Maintenance, Troubleshooting and Alarm Response for:
Oxygen sensors, toxic gas sensors and related ventilation systems

Purpose: Safe oxygen levels range from 19.5% to 21%, outside of these ranges health effects and death can occur. Liquefied cryogens can create low oxygen levels during catastrophic releases as they expand and displace oxygen from the room. This can overwhelm standard ventilation systems but will often quickly dissipate and return to normal. This risk is generally very low because cryogen tanks and systems are designed to slowly vent instead of a complete rupture or failure. Cryogens can also freeze exposed flesh, eyes or mucous membranes if contacted or inhaled so exposure must be avoided. A small number of areas also contain potentially toxic gasses associated with mechanical or research systems. For these reasons a number of rooms and areas on campus are equipped with oxygen sensors, toxic gas sensors, alarms and in some cases ventilation systems for restoration of atmospheric oxygen concentrations. These systems require routine calibration, maintenance, response testing and control sequence confirmation.

Scope:

Cryogen Systems
Burke 011A- NMR magnet, helium/nitrogen cooled - Dale Mierke/Maria Pellegrini
Burke 004 - 2x NMR magnets, helium/nitrogen cooled – Wayne Casey
Burke 014A - liquid nitrogen bulk tank fill room (loading dock) – Wayne Casey
Moore B75 - MRI magnet, helium/nitrogen cooled – Dr. James Haxby
Cummings 01 – helium/nitrogen cooled squid detector – Solomon Diamond
Cummings B12 – nitrogen cooled milling equipment – Ian Baker
MacLean 028 – nitrogen dewar storage location – Chris Levey
Life Sciences – 2 NMR magnets to come on line ~2011-12
Wilder 10 – nitrogen and helium cooling systems – Alex Rimberg

DMS facilities managed to the same standard:
Borwell 383102 - 9.2 T MRI – John Pefeiffer

Other Air Monitoring Systems:
CO/Nitrogen Oxide sensors – Thompson Arena (under scorers table) – DCAD/ FO&M
Ammonia refrigeration system – Thompson Arena – DCAD and Refrigeration shop
Hydrogen monitor – Rauner, Bildner, Berry Dormitories (battery bank)
Halon extinguishing system – 56 Etna Rd. data center

Responsibilities: the following roles and responsibilities apply.

1. FO&M
   a. HVAC engineers and project managers are responsible for review of/or design and installation of toxic gas, oxygen alarm and ventilation systems. System design, alarm settings, posting/labeling and commissioning functions are encompassed in this function.
   b. Heating plant attendants, and building personnel have responsibility for monitoring building management systems, communicating alarm conditions, and directing repair/response actions.
   c. During normal hours of operations FO+M equipment repair shop is responsible for troubleshooting and alarm maintenance. FO+M troubleshooters are responsible for alarm and system response after hours.

2. Hanover Fire Department – will be summoned in the event of an automated alarm indication or should an occupant call 911 or activate local fire alarms.

3. Environmental Health and Safety

   a. Train maintenance and laboratory staff in hazard recognition, PPE, materials handling and standard emergency response (i.e. dial 911).
   b. Review emergency procedures and postings during annual laboratory inspections.
   c. Identify and notify FO+M of significant toxic gas or cryogen applications as they become evident during field inspections. EHS will also be summoned for emergency/spill response and follow up.

Procedures:

Calibration, Maintenance and Replacement of Sensors:

FO+M Equipment Maintenance Shop is responsible for determining if system maintenance can be handled in house or via sub contractor. Maintenance must include at a minimum:
Annual: sensor calibration, sensor response/alarm test, confirmation of controls sequencing (if applicable), local and remote alarm annunciation and facility postings.

Quarterly: system check, confirm power and no error messages, consult with occupants regarding false alarms or other system malfunctions or modifications.

As needed: sensor replacement per manufacturer specifications. Most oxygen sensors are electrochemical cells that detect oxygen as voltage as it diffuses through a membrane. Manufacturers dictate sensor replacement intervals and some monitor systems will alert/alarm when sensors require change out (i.e. Cummings 01 is equipped with Toxalert™ sensors boasting a 10-year life span but most other sensors have a 2-5 year life span at maximum.) Most sensor units are failsafe such that a sensor failure will result

in an alarm condition (0% oxygen). Alarm set points are normally factory defaulted to 19.5% oxygen; some units also have a high alarm at 21% and may have an additional user defined alarm point.

System requirements

- All alarm sensors must be calibrated per the manufacturer requirements and, at a minimum yearly using certified calibration gas of known O2 concentration.
- Systems must have a visual and audible local alarm and be connected to the building monitor system for alarm annunciation at the heating plant. Alarm function/operation must be tested annually at a minimum during calibration.
- In the case of sensors linked to control emergency ventilation systems (i.e. Moore, Cummings 01) this functionality should also be tested annually.
- Sensor replacement must be per manufacturer recommendations or sooner as indicated by errors or calibration/response issues.
- If sensor/alarm systems are disabled users must be notified verbally and in writing that the systems/areas are not to be used until repair is completed.

Alarm Response Procedures:

- Pull the nearest fire alarm pull station and dial 911
- Occupants must exit the area in the event of an alarm. Even if no evidence of cryogen release exists (white clouds resembling fog/smoke) we must assume alarms are valid. Staff and other building occupants must be denied entry.
- Alarms received at the central heating plant or building monitor stations will trigger a service call by the EM shop or troubleshooters (after hours) to ensure occupants are evacuated. Post the area with the enclosed posting.
- At no point should alarms be silenced without authorization of HVAC engineers or EHS.
- Other alarm conditions should be evaluated by knowledgeable personnel and dealt with appropriately. Any questions should be directed to FO&M HVAC engineers or EHS staff.
- If injuries, fire, smoke or hazardous material spill conditions are encountered – do not enter the area. Pull the fire alarm and call 911.

Reentry Procedures:

Cryogen releases will normally clear themselves as the liquid evaporates and ventilation systems remove the gas.

- Alarm conditions may subside quickly but at least 30 minutes should be allowed to clear the area.
- All re-entry must be in teams of two personnel to ensure rescue.
- Alarms may be latching, meaning that once triggered they will not turn off until manually re-set, even if oxygen levels return to normal. In this case a second calibrated O2 monitor will be required to test the air during re-entry. FO+M has confined space monitors for this purpose and EHS has one unit that can be used in this regard.

Sample Room Posting:

DO NOT ENTER

Potential for HAZARDOUS ATMOSPHERE

Date: Time: AM/PM

Contact Person: _____

Phone: _____

Facilities Operation & Maintenance