



RICH CO₂ Gas System Operating Procedures

procedure name

PHENIX Procedure No. PP-2.5.2.7-04

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Hand Processed Changes

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[Signature] 5/4/99
 Cognizant Scientist/Engineer Date
 /Activity Manager

[Signature] 5/5/99
 PHENIX QA/Safety Date

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PHENIX Procedure # PP-2.5.2.7-04 Rev A

REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	WRITTEN BY	APPROVED BY	TYPED BY
A	First Issue	4/20/1999	n/a	A. Frawley, W. Lenz, 2 others unitelligible.	n/a
RETIRED	Procedure no longer needed, Superceded by other procedures.	3/6/2007	(Retirement note written by. D.Lynch)	Retirement approved by D. Lynch, R. Pisani and P. Giannotti for the PHENIX experimint	n/a

1.0 Purpose

This document describes the operating and emergency procedures for the PHENIX RICH carbon dioxide radiator gas system that will be used during the engineering run, and for approximately the first year of physics running.

2.0 Responsibilities

The RICH scientist who is responsible for training all personnel in the use of the RICH CO₂ gas system is Anthony D. Frawley.

3.0 Precautions

During a purge of the RICH, the CO₂ flow rate is 25 liters/min. Since a purge takes 80 hours, there is the possibility of flowing a substantial amount of CO₂ into the interaction region if the entire flow was diverted into the room. Therefore, during purges of the RICH, area CO₂ monitors should be placed in the interaction region and monitored continuously.

There is a pressure interlock that will prevent the RICH pressure exceeding the room pressure by more than 0.7" of water. At a pressure of 0.7" of water, a breach of the gas vessel will release about 170 liters of CO₂ before the RICH pressure is equalized with the ambient pressure in the interaction region. The release of 170 liters of CO₂ into the interaction region would not produce an oxygen deficiency hazard, so no special precautions are considered necessary.

Under normal operating conditions, the CO₂ flow rate into the RICH is 0.5 liters/min. Even if the entire RICH input flow were diverted into the interaction region, there would be no oxygen deficiency hazard, so no special precautions are considered necessary.

4.0 Equipment

The gas handling system is shown schematically in figure 1. It is used to perform the following tasks:

- Purge the RICH of air, replacing it with CO₂ (see section 5.1).
- Maintain a CO₂ atmosphere in the RICH at a pressure of 0.5" of water above ambient (see section 5.2).
- Monitor the RICH internal pressure. There is an interlock that shuts off the input gas flow if the RICH pressure exceeds a preset limit, and a warning is sounded if the RICH pressure drops below a preset threshold (see section 5.3.2).
- Monitor the water sensor, placed at the lowest point of the RICH, and sound an alarm if water is detected so that the cooling water flow can be shut off. This is a precaution against cooling water leaks (see section 5.3.1).

5.0 Procedures

Note that V3 and V7 fail closed if there is a power failure. This isolates the RICH, but with the path through the bubbler still available for overpressure relief.

5.1 Initial purge of the RICH

The purpose is to replace air in the RICH with CO₂ gas. This will be necessary only after installation of the RICH in PHENIX, or after the RICH has been opened.

The RICH internal pressure and gas flow rate must be monitored at 60 minute intervals or less during the entire purge procedure. The purge procedure should be interrupted (see 8 below) whenever the RICH is to be left unattended for more than 60 minutes.

1. With V1 and V2 closed, open the CO₂ supply valve (SV1) and set the pressure regulator (R1) output to 20 psig. The overpressure relief valve RV1 is set for 25 psig.
2. Close throttle T1 on the high volume flowmeter following V1.
3. Open V7 (to bypass the bubbler), V3, V1 and the CO₂ supply valve.
4. Open throttle T1 on the high volume flowmeter until the flow rate equals 25 liters/min.
5. Note the starting time of the purge in the logbook.
6. Monitor the RICH pressure until it stabilizes. The high-pressure interlock will automatically shut off the input gas flow if the RICH pressure exceeds the preset upper limit of 0.75".
7. Flow enough CO₂ into the RICH to provide three volume changes. The RICH volume is 40,000 liters. At 25 liters/min, three volume changes will take about 80 hours.
8. If the RICH is to be left unattended for more than 60 minutes, interrupt the purge by closing V1 and then V7. Resume the purge by opening V7 and then V1. Note the times in the logbook.
9. After three volume changes, close V1, make a note of the time in the log book, and then change to normal operation mode as described in section 5.2 of this document.

5.2 Normal operation

1. Make sure that V1, V2 and V7 are closed.
2. If necessary, open the CO₂ supply valve and set the pressure regulator (R1) to 20 psig.
3. Close throttle T2 on the low volume flowmeter following V2.
4. Open V3 and V2.

5. Open throttle T2 on the low volume flowmeter until the CO₂ flow rate is equal to 0.5 liters/min.
6. Monitor the RICH pressure until it stabilizes at the bubbler back-pressure, which is about 0.5" water.

5.3 Emergency responses

There are two situations that could threaten the integrity of the RICH gas vessel.

1. **Cooling water leak:** If there was a large cooling water leak inside the RICH (which is unlikely because the stainless steel water cooling pipes are continuous inside the RICH, with no joints), water could build up until the pressure broke the RICH exit window. Water buildup at the lowest point in the RICH would be detected by the water sensor, and an alarm would sound in the control room. If this happens, the operator must:
 - Manually close valves V4 and V5 to isolate the RICH from the water cooling lines. Note that the heat generated by the RICH phototubes will raise the PMT array temperature only by 20° to 25° F without cooling, so there is no danger of damage to the RICH if the PMT array is left powered without water-cooling.
 - Once the RICH has been isolated from the cooling water supply and return, the water built up in the RICH should be drained manually using V6.
2. **Overpressure in the RICH:** If the RICH internal pressure exceeds the preset upper limit of 0.75" of water, the inlet gas flow will be automatically shut off and an alarm will sound in the control room. The operator would then be required to:
 - Go to the RICH gas control panel and check that the pressure interlock that automatically shuts off the gas flow has worked properly.
 - If not, the operator should manually close valves V2 and V1. If the pressure interlock failed, it would take about 2.75 hours at the normal flow rate of 0.5 liters/min for the RICH pressure to exceed 1.5" of water, the maximum pressure at which the RICH has been tested. Finite element model calculations for the window support beams lead us to expect that the RICH pressure could easily go to 3" of water without damage to the windows. This would take 7.5 hours at a flow rate of 0.5 liters/min.

5.4 Removing CO₂ from the RICH prior to opening

This procedure describes the removal of CO₂ from the RICH by purging it with N₂, and then the preparation of the RICH for opening by ventilating it with a fan blowing through open access hatches.

1. Exchange a nitrogen supply bottle for the CO₂ supply bottle in Fig 1.
2. With V1 and V2 closed, open the nitrogen supply valve and set the pressure regulator (R1) output to 20 psig.
3. Close throttle T1 on the high volume flowmeter following V1.
4. Open V7 (to bypass the bubbler), V3, V1 and the nitrogen supply valve.
5. Open throttle T1 on the high volume flowmeter until the flow rate equals 25 liters/min.
6. Note the starting time of the purge in the logbook.
7. Monitor the RICH pressure until it stabilizes. The high-pressure interlock will automatically shut off the input gas flow if the RICH pressure exceeds the preset upper limit of 0.75".
8. Flow enough nitrogen into the RICH to provide three volume changes. The RICH volume is 40,000 liters. At 25 liters/min, three volume changes will take about 80 hours.
9. After three volume changes, close V1 and make a note of the time in the log book.
10. Remove the center access hatch on each side of the RICH, and use a large fan to blow air through the RICH for at least 3 hours before anyone enters the RICH.
11. After three hours of ventilation, the RICH windows may be removed, if necessary, or maintenance work can be carried out by leaning through the hatches from outside the RICH.

5.5 Shut down procedure when the RICH will be left unattended

When the RICH is to be left unattended for more than 2 hours, close valves V4 and V5 to isolate the RICH from the water cooling system.

6.0 Documentation

None.

7.0 Attachments

Fig. 1 – P&ID drawing of the gas system.

