PHENIX CANARY CHAMBER OPERATING PROCEDURE

PHENIX Procedure No. PP-2.5.2.4-03

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Hand Processed Changes

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Approvals

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PHENIX S E & I Date Cognizant Scientist/Engineer Date
/Activity Manager

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PHENIX Safety Date CA-D ES&H/SAFETY Date

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1.0 Purpose and Scope

The scope of this procedure is those safeguards and operations that are necessary for turning on flammable gas, high voltage (HV) and low voltage (LV) in the PHENIX Canary Chamber. This procedure also describes the response of the Canary Chamber system to emergencies.

2.0 Responsibilities

It is the responsibility of the Canary Chamber Operators to prepare Canary Chamber for operation with flammable gas.

The list of Canary Chamber Operators is given in Attachment 1.

Once Canary Chamber is ready to flow flammable gas, it is the responsibility of the Flammable Gas Operators to initiate the flow of flammable gas in a manner that is safe to personnel and equipment. The details of turning on of the flammable gas flow through Canary Chamber are contained in the Standard Operating Procedures listed in Sec. 6.1.

When PHENIX has a long shutdown, it is the responsibility of the Flammable Gas Operators to turn off the flow of flammable gas. During this period there can be no high voltage and no low voltage on the Canary Chamber. It is the responsibility of the Flammable Gas Operators to ensure that the HV is off before flammable gas shutdown.

The list of trained and approved Flammable Gas Operators is given in the PHENIX Flammable Gas System OPM # PP-2.5.3.14-02.

It is the responsibility of the Canary Chamber Operators to prepare Canary Chamber for operation with high voltage in a safe manner, as described in Sec. 6.2.

It is the responsibility of the source custodian Carter Biggs to install Sr^{90} β-source in the Canary Chamber, close and lock the external box.

During commissioning, it is the responsibility of the Canary Chamber Operators to bring on the LV in a safe manner, as described in Sec. 6.3.

During data taking, it will be the responsibility of the PHENIX Shift Crew to:

- Monitor the status and alarms of the gas system according to a prescribed checklist (Attachment 2) at least once a shift (eight hours).
- Monitor the status and alarms of the HV system throughout the shift, according to a prescribed checklist (Attachment 2).
- In the event of an alarm or irregularity, contact an expert from the list of Canary Chamber Operators (Attachment 1).

3.0 Prerequisites

The Canary Chamber Operators must have training in the following areas:

3.1 Collider - Accelerator User Training,
3.2 PHENIX Awareness Training,
3.3 This document.

4.0 Precautions

The PHENIX Safety Monitoring and Control System (SMCS) is interlocked with the power to the Mixing House (MH). In the event of any Level 3 alarm, all power to the Gas Room of the MH is shut off. The Level 3 alarms include:

- Detection of flammable gas by the VESDA system in the Interaction Region (IR),
- Detection of smoke by the HSSD system in the IR.
- Flammable gas alarms in the MH.
- Heat sensor alarms in the MH.

Canary Chamber contains sealed Sr^{90} β - source of 18μCi activity. After installation of Sr^{90} β - source Canary Chamber external box must be closed and locked at all times.

4.1 *Gas System Precautions:*

4.1.1 Before initiation flow of flammable gas in the Canary Chamber, or after long shutdown periods when the flammable gas flow has been turned off all precautions for the PHENX Flammable Gas System Operation (OPM # PP-2.5.3.14-02) must be taken.
4.1.2 When Level 3 alarm occurs, solenoid valves (normally closed) and pump in the flammable gas lines shut automatically. This leaves gas inlets of the Canary Chamber closed.
4.1.3 Canary Chamber external box must be purged with nitrogen at all times. Flow controller in the Canary Chamber gas rack located in the Gas Room of the MH provides verification of the nitrogen flow status.

4.2 *High Voltage System Precautions:*

4.2.1 The SMCS is interlocked with the power to the MH. Activation of the alarms automatically shuts down the power to NIM crate housing BERTAN HV power supplies and to PMT Bertan HV power supply in the Canary Chamber control rack.
4.2.2 An insulating layer covers all HV points in order to eliminate the danger to personnel.
4.2.3 Before any HV can be turned on, sufficient gas must have flowed through the detector to remove oxygen from the chamber. This will be accomplished by purging the chamber with inert gas prior to the introduction of flammable gas. The gas flow rate is

50 Standard Cubic Centimeters per Minute (sccm) to Canary Chamber. Canary Chamber has a volume of 60 cm^3, twice as small as Canary Chamber gas system volume. Thus it will take 4 minutes for a single exchange of gas, or 16 minutes for four volume exchanges. So flammable gas shall not be introduced into the chamber until it has been purged with inert gas for at least 16 minutes. This ensures that there will not be a flammable mixture in the chamber or gas system.

4.2.4 In order to raise the HV to operating voltage, the chamber must be filled with operating gas. For the safety of the chamber, HV will not be turned on, except for low voltage testing, until operating gas has filled the chamber. Voltages less than 1000 volts may be applied to the chamber for short periods of time provided the operation is monitored at all times by a Canary Chamber Operators.

4.2.5 All HV controls associated with the Canary Chamber HV system are to be operated by designated Canary Chamber Operators only, or by the PHENIX shift leader following specific instructions from Canary Chamber Operators.

4.3 *Low Voltage System Precautions:*

4.3.1 The SMCS is interlocked with the power to the MH. Thus, activation of the alarms automatically shuts down the power to all LV supplies located in Canary Chamber control rack. The LV system is used to provide power to the Canary Chamber amplifiers, read-out Arcnet card and Gas System pressure transmitters.

4.3.2 Any reconfiguration of the Canary Chamber LV, turning the power on/off is to be performed by Canary Chamber Operators only, or by PHENIX shift leader following specific instructions from Canary Chamber Operators.

5. Emergency Procedures

5.1 In the event of an emergency, follow the procedures outlined in PHENIX Emergency Procedure 3.16.

5.2 In the event of an emergency related specifically to the Canary Chamber gas or electronics:

5.2.1 The SMCS is interlocked with the Gas, HV and LV power supplies. Activation of the alarm automatically shuts down the flammable gas flow and all power to HV and LV supplies. Nevertheless Canary Chamber external box will be continuously purged with nitrogen. Flow indicators in the Canary Chamber gas rack provide verification of the gas flow status.

5.2.2 Notify the Canary Chamber Operator that an emergency affecting the Canary Chambers has occurred.

6. Standard Operating Procedures

There are three elements to these Operating Procedures. The first element covers running ***flammable gas*** to the Canary Chamber. Only Flammable Gas Operators shall carry out this Procedure. The second covers the ***high voltage system*** for the chambers. The third covers the

low voltage system for the chamber. Only Canary Chamber Operators shall carry out these Procedures.

Operation of the Canary Chamber is possible only when SVOK switch on the DC/PC control screen is on..

The Gas System for the Canary Chamber is shown in Attachment 3. For details of the Canary Chamber LV and Control Systems schematics, please refer to Attachment 4.

The Canary Chamber performs series of measurements of the Drift Chamber operating gas properties every 12 hours. Every series of measurements takes a few hours.

6.1 *Gas System Procedures.*

Before flowing flammable gas to the Canary Chamber make sure that there are no alarms in the PHENIX DC/PC Gas System, that DC/PC purge the full flow. External Canary Chamber box must be closed and locked.

6.1.1 The following procedure describes starting gas flowing to the Canary Chamber after a long shutdown. It assumes no gas is currently flowing, no flowmeters are adjusted. If no gas has been flowing in the Canary Chamber for 24 hours one must start flowing inert gas first:

6.1.1.1 Inspect all Gas and Electrical connections in the Canary Chamber gas rack.
6.1.1.2 Close 'manual valve-4' (closes Canary inlet).
6.1.1.3 Start nitrogen flow to external box at 5 l/min with help of 'N_2 master flowmeter' and 'N_2 purge box-in flowmeter' FM-3.Check consistency between FM-3 and 'N_2 purge box-out flowmeter' FI-5 readings.
6.1.1.4 Check readings of 'N_2 purge box pressure' pressure transmitter PT-N2. Readings should be < 5 inches W.C. Check status of nitrogen bubblier in the exhaust line.
6.1.1.5 Set '3-way manual valves - 0,1,2 and 3' to 'N_2 purge'.
6.1.1.6 Open solenoid valve SV0 from the Canary Chamber control screen.
6.1.1.7 Open 'Back Pressure Control Valve' BPCV to maximum.
6.1.1.8 Activate Compressor from the Canary Chamber control screen. Adjust BPCV and 'Compressor Bypass Flowmeter' FM-2 to have gas flow of 1 l/min in 'DC-W-in' flow indicator FI-1, gas pressure > 0.5 atm in 'Output Pressure From Compressor' pressure indicator PI-2.Check status of DC gas bubblier in the exhaust line.
6.1.1.9 Set gas flow through Canary Chamber to 50 cm^3/min with help of 'Flow Mass Controller' FMC located in the Canary Chamber control rack.
6.1.1.10 Open 'manual valve-4' to start flow through Canary Chamber. Check readings of 'Canary Chamber Pressure' pressure transmitter PT-1. Readings should not exceed 0.5 inches W.C. Check consistency of FMC and 'Output Flow Canary Chamber' flow meter FM-1 readings.
6.1.1.11 Run Gas System for 20 minutes to purge gas lines and Canary Chamber.
6.1.1.12 Open SV1, close SV0 from the Canary Chamber control screen. Check 'DC-W-out' flow indicator FI-2 readings. Run Gas System for 20 minutes.

6.1.1.13 Open SV2, close SV1 from the Canary Chamber control screen. Check 'DC-E-in' flow indicator FI-3 readings. Run Gas System for 20 minutes.

6.1.1.14 Open SV3, close SV2 from the Canary Chamber control screen. Check 'DC-E-out' flow indicator FI-4 readings. Run Gas System for 20 minutes.

6.1.1.15 Shut down compressor and close SV3 from the Canary Chamber control screen. Set '3-way manual valves – 0,1,2 and 3' to the 'DC gas purge'.

6.1.1.16 Reduce nitrogen flow to External box to 1 l/min with help of 'N2 master flowmeter' and 'N_2 purge box-in flowmeter' FM-3. Check consistency between FM-3 and FI-5 readings.

6.1.1.17 Open SV0 and activate compressor from the Canary Chamber control screen. Check readings of PI-2, FI-1, FMC, PT-1 and FM-1. Adjust BPCV and FM-2 if necessary. Check status of DC gas bubblier in the exhaust line.

6.1.2 Normal operation of the Canary Chamber is fully automated and controlled by PC located in the Canary Chamber control rack. Normal operation of the Canary Chamber can be started only when procedure 6.1.1 has been successfully accomplished. Flow chart of the control program is presented in Attachment 5.
Normal operation of the Canary Chamber can be interrupted at any moment. At interruption control program ramps down high and low voltage, shuts down pump and solenoid valves SV-0,1,2 and 3. To shut down the Canary Chamber one should run procedure 6.1.3.

6.1.3 The following procedure describes shutting off flammable gas flowing to the Canary Chamber:

6.1.3.1 Shut down compressor and close solenoid valves SV0,1,2 and 3 from the Canary Chamber control screen.

6.1.3.2 Set '3-way manual valves – 0,1,2 and 3' to 'N_2 purge'.

6.1.3.3 Start nitrogen flow to external box at 5 l/min with help of 'N_2 Master Flowmeter' and 'N_2 Purge Box-in Flowmeter' FM-3. Check consistency between FM-3 and 'N_2 Purge Box-out Flowmeter' FI-5 readings.

6.1.3.4 Check readings of 'N_2 Purge Box Pressure' pressure transmitter PT-N2. Readings should be < 5 inches W.C. Check status of nitrogen bubblier in the exhaust line.

6.1.3.5 Open SV0 and activate Compressor from the Canary Chamber control screen.

6.1.3.6 Adjust 'Back Pressure Control Valve' BPCV and 'Compressor Bypass Flowmeter' FM-2 to have gas flow of 1 l/min in 'DC-W-in' flow indicator FI-1, gas pressure > 0.5 atm in 'Output Pressure From Compressor' pressure indicator PI-2.Check status of DC gas bubblier in the exhaust line.

6.1.3.7 Check readings of 'Canary Chamber Pressure' pressure transmitter PT-1. Readings should not exceed 0.5 inches W.C. Check consistency between 'Flow Mass Controller' FMC and 'Output Flow Canary Chamber' flowmeter FM-1 readings.

6.1.3.8 Run Gas System for 20 minutes to purge gas lines and Canary Chamber.

6.1.3.9 Close 'manual valve-4'. Set FMC to zero flow.

6.1.3.10 Open SV1, close SV0 from the Canary Chamber control screen. Check 'DC-W-out' flow indicator FI-2 readings. Run Gas System for 20 minutes.

6.1.3.11 Open SV2, close SV1 from the Canary Chamber control screen. Check

'DC-E-in' flow indicator FI-3 readings. Run Gas System for 20 minutes.

6.1.3.12 Open SV3 and close SV2 from the Canary Chamber control screen. Check 'DC-E-out' flow indicator FI-4 readings. Run Gas System for 20 minutes.

6.1.3.13 Shut down compressor, close SV4 from Canary Chamber control screen.

6.1.3.14 Reduce nitrogen flow to External box to 1 l/m with help of 'N2 Master Flowmeter' and 'N_2 Purge Box-in Flowmeter' FM-3. Check consistency between FM-3 and 'N_2 Purge Box-out Flowmeter' FI-5 readings.

6.2 *HV System Procedures.*

If the HV is being turned on for the first time, verify by checking with Flammable Gas Operators and Canary Chamber Operators that operating gas has been flowing to the Canary Chamber for at least half an hour before attempting to bring on the HV.

6.2.1 Turning on High Voltage to a chamber:

6.2.1.1 Check that the appropriate current limits are in place for the NIM Bertan HV power supplies. The limits are 1 μA and 100 μA for anode and cathode power supplies respectively. Check that these power supplies are in 'Trip restore' mode.

6.2.1.2 Check that the ramp up/down rate for each NIM Bertan HV channel is appropriate (10 volts per second).

6.2.1.3 Ramp up PMT voltages to –1400 V.

6.2.1.4 Ramp up cathode voltage to required voltage (-3000 V).

6.2.1.5 Ramp up anode voltage to +1650 V.

6.2.1.6 If any of the HV channels trip, turn it off until the reason for the trip is understood. Then begin the procedure again from 6.2.1

6.2.1.7 If there are no HV trips, verify that operating currents are appropriate. These are <50 nA for anode, <100 μA for cathode, <20 mA for PMTs.

6.2.2 Turning off High Voltage to a chamber:

6.2.2.1 Begin ramping down the HV.

6.2.2.2 Verify by the read back that the HV is off the anode and cathode.

6.3 *LV System Procedures.*

6.3.1 Turning on Low Voltage to a chamber:

6.3.1.1 Turn on the appropriate button to turn LV powe.

6.3.1.2 Verify that the button LED changes color to indicate power is on (GREEN).

6.3.2 Turning off Low Voltage to a chamber:

6.3.2.1 Click on the appropriate button to turn LV power off to the channel required.

6.3.2.2 Verify that the button LED changes color to indicate power is off (RED).

Attachments

A.1 List of Approved Operators of the Canary Chamber System.
A.2 Checklist for the Canary Chamber Gas and HV System.
A.3 Schematic of the Canary Chamber Gas System.
A.4 Schematic of the Canary Chamber HV and LV Systems.
A.5 Flow chart of control program.

Attachment 1: Canary Chamber System Operators (Experts)

The following people have been trained to operate the Canary Chamber. They have completed the prerequisite BNL training courses (see section 3).

Lesha Khanzadeev	x3794
Vladislav Pantuev	632-8112(office)
Victor Riabov	x3794
Yuri Riabov	x3794

Additional qualified users are to be listed below and posted in the counting house:

Attachment 2: Checklist for the Canary Chamber Gas and HV System

The PHENIX shift crew must go over the following checklist.

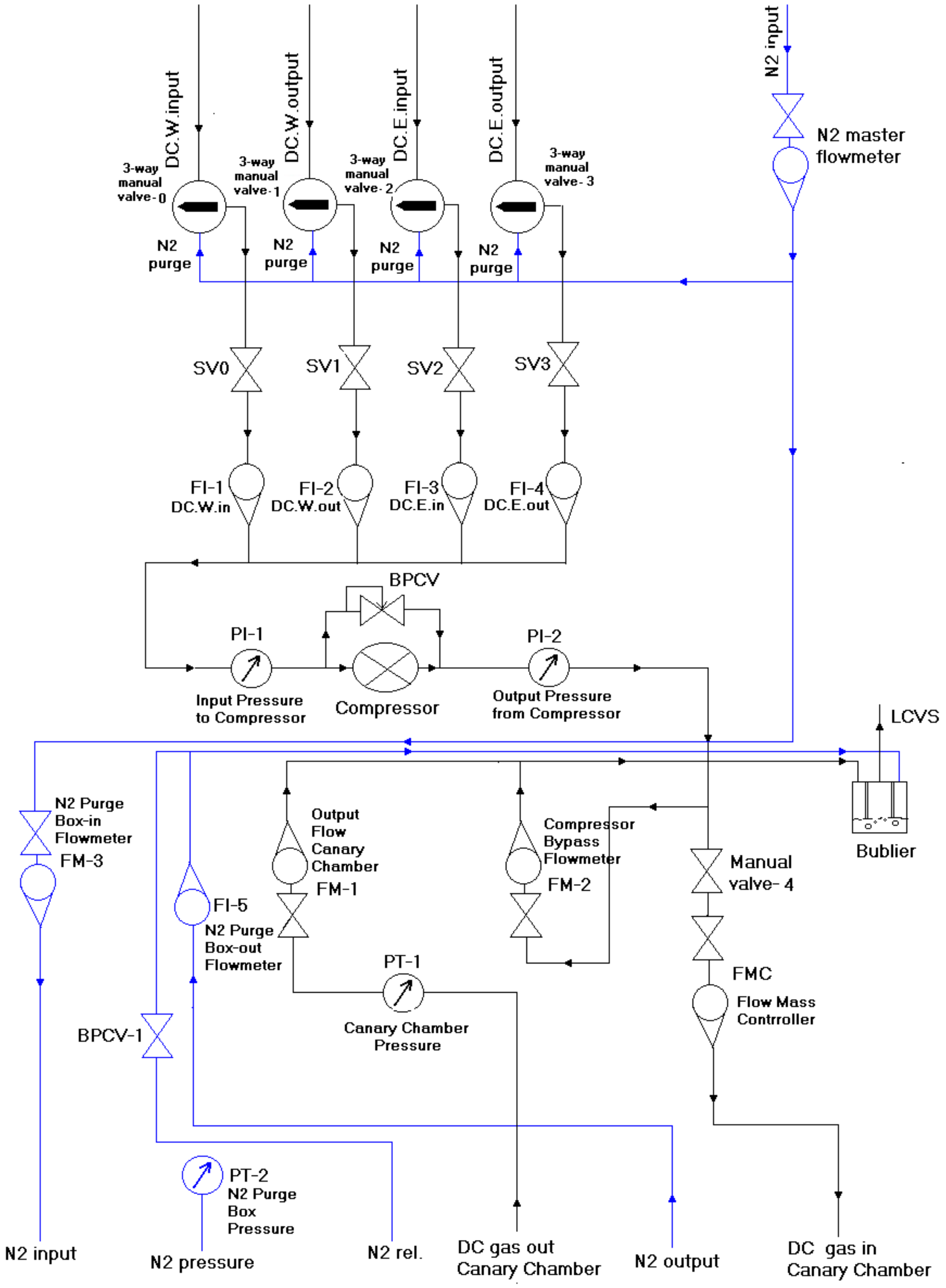
Canary Chamber Gas Rack

Item	Check point	Nominal	Minimum	Maximum
1	Canary Chamber Pressure (PT1)	0.3	0.1	0.5
2	N_2 Purge Box-out Flowmeter (FI-5)	1	0.5	5
3	N_2 Purge Box Pressure (PT_N2)	1	1	5

Canary Chamber Control Rack

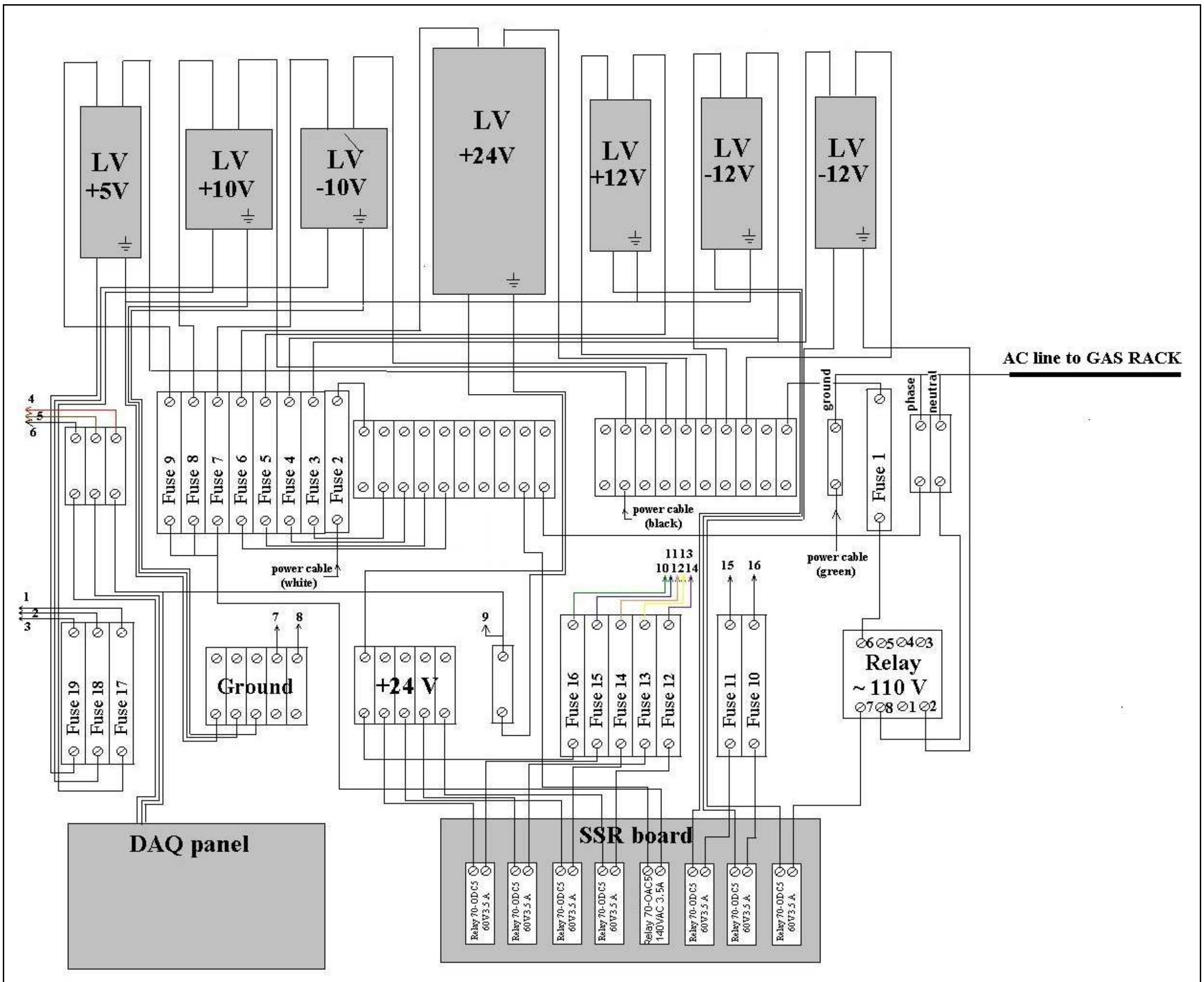
Item	Check point	Nominal	Minimum	Maximum
1	Flow Mass Controller (FMC)	50	10	90
		Status		
2	Bertan HV power supply (210-03R)	1. Polarity: negative 2. Current: 10 mA < I < 20 mA		
3	Bertann HV power supplies (1755P(N)) NIM crate	1. Marked channels LED on		

Attachment 3: Schematic of the Canary Chamber Gas System



Blue – nitrogen gas lines. Black – flammable gas lines

Attachment 4: Schematics of the Canary Chamber HV and LV Systems



Black cable from Control rack to Gas rack:

1. White-black (+5V Arcnet)
2. White-gray (-10V Arcnet)
3. White-red (+10V Arcnet)
4. Red (DAQ 24, Ground)
5. Brown (DAQ 57, PT_N2)
6. Black (DAQ 25, PT11)
7. White-brown (Ground)
8. White (Ground)
9. White-green (Ground)
10. Green (+24V)
11. Blue (SV0)
12. Orange (SV1)
13. Yellow (SV2)
14. Pink (SV3)
15. White-blue (+12V)
16. White-pink (-12V)

Attachment 5: Flow chart of control program