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Toxic Gas Monitoring Evacuation Plan

REVISION

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1. PURPOSE AND SCOPE

1.1 Provide a toxic gas monitoring system (TGMS) evacuation procedure for all CNSE employees, tenants, contractors, subcontractors and visitors that have access to the cleanroom located in NanoFab North (NFN), NanoFab Central (NFC), NanoFab South (NFS), NanoFab South Annex (NFSX), NanoFab Xtension (NFX), CESTM and the CUB.

1.2 Provide an immediate course of action to be taken in the event of an emergency situation, which results in an evacuation.

1.3 Provide management with a visible means for managing facility evacuations and minimizing personnel and business inconveniences.

1.4 Provide cleanroom evacuation response documentation (EHS-00049-F1) of the actions taken and any necessary corrective actions.

1.5 Develop awareness on the part of all employees that evacuation can be managed with a minimum of confusion, no matter the time of day or day of the week.

1.6 This specification shall apply to:

1.6.1 All personnel within a designated alarm area when an alarm is activated,

1.6.2 All members of the Emergency Response Team (ERT) on site, and

1.6.3 All Security personnel on site.

2. DEFINITIONS

2.1 **Hazardous gas**: A gas (or mixture of gases) that is toxic, an irritant, corrosive, combustible, flammable, dangerously reactive, pyrophoric, or that otherwise may cause substantial acute or chronic personal injury or illness during, or as a direct result of, any customary or reasonably foreseeable handling or use.

2.2 **Hazardous production area** Any area that may reasonably be exposed to a hazardous gas and is continuously occupied by personnel in the normal performance of their job.

2.3 **Permissible Exposure Limit (PEL)** The Permissible Exposure Limit is the maximum permitted 8-hour time-weighted average concentration of an airborne contaminant established by the Occupational Safety and Health Administration (OSHA).

2.4 **Threshold Limit Value (TLV)** The Threshold Limit Value is an 8-hour time-weighted average concentration of a hazardous chemical that an average person may be exposed to day after day without any adverse effect. TLVs are guidelines established by the American Conference of Governmental Industrial Hygienists.

2.5 **Lower Explosive Limit (LEL)** The minimum concentration of flammable gas or vapor mixed with air that can be ignited. LEL is typically expressed as a percent of flammable gas or vapor in air.

2.6 **Warning Condition:** Warning conditions have been set for both toxic and combustible gas sensors and pressure transducers, which if the system detects any of these conditions, it will activate a warning alarm.

2.7 **Alarm Condition:** Alarm conditions have been set for both toxic and combustible gas sensors and pressure transducers, which if the system detects any of these conditions, it will activate a warning alarm.

2.8 **Toxic Gas Monitoring System (TGMS):** TGMS monitors toxic gas and controls the use of toxic gasses in the NanoTech center. TGMS also monitors exhaust flow and heat sensors to ensure safety of work area. When evacuation is required, TGMS sets off strobe lights and horns.

2.9 **Area Alarm Controller (AAC)** AAC touch screens that display local status of fixed gas detectors, heat detectors and pressure transmitters that detect exhaust flow are connected to AAC. The CUB building, North, South Annex and South Lab area alarms and horns are controlled and monitored by the corresponding AACs. These AACs send signals to the local PLC (Programmable Logic Control), located in communication hubs, via the Ethernet network, which sets off area alarms and horns.

2.10 **Supervisory Control and Data Acquisition (**SCADA**) Computer**: A SCADA Computer communicates with the PLCs and AACs through a Fiber Optic Cable Network (Backbone), it also monitors the health of the network and displays alarm information and location. Intellution iFix software that is utilized by the SCADA provides interactive screens to display an overview of the facility, alarm locations and alarm status.

2.11 **Backbone (Fiber Optic Cable Network):** The Backbone provides communication between all PLCs and the SCADA. The Fiber Optic network offers fast communication between the hubs in each location monitoring the AACs. The communication hubs contain an Ethernet Switch and Fiber Optic Expansion Modules to support connection between the local Ethernet network and Backbone.

3. RESPONSIBILITIES

3.1 Incident Command (IC) Responsibilities

3.1.1 Establish an Incident Command Center (ICC)

3.1.1.1 If the alarm occurs in NFS/NFSX/CUB the ICC shall be located in the NFS loading dock.

3.1.1.2 If the alarm occurs in NFX, the ICC shall be located across from the NFN ERT closet.

3.1.1.3 If the alarm occurs in NFN/NFC the ICC shall be located in the NFC gowning room.

3.1.2 Evaluate nature of the call: odor, gas alarm, exhaust failure or chemical release and plan incident response. Both the employee reporting the incident and area supervisor shall make themselves known to the IC. The IC should question all employees involved when necessary.

3.1.3 Ensure that all appropriate outside emergency services are contacted when necessary.

3.1.4 Communicate with security regarding the status of the evacuation.

3.1.5 Communicate the “All-Clear” via the overhead building intercom system to all employees, contractors, subcontractors and/or vendors impacted by the evacuation. For NFN/NFC evacuation the communication shall also be transmitted to the NFS/X and CESTM buildings.

3.1.6 Interface with CNSE Executives regarding the alarm status and whether a building or site wide evacuation needs to occur.

3.1.7 Interface with the Communications Director who shall communicate directly with the media, clearing all information with CNSE Executives prior to being presented external to CNSE.

3.1.8 Document the Evacuation using EHS-00049-F1.

3.1.9 Prepare a written follow-up report to document the cause of the incident and corrective actions taken to control the situation. This report shall be distributed to the appropriate parties within 24 hours after the incident.

3.2 CNSE Facilities, or Cleanroom Operations Manager Responsibilities

3.2.1 Inform the IC of any process or facility changes that may need to be addressed in this procedure.

3.2.2 Provide specific process, production, or facility information in the event of an emergency.

3.2.3 Assist in problem identification, determination of resources required and implementation of corrective measures.

3.3 CNSE, Tenant Area Supervisor/Cleanroom Manager Responsibilities

3.3.1 Provide Evacuation Plan orientation and training for all employees reporting to them and review procedures with employees whenever changes are made, or at least annually. Submit evidence of such training to the CNSE EHS Department.

3.3.2 Instruct employees on how to leave equipment in the event a cleanroom evacuation should occur.

3.3.3 Ensure the safe and rapid evacuation of all personnel within their area.

3.3.4 Ensure that the area is accessible to ERT and outside emergency services personnel.

3.3.5 Ensure that all key personnel are made aware of the situation, kept appraised of developments and informed of the final outcome.

3.4 Emergency Response Team (ERT) Responsibilities

3.4.1 ERT members evacuating an area shall remain at the cleanroom entrance until directed otherwise. Do not allow anyone except for emergency personnel to enter, until such time as the permission to re-enter the cleanroom is given.

3.4.2 Under no circumstances are you required to re-enter the cleanroom to perform a sweep, unless specifically asked to do so by the person who assumes the Incident Command role, and then only when wearing the appropriate PPE.

3.4.3 ERT members should retrieve walkie-talkies from designated storage locations (ERT Supply room NFS 161, NFSX Gowning area, Corridor outside Room 106, CESTM 1st floor metrology, NFN gowning room, NFN ERT closet).

3.4.4 ERT should assemble at the building TGMS touch screen for gas alarms unless paged to a specific area, except for CESTM cleanroom evacuation when the ERT shall assemble at the fire panel in the CESTM Rotunda.

3.4.4.1 If the alarm occurs in NFS/NFSX/CUB proceed to the NFS loading dock.

3.4.4.2 If the alarm occurs in NFX proceed to the TGMS panel across from the NFN ERT Closet.

3.4.4.3 If the alarm occurs in NFN/NFC proceed to the NFN Fab level gowning room.

3.5 Security Personnel Responsibilities

3.5.1 Any odor, toxic or combustible gas alarm, exhaust failure or chemical release that is transmitted through the TGMS, Building Management System (BMS) or via an emergency phone call and/or that warrants the cleanroom to be evacuated shall result in an ERT investigation.

3.5.2 Summon the ERT via the Verizon pager system and give them exact details on the alarm such as: building, tool affected, condition detected.

3.6 CNSE Employees, Tenant Employees, Contractors and Sub-Contractors Responsibilities

3.6.1 Evacuate the cleanroom in a timely fashion and conduct a sweep of your area prior to evacuating.

3.6.2 Ensure contractors, sub-contractors and/or vendors under your control are accounted for.

3.6.3 Remain at the designated rally point until the ‘all-clear’ is given.

3.6.4 Ensure you have received and understood training on what you should do during a TGMS evacuation.

4. ASSOCIATED DOCUMENTS

EHS-00031 - Toxic Gas Monitoring System Operation and Maintenance

EHS-00049-F1 - Cleanroom Evacuation Response Report

5. TOXIC GAS MONITORING SYSTEM (TGMS)

5.1 TGMS monitors toxic and combustible gases and controls the use of such gasses at CNSE Facilities. It also monitors exhaust flow and heat going

through the exhaust system utilizing pressure and heat detectors. When an evacuation is required, the TGMS sets off the blue strobe lights and horns in the areas affected.

5.2 The TGMS control system is composed of several interdependent pieces of hardware. Such hardware includes:

- Area Alarm Controllers (AAC)
- Human Machine Interface (HMI)
- Supervisory Control and Data Acquisition (SCADA)

5.2.1 The AAC panels provide local monitoring and protection on a continuous basis. These panels distribute this information via the facility's Ethernet communications system and a central alarm PLC in the CUB, South Annex and South Lab.

5.2.2 Gas level monitoring is performed by gas monitoring sensors, installed at gas usage points, pressure sensors are used to detect low airflow conditions, and heat sensors are monitored to alarm on high temperatures. The detectors/sensors are connected to the AAC panels which are used to supervise several sensors at each tool location.

5.2.3 Each AAC is provided with a local status display and alarm strobe to provide local indication of status and alarm conditions on a continuous basis.

5.2.4 There are four HMI or remote monitoring nodes are located on site, two in the South Lab building – one at the rear entry door area or loading dock, and one in the rear entrance area or loading dock to the South Annex; and two in the North Building – one at the gowning exit on the fab level and one outside the DI Water room. If an alarm or warning condition is detected, the AAC status information will be displayed on each computer screen.

5.2.5 These HMI or remote screens allow ERT personnel: to view current conditions in the cleanroom, to acknowledge alarms, and to examine historical trend logs of monitored values. The computer systems and remote screens are password protected to prevent unauthorized personnel from gaining access to the system.

5.2.6 The SCADA Computer is located in NFN and has information transmitted from the Ethernet communication system through a Fiber Optic Cable Network system or Backbone. It is also known as a Distributed Computer System which provides cleanroom-wide monitoring for all AACs and alarm management units.

5.2.7 Further details regarding the use and activation of the AAC and SCADA systems can be read in EHS-00031 - Toxic Gas Monitoring System Operation and Maintenance Manual.

6. ALARM CONDITONS

6.1 There are two types of alarm conditions that we are concerned about that are automatically initiated from the TGMS system:

- Warning alarms
- Evacuation alarms

6.1.1 **Warning alarm conditions** have been set for both toxic, combustible gas sensors and pressure transducers, a warning alarm condition will not activate an alarm but does send a page to the ERT to investigate the condition.

6.1.1.1 Toxic Gas Sensors – The warning set point for a toxic gas sensor is the lowest concentration level that will set off an alarm and has been set at one quarter (¼) the TLV.

6.1.1.2 Combustible Gas Sensors – The warning set point for a combustible gas sensor is the lowest concentration level that will set off an alarm and has been set at ten percent (10%) of the LEL. Example: Hydrogen LEL is 4% the warning level is set at 0.4%.

6.1.1.3 Pressure Transducers – The warning set point for pressure transducers has been set at three quarters (¾) of the steady state pressure.

6.1.2 **Evacuation alarm conditions** have been set for toxic, combustible gas sensors, pressure transducers and heat detectors. Only toxic, combustible gas sensors and pressure transducers condition will activate an alarm but all alarm conditions send a page to the ERT to respond to the alarm.

6.1.2.1 Toxic Gas Sensors – The alarm set point for a toxic gas sensor is the lowest concentration level that will set off an alarm and has been set at one half (½) the TLV.

6.1.2.2 Combustible Gas Sensors – The alarm set point for a combustible gas sensor has been set at twenty percent (20%) of the LEL. Example: Hydrogen LEL is 4% the warning level is set at 0.8%.

6.1.2.3 Pressure Transducers – The alarm set point for pressure transducers has been set at one half (½) of the steady state pressure. This condition will NOT activate the evacuation alarm.

6.1.2.4 Heat Sensors – The alarm set point for a heat detector is 150°F. Heat detectors are installed in locations where flammables are used, distributed and/or stored. Detection of heat over 150°F by heat detector will NOT activate the evacuation alarm.

6.2 Alarm and warning conditions initiate a page from the TGMS system and are indicated on the AAC, SCADA and remote monitoring screens by blinking the tool, or tools, that are in alarm. The condition will continue to blink until the alarm has been acknowledged; once the condition has been acknowledged; the section will stop blinking and be displayed as a solid color until the alarm or warning condition is cleared.

6.3 **Local alarms** are tool specific alarms which send out a page to the ERT and cause the tools, AAC, SCADA and remote monitoring screens to blink but do NOT set off room alarms. Conditions that set off local alarms must be cleared and reset by tool maintenance support personnel.

6.3.1 The following are classified as local alarm conditions:

- Toxic/Combustible Gas Detection Warning alarms:
    - Toxic/combustible gas detection in the ambient air
    - Toxic/combustible gas detection in an exhausted enclosure
    - Toxic/combustible gas detection in a gas cabinet, VMB or GIB.
- Heat Sensor alarms,
- Pressure Transmitter alarms,
- Tool EMO or Shutdown.

6.4 **Global alarms** are the only alarms that will activate the cleanroom blue alarm lights, signaling that an evacuation is required.

6.4.1 The following are classified as global alarm (TGMS Evacuation Alarm) and are the only conditions that initiate a cleanroom evacuation:

- Toxic/Combustible Gas Detection alarms:
    - Toxic/combustible gas detection in the ambient air
    - Toxic/combustible gas detection in an exhausted enclosure
    - Toxic/combustible gas detection in a gas cabinet, VMB or GIB.

- Loss of House Exhaust Pressure alarms.

6.5 In the event that the IC has assessed the situation and a condition arises where the Building Management System is compromised and toxic gases could be emitted into the remainder of the building, then the fire alarm for that building will be activated to initiate a full building evacuation. Such conditions could include:

6.5.1 Simultaneous loss of exhaust and detection of a toxic gas, and/or

6.5.2 Ambient detection of a toxic gas exhaust above the TLV.

7. EVACUATION PROCEDURE

7.1 As soon as the cleanroom alarm has sounded, everyone is to place their equipment into the mode as previously instructed by their supervisor, and walk directly to the nearest safe exit aisle. Do not remove your cleanroom garments.

7.2 Once out of the area all employees shall proceed directly to the following locations, see Appendix 1 for a list of locations:

7.2.1 **NFS and NFSX** - All first floor evacuees should report to the NFS Rotunda.

- The determination to evacuate to NFS Rotunda is based on the absence of highly toxic gases in the NFS/X cleanroom. If such highly toxic gases are introduced to this cleanroom the evacuation point will be re-evaluated. See Appendix 2 for a List of Toxics Currently In Use in the NFS/NFSX Cleanroom.

7.2.2 **NFN (All levels)** fab, sub-fab, interstitial, penthouse, HPM corridor, purifier room - All building evacuees (cleanroom workers and suites) should report to the CESTM Rotunda.

7.2.3 **NFN HPM Corridor only** - All HPM room and corridor evacuees should report to the CESTM Rotunda.

7.2.4 **NFN Purifier Room only** - All Purifier room evacuees should report to the CESTM Rotunda.

7.2.5 **NFC (All levels)** fab, sub-fab, interstitial, penthouse, HPM corridor- All building evacuees (cleanroom workers and suites) should report to the CESTM Rotunda.

7.2.6 **NFX (All levels)** fab, sub-fab, interstitial, penthouse, HPM corridor, air return chase, SEM rooms should report to the CESTM Rotunda.

7.2.7 **CESTM** - All cleanroom evacuees should report to the first-floor, CESTM Rotunda.

7.2.8 **CUB** - All CUB evacuees should report to the NFS loading dock.

7.3 The supervisor of the area, or his/her designated alternate, shall perform the following:

- Direct personnel to the nearest exit;
- Check to be sure that the area is clear of all personnel.

7.4 Personnel that are not in their normal work area at the time of the cleanroom evacuation alarm shall exit the cleanroom and follow the direction of the area supervisor.

7.5 Once the cleanroom is evacuated, personnel can not re-enter until it has been determined safe to re-enter by the ERT. The IC shall provide information about the plan of action, next steps, and anticipated length of time 'til "All-Clear" and communicate such to the affected parties.

7.6 Those that work on the second and third floors in NFS or CESTM, once they have been accounted for, can proceed back to their suites to await the announcement of the "All-Clear".

7.7 Those that work on the first floor in NFS, once they have been accounted for, can only return to their suites if the evacuation is not occurring in NFS/X cleanroom.

7.8 Once an investigation of the event has been completed, the root cause of the event identified, the ambient readings have been at zero for five minutes, the exhausted detection points are below the warning level for five minutes and no future work by the ERT or the Facilities department could cause a threat in rising detection levels, then the "All-Clear" can be communicated.

7.9 The "All-Clear" notification shall be communicated by the Incident Command to Security and Security will then communicate the "All-Clear" via the overhead fire alarm intercom system.

8. EVACUATION DRILLS

8.1 The ERT Coordinator will schedule evacuation drills for each cleanroom building and shift at a minimum of once per year.

8.2 TGMS Emergency Evacuations can be counted toward meeting the requirements of Section 7.1.

9. RECORDS

Copies of ERT Incident reports and Security reports shall be maintained on file in the EHS department.

10. APPENDICES

10.1 **Appendix 1** – Rally Point Location

10.2 **Appendix 2** – List of Toxics Currently in use in the NFS/NFSX/NFN/NFC Cleanrooms as of January 2007.

10.3 **Appendix 3:** Sick Person Decision Matrix for non-ERT

Appendix #1
RALLY POINT LOCATIONS

NanoFab South (NFS) and NanoFab South Annex (NFSX)
Rally Point: NFS Rotunda

***NanoFab North (NFN)* (All levels - fab, sub-fab, interstitial, penthouse, HPM corridor, purifier room)**
Rally Point: CESTM Rotunda

NanoFab North (NFN) - HPM corridor only
Rally Point: CESTM Rotunda

NanoFab North (NFN) – Purifier room only
Rally Point: CESTM Rotunda

***NanoFab Central (NFC)* (All levels - fab, sub-fab, interstitial, penthouse, HPM corridor)**
Rally Point: CESTM Rotunda

***NanoFab Xtension (NFX)* (All levels – fab, sub-fab, interstitial, penthouse, HPM corridor, air return chase, SEM rooms)**
Rally Point: CESTM Rotunda

CESTM
Rally Point: CESTM Rotunda

Central Utility Building (CUB)
Rally Point: NFS Loading Dock

Appendix #2
LIST OF TOXICS CURRENTLY IN USE IN THE CNSE CLEANROOMS AS OF JANUARY 2007

Gas Name	Symbol	NFPA Rating		
		H	F	R
Arsine	AsH3	4	4	0
Ammonia	NH3	3	4	0
Boron Trichloride	BCl3	3	0	1
Boron Trifluoride	BF3	4	0	1
Carbon Monoxide	CO	2	4	0
Chlorine*	Cl2	4	0	0
Diborane	B2H6	4	4	4
Disilane	SiH4	0	4	1
Ethylene	C2H4	2	4	2
Fluorine/Argon/Neon mixture **	F2/Ar/Ne	4	0	2
Freon 32 (Difluoromethane)	CH2F2	0	4	0
Freon 41 (Methyl Fluoride)	CH3F	1	4	0
Freon 113 (Trichlorotrifluoromethane)	CHF3	1	0	0
Germane	GeH4	4	4	4
Hexafluorobutadiene	C4F6	3	4	0
Hydrogen	H2	0	4	0
Hydrogen Bromide	HBr	3	0	0
Hydrogen Chloride	HCl	3	0	0
Nitrogen Trifluoride	NF3	3	0	0
Octafluorocyclopentene	C5F8	3	0	1
Propane	C3H6	1	4	0
Phosphine	PH3	4	4	0
Silane	SiH4	0	4	1
Silicone Tetrachloride	SiCl4	3	0	1
Silicon Tetrafluoride	SiF4	3	0	2

*This chemical is exempt as the odor threshold for this material is 0.03 ppm.

** NFPA ratings are based on 100% Fluorine concentration, currently using less than 5% Fluorine concentration.

APPENDIX #3
SICK PERSON DECISION MATRIX FOR NON-ERT

Situations may be encountered where a person is reporting that they are sick and the ERT have not yet arrived and/or no TGMS alarm has been activated. In this case, the steps described below should be followed.

1. Assess the situation:
   - Is the sick person working around hazardous chemicals?
   - What symptoms is the person experiencing?
   - Is anyone in the surrounding area experiencing the same/similar symptoms?
   - Is there an odor present?
   - What's going on in the surrounding area- Chamber open? Chemical dispense? Is there a spill present?
2. Evacuate/Barricade:
   If there is potential exposure to hazardous chemicals/atmospheres in the area and more than one person is experiencing symptoms, remove the sick people from the area and evacuate the surrounding bay of the cleanroom. If the potential exposure source is not confined in a bay, use the EMO button to evacuate the entire cleanroom. If only one person is experiencing symptoms, barricade a 10' area surrounding the suspected exposure and evacuate the barricaded area.
3. In the event of an evacuation, procedures outlined in Section 7 of EHS-00049 should be followed.
4. Simultaneously have someone call CNSE Security (518) 437-8600 and let them know your location, so the ERT can locate the sick person (people).
5. Wait for ERT arrival, for ERT to assess the sick person (people). ERT will then follow procedures outlined in EHS-00019.