



---

## Handling and Use of Sulfur Hexafluoride Gas

---

### Contents

---

<u>Section</u>	<u>Page</u>
I. PURPOSE	2
II. SCOPE	2
III. POLICY	2
A. Sulfur Hexafluoride Gas	2
B. Decomposition Gasses and Solid By-products	3
IV. DEFINITIONS	3
V. PROCEDURE	4
A. Handling of Sulfur Hexafluoride Gas - Central Facilities	4
B. Handling of Sulfur Hexafluoride Gas - Districts	4
C. Filling Equipment with Sulfur Hexafluoride Gas	5
D. Removal of Sulfur Hexafluoride Gas from In-Service Equipment	6
E. Removal of Hazardous Solid By-products	7

***This document is provided for informational purposes only for co-partners of the U.S. Environmental Protection Agency's SF<sub>6</sub> Emissions Reduction Partnership for Electric Power Systems. It is not intended as legal advice. Neither Northeast Utilities nor any of its subsidiaries or affiliates make any warranties or guarantees as to its sufficiency or adequacy for any purpose and are not liable for any use or misuse of this material.***



---

## Handling and Use of Sulfur Hexafluoride Gas

---

### I. PURPOSE

This procedure establishes safe working practices for handling sulfur hexafluoride (SF<sub>6</sub>) gas. It specifies methods for handling of SF<sub>6</sub> gas and removal, handling, and disposal of hazardous by-products.

### II. SCOPE

The following departments are affected by this procedure:

- Transmission & Distribution Maintenance
- Substation Construction
- General Construction & Maintenance

### III. POLICY

#### A. Sulfur Hexafluoride Gas

Clean SF<sub>6</sub> gas is an inert, stable, colorless, odorless, nontoxic, nonflammable gas. It is approximately five times heavier than air and will displace air in confined areas. SF<sub>6</sub> gas contains no oxygen and will not support life. Confined areas must be force-ventilated when working with SF<sub>6</sub> gas.

The Occupational Safety and Health Administration (OSHA) regulation on air contaminants, 29 CFR 1910.1000, establishes that SF<sub>6</sub> gas has no adverse effects when inhaled in the air at a Threshold Limit Value (TLV) of 1,000 ppm.

DOT regulations require equipment containing SF<sub>6</sub> gas at pressures greater than 39.6 psia to be certified to transport compressed gas.

The Environmental Protection Agency has identified Sulfur Hexafluoride as a greenhouse gas with a global warming potential 23,900 times the effect of an equal mass of Carbon Dioxide and an atmospheric lifetime of 3,200 years. Northeast Utilities has entered a Memorandum of Understanding (MOU) with the EPA requiring monitoring and reporting of annual usage and leakage amounts. Under no circumstances should equipment pressurized with SF<sub>6</sub> be voluntarily vented to



---

## Handling and Use of Sulfur Hexafluoride Gas

---

atmosphere. If discharge of small quantities is necessary for test purposes (i.e., contamination or moisture analysis, etc.), such discharge is to be kept to the minimum required to obtain a reading.

### B. Decomposition Gasses and Solid By-Products

When exposed to sustained or intense electrical arcs, SF<sub>6</sub> gas decomposes to form sulfur-fluoride gases and metal-fluorides which are toxic. If moisture is present, the decomposition by-products may also include sulfur-oxyfluorides and hydrofluoric and sulfuric acids. The presence of these by-products can be readily detected by a white or gray powdery substance or a very pungent odor similar to rotten eggs.

All in-service SF<sub>6</sub> equipment shall be assumed to contain decomposition by-products. All employees shall wear the protective equipment specified in this procedure when removing gas or solid by-products.

OSHA regulations on respiratory protective equipment, 29 CFR 1910.134, require that all employees wearing respiratory protective equipment be properly trained in the use of this equipment.

## IV. DEFINITIONS

- A. Processing Cart - a gas-handling unit equipped with a vacuum pump, storage tank(s), and filtration equipment necessary to recycle SF<sub>6</sub> gas.
  - 1. The storage tank(s) on these carts is either a large central reservoir or one or more DOT-approved cylinders.
  - 2. Reservoir-equipped carts shall not be transported over public roadways if the gas pressure is above 25 psig, unless the cart is properly certified for transportation of compressed gas.
- B. Transfer Cart - a cart used to invert and/or heat gas cylinders when filling equipment to ensure the cylinder is thoroughly emptied.



---

## Handling and Use of Sulfur Hexafluoride Gas

---

### V. PROCEDURE

#### A. Handling of Sulfur Hexafluoride Gas - Central Facilities.

1. All SF<sub>6</sub> gas shall be obtained through a central facility.
2. The designated central facility is responsible for maintaining a log of all SF<sub>6</sub> gas procurements and disbursements. The log shall include the weight of each bottle transported before shipment and after return from Districts.
3. SF<sub>6</sub> gas shall be shipped only in DOT-approved cylinders.

#### B. Handling of Sulfur Hexafluoride Gas - Districts.

1. SF<sub>6</sub> gas shall not be voluntarily discharged into the atmosphere.
2. The Maintenance or Construction Supervisor shall request the amount of SF<sub>6</sub> gas needed from the designated central facility.
3. The Maintenance or Construction Supervisor is responsible for maintaining a log for each cylinder provided.
  - a) This log shall be retained with the cylinder, and indicate the location and nomenclature of the equipment being filled and weight of the cylinder before and after filling.
  - b) The log shall be returned with the cylinder to the central facility when work is complete or the cylinder is empty.
4. Partially used or full cylinders may be retained at the work center at the discretion of the District Supervisor - Substation Equipment. The supervisor is responsible for maintaining the required logs and forwarding usage reports to the central facility upon request.



---

## Handling and Use of Sulfur Hexafluoride Gas

---

### C. Filling Equipment with Sulfur Hexafluoride Gas

1. Obtain a SF<sub>6</sub> Gas Processing or Transfer Cart as needs dictate.
2. Connect SF<sub>6</sub> source to gas compartment valve.
  - a) Processing cart (preferred method):
    - (1) Connect hose to gas compartment valve and tighten all fittings.
    - (2) Evacuate hose using vacuum pump.
    - (3) Break vacuum using SF<sub>6</sub> gas.
    - (4) Open gas compartment valve.
  - b) Transfer Cart/cylinder:
    - (1) Loosely connect hose to gas compartment valve.
    - (2) Partially open the gas cylinder valve.
    - (3) Check for presence of SF<sub>6</sub> gas in the vicinity of the connection to the gas compartment valve using an approved halogen leak detector.
    - (4) Seal all fittings as soon as SF<sub>6</sub> gas is detected.
    - (5) Open gas compartment valve.
3. Fill and pressurize the equipment per manufacturer's instructions.
4. Using an approved halogen leak detector, check the gas compartment and associated devices for any SF<sub>6</sub> gas leaks into the atmosphere.
5. Repair all leaks to prevent discharge of SF<sub>6</sub> gas.
6. Close gas compartment valve and source valve.
7. Disconnect hose from gas compartment valve and cap hose fitting.
8. Weigh all SF<sub>6</sub> gas cylinders used to fill the equipment.
  - a) Record final weight on cylinder log.



---

## Handling and Use of Sulfur Hexafluoride Gas

---

- b) Record date, location, and equipment nomenclature on cylinder log.
- 9. Return all empty cylinders and appropriate logs to the central facility.
- D. Removal of Sulfur Hexafluoride Gas from In-Service Equipment.
  - 1. Prior to removal of gas, check the gas compartment and associated devices for leaks using an approved halogen leak detector.
    - a) Identify any components that must be repaired while SF<sub>6</sub> gas is evacuated from equipment.
    - b) Obtain replacement parts as necessary to repair leaks.
  - 2. Attach the hose from the SF<sub>6</sub> Processing Cart to the gas compartment valve.
  - 3. Draw a vacuum on the hose to remove air and moisture.
  - 4. Open the gas compartment valve.
  - 5. Remove SF<sub>6</sub> gas from the gas compartment via the processing cart filtration system as described in the processing cart operating/maintenance instruction booklet.
  - 6. Draw a vacuum on the gas compartment to complete the SF<sub>6</sub> gas removal process.
  - 7. Break vacuum with nitrogen or dry air as applicable.
  - 8. SF<sub>6</sub> Gas that is to be reused on the same equipment may be kept in the processing cart until maintenance is complete.
    - a) If equipment is to be retired from use, SF<sub>6</sub> gas must be transferred to DOT-approved cylinders for return to the central facility.
    - b) Cylinders of SF<sub>6</sub> from retired equipment returned to central facility must include log indicating cylinder weight and the nomenclature of the equipment from which the gas was removed.
    - c) Reservoir-equipped gas carts must not be transported over public roadways if gas pressure exceeds 25 psig unless the cart is properly certified for transportation of compressed gas.



---

## Handling and Use of Sulfur Hexafluoride Gas

---

9. Clean interior of equipment in accordance with section E prior to working on any internal parts.
  10. When equipment is to be returned to service, seal all portholes and fittings.
  11. Evacuate equipment using processing cart vacuum pump.
  12. Break vacuum using SF<sub>6</sub> gas.
  13. Fill equipment in accordance with section A.
- E. Removal of Hazardous Solid By-Products
1. After the SF<sub>6</sub> gas has been removed from the gas compartment and prior to opening the gas compartment's porthole(s), put on the following approved protective outerwear:
    - a) clothing, protective, rainsuit, poly, x-large, yellow, 3 piece
    - b) glove, safety, disposable, polyethylene, large, clear
    - c) respirator, half-face or full-face, reusable, with two HEPA cartridges for organic vapor/acid gas (cartridge type F/C).
    - d) goggles, chemical splash resistant, without vent, clear lens (if using half-face respirator)
    - e) boot, pullover, disposable, for pcb and nuclear use, yellow, plastic
  2. Open the porthole(s) to gain access to the gas compartment.
  3. Before entry, ventilate gas compartment with a 50 cfm blower for at least one-half hour.
  4. Test the compartment with an approved air monitor to verify a minimum of 20.9% oxygen and no presence of combustible gases or carbon monoxide.
  5. Using an approved halogen leak detector, perform checks at various low points within the gas compartment to determine any presence of SF<sub>6</sub> gas.
  6. Continue ventilation in low point areas until the detector indicates that SF<sub>6</sub> gas has been purged.



## Handling and Use of Sulfur Hexafluoride Gas

---

7. Continue ventilation while work is being performed.
8. Remove contaminated powdery deposits using an approved vacuum cleaner equipped with high-efficiency particle arresting (HEPA) filters.  
  

Note: These deposits must be removed promptly once the gas compartment is opened, since they readily absorb moisture, becoming corrosive and sticky, and making their removal more difficult.
9. Clean up any powdery residue using approved wipes.
10. Place powdery deposits contained in the vacuum cleaner disposal bag along with any wipes and other contaminated materials in a plastic waste bag.
11. Upon completion of repair and/or maintenance work, seal all portholes of the gas compartment.
12. Remove protective outerwear.
13. Place disposable coveralls, gloves, boots, and respirator cartridges, and any other contaminated materials in the plastic waste bag.
14. Secure bag with filament tape.
15. Place plastic waste bag in a 55 gallon drum.
16. Wash face and hands following completion of work and before eating or drinking.
17. Label the side of the drum with a Hazardous Waste sign and a Sulfur Hexafluoride Caution sign.
18. Leave the drum in a safe location at job site for proper disposal.
  - a) Inform the Environmental Coordinator or the Environmental Administrator that a drum containing Hazardous Waste is at the job site and is ready for removal.
  - b) The Environmental Coordinator/Administrator will make arrangements for disposal of the drum in accordance with federal and state regulations.
  - c) The Environmental Coordinator/Administrator will retain copies of all manifests in a central file.