A. **Purpose**
To inform the University research community and other staff members regarding response to oxygen deficiency equipment (O\textsubscript{2} sensors) installed in laboratories handling, using and storing liquid nitrogen or other cryogenic gases.

B. **Applicability/scope**
This policy covers all personnel including laboratory staff, faculty, students, Facilities, Public Safety and Environmental Health & Safety (EH&S) staff in areas O\textsubscript{2} sensors are installed or when responding to oxygen deficiency warning systems. This policy applies to Columbia University’s Morningside (MS) and Medical Center (CUMC) campuses.

C. **Responsibilities**
1. Environmental Health & Safety/ Fire Safety are responsible to maintain records of alarm activations and perform semi-annual inspection of O\textsubscript{2} sensors.
2. All laboratory occupants should immediately notify EH&S/Fire Safety in case of an alarm or malfunction of O\textsubscript{2} sensors during work hours and Public Safety in off hours.

D. **Definitions**
- **Asphyxiation**: to lose consciousness by impairing normal breathing, as by gas or other noxious agents; suffocate; smother.

- **Dewars**: Vacuum flask that holds liquid air or helium for scientific experiments.

- **Hazardous Atmosphere**: An atmosphere that may expose personnel to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness.

- **Oxygen Deficient Atmosphere**: An atmosphere containing less than 19.5% oxygen by volume.

- **Oxygen Sensors**: A device which measures the amount of oxygen in the atmosphere.

E. **Procedures**
1. Type and location of oxygen deficiency monitoring equipment.

   When New York Fire Department (FDNY) regulation or EH&S risk assessment requires O\textsubscript{2} sensors for the protection of laboratory workers using a cryogenic gas:
   a. An O\textsubscript{2} sensor shall be installed.
   b. The O\textsubscript{2} sensors shall be attached on the wall at a height of 3-5 feet above ground.
   c. Electrical powered sensors shall be directly connected to the electrical outlet and protected from accidental disconnect.
   d. Battery operated O\textsubscript{2} sensors shall be placed in locked protective covers.
   e. All O\textsubscript{2} sensors are equipped with a warning alarm and/or lights to warn both the room occupants and those outside the room of the hazard within.

2. Equipment Maintenance.
a. The manufacturer’s instructions should be followed regarding the frequency of maintenance and O₂ sensors and/or battery replacement.

b. O₂ sensors should be calibrated to alarm when oxygen concentrations fall below 19.5% (low level alarm) or exceed 23.5% (high level alarm) and it should automatically reset (no alarm) when between these two values.

c. Laboratory personnel must visually check O₂ sensors daily to ensure that they are operational. Any malfunctioning of the O₂ sensors shall be reported to EH&S.

3. Procedures in the event of an O₂ sensors alarm

Note that the following situations may be indications that there has been a release of liquid nitrogen (LN) or other cryogenic gas creating a possible O₂ sensor alarm activation and an oxygen deficient atmosphere:

- A port of a LN tank release.
- An audible hissing noise from a LN tank.
- A fog or cloud condition in the area of a LN tank.
- A recently delivered tank off-gassing excess pressure in tank.

a. Laboratory Staff Response

- In all cases assume the alarm to be valid.
- All staff in the area must evacuate the room immediately.
- Do not enter the room while the alarm is sounding.
- Immediately make notifications - inform the PI or other designated person about the alarm and await their arrival. Do not take any action by yourself.
  - If the alarm occurs during normal hours contact EH&S (212-305-6780 at CUMC and 212-854-8749 at Morningside).
  - If the alarm occurs outside normal hours contact the Public Safety (212-305-7979 at CUMC and 212-854-5555 at MS). Do not take any action by yourself; await arrival or instruction from Public Safety.
- Do not open the door as gas could escape into the corridor exposing others. Door should be left closed for at least one hour to allow the ventilation system to clear any gas.
  - During normal working hours seek EH&S help to monitor ambient oxygen concentrations if the alarm has not cleared.
- If the alarm has not cleared within one hour then wedge the door fully open to increase the amount of air entering the room and wait to re-enter the room until the alarm clears.
  - If the O₂ sensor alarm cannot be silenced, unplug the O₂ sensor or call EH&S during normal business hours to replace.
  - If the alarm does not clear or the sensor has been disconnected, relocate cryogenic processes to another laboratory where oxygen
deficiency monitoring is available until such time as the defective sensor is replaced or reinstated.

- If the O₂ sensor alarm is found by EH&S to be false due to O₂ sensors failure, the sensor will be replaced.

b. Public Safety Response:

When notified of O₂ sensor alarm:

- Respond with two way radio equipped personnel along with a portable O₂ sensor, if available.
- **Do Not Immediately Enter Room!** Knock on the door to ascertain if anyone is in the room.
- If portable O₂ sensor is available, monitor the area by door. Briefly open the door to verify that there is no unconscious worker in the room. If O₂ sensor remains above 19.5%, perform a quick survey by walking through the room to ensure that O₂ measurements are above 19.5%.
- If the room is unoccupied, keep door closed and make phone notifications as per Public Safety’s “EH&S Emergency Contact List”
- If an unconscious person is present:
  - Do not enter the room, immediately notify 911 for FDNY and EMS response.
  - Leave door in the open position to allow corridor air to enter the room, which will dilute the concentration of gas.
- When O₂ levels reach 19.5% or above the alarm will automatically silence and reset.

c. Facilities Operations Response:

- When notified, or become aware of, an activated O₂ sensor alarm, immediately notify:
  - During working business hours: EH&S (212-305-6780 at CUMC and 212-854-8749 at MS)
  - During off hours: Public Safety (212-305-7979 at CUMC and 212-854-5555 at MS)

d. Environmental Health and Safety Response:

- During normal working hours contact EH&S to perform additional monitoring before re-entry.
F. Emergency contacts
   Public Safety – 212-305-7979 (CUMC), 212-854-5555 (Morningside)
   EH&S - 212-305-6780 (CUMC), 212-854-8749 (Morningside)

G. Cross References like URL, Forms, web addresses, etc.
   N/A

H. Medical Surveillance
   For persons working in area that had an alarm activation, monitor health
   conditions and if any indications of illness or effects from possible exposure to
   hazardous atmosphere, have person report to Workforce Health and Safety
   and/or local Emergency Room

I. Recordkeeping
   EHS-Fire Safety will maintain records of O₂ sensor locations, alarm activations

J. Appendices
   Appendix I: Signage for Laboratories and Areas with O₂ Sensors (See page 5)

K. Forms
   N/A

L. References
   Compressed Gas Association pamphlet P-12 Safe Handling of Cryogenic
   Liquids available from the Compressed Gas Association, Inc., 1725 Jefferson
   Davis Highway, Arlington, VA 22202-4102 Telephone (703) 412-0900.

   NYC 2008 Fire Code – Section 3205.4.1.1.1
   ed_li37_39_41_64_2009_li2_2013.pdf#page=410)

   MSDS for Liquid Nitrogen

M. Acknowledgements (optional)

APPENDIX I- Signage for Laboratories and Areas with O₂ Sensors

- All laboratories and/or areas where an O₂ sensor is present will be identified by the below
  signage in the following area:
    - On the door to room where O₂ sensor is located.
    - In close proximity to the O₂ sensor
Sample

**DANGER**

*If you hear an alarm, **DO NOT ENTER** Call Public Safety 305-7979*
*During work hours also call EH&S 305-6780*

**POTENTIAL OXYGEN DEFICIENCY HAZARD**

*If Alarm is Activated*

- Assume alarm activation to be valid
- Evacuate all workers in room and close the door
- Call Public Safety immediately; also叫 EH&S
- Be prepared to provide information to responders
- **DO NOT** Enter the room
- **DO NOT** Attempt to rescue anyone, as asphyxiation can be rapid with no warning signs
- **DO NOT** Open door within first hour after the alarm has stopped sounding

- Do **NOT** attempt to repair a faulty sensor. Report it to EH&S
- Review Columbia University policy (www.ehs.columbia.edu/OxygenDeficiency)

Columbia University

www.ets.columbia.edu

Ph: ____________________ Tel #: ____________________

Environmental Health & Safety (EH&S): (212) 305-6780