# PSEG NUCLEAR L.L.C.

# INDUSTRIAL SAFETY

# HANDLING AND STORAGE OF COMPRESSED GAS CYLINDERS PORTABLE TANKS AND CRYOGENIC CONTAINERS/DEWARS

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**REVISION SUMMARY:**

- Revision bars are used in this procedure.

- Changed “MSDS” with “SDS, Safety Data Sheet” per new regulations per Notification/Order 20625350/70159792.

- **HANDLING AND STORAGE OF COMPRESSED GAS CYLINDERS PORTABLE TANKS AND CRYOGENIC CONTAINERS/DEWARS**

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## 1. PURPOSE

1.1. This procedure provides requirements and instruction for the use, storage, and identification of compressed gas cylinders.

1.2. Emergency response compressed gas cylinders such as SCBA's, fire extinguishers and portable medical grade oxygen cylinders are exempt from this procedure.

1.3. This procedure provides guidance for the storage and handling of lecture bottles, and small quantity calibration gas cylinders in the absence of any regulatory requirements or consensus standard applicability.

## 2. TERMS AND DEFINITIONS

2.1. **Approved Storage Area:** An area designated and posted to store compressed gas cylinders that are **not** in-use.

2.2. **CGA:** Compressed Gas Association.

2.3. **Compressed Gas:** Any gas or mixture of gasses exerting in a container, a pressure exceeding 40.6 psia at 68 degrees F.

2.4. **Compressed Gas Container:** A container that contains either a non-liquefied gas or a liquefied gas, under a charged pressure, that is used to store and transport the gas for use. This includes portable containers and cylinder storage tanks. For the purpose of this procedure, this term does **not** include containers manufactured for the storage and transport of cryogenic or refrigerated liquefied gas provided that the container is open to the atmosphere or equipped as part of a manufactured design, with a device to preclude pressure build-up.

2.5. **Compressed Gas Cylinder:** A cylindrical compressed gas container having a maximum water capacity of 1000 lb. (454 kg), and meeting the specifications of either the ASME, TC or the DOT, for storage and transport of liquefied and non-liquefied compressed gas. For the purpose of this document, this does **not** include Cryogenic Liquid Containers (See 2.6).

2.6. **Cryogenic Liquid:** A refrigerated liquefied gas having a boiling point of less than negative 130 °F at normal atmospheric temperature and pressure.

2.7. **Cryogenic Liquid Container:** A pressurized, double walled, insulated container used to hold either cryogenic liquefied gas or refrigerated liquefied gas.

2.8. **Cryogenic Liquid Dewar:** An open-mouthed, non-pressurized, vacuum jacketed or insulated vessel designed to hold cryogenic liquids.

2.9. **Cylinder In-use Tag:** A tag attached to In-Use cylinders that are **not** connected to a plant system that identifies the purpose for use, responsible supervisor, supervisor

phone extension, placement date and estimated removal date. The tag may also contain a summary of handling and storage requirements.

2.10. **DOT:** Department of Transportation.

2.11. **Flammable Gas:** A gas that is flammable in a mixture of 13 percent or less (by volume) with air, or has a flammable concentration range with air of at least 12 percent regardless of the lower limit, at atmospheric temperatures and pressure.

2.12. **Fuel Gas Cylinder:** A compressed gas cylinder containing a flammable gas such as liquid petroleum or acetylene.

2.13. **Hydrostatic Test:** A testing method in which water is used, within a controlled environment, to pressurize a cylinder and test the integrity of the cylinder.

2.14. **ICC:** Interstate Commerce Commission.

2.15. **In-Use:** A compressed gas cylinder is considered "in use" when a gas is flowing from the container, when the container is maintaining pressure in a supply line, when the container is connected for use, or when the container is in standby or staged during and between operations utilizing gas.

2.16. **In-Storage:** Compressed gas cylinders are considered in storage when **not** in-use and when placed in an approved storage area with regulators removed and valve caps installed (when provided).

2.17. **Liquefied Gas:** A gas, other than in solution, that is packaged under a charged pressure and exists as a liquid and a gas at a temperature of 20 degrees Celsius (68 degrees F).

2.18. **Safety Data Sheet (SDS):** Information provided with gases and chemicals to list their properties, safety information, and health hazard information.

2.19. **Oxidizing Gas:** A gas that can support and accelerate combustion of other materials.

2.20. **Pyrophoric:** A chemical or substance that is capable of igniting spontaneously when exposed to air.

2.21. **Refrigerated Liquefied Gas:** A gas that has assumed a liquid state as a result of artificial cooling (as opposed to subjecting it to increased pressure).

2.22. **Segregate:** Segregation of cylinders means to sort and group according to like status.

Example (1): Empty cylinders shall be segregated (i.e., grouped together but **not** intermingled with) full cylinders.

Example (2): Nitrogen cylinders need **not** be separated from argon cylinders, but shall be segregated within the same storage area.

2.23. **Separate:** For the purpose of this document, separation means to provide an effective barrier between oxidizer and fuel-gas compressed gas cylinders or combustible materials by one of the following methods:

1. Maintain a distance of at least 20 feet, or,

2. Provide a non-combustible barrier at least 5 feet high having a one-half hour fire resistant rating.

2.24. **Small Quantity Containers:** Includes lecture bottles, and small quantity calibration gas cylinders typically less than 150 liters gas volume, or 5 liters liquid volume.

2.25. **Standard Cubic Foot (SCF):** One cubic foot of gas at 70 degrees Fahrenheit and 14.7 psia.

2.26. **Toxic Gas:** A gas that will kill 50% of test rats when the rats are exposed for up to one hour at a concentration of 5,000 ppm or less.

2.27. **Valve Protective Cap:** A rigid, removable cover provided for compressed gas cylinder valve protection.

## 3. RESPONSIBILITIES

3.1. All Employees/Compressed Gas Users

3.1.1. **TREAT** "empty" compressed gas cylinders with the same respect as "full" cylinders.

3.1.2. **DO not USE** unlabeled compressed gas cylinders.

3.1.3. **REMOVE** from service any compressed gas cylinder that is damaged.

3.1.4. **DO not MODIFY**, tamper with, paint, deface, obstruct, remove, or repair any part of a cylinder, including the pressure relief device and the container valve or valve protection device.

3.1.5. **DO not DIRECT** a compressed gas stream towards any person.

3.1.6. **DO not USE** compressed gas, including compressed oxygen, for self-cleaning purposes, such as dusting off clothing.

3.1.7. **ENSURE** compressed gas cylinders are labeled in accordance with this procedure.

3.2. Supervision

3.2.1. **ENSURE** the in-plant marking, labeling, handling, storage, and utilization of all compressed gas cylinders, dewars and portable tanks are in accordance with applicable procedures.

3.2.2. **ENSURE** only properly trained persons handle and use compressed gases.

3.3. Industrial Safety

3.3.1. **PROVIDE** oversight and inspection to evaluate field compliance with this procedure on a periodic basis.

3.3.2. **PROVIDE** technical guidance in interpreting this procedure.

3.4. Materials/Supply Management

3.4.1. **ENSURE** compressed gas cylinders are clearly and permanently marked on the shoulder with name of gas, and DOT or ICC characteristic designation.

3.4.2. **DO not ACCEPT** delivery from the gas supplier if the cylinders are visibly damaged, **not** legibly and clearly marked with the cylinders contents, or fail to meet the above requirements.

## 4. MAIN BODY

4.1. General Safety Precautions and Guidelines

4.1.1. **REVIEW** SDS before using any compressed gas or cryogenic liquid.

4.1.2. **DO not USE** dented, cracked, or other visibly damaged cylinders.

4.1.3. **DO not USE** compressed gas cylinders as rollers, supports, or for any other purpose other than to contain and use the contents as received.

4.1.4. **DO not USE** compressed gas cylinders without attaching a pressure-reducing regulator to either the manifold or to the cylinder valve.

> **NOTE:** Valve protection caps should either be attached or kept in close proximity to cylinders.

4.1.5. **SELECT** the smallest, available, reusable cylinder compatible with the need.

4.1.6. **RETURN** empty cylinders with closed valves and all valve caps in place.

**WARNING**

**DO not perform this valve cracking sequence near other welding work, sparks, open flames or other sources of ignition.**

**WARNING**

**DO not "crack" (open and close quickly before attaching regulator) hydrogen, fuel-gas, pyrohoric or toxic gas cylinder – just wipe out the outlet connection with a clean lint-free cloth.**

4.1.7. **PERFORM** the following before connecting a regulator to a cylinder valve. This sequence will ensure that the threading and opening is clear of grit and other obstructions.

1. **STAND** to the side of the outlet.
2. **OPEN** valve slightly and,
3. **Immediately CLOSE** the valve.

> **NOTE**
>
> Ensure liquid containers are stored and used in well ventilated areas or areas with forced ventilation. Containers should be stored away from high traffic areas and air intakes. [**70155150]**

4.1.8. **USE** cylinders containing toxic gases in areas where both local and general ventilation is provided (including distribution systems) with the receiving end inside a containment hood or other adequately ventilated space.

4.1.9. **DO not STORE** or use grease, cleaning solvents, or other flammable material with an oxygen valve, oxygen regulator, or oxygen use piping.

4.1.10. **DO not REFILL** cylinders that exceed the hydrostatic test date.

4.1.11. **REPORT** leaking cylinders as an emergency and perform the following:

1. **EVACUATE** area
2. **ISOLATE** possible ignition sources

4.2. Flammable, Oxidizer and Fuel Gases

4.2.1. **STORE and USE** acetylene cylinders in the upright position at all times.

4.2.2. **DO not USE** acetylene in a free state (i.e., low-pressure side of the regulator), at pressures above 15 pounds psig. Acetylene stored in cylinders is stabilized within a mixture of acetone and will **not** decompose or release energy within the cylinder at the higher pressures.

4.2.3. **If** it is reasonably anticipated that gas will **not** be drawn from an oxidizing or fuel-gas cylinder within 24 hours (overnight hours included), **then**:

1. **SEPARATE** oxidizer cylinders from fuel-gas cylinders or other combustible material a minimum distance of 20 feet, **or**

2. **SEPARATE** oxidizer cylinders from fuel-gas cylinders or other combustible material by a non-combustible barrier at least 5 feet high having a fire resistance rating of at least one-half hour.

4.2.4. Flammable Gas Cylinders **(**Reference FP-AA-001, Precautions against Fire**)**

1. **STORE** flammable gases in a well-ventilated area away from oxidizers, open flames, sparks or other sources of heat or ignition.

2. Flammable gas cylinders in any safety-related area or room, regardless of the amount, shall NOT be left unattended for > 1 hour. **[78111]**

3. Flammable gas cylinders in any safety-related area or room, regardless of the amount require TCP.

   A. An exception for the TCP would be when a Hot Work Permit (HWP) is issued for the gas cylinders on a daily basis.

   B. The requirement to monitor flammable gas cylinders left for longer than one hour in a safety related area or room of the stations remains the same. **[CD-830X, TS990325186]**

4.3. Handling Compressed Gas Cylinders

4.3.1. **ATTACH** a Cylinder In-use Tag to in-use cylinders that are **not** connected to a plant system.

4.3.2. **DO not LIFT** compressed gas cylinders by the cap, valve, or with magnets.

4.3.3. **DO not DRAG** or slide compressed gas cylinders

4.3.4. **DO not ROLL** cylinders on their sides.

4.3.5. **HAND ROLL** cylinders into position by tilting the cylinder and rolling them along their bottom edges.

4.3.6. **DO not USE** slings, ropes, or chains to handle compressed gas cylinders, unless retrofitted with appropriate lifting attachments.

4.3.7. **DO not WELD** lifting attachments to cylinders.

4.3.8. **REMOVE** regulators **and INSTALL** valve protection caps (when provided) prior to moving cylinders **unless** a special truck or cart designed for moving cylinders is used **and** the work activity specifically requires movement of an in-use cylinder.

4.3.9. **If** transporting cylinders by vehicle, **then CLOSE** valves, **INSTALL** protective caps (when provided), **and SECURE** in an upright position.

4.3.10. **USE** hand-trucks, cylinder carts or motorized trucks when transporting cylinders.

4.3.11. **DO not HANDLE** compressed gas cylinders with oily or greasy gloves or hands.

4.4. Compressed Gas Container/Cylinder Labeling

4.4.1. **ENSURE** all compressed gas containers are properly marked for contents as follows:

1. The chemical or trade name of the gas.
2. The marking must be a stencil, stamp or label.
3. The marking **cannot** be easily removed.

4.4.2. **ENSURE** oxygen service regulators are marked “Oxygen – Use No Oil.”

4.4.3. **DO not RELY** solely on color-coding to identify a gas.

4.5. General Compressed Gas Container Storage Requirements

4.5.1. **MAINTAIN** valves closed and valve protection caps, where cylinders are designed to accept a cap, in-place and hand-tight **except** when in-use.

4.5.2. **POST** approved storage areas with the hazard class or the name of the gases stored. **POST** no smoking signs where appropriate.

4.5.3. **DO not STORE** compressed gas containers so that they are exposed to corrosive chemicals or vapors.

4.5.4. **DO not STORE** compressed gas containers, of any kind, in areas that contain plant safety related equipment unless storage is done in accordance with site procedures.

4.5.5. **STORE** compressed gas containers only in areas approved by Supervisor or Safety representative. **[70112397]**

4.5.6. **SEPARATE** compressed gas containers in storage; according to hazard class and compatibility of the gasses they contain (Reference Attachment 1).

4.5.7. **POST** warning signs in cylinder storage areas for the hazards of the gas stored (i.e., Flammable Gas, No Smoking, Open Flame, or Sparks, etc.).

4.5.8. **DO not ALLOW** compressed gas container, storage area temperatures to exceed 125°F, or subject cylinders to artificially created low temperatures.

> **NOTE:** It is acceptable to have empty cylinders (marked as such) in the same storage location with full cylinders of the same gas type. Empty cylinders shall be segregated from full.

4.5.9. **SEGREGATE** containers by gas type and empty, or full status of the container.

4.5.10. **STAGE** compressed gas containers so they will **not** obstruct exit routes or other means of egress.

4.5.11. **DESIGN** storage areas to accommodate gas container types required.

4.5.12. **DO not STORE** handheld propane gas cylinders within flammable liquid storage lockers.

4.5.13. **USE** Attachment 2, Compressed Gas Checklist as necessary to verify correct placement and storage of compressed gas containers.

4.6. Additional Compressed Gas Cylinder Storage/Handling Requirements

4.6.1. **STORE** all compressed gas cylinders in an upright and secure position unless specific container design allows for other storage orientation (e.g., liquid propane fuel cylinders for fork trucks). In such instances, the manufacturer's recommended practice shall be followed.

> **NOTE:** Small quantity containers need **not** be secured by chain but should be stored in accordance with recommendations made by the manufacturer, or as provided on the SDS. At minimum all such containers should be stored in a stable manner (i.e., in a suitable rack, cart or case) such that they are prevented from rolling, tipping or from obtaining damage by puncture, heat, abrasion, movement or adverse environmental conditions.

4.6.2. **SECURE** all compressed gas cylinders, including empties, by one of the following options to prevent cylinders from falling while in use, being transported, or in storage. **POSITION** the securing device in front of or around the cylinder(s) at the mid-section of the cylinder. **[70153334]**

1. A minimum1/4 inch wire cable.

2. A substantial metal chain.

3. Substantial straps that include a fastening mechanism (e.g., buckle). Velcro is **not** a suitable fastening mechanism.

4. Clamps chains or straps that are designed as part of a manufactured system for the purpose of securing cylinders.

4.6.3. **SECURE** compressed gas cylinders to substantial supports. Examples of components that should **not** be used are instrument lines, conduit, and plant safety related components.

4.6.4. **MARK** as **"Empty" and SEGREGATE** empty cylinders from full cylinders.

4.6.5. **STORE** Liquefied Petroleum (LP) Cylinders vertically with LP regulators removed and plugs installed.

4.6.6. **DO not PLACE** compressed gas cylinders near highly flammable substances such as oil and gasoline.

4.6.7. **DO not PLACE** cylinders where they might become part of a "live" electrical circuit.

4.6.8. **If** placing compressed gas cylinders inside any building, **then COMPLY** with the following general rules:

1. **PLACE** compressed gas cylinders in a well-protected, well-ventilated, dry location **and SEPARATE** from highly combustible materials such as oil, accelerant or sawdust.

2. **PLACE** flammable compressed gas cylinders away from elevators, stairs, or gangways and in areas where they will **not** be knocked over or damaged by passing or falling objects or subject to tampering by unauthorized personnel.

3. **DO not PLACE** compressed gas cylinders in unventilated enclosures or areas such as lockers, cabinets, or below ground level.

4.6.9. **STORE** all compressed gas cylinders in accordance with Attachment 1, Separation of Gas Cylinders by Hazards.

4.6.10. **If** storing compressed gas cylinders outside a building or in a separate, dedicated, stand-alone exterior building, **then**:

1. **ENSURE** the building is well ventilated and no open flames are permitted within the building.

2. **DO not STORE** combustible materials within the building.

4.7. Interior Room Storage Requirements for Fuel-Gas Cylinders

4.7.1. **If** fuel gas cylinders are stored within an interior room of a building, **then**:

1. **ENSURE** the total quantity of flammable/combustible compressed gas cylinders stored in any one approved storage area is less than 2,000 cubic feet or 300 lbs.

2. **If** the 2,000 cubic feet/300 lb limit must be exceeded, **then** the cylinder storage location must be a separate room or compartment constructed with the following requirements:

   A. Walls, partitions, floors and ceilings shall be made of non-combustible materials with a fire resistance rating of at least one (1) hour.

   B. Doorways opening to other parts of the building shall be of a swinging, self-closing type with a fire protective rating of at least 1 hour.

   C. At least one wall of the room shall be an exterior wall.

4.8. Connections and Appurtenances

4.8.1. **ENSURE** all hardware connecting the compressed gas container or cylinder to receiver is compatible with the pressure and contents to which it is exposed.

4.8.2. **STAND** to the side of the regulator when opening the valve.

4.8.3. **DO not OPEN** or crack open the discharge valve to test flammable gas or oxidizing gas cylinders near open flames or other ignition sources.

4.8.4. **DO not CONNECT** oxygen service regulators to a fuel gas source nor fuel gas regulators to an oxygen source.

4.8.5. When placing a regulator in operation, **PERFORM** the following steps:

1. **ENSURE** the regulator is fully backed off, **and STAND** to one side of the gauges while slowly opening the cylinder valve.

2. **SCREW-IN** the regulator pressure adjusting screw to obtain desired outlet pressure or flow rate.

4.8.6. When removing a regulator from operation, **PERFORM** the following steps:

1. **CLOSE** any isolation valves on regulator tubing.

2. **CLOSE** cylinder valve and release gas pressure from the regulator.

3. **OPEN** any isolation valves on regulator tubing.

4.8.6 (Continued)

4. **RELEASE** the regulator pressure-adjusting screws (back-off the regulator).

5. **CLOSE** isolation valves on regulator tubing.

6. **DISCONNECT** regulator and tubing.

4.8.7. **USE** only approved equipment, regulators and flow control devices.

4.8.8. **DO not MODIFY** relief valves.

4.8.9. **DO not USE** copper fittings or tubing on acetylene tanks.

4.8.10. **DO not FORCE** container valve connections that **DO not** fit.

4.8.11. **INSPECT** the hose and all connections for defects or loose fittings.

4.8.12. **MAINTAIN** piping, regulators, and other apparatus gas tight to prevent leakage.

4.9. Use Transport and Storage of Cryogenic Liquid Containers

4.9.1. **UTILIZE** a transport cart when transporting cryogenic liquid containers with a capacity greater than 20 gallons.

4.9.2. **SECURE** cryogenic liquid containers with a capacity greater than 20 gallons to the cart.

4.9.3. **SECURE** cryogenic liquid containers with a capacity greater than 20 gallons that are prone to tipping or instability.

4.9.4. **HANDLE and STORE** cryogenic containers in an upright position and in a well-ventilated area to prevent hazardous concentrations of the gas.

4.9.5. **DO not DROP or ROLL** cryogenic containers

4.9.6. **WEAR** a face shield, and safety glasses or safety goggles, when there is a potential for exposure to cryogenic liquids.

4.9.7. **WEAR** cuffless trousers over high-topped shoes when there is a potential for exposure to cryogenic liquids to prevent spills from being trapped in shoes or allowed to contact the feet.

4.9.8. **WEAR** hand protection, such as insulated gloves, to prevent contact with cold liquid, cold gas, and cold equipment or piping. Gloves should be loose fitting so that they can be readily removed in the event liquid is splashed into them.

## 5. DOCUMENTATION

5.1. None

## 6. REFERENCES

6.1. 29 CFR 1910.101, Compressed Gases (General Requirements)

6.2. 29 CFR 1910.253, Oxygen-Fuel Gas Welding and Cutting

6.3. 29 CFR 1926.350, Gas Welding and Cutting

6.4. Compressed Gas Association Pamphlet P-1-2000.

6.5. Compressed Gas Association Position Statement PS-6 1999.

6.6. TQ-AA-119-0201, Industrial Safety Training Matrix

6.7. FP-AA-001, Precautions against Fire

## 7. ATTACHMENTS

7.1. Attachment 1, Separation of Gas Cylinders by Hazard

7.2. Attachment 2, Compressed Gas Checklist

## ATTACHMENT 1
## Separation of Gas Cylinders by Hazard
## Page 1 of 1

| GAS HAZARD CATEGORY | NONFLAMMABLE | OXIDIZING | FLAMMABLE | PYROPHORIC | TOXIC |
|---|---|---|---|---|---|
| TOXIC | C | 20 FT.* | 20 FT.* | 20 FT.* | -- |
| PYROPHORIC | C | 20 FT.* | 20 FT.* | -- | 20 FT.* |
| FLAMMABLE | C | 20 FT.* | -- | 20 FT.* | 20 FT.* |
| OXIDIZING | C | -- | 20 FT.* | 20 FT.* | 20 FT.* |
| NONFLAMMABLE | -- | C | C | C | C |

**20 FT =** Separated by distance of 20 feet or by the "*****" indicated requirement described below.

**C =** Compatible. Cylinders of these hazards may be stored adjacent to each other.

*** =** The 20 FT distance shall be permitted to be reduced without limit when separated by a barrier of noncombustible materials. The barrier material must have a fire resistance rating of at least one-half hour (30 minutes).

**ATTACHMENT 2**
**Compressed Gas Checklist**
**Page 1 of 2**

| General | Location | Compliance (√) | Non-Compliance (Specify) |
|---|---|---|---|
| Containers have a legible label identifying contents | | | |
| Cylinders are secured by a:<br>• 1/4 inch wire cable, or<br>• a substantial chain, or<br>• a substantial strap,<br>• or devices part of a manufactured system<br>(Rope is **not** allowed) | | | |
| In-use cylinders that are **not** connected to a plant system have a Cylinder In-use Tag attached | | | |
| Oxidizer cylinders separated from fuel-gas cylinders if gas will **not** be drawn from the cylinders for 24 hours | | | |
| Containers are placed so that they will **not** become part of an energized electric circuit | | | |
| Flammable cylinders away from elevators, stairs or gangways and in areas where they will **not** be knocked over or damaged. | | | |

**ATTACHMENT 2**
**Compressed Gas Checklist**
**Page 2 of 2**

| Storage | Location | Compliance (√) | Non-Compliance (Specify) |
|---|---|---|---|
| Storage areas posted with the hazard class or the name of the gases stored. No smoking signs posted where appropriate | | | |
| Containers segregated and grouped together according to hazard class | | | |
| Storage area temperatures will **not** exceed 125 °F. | | | |
| Empty cylinders are segregated from full cylinders | | | |
| Hand held propane gas cylinders **not** stored in flammable liquid storage lockers | | | |
| Flammable containers stored in a well ventilated area away from ignition sources | | | |
| Cylinders stored in an upright position unless container design allows for other storage orientation | | | |
| Cylinders, **not** in-use, in an approved storage area with regulators removed and valve caps installed (where provided) | | | |