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Ventilation System and Alarms at X18A, X18B, and X19A

1.0 Description of System

Work at X18A, X18B, and X19A often involves use of nano-scale particulates and toxic gases (mainly Carbon Monoxide). A ventilation system with a HEPA filter is installed to control release of both these materials to the experiment hall area. The ventilation system draws air from the hutches at X18A, X18B, X19A, in addition to a gas cabinet, and exhausts to the roof of Bldg. 725. The hutch flows are designed to be 300 cubic feet per minute (cfm).

The manufacturer specifications for the gas cabinet unit indicate a required volume flow of air through the system of 175 cfm. The gas cabinet is designed to hold one standard 1A compressed gas cylinder and may be used for smaller cylinders also. The cabinet will be used to void gases from the building in the event of a leak from the compressed gas cylinder kept inside the device. It is intended for control of cylinders that are in active use and not as a cylinder storage device.

There are low flow alarms installed at each hutch with an audible alarm and indicator lights (Figure 1). There is a magnehelic gauge on the outside of the X19A hutch to measure pressure drop across the HEPA filter. Annual testing of the ventilation system is done to ensure both HEPA efficiency, and flow rates (See Attachment 1).

The control switch for the ventilation fan is located on the exterior of the X19A hutch (Figure 2).

Figure 1
Hutch Flow Alarm

Figure 2
Ventilation System Controls

2.0 Gas Use

Only gases which are not Toxic, Highly Toxic, Corrosive or Pyrophoric are allowed to be used in the gas cabinet, due to the type of piping connections. The gas flow controller has solenoid valves that fail closed on loss of power. All gas use at this and every other beam line at the NSLS, will be reviewed as part of the NSLS Experimental Safety Review Program. Use of H2 with this system requires dilution at or below 1% prior to entry into the exhaust system. Use of a flash arrestor for H2 cylinders may be required, and will be indicated on the Safety Approval Form. Normal operation of the gas flow experiments involves low flow rates (typically less than 200cc/min). The size of the supply tanks will be kept to a minimum. Toxic and flammable gases are required to be attended while flowing.

Use of CO requires gas monitoring with portable gas sensors. When CO is required for the experiment, one CO sensor should be clipped to the CO mass flow controller. The other sensor should be placed at the user work area. If a third sensor is available, place one inside the gas cabinet at the CO gas cylinder. Use and daily testing of the CO sensors is described in Attachment 2.

Typical CO use at these beamlines involves a 5% CO 'B' size cylinder. If the total contents of the cylinder were to vent at the beamline with no building ventilation, there would be a 1200 ppm (IDLH) concentration for a 3250 ft3 area (approximately 10 x 22 x 15).

The ventilation indicator green light must be on prior to using toxic or flammable gases in any of the hutches (see Figure 1 above). Each User must fill out the Gas Log (Attachment 3) on the front of the gas cabinet to document the gas use for their experiment, and performance of the CO sensor self-test (if applicable).

Since there is only one fan for all three hutches, if there is a problem with the ventilation fan, the alarms will all sound at once. It is also possible for one hutch to have a blockage of the ventilation ductwork, causing an individual alarm.

Loss of flow for the ventilation system presents no immediate hazard. This alarm indicates that we have diminished air flow in the system with the following results:

- Possible release of CO or H2 if gas is flowing in the gas cabinet.
- Possible release of either toxic gases, or nano-particulates to the hutch and experiment floor area.

Users will occasionally bring other toxic gases, such as hydrogen sulfide (H2S) for use at these beamlines, and may use their own toxic gas sensors. Control of these toxic gases is done by limiting the quantity allowed in the area, and is covered in the Safety Approval Form.

3.0 Alarm Response

Ventilation Low Flow Alarm

User/Beam Line Staff:

1. Attempt to reset the ventilation fan using the green button inside the enclosure mounted on X19A
   - If reset succeeds, continue with operations
   - If reset fails, call the Control Room at extension 2550 for assistance.
2. Terminate all toxic/flammable gas or nano-particulate work
3. Close all toxic/flammable gas cylinders at the main cylinder valve
4. Close any gas cylinders used to provide flow that may entrain unbound nano-particulates

NSLS Operations Staff:

1. Attempt to reset the ventilation fan using the green button inside the enclosure mounted on X19A
   - Contact the NSLS Utilities Group for assistance as needed. The Control Room should have a call-in list for after hours contacts.

NOTE: Toxic/flammable gas and nano-particulate work cannot be resumed until the ventilation is restored.

CO Monitor Alarm

User / Beam Line Staff

1. Compare the response from both CO monitors

   a. If only one device is alarming
      i. Attempt to reset the alarming device, while carrying the second monitor. If the second monitor also alarms, respond as below (b)
      ii. If the second monitor does not alarm, contact beam line local contact to resolve the discrepancy
      iii. Terminate CO use and close the gas cylinders at the main cylinder valve until alarm is resolved

   b. If both devices alarm
      i. Notify all workers in the area
      ii. Evacuate everyone to an area where the CO detector is no longer alarming
      iii. Call the Control Room at extension 2550
      iv. One person may attempt to close the valve on the CO gas cylinder if the CO levels in the area are below 125 ppm, and it will take no more than 5 minutes.

   NSLS Operations Staff:
   1. Contact BNL Fire/Rescue
   2. Proceed to the scene
   3. Control access to the area between X16 and X21 from the front ends to the walkway

NOTES

- If a gas alarm is confirmed, The BNL Fire/Rescue group will verify that conditions are safe for re-entry to the area.
- Low alarm 35 ppm, (one slow beep, flash, and vibration every second)
- High alarm 200 ppm (two fast beeps, flashes and vibrations every second)
- Response described is for low and high alarms
- A minimum of two CO detectors must be operating for work with CO gas

Toxic Gas Alarm (other than CO)

User/Beamline Staff:

• If only one device is alarming

- Consult the instructions in the SAF, and contact beam line Local Contact
- Attempt to reset the alarming device
- Terminate toxic gas use and close the gas cylinders at the main cylinder valve until alarm is resolved.

• If two or more devices alarm

- Notify all workers in the area
- Evacuate everyone to an area where the toxic gas detector is no longer alarming
- Call the Control Room at extension 2550
- One person may attempt to close the valve on the gas cylinder if the levels in the area are below the ceiling level noted on the SAF, and it will take no more than 5 minutes.

NSLS Operations Staff:

• Contact BNL Fire Rescue

• Proceed to the scene

• Control access to the area between X16 and X21 from the front ends to the walkway.

Attachment 1

Annual X18A, X18B. X19A Gas Cabinet Validation Checklist

(Post this form each year on the Gas Cabinet)

<u>Exhaust system air flow:</u>

- Clean gas cabinet air intake filter.
- Required volume flow rate = 175 cubic feet/min
- Linear flow rate is measured in the duct above the cabinet. The radius of duct is 0.25 feet. The area of that duct = $\pi r^2 = \pi(0.25)^2 = 0.196$ square feet.

Measured Linear Flow Rate _____
(feet/min)

Calculated Volume Flow Rate _____
(cu ft/min)
(measured linear flow rate)(0.196)

SHSD/RCD support _____ _____
(print name) (signature)

_____ _____
(date) (Life #)

Local contact (Syed Khalid) _____ Date_____
(signature)

Attachment 2

BW Technologies by Honeywell

Gas Alert Clip Extreme Operation

Before using CO gas, the users must perform the following:

1. Locate two CO detectors (yellow units about the size of a small cell phone). One is usually in the gas cabinet, clipped onto the CO cylinder, and the other one is in the hutch, clipped onto the CO mass flow controller. Check the LCD display on each of the sensors. If the LCD shows “Test”, the unit requires self-test. The self-test must be performed on each CO sensor **every 22 hours**.
2. Find the circle button located on the right hand side of the detector, just below its LCD display. Press it and hold for one second. This initiates a self-test. The Self-test takes about 30 sec to complete. **Watch the display** as it goes through the self-test; first the sensor beeps and vibrates once; all the LCD elements display; then High and Low alarm set points flash. **If an alarm has occurred within last 24 hours, the LCD displays the maximum gas exposure value and the hours that have elapsed since the exposure.** If that happens, check all the connections or call the beamline staff for help. Initial the Gas Log on the gas cabinet.
3. When the self-test is completed, a check mark appears in the top-left corner of the LCD display. Next to it the gas for which it is calibrated (CO) is displayed, along with a clock symbol and the remaining lifetime of the sensor.
4. Keep one CO sensor in the user area, and the clip the other to the CO mass flow controller.
5. Remember to perform the self-test every day, and initial the Gas Log. If the self-test fails, CO sensor beeps five times and its LCD again shows “Test”. Repeat the procedure. If the self-test fails three times, do not use the sensor. Call the beamline staff (8am – 10 pm, contact information is on the Green Sheet at the beamline) or PS ESH Coordinator (x5366) for further assistance. If neither are present, try calling the manufacturer (BW Technologies by Honeywell, 1-888-749-8878).

Date	Beam line	SAF #	Gas Used	Life/ Guest#	Hutch Flow Indicator Green?	CO Meters Self-Check? (Initial)