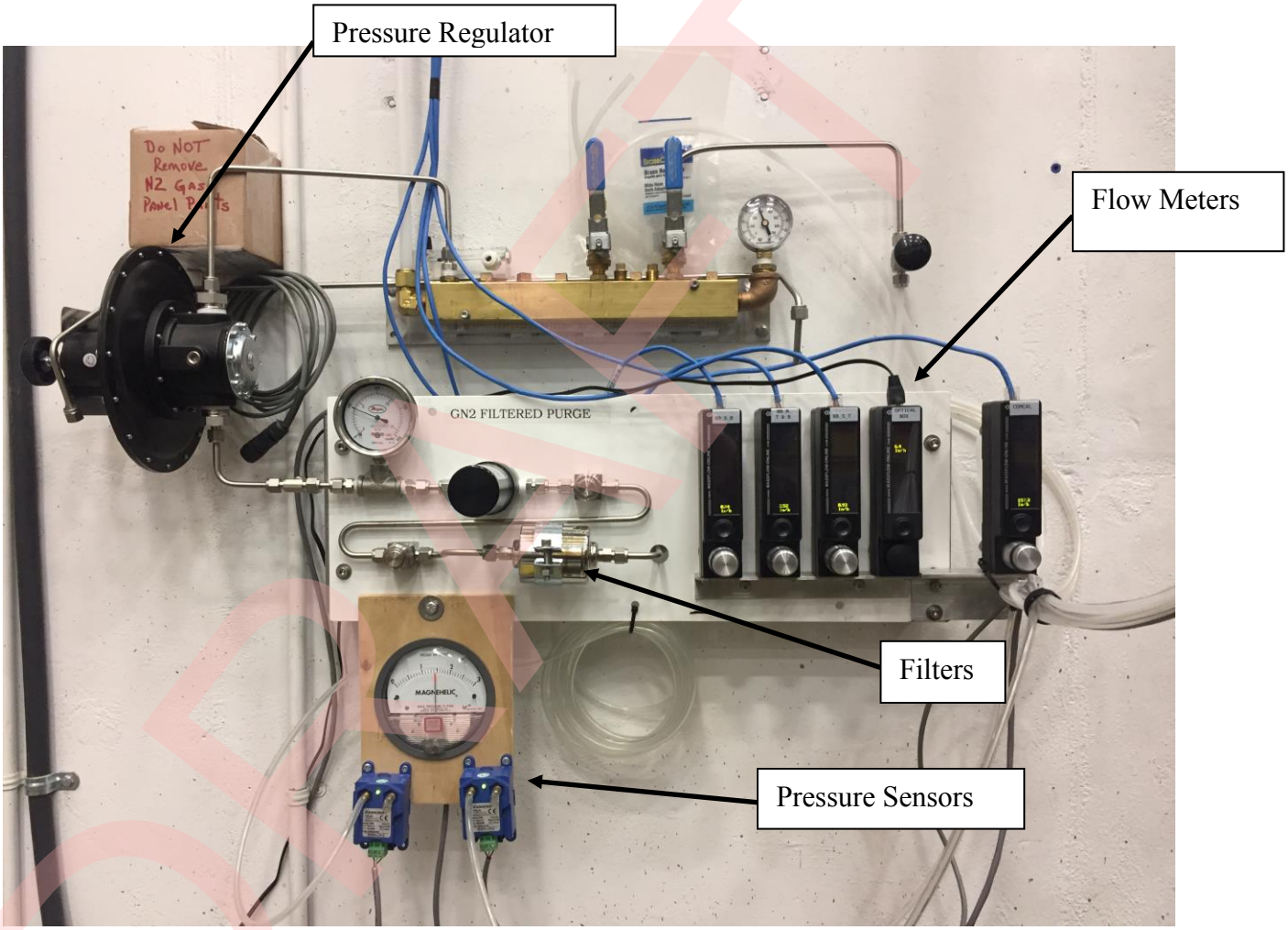


Fig 8 Nitrogen Purge Panel

5. Maintenance

The following items require periodic maintenance or testing in order to keep the system running efficiently;

a. Nitrogen system filter inspections and change outs
b. Water system filter inspections and change outs
c. Water system water analysis to ensure consistency of water purity (see D000000108S006 water monitoring plan)

d. Water system has 2 pumps which will be alternately run to ensure there is always an operational system.
e. Lift system ACME thread lubrication
f. Air cooling system filter change
g. Test N2 relief valves

The tasks are loaded into a web based maintenance data base. Email reminders are sent to responsible parties when maintenance is due. Initial durations are set and can be changed by the hall engineer depending on conditions.
Durations and instructions are found at:
https://halldweb1.jlab.org/cgi-bin/maintenance/cgi/status.pl

6. Training

This document along with the referenced material is used for training the technicians performing moves, maintenance and responding to alarms and trips. All Hall D mechanical on-call personnel will be trained.