

Compressed Gas Cylinder Removal Plan

Nuclear Metals, Inc. Superfund Site
Non-Time Critical Removal Action
Concord, Massachusetts

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Revision-3

1. Introduction

This plan has been developed pursuant to the Interim Removal Action Work Plan (de maximis, November 2011) to provide a process to safely manage compressed gas cylinders at the Nuclear Metals, Inc. Superfund Site (Site). Ongoing inventory activities have identified compressed gas cylinders abandoned in place throughout the buildings. The intent of this work plan is to describe the initial, near-term procedures to safely investigate and mitigate chemical and physical hazards presented by compressed gas cylinders. Only cylinders that are clearly marked as to their contents will be covered by this procedure. Cylinders not covered by this plan will be handled under the Removal Action Work Plan (RAWP) Phase I Hazardous and Regulated Materials Removal and Disposal Plan.

Compressed gases expose workers to both chemical and physical hazards. Gases contained within compressed gas cylinders can be toxic, flammable, oxidizing, corrosive, inert, or some combination thereof. Because the chemical is in gaseous form and pressurized, it can quickly contaminate a large area in the event of a leak in the cylinder or the regulator. The gas can also be injected into the body through the skin if the gas is blown against the skin with sufficient pressure. In addition to the chemical hazards, there are hazards from the pressure of the gas and the physical weight of the cylinder. A gas cylinder falling over can break chemical containers or crush feet. The cylinder can itself become a high speed projectile if the cylinder valve is broken off. Appropriate care in the handling and storage of compressed gas cylinders is essential. This plan provides detailed procedures so that the necessary work can proceed safely and in the near-term.

2. Investigation

The investigation phase of the cylinder removal process involved locating and physically inspecting the compressed gas cylinders throughout the buildings. Additional investigations were performed to locate cylinders within beryllium restricted areas that were not accessible during the earlier initial survey. An inventory is attached as Table 1.0.

Cylinders with known contents will be identified by fixed labels or symbols indicating the contents of the container. Cylinders that contain unknown contents will be secured in place until RAWP Phase I activities.

An inventory of each cylinder content, type, volume and location will be developed to place contents into one or more of the following categories:

- **Corrosive** - Gases that corrode material or tissue with which they come in contact, or do so in the presence of water, are classified as corrosive. They can also be reactive

and toxic and/or flammable or an oxidizer. No cylinders with corrosive contents have been identified on site to date.

- **Flammable** - Gases that, when mixed with air at atmospheric temperature and pressure, form a flammable mixture at 13% or less by volume, or have a flammable range in air of greater than 12% by volume regardless of the lower flammable limit, are classified as flammable. They can be high-pressure, toxic, and reactive and displace oxygen in air. A change in temperature, pressure or oxidant concentration may vary the flammability range considerably.
- **Inert** - Gases that do not react with other materials at ordinary temperature and pressure are classified as inert. They are colorless and odorless, as well as nonflammable and nontoxic. The primary hazard of these gases is pressure. These gases are often stored at pressures exceeding 2,000 psi. Also, they can displace the amount of oxygen necessary to support life when released in a confined place. Use of adequate ventilation and monitoring of the oxygen content within confined places will minimize the danger of asphyxiation.
- **Oxidizer** - Gases that do not burn but will support combustion are classified as oxidizers. They can be high-pressure, toxic and reactive, and can displace breathing oxygen from air.
- **Toxic** - Gases that may produce lethal or other harmful effects on humans are classified as toxic. They can be high pressure, reactive, nonflammable or flammable, and/or oxidizing in addition to their toxicity. The degree of toxicity and the effects will vary depending on the gas. Carbon monoxide is classified as a toxic gas.

The Material Safety and Data Sheets (MSDS) for compressed gases identified during the inventory process shall be maintained by the Site Health & Safety Officer. The MSDSs for the Site are stored within the Project Trailer and are readily available for all workers to review at any time.

In order to determine if a cylinder is pressurized, test regulators for specific gas cylinder types will be assembled with plugs in place to prevent uncontrolled release of contents. A test regulator will be attached to the pressure vessel to determine the pressure in the cylinder. Pressure regulators will be fully “backed out” prior to opening the tank valve to prevent leakage. Following the completion of gas venting activities all empty cylinders will be marked “EMPTY” and with the date, in large block letters.

Cylinders connected to gas distribution systems will be assessed in the field to determine if they can safely be disconnected. The assessment will determine if the cylinder can be isolated from the distribution system by closing associated valves to ensure that pressurized lines do not discharge. If it is determined that the cylinder cannot be safely separated from the gas distribution system, it will be secured in place until the Natural Gas Piping and Hydrogen Piping Purge and Depressurization of the Compressed Air, Helium, and Argon Systems Plan (Appendix H of the RAWP) is implemented. If the

system is charged with a gas that is not inert or poses a potential hazard, a separate plan will be developed to safely remove the cylinder and purge the distribution system.

If cylinders are connected to regulators, an assessment will be performed to determine if the regulator can be safely removed. If it cannot be safely removed, the regulator will be fitted with the proper tubing and utilized for venting as described below.

3. Gas Venting

As recommended by individual MSDS disposal requirements and in accordance with local regulations, compressed gas cylinders will be open-air discharged using the following gas venting procedures:

1. Cylinders will be surveyed for contamination in accordance with the “Regulated and Hazardous Materials Assessment and Segregation Plan” before proceeding with the following steps. Appropriate precautions will be implemented based on the results from the contamination assessment.
2. Cylinders will be removed from confined areas and relocated to areas that will allow exterior venting, i.e., window or exterior doorways. The venting locations will be selected to be of the same contamination classification as the cylinder’s original location to prevent potential cross-contamination unless the free release criteria under Section 3 of the “Regulated and Hazardous Materials Assessment and Segregation Plan” have been met. The exterior areas shall allow for easy dissipation of gases.
3. Prior to moving cylinder, review cylinder label to confirm contents. Ensure valve caps are in place. Cylinders shall not be moved without valve caps properly fastened. Inspect cylinder, valve cap and valves for overall condition, rust, or damage prior to moving the cylinder to prevent an uncontrolled release.
4. Use a hand truck or approved lifting device to move cylinders to venting location.
5. Secure cylinders to a temporary cylinder rack to prevent accidental movement during venting.
6. Once secure, remove valve cap and inspect cylinder valve for signs of damage or deterioration. Inspect threading on valve for signs of dirt and/or dust. Clean threading as necessary.
7. Confirm that a safe distance (40 feet interior and exterior) from the cylinder has been clearly marked to establish a zone for the gas to disperse.
8. Confirm that all employees have been evacuated to a safe distance (40 feet interior and exterior) for the duration of the purging and until gas monitoring indicates the area is safe to enter.

9. Gas monitoring shall be performed at or beyond the safety distance line. If gas monitoring results indicate an unsafe environment, the safe distance area will be expanded.

NOTE

Oxygen deficient atmosphere is defined as less than 19.5 percent oxygen. An oxygen enriched atmosphere (potentially explosive environment) is defined as above 23.5 percent oxygen. Do not operate outside of these limits.

10. Connect regulator to the compressed gas cylinder. The regulator will be checked to confirm it is in a fully “backed out” position. Ensure that oxygen cylinders are equipped only with tubing, piping and apparatus specifically meant for oxygen cylinder use (See Section 6.E.a for additional oxygen cylinder safety information).
11. Connect an air line to the regulator and route the discharge end to the nearest door or window opening to the outside of the buildings.
12. Secure hose with a minimum of 25 feet of hose extended to the exterior of the building.
13. Slowly open the cylinder valve $\frac{1}{4}$ to $\frac{1}{2}$ turn.
14. Slowly increase the discharge pressure valve to start discharging the gas to the building exterior. If releasing a gas, such as propane, that has an indicator odorant added, ensure the release rate is at a low flow rate to ensure that the odorant is not detectable at the site perimeter to not alarm Site neighbors.
15. Perform air monitoring at the perimeter of the marked area to verify oxygen content remains safe outside of zone. If oxygen is being displaced by the gas, immediately step back and widen the “safe area”. When complete, mark the cylinder with the word “EMPTY” in large block letters.

4. Compressed Gas Container Handling & Storage

All compressed gas cylinder containers that require off-site disposal will be evaluated for radiological and beryllium contamination, and decontaminated as needed to achieve unrestricted release for treatment and disposal following the procedures and guidelines established in the attached “Regulated and Hazardous Material Assessment and Segregation Plan” (DDES, March 1, 2012). Storage areas for these compressed gas cylinders will be determined following the investigation phase.

5. Empty Container Destruction

Empty containers, including the gas containers emptied as part of the work under this plan, will be destroyed using the following procedures:

- a. Verify the container is empty using the Gas Venting procedures stated above.
- b. Remove regulator and slightly open the valve to ensure the cylinder is empty.
- c. Continue to open the valve to the full-open stop position.
- d. Remove cylinder valve. If valve cannot be removed with a wrench, the valve will be “cold cut” at the stem with a reciprocating saw or similar.
- e. Lay cylinder flat on the ground and “cold cut” the cylinder in two at the midway point using a reciprocating saw or similar.

If a cylinder meets contamination free-release limits, as demonstrated by the initial survey, it may be transferred to a “clean” waste area. Alternatively, the cylinder pieces will remain where they are, or will be placed in a nearby storage area to consolidate similar waste.

6. General Procedures

The following summarizes the general procedures for handling and storage of cylinders:

A. Moving and Transporting Cylinders

- a) Always use a suitable cylinder cart for transporting cylinders, with the cylinder securely chained or strapped to the cart. Do not roll or drag a cylinder to move it or allow cylinders to strike each other or any other surface violently.
- b) Protective valve caps must be secured when moving cylinders. Avoid lifting or moving the cylinder by the cap.
- c) Ropes or slings should not be used to suspend cylinders unless proper lifting and attachment points are provided on the cylinder.

B. Storing Cylinders

- a) All cylinder storage areas must be prominently marked with the hazard class or the name of the gases to be stored, e.g., "Flammable Gas Storage Area," and "No Smoking" signs posted where appropriate.
- b) Always secure gas cylinders upright (with valve end up) to a wall, bench top, cylinder rack or post, unless the cylinder is specifically designed to be stored otherwise. Specially designed cylinder clamps will be used when securing a cylinder against a bench top.
- c) Where gases of different types are stored at the same location, cylinders (empty or full) should be grouped by the type of gas; e.g., flammable, oxidizer, toxic or corrosive. Inert gases can be stored with any other type of gas.
- d) To avoid confusion, full cylinders will be stored separately from empty cylinders.

- e) Cylinders will be stored in a well-ventilated area away from sparks, flames or any source of heat or ignition. Cylinders may be stored outside on a slab; however, where extreme temperatures prevail, cylinders should be stored so that they are protected from the direct rays of the sun. Do not expose cylinders to temperatures above 125 degrees F.
- f) Cylinders should not be exposed to continuous dampness or stored near salt or other corrosive chemicals or fumes. Corrosion may damage cylinders and cause their valve protection caps to stick.
- g) Never store cylinders in elevator lobbies, stair towers or any other location which could obstruct the safe exit pathway of the building occupants.

C. General Use Precautions

- a) Never tamper with or attempt to repair or alter cylinders, regulators or any pressure relief devices.
- b) Do not attempt to remove a stuck cylinder cap by using a lever in the cap ports. The lever may accidentally open the valve when the cap turns.
- c) Do not place cylinders where they might become part of an electric circuit or allow them to come into contact with an electrically energized system.
- d) Use pressure regulators that are equipped with pressure relief devices.

D. Special Precautions for Flammable Gases

In addition to the above guidelines, the following measures should be taken when handling flammable gases:

- a) Cylinders containing flammable gases (empty or full) should be separated from cylinders containing oxidizing gases by a minimum distance of 20 feet or by a barrier at least 5 feet high which has a fire-resistance rating of at least one hour, e.g., a concrete block wall.
- b) Do not store flammable gases near unprotected electrical connections, heat sources or any source of ignition.
- c) Store flammable gases in a ventilated, fire resistant enclosure if possible, e.g., an approved gas cabinet or chemical fume hood. If this is not possible, flammable gas cylinders should be stored in a well-ventilated space.

E. Special Precautions for Using Oxygen and Oxidizing Gases

In addition to the general guidelines, the following measures should be taken when handling oxidizing gases:

- a) Oxygen cylinders hoses, couplings, regulators and apparatus shall be separate from and easily distinguishable from those used for other cylinders. Do not interchange fuel gas and oxygen manifolds for the discharge of oxygen gas. Do not permit oil or

grease to come in contact with compressed oxidizing gases. Do not handle oxygen cylinders or apparatus with oily hands or gloves. Regulators and tubing used with oxidizing gases must be specially cleaned to remove oil and other reducing agents. Explosions may occur when pressurized oxidizers come into contact with grease or oil.

- b) Cylinders containing oxygen or oxidizing gases (empty or full) should be separated from cylinders containing flammable gases by a minimum distance of 20 feet or by a barrier at least 5 feet high having a fire-resistance rating of at least one hour, e.g., a concrete block wall.

Do not store oxidizing gases near flammable solvents, combustible materials or near unprotected electrical connections, heat sources or sources of ignition.

F. Special Precautions for Using Corrosive Gases

In addition to the general guidelines, the following measures should be taken when handling corrosive gases:

- a) Cylinders containing corrosive chemicals should be periodically checked to ensure that the valve has not corroded. If a cylinder or valve is noticeably corroded, the gas vendor should be contacted and the gas vendor's instructions followed. Any other damage that might impair the integrity of the cylinder should be called to the attention of the Site Manager.

Nuclear Metals Inc. NTCRA
Compressed Gas Cylinder Inventory Of Buildings A, B, C, D, E and Gas Cylinder Storage Shed
Table 1.0

Room Number	Qty.	Description	Comments	Category	Restricted/Unrestricted
A128	1	Propane	14 Ounce Cylinder	Flammable - but can be safely discharged with precautions	Unrestricted
A134	1	Helium		Inert	Unrestricted
A145	1	Compressed Air		Oxidizer - but can be safely discharged	Unrestricted
A154A	1	Argon		Inert	Unrestricted
A154A	2	Helium & Oxygen Mixture		Non-Flammable	Unrestricted
A159	1	90% Argon/10% Methane	P-10	Non Flammable	Unrestricted
A160	1	Helium		Inert	Unrestricted
A160	1	Nitrogen		Inert	Unrestricted
A160	1	Argon		Inert	Unrestricted
A220	1	Argon		Inert	Unrestricted
A220	1	Compressed Air		Oxidizer - but can be safely discharged	Unrestricted
A223	1	Propane	14 Ounce Cylinder	Flammable - but can be safely discharged with precautions	Unrestricted
A224	1	Argon		Inert	Unrestricted
A224	1	Nitrogen		Inert	Unrestricted
A224	1	Helium		Inert	Unrestricted
A228	1	Helium		Inert	Unrestricted
A228	2	Nitrogen		Inert	Unrestricted
A228	2	Unknown	No Identification On Either Cylinders Except For Toxic. One Cylinder is Empty without a valve.	Unknown	Unrestricted
Butler Building B-1	1	Argon		Inert	Unrestricted
Butler Building B-1	1	Gold Gas Argon Oxygen Mixture	Gold Gas=Premium Quality Mixture	Inert	Unrestricted
Butler Building B-1	1	75% Argon/25% Carbon Dioxide		Non Flammable	Unrestricted
Butler Building B-1	1	Acetylene		Off-Site Disposal	Unrestricted
Butler Building B-4	6	Argon		Inert	Unrestricted
C111	3	Argon		Inert	Restricted
C115	1	Oxygen		Oxidizer - but can be safely discharged	Restricted
C115	1	Acetylene		Off-Site Disposal	Restricted
C117	4	Argon		Inert	Restricted
C117	1	Nitrogen		Inert	Restricted
C117	1	90% Argon/10% Methane		Non Flammable	Restricted
C117	1	Unknown	Illegible Label, Possibly Argon	Unkown	Restricted
E-106	3	Unknown	(3.6 cubic feet cylinders)	Unkown	Restricted
E-125	1	Helium		Inert	Restricted
E-140	1	Nitrogen		Inert	Restricted
E-140	2	Propane		Flammable - but can be safely discharged with precautions	Restricted
E-140	1	Turbo Touch MAPP Gas	cylinder)	Flammable	Restricted
E-140	1	Propane	14 Ounce Cylinder	Flammable - but can be safely discharged with precautions	Restricted
E-205	1	Helium		Inert	Restricted
Gas Cylinder Storage Shed	1	Argon		Inert	Unrestricted
Gas Cylinder Storage Shed	1	Helium		Inert	Unrestricted
Gas Cylinder Storage Shed	3	1% Oxygen/99% Helium		Inert	Unrestricted
Gas Cylinder Storage Shed	1	Carbon Monoxide		Toxic, Flammable	Unrestricted
Gas Cylinder Storage Shed	2	Propane		Flammable - but can be safely discharged with precautions	Unrestricted
Gas Cylinder Storage Shed	1	Nitrogen		Inert	Unrestricted

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 Table 1.0

Room Number	Qty.	Description	Comments	Category	Restricted/Unrestricted
Gas Cylinder Storage Shed	1	1% Nitrogen/1% Oxygen/98% Helium		Inert	Unrestricted
Gas Cylinder Storage Shed	1	75% Argon/25% Carbon Dioxide		Non Flammable	Unrestricted
Gas Cylinder Storage Shed	3	Propane	Forklift Cylinders	Flammable - but can be safely discharged with precautions	Unrestricted
Gas Cylinder Storage Shed	1	Liquid Petroleum Gas	Small Cylinder	Flammable	Unrestricted

1	1% Nitrogen/1% Oxygen/98% Helium
3	1% Oxygen/99% Helium
2	75% Argon/25% Carbon Dioxide
2	90% Argon/10% Methane
2	Acetylene
19	Argon
1	Carbon Monoxide
2	Compressed Air
1	Gold Gas Argon Oxygen Mixture
7	Helium
2	Helium & Oxygen Mixture
1	Liquid Petroleum Gas
7	Nitrogen
1	Oxygen
10	Propane
1	Turbo Touch MAPP Gas
6	Unknown
68	Total

Restricted (Radiologically Controlled Area)	22
Unrestricted (non-Radiologically Controlled Area)	46
Total:	68