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Standard Operating Procedure
for

Confined Space Entry

REVISION

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1. PURPOSE

1.1 The purpose of this procedure is to establish minimum rules to protect the health and safety of College of Nanoscale Science and Engineering (CNSE) employees, staff, students, tenants or contractors required to enter confined spaces to work, clean, repair, inspect or perform other duties.

1.2 This procedure is not intended to provide the basis for establishing more detailed entry and work procedures for permit required confined spaces. The procedures used will depend on the scope of work, size of space, material and equipment to be used in the space.

1.3 Although this procedure describes specific safety steps to be taken for entry into permit required confined spaces, it is not intended to prevent the use of any additional measures that may be deemed necessary for a particular situation. Each situation must be reviewed on an individual basis by the responsible Supervisor.

1.4 This procedure is not intended to list the confined spaces that are associated with tenant owned and operated equipment or tools.

2. SCOPE

2.1 This program establishes the minimum requirements for entering confined spaces at CNSE. Tenant employees, contractors and sub-contractors may comply with their own organization's program provided that it meets and/or exceeds the minimum requirements set forth in this procedure.

2.2 This program applies to CNSE employees, tenant employees, contractors and sub-contractors who may be entering confined spaces within the facility.

2.3 CNSE employees, tenant employees, contractors and sub-contractors will be notified of the requirement to follow this program and are required to comply with the restrictions and limitations imposed upon them by CNSE during confined space activities.

3. DEFINITIONS

3.1 A <u>confined space</u> is defined by OSHA as a space that:

3.1.1 Is large enough for a worker to enter and perform work;

3.1.2 Has limited or restricted entrances or exits; and

3.1.3 Is not designed for continuous employee occupancy.

3.2 A permit required confined space is a confined space that, in addition to the above, poses any one or more of the following hazards:

3.2.1 Potentially hazardous atmosphere;

3.2.2 Potential engulfment of a worker;

3.2.3 An internal configuration, such as a tapered floor, which could cause a worker to become trapped.

3.3 A potentially hazardous atmosphere is defined as any atmosphere that could cause death, incapacitation, injury, or acute illness, impairment of ability to self rescue, and would include any of the following:

3.3.1 An atmosphere with a build-up of flammable gases or vapors in excess of 10% of the LEL;

3.3.2 Excessive airborne combustible dust;

3.3.3 An oxygen deficient (less than 19.5%) or an oxygen enriched (greater than 23.5%) atmosphere;

3.3.4 Atmospheres containing acutely toxic contaminants at a concentration level greater than the permissible exposure limit (PEL) or the threshold limit value (TLV).

4. PERSONNEL ROLES AND RESPONSIBILITES

Personnel who are involved with routine permit confined space entry will perform one of the three roles. These roles are:

- Authorized Entrant(s) - Person(s) physically entering the confined space
- Attendant - Person(s) monitoring on the outside
- Entry Supervisor - Person supervising activities which require confined space entry

4.1 **Authorized Entrants** are personnel who enter permit spaces to perform work. In addition to safely performing the assigned task within the permit space, their responsibilities are to:

4.1.1 Know the hazards associated with the permit space and their effects,

4.1.2 Properly use the equipment required for entry,

4.1.3 Maintain a continuous means of communication with the attendant,

4.1.4 Alert the attendant in the event of an emergency, and

4.1.5 Evacuate the space if an emergency occurs.

4.2 **Attendants** are personnel stationed outside the permit space to monitor the conditions in and around the space and the authorized entrants. They additionally coordinate rescue efforts in the event of an emergency. Their specific responsibilities are to:

4.2.1 Know the hazards associated with the permit space and their effects,

4.2.2 Maintain an accurate account of the authorized entrants,

4.2.3 Remain at their assigned station until relieved by another attendant or until the permit space entry is complete and authorized entrants have exited the space,

4.2.4 Monitor conditions in and around the permit space,

4.2.5 Contact the entry supervisor who will summon rescue and applicable medical services in the event of an emergency,

4.2.6 Perform continuous monitoring of the space,

4.2.7 Perform non-entry rescue procedures, and

4.2.8 Perform appropriate measures to prevent unauthorized personnel from entering the permit space.

4.3 **Entry Supervisors** are personnel who supervise activities, which require confined space entry. Their responsibilities are to:

4.3.1 Know the hazards associated with the permit and their effects,

4.3.2 Verify that the safeguards required by the permit have been implemented,

4.3.3 Terminate entry and cancel the permit when the entry operations have been completed or a condition arises that is not allowed under the entry permit,

4.3.4 Remove personnel who are not authorized to enter the permit space during entry operations, and

4.3.5 Determine, when appropriate, that the entry operation is performed consistent with the requirements of the permit space entry procedures and that acceptable entry conditions are maintained.

5. HAZARDS

5.1 The potential hazards which may be encountered in permit required confined spaces are the following:

5.1.1 A lack of or excess oxygen, which may cause asphyxiation or increased fire hazard.

5.1.2 Flammable gases or liquids in excess of their lower explosive limit (LEL).

5.1.3 Toxic gases, vapors and liquids in excess of their threshold limit values (TLV's).

5.1.4 Injury caused by direct contact with corrosive or dermatitis producing chemicals.

5.1.5 Physical hazards, such as slipping and falling.

5.1.6 Electric shock from portable lights and tools.

5.1.7 Inability to readily get into or out of the space due to the location and/or size of openings.

6. ENTRY REQUIREMENTS

6.1 All individuals associated with a permit required confined space entry shall be properly trained in safe entry and rescue procedures, use of protective equipment, and instructed as to the hazards they may encounter.

6.2 The entry supervisor is responsible for assuring that the workers are properly instructed as stated above for each job requiring confined space entry.

6.3 Entry into permit required confined spaces shall be by written entry permit (EHS-00007-F1), issued and approved by ERT/EHS. The purpose of the entry permit is to ensure that a checklist of precautions has been reviewed prior to entry. This permit describes:

- The work to be done
- Time and date
- Nature of space

- Inspection checklist
- Protective and rescue equipment requirements
- Approvals for entry

6.4 This permit is an authorization, and approval in writing certifying that all existing hazards have been evaluated and necessary protective measures have been taken to ensure the safety of the entrant.

6.5 The space shall be emptied, flushed or otherwise purged of flammable, injurious or incapacitating materials as much as possible.

6.6 The confined space shall be isolated by:

6.6.1 Disconnecting, blinding, or blocking off any piping, lines or vents which may convey flammable, injurious or incapacitating materials into the space, and

6.6.2 De-energizing and locking or tagging out any machinery, mixers or agitators.

6.6.3 All items above which have been disconnected, blanked, capped, blocked off or turned off, shall be identified with a Lock Out/Tag Out "DANGER' tag which shall not be removed until the entrants are out of the space and the work complete.

6.7 The air in the space shall be tested for contaminants listed below. The space shall be tested prior to entry and periodically while an entrant is in the space:

6.7.1 Flammable or combustible vapors using a combustible gas meter.

6.7.2 Oxygen deficiency or excess using a properly calibrated oxygen meter.

6.7.3 Toxic or corrosive contaminants using a suitable meter. The choice of test will depend on whether the space contained any particular corrosive or toxic chemicals or whether any such chemical will be used during entry operations, such as cleaning.

6.7.4 Tests shall be performed by a qualified person who has been trained in proper sampling methods, correct interpretation or results, and proper calibration and limitations of test instruments.

6.7.5 ERT/EHS will issue a Confined Space Permit sign (signed and dated) when this permit has been issued. This sign will be posted for the duration of the work. The purpose of this signage is for passerby's to be aware the area is a Confined Space (entry by permit only) and for other employees to know this permit has been approved and signed off by ERT/EHS.

6.7.5.1 Upon completion of the work, the contractor or supervisor will either return this sign to the NFE Security desk or ERT/EHS. This will notify ERT/EHS the work is complete and the time will be noted on the permit.

7. VENTILATION

7.1 Proper and adequate ventilation of the space with safe respirable air shall be required if one or more of the following conditions exist or could exist during the course of the work:

7.1.1 Flammable or combustible vapors are present above 10% of the LEL.

7.1.2 Combustible dusts are present.

7.1.3 Toxic or corrosive contaminants are present above the TLV.

7.1.4 The oxygen concentration is below 19.5% or above 21.5%.

7.1.5 Toxic or other contaminants which:

7.1.5.1 Have no rated TLV, or

7.1.5.2 Cannot be accurately determined to be present with field testing instruments.

7.2 Oxygen shall not be used to ventilate a confined space.

7.3 Equipment used for ventilation shall be suitable for the atmosphere which is being ventilated. When flammable contaminants are present, only equipment designed for use in hazardous locations shall be employed. Sources of ignition shall be eliminated.

8. PROTECTIVE EQUIPMENT REQUIREMENTS

8.1 Appropriate protective equipment for eyes, ears, head, hands, feet and body shall be provided to the entrant prior to entry.

8.2 If necessary, the appropriate respiratory equipment shall be provided by the entrant's organization, provided they are listed under their organization's Respiratory Protection Program.

8.3 The use of approved respiratory protection with separate air supply shall be required when one or more of the following conditions exists, or could exist during confined space operations:

8.3.1 Flammable or combustible vapors greater than 10% of the LEL.

8.3.2 Oxygen content below 19.5% or above 21.5%.

8.3.3 Toxic or corrosive contaminant above the TLV.

8.4 Approved safety belts or harnesses and safety lines shall be provided. Lines shall be at least 1/2 inch in diameter, 2,000 pound test, and long enough to be secured outside the entry opening.

8.5 Approved rescue equipment shall be pre-positioned near the entrance prior to the entry into the confined space. This is to cut down on the response time should a rescue be required.

8.6 An effective means of communication between employees inside a confined space and a standby employee ("buddy") shall be provided and used whenever:

8.6.1 The use of respiratory equipment is required, or

8.6.2 The employees inside the space are out of sight of the "buddy".

8.7 In spaces which require lighting and there exists the potential for flammable vapors above the LEL, lighting shall be explosion proof and rate for hazardous locations.

9. PERSONNEL REQUIREMENTS

9.1 Only trained personnel shall be utilized for confined space operations.

9.2 The "buddy system" shall be employed whenever an employee is inside a permit required confined space. At least one employee shall stand by outside the space to provide assistance in case of emergency. This person shall remain in visual contact or have direct communication with the employee inside the space and have no other duties except to provide assistance in case of an emergency.

9.3 The permit required confined space work team shall have at least one person who is trained in CPR. This person must remain outside the space and be immediately available. This requirement can also be met by having a member of the on-site Emergency Response team (ERT) present during the entry.

10. SPECIAL REQUIREMENTS FOR PERMIT REQUIRED CONFINED SPACE OPERATIONS

10.1 If the concentration of flammables or combustibles exceeds 20% of the LEL, entry into a confined space shall "NOT" be made and existing

operations shall be terminated if this condition occurs during the entry. Workers shall leave the space immediately. Approved ventilation shall be used to lower the concentration to 10% LEL and the source eliminated.

10.2 Sources of ignition are prohibited within the confined space, except where hot work is required. A separate "Hot Work Permit (EHS-00029-F1)" is required whenever the use of flame, arc or spark, such as welding or cutting, is necessary.

10.3 Whenever oxygen consuming equipment, such as torches are used, or welding is performed, adequate local exhaust venting shall be provided.

10.4 When required, the standby employee, as well as the employee in the space, shall be equipped with appropriate respiratory protective apparatus, including an independent source of breathing air. The equipment must be available for immediate use.

10.5 Periodic testing of air in confined spaces shall be performed with sufficient frequency to assure that dangerous air contaminants and/or oxygen deficiency (or excess) does not occur during confined space operations.

11. TRAINING

11.1 Authorized Entrants, Attendants and Entry Supervisors must receive formal training concerning their roles and responsibilities. Formal training ensures that they have acquired the understanding, knowledge, and skills necessary to perform their assigned duties. Training for each authorized person is provided:

11.1.1 Before personnel are assigned duties outlined in this plan,

11.1.2 When their assigned duties change, and/or

11.1.3 When there is a change in a permit space that creates hazards of which affected personnel have not been informed.

11.2 Each Authorized Entrant, Attendant and Entry Supervisor receives refresher training annually in confined space entry procedures. ERT members shall also receive annual training on the use, care, maintenance and inspection of Personal Fall Arrest System.

11.3 Training records are maintained by the EHS Department.

12. RESCUE AND EMERGENCY MEDICAL SERVICES

12.1 In the event of an emergency, the ERT will be used for rescue and emergency medical services.

12.2 A method of communication such as telephone or radio must be in place between the Attendant and Entry Supervisor during a confined space entry. If multiple confined space entries are performed, sufficient emergency personnel must be available to perform simultaneous rescues at each entry location.

12.3 Requests for emergency services must be made by telephone or two-way radio directly to the Entry Supervisor. The Entry Supervisor will then contact Security at 78600 or 518-437-8600 who will contact the ERT for assistance.

12.4 In accordance with OSHA regulations (29 CFR 1910.146), an emergency rescue drill, including emergency responders and authorized personnel, will be performed annually at the facility.

12.5 During this annual training the ERT are evaluated in terms of proficiency with rescue-related tasks and equipment, and if they function appropriately while rescuing entrants from a permit-required confined space.

13. CONTRACTOR ENTRY COORDINATION

13.1 The CNSE ERT or EHS Department shall coordinate entry into a permit-required confined space, which may involve Authorized Entrants from more than one contractor. The ERT or EHS Department must understand the hazards of the work to be performed by all Authorized Entrants and ensure that the activities of one contractor or sub-contractor do not endanger employees of another.

13.2 Before a contractor begins work in a confined space, the site project coordinator will:

13.2.1 Inform the contractor that the workplace contains permit-required confined spaces and that entry into such spaces is allowed only through compliance with a Confined Space Entry Program meeting the requirements of 29 CFR 1910.146;

13.2.2 Review and approve the contractor’s Confined Space Entry Program;

13.2.3 Ensure that contractor personnel have received the required confined space entry training as required by 29 CFR 1910.146;

13.2.4 Ensure the contractor monitors the space prior to and during entry, and completes a confined space entry permit form EHS-00007-F1;

14. ASSOCIATED DOCUMENTS

14.1 **EHS-00007-F1** - Confined Space Entry Permit

15. APPENDIX

Appendix A – CNSE Confined Space Inventory

Appendix B- CNSE Confined Space Sign

Appendix A – CNSE Confined Space Inventory

Prior to entry to any of the spaces listed below, a Confined Space Entry Permit EHS-00007-F1 and an air survey must be completed. No one shall access these spaces without both a permit and a survey.

Inventory #	Building/ Room	Area	Posted
00001	NFN DI Water Room	Calcium Chloride Tank	Yes
00002	NFN DI Water Room	Raw Water Tank	Yes
00003	NFN DI Water Room	Filtered Water Tank	Yes
00004	NFN DI Water Room	Ultra Pure Water Tank T401	Yes
00005	NFN DI Water Room	Ultra Pure Water Tank DIW T301	Yes
00006	NFN DI Water Room	Humidification Tank DIW T201	Yes
00007	NFN WWT I	Fluoride Waste Tank	Yes
00008	NFN WWT I	Effluent Equalization Tank	Yes
00009	NFN WWT I	1st Stage pH Tank	Yes
00010	NFN WWT I	2nd Stage pH Tank	Yes
00011	NFN WWT I	Acid Waste Lift Tank	Yes
00012	NFN WWT II	Emergency Tank	Yes
00013	NFN WWT II	Equalization Tank	Yes
00014	NFN WWT II	50% Sulfuric Acid Tank	Yes
00015	NFN WWT II	25% Sodium Hydroxide Tank	Yes
00016	NFN WWT II Dock	Under Lifting Dock	Yes
00017	NFN 135 Electrical Room	Manhole	Yes
00018	NFN Penthouse	Acid Scrubber SA-1	Yes
00019	NFN Penthouse	Acid Scrubber SA-2	Yes
00020	NFN Penthouse	Acid Scrubber SA-3	Yes
00021	NFN Penthouse	Cabinet EXH Scrubber SC-1	Yes
00022	NFN Penthouse	Base Scrubber SB-1	Yes
00023	NFN Penthouse	Base Scrubber SB-2	Yes
00024	NFN N-225	Boiler N-HWB-1	Yes
00025	NFN N-225	Boiler N-HWB-2	Yes
00026	NFN N-225	Boiler N-HWB-3	Yes
00027	NFN N-225	Heating Hot Water Expansion Tank	Yes
00028	NFN N-116	Red Tank (West End)	Yes
00029	CUB	Polisher A Tank	Yes
00030	CUB	Polisher B Tank	Yes
00031	CUB	Spare Polisher Vessel	Yes
00032	CUB	DI Water Storage w/ N2 Blanket Tank 1	Yes
00033	CUB	DI Water Storage w/ N2 Blanket Tank 2	Yes
00034	CUB	35% Calcium Chloride Tank	Yes

Inventory #	Building/ Room	Area	Posted
00035	CUB	25% Sodium Hydroxide Tank	Yes
00036	CUB	50% Sulfuric Acid Tank	Yes
00037	CUB	FW Influent Tank	Yes
00038	CUB	Reaction Tank 1	Yes
00039	CUB	Reaction Tank 2	Yes
00040	CUB	Reaction Tank 3	Yes
00041	CUB	Reaction Tank 4	Yes
00042	CUB	UPW Tank	Yes
00043	CUB	RO Permeate Tank	Yes
00044	CUB	AW Influent Tank	Yes
00045	CUB	AW Off Spec Tank	Yes
00046	CUB	AW Monitoring Tank	Yes
00047	CUB	pH Adjust Stage 1 Tank	Yes
00048	CUB	pH Adjust Stage 2 Tank	Yes
00049	CUB	Sludge Tank	Yes
00050	CUB	Activated Carbon Filter A Tank	Yes
00051	CUB	Activated Carbon Filter B Tank	Yes
00052	CUB	Raw Water Tank	Yes
00053	CUB	Primary Mixed Bed A Tank	Yes
00054	CUB	Primary Mixed Bed B Tank	Yes
00055	CUB	Lead Mixed Bed A Tank	Yes
00056	CUB	Lead Mixed Bed B Tank	Yes
00057	CUB	Lag Mixed Bed A Tank	Yes
00058	CUB	Lag Mixed Bed B Tank	Yes
00059	CUB	Trench Entrance	Yes
00060	NFC WWT N-150	UPW Storage Tank	Yes
00061	NFC N-418	Acid Cabinet Scrubber 02	Yes
00062	NFC N-419	Acid Cabinet Scrubber 07	Yes
00063	NFC 3rd Floor	Acid Scrubber-04	Yes
00064	NFC 3rd Floor	Acid Scrubber-05	Yes
00065	NFC 3rd Floor	Base Scrubber-03	Yes
00066	NFC N-310B	Boiler N-HWB-4	Yes
00067	NFC N-310B	Boiler N-HWB-5	Yes
00068	NFC N-310B	ET5 - Red Tank	Yes
00069	NFC N-156	Crawl Space	Yes
00070	NFS 168	Trench Entrance	Yes
00071	NFE Mechanical Room	Red Tank	Yes
00072	Electrical Substation Building	Under Transformers	Yes
00073	Gas Yard	Nitrogen Purifier Building	Yes
00074	HPM 105A	Manhole 1	Yes

Inventory #	Building/ Room	Area	Posted
00075	HPM 104	Manhole 2	Yes
00076	HPM 104	Manhole 3	Yes
00077	HPM 104	Manhole 4	Yes

Appendix B – CNSE Confined Space Sign

After ERT/EHS signs off on the Confined Space Permit, they will issue this sign (signed and dated by ERT/EHS) to be posted in the area of the work. Upon completion of the work, the contractor or supervisor will either return this sign to the NFE Security desk or ERT/EHS. This will notify ERT/EHS the work is complete and the time will be noted on the permit.