



Northeast Utilities System

TD PROCEDURE

TD 710 Rev. 2

Handling and Use of Sulfur Hexafluoride (SF₆) Gas

Issue Date:

12/29/05

Effective Date:

01/04/06

Owner Department: Transmission Construction & Maintenance

SME Name, Department: Gregg Sauer, Transmission Operational Engineering

Applicability:

CT, MA, NH

All changes to TD procedures are controlled by TD 001

“Writing, Revising, and Publishing Transmission and Distribution Procedures.”

This procedure replaces and supersedes the following procedures (in whole or in part), as described in Section 3 “Summary of Changes”: TD710 Rev. 1, “Handling and use of Sulfur Hexafluoride Gas”

Roll Out Instructions:

Prior to initial use of this procedure, each individual using this procedure is required to review these requirements with immediate supervision.

Approvals:

CL&P:

Name:

Doreen C. Jennings

Title:

Director – Maintenance

WMECO:

Name:

Michael T. Smith

Title:

Director – Operations

PSNH:

Name:

Stephen M. Johnson

Title:

Director – Energy Delivery

TG:

Name:

Dominick M. Lauria

Title:

Director - Transmission Construction & Maintenance

Procedure applicable only to NU companies for which an approval signature appears above.

Ensure you are using the current revision by verifying it against the controlled electronic copy located on the Distribution Engineering Standards Bookshelf or the Regulated Businesses Policies and Procedures Lotus Notes database.

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1. INTRODUCTION

1.1 Objective

This procedure establishes safe working practices for handling sulfur hexafluoride (SF₆) gas. It specifies methods for handling SF₆ gas and removal, handling, and disposal of hazardous by-products.

1.2 Applicability

The following NU Companies and Business Units are affected by this procedure:

CL&P

PSNH

WMECO

Transmission Group

SF₆ handling and use is part of the Electrician SERT curriculum.

1.3 References

Unless otherwise specified:

- Forms are available through Lotus Notes NU Forms Catalog or NU Forms Catalog on the NUNet at:
<http://nunotes2.nu.com/apps/Enterprise/nufoms/NUFORMS.NSF?OpenDatabase>
- Procedures are available at the following locations:
 - Lotus Notes UG Policies and Procedures database
 - System Engineering Standards Bookshelf on the NUNet at:
<http://wwwrbgis.nu.com/standards/standard.pdf>

Development References

Documents used to develop this procedure and the process it controls:

- TD 001 “Writing, Revising, and Publishing Transmission & Distribution Procedures”
- TD 710 Rev. 1, “Handling and Use of Sulfur Hexafluoride Gas”

Supporting References

Documents that support performance of activities directed by this procedure:

- OSHA 29CFR1910.1000
- OSHA 29CFR1910.134

Supporting Programs and Databases

Programs and databases that support performance of activities directed by this procedure:

- SF₆ Emission Reduction Partnership for Electric Power Systems (United States Environmental Protection Agency) – Ref. Appendix B

1.4 Discussion

1.4.1 Sulfur Hexafluoride (SF₆) Gas

Clean SF₆ 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. SF₆ gas contains no oxygen and will not support life.

WARNING

Confined areas must be force-ventilated when working with SF₆ gas to eliminate a potential asphyxiation hazard.

The Occupational Safety and Health Administration (OSHA) regulation on air contaminants, 29 CFR1910.1000, establishes that SF₆ gas has no adverse effects when inhaled in the air at a Threshold Limit Value (TLV) of 1,000 ppm.

Federal regulations require equipment containing SF₆ gas at pressures greater than 39.6 psia to be certified to transport compressed gas.

The Environmental Protection Agency (EPA) 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. Under no circumstances should equipment pressurized with SF₆ be voluntarily vented to the atmosphere. If discharge of small quantities is necessary for test purposes (i.e., contamination, moisture analysis, etc.), such discharge is to be kept to the minimum required to obtain a reading (ref. Attachment 1). Northeast Utilities (including all operating subsidiaries) is a member of the EPA Partnership for the Reduction of SF₆ Emissions, which requires monitoring and reporting of annual usage and leakage amounts (Ref. Attachment 2).

WARNING

Exercise appropriate lifting and handling procedures for heavy objects when manually manipulating SF₆ gas cylinders.

Sulfur Hexafluoride Gas is normally supplied in 220 ft³. cylinders (s/c 0207159) which have a gross weight of approximately 230 lb., or 80 ft³. cylinders (s/c 0206835, 0351897) which weigh approximately 100 lb. when full.

WARNING

Exercise caution when handling recently-discharged cylinders, due to the possibility of cold surfaces.

Sulfur Hexafluoride Gas supplied in cylinders is a refrigerated liquid. Discharge of gas may rapidly decrease the temperature of the cylinder.

1.4.2 Decomposition Gasses and Solid By-Products

WARNING

Smoking and use of open flames or high-temperature heat sources are prohibited while working with SF₆ gas.

When exposed to intense heat or electrical arcs, SF₆ gas decomposes to form sulfur-fluoride and sulfur-oxide 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 SF₆ equipment shall be assumed to contain decomposition by-products.

Proper Personal Protective Equipment (PPE) shall be worn whenever in-service equipment containing SF₆ gas is to be opened for maintenance. PPE shall include as a minimum:

- clothing, protective, rainsuit, yellow, 3 piece [s/c 0189720 (L), 0206699 (XL)] (seal all openings with duct tape [s/c 132830])
- glove, disposable, solvent [s/c 0189176 (L), 0189178 (XL)]
- respirator, half-face or full-face, reusable, with two HEPA cartridges for organic vapor/acid gas [see table below] *

ITEM	MANF.	SIZE	S/C
Respirator, half-face	Willson	S	0191479
Respirator, half-face	Willson	M	0191043
Respirator, full-face	Willson	S	0191483
Cartridge, organic vapor/acid gas	Willson	N/A	0186268
Respirator, half-face	Mine Safety	S	0191480
Respirator, half-face	Mine Safety	M	0191481
Respirator, half-face	Mine Safety	L	0191482
Respirator, full-face	Mine Safety	S	0191484
Respirator, full-face	Mine Safety	M	0191485
Respirator, full-face	Mine Safety	L	0191486
Cartridge, organic vapor/acid gas	Mine Safety	N/A	0186507

NOTE: Cartridges are **not** interchangeable between manufacturers.

* OSHA regulations on respiratory protective equipment, 29CFR1910.134, require that all employees wearing respiratory protective equipment be properly trained in the use and “fit testing” of this equipment.

- goggles, chemical splash resistant, without vent, clear lens (if using half face respirator) [s/c 0189095]
- boot, rubber, disposable, for PCB and nuclear use [s/c 0186525 (S), 0186521 (M), 0186522 (L), 0186523 (XL)]

It is further recommended that an emergency eyewash station (eyewash, station, portable, 5 gal, free standing [s/c 0185047]) be available in the immediate vicinity of the work area whenever handling decomposition by-products

End of Section

2. INSTRUCTIONS

2.1 Handling of Sulfur Hexafluoride Gas – Central Facilities

*Mntc. Mgr or designee. - CL&P, PSNH,
TCT&M, WMECO*

- 2.1.1 MAINTAIN SF₆ gas inventory at a designated central facility.
- 2.1.2 MAINTAIN an accurate account, by weight, of SF₆ gas retained in inventory.
- 2.1.3 SHIP or DELIVER SF₆ gas in DOT-approved cylinders to district personnel upon request.
- 2.1.4 PROVIDE beginning-of-year and end-of-year inventory amounts to EPA Partnership Representative upon request

CAUTION

SF₆ gas shall not be voluntarily discharged into the atmosphere.

2.2 Filling Equipment with Sulfur Hexafluoride Gas

Supv. CL&P, PSNH, TCT&M, WMECO

- 2.2.1 OBTAIN a SF₆ Gas Processing or Transfer Cart as needs dictate.

WARNING

Smoking and use of open flames or high-temperature heat sources are prohibited while working with SF₆ gas.

CAUTION

An approved Halogen Leak Detector (s/c 0439477) shall be available whenever work is performed on equipment containing SF₆ Gas.

Assigned Qualified Employee (AQE)

- 2.2.2 CONNECT SF₆ 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 SF₆ gas.
 - 4) OPEN gas compartment valve.

- b. Transfer Cart/Cylinder (alternate method – processing cart not available or “topping off” equipment due to low pressure)

WARNING

Exercise caution when handling recently-discharged cylinders, due to the possibility of cold surfaces.

- 1) Loosely CONNECT hose to gas compartment valve.
 - 2) Partially OPEN the gas cylinder valve.
 - 3) CHECK for presence of SF₆ gas in the vicinity of the connection to the gas compartment valve using an approved halogen leak detector (s/c 0439477).
 - 4) SEAL all fittings as soon as SF₆ gas is detected.
 - 5) OPEN gas compartment valve.
- 2.2.3 FILL and PRESSURIZE the equipment per manufacturer’s instructions.
- 2.2.4 Using an approved halogen leak detector (s/c 0439477), CHECK the gas compartment and associated devices for any SF₆ gas leaks into the atmosphere.
- 2.2.5 REPAIR all leaks to prevent discharge of SF₆ gas.
- 2.2.6 CLOSE gas compartment valve and source valve.
- 2.2.7 DISCONNECT hose from gas compartment valve and cap hose fitting.

2.3 Removal of Sulfur Hexafluoride Gas from In-Service Equipment.

WARNING

Smoking and use of open flames or high-temperature heat sources are prohibited while working with SF₆ gas.

AQE

- 2.3.1 CHECK the gas compartment and associated devices, prior to removal of gas, for leaks, using an approved halogen leak detector.
 - a. IDENTIFY any components that must be repaired while SF₆ gas is evacuated from equipment.
 - b. OBTAIN replacement parts as necessary to repair leaks.
- 2.3.2 ATTACH the hose from the SF₆ Processing Cart to the gas compartment valve.
- 2.3.3 DRAW a vacuum on the hose to remove air and moisture.
- 2.3.4 OPEN the gas compartment valve.
- 2.3.5 REMOVE SF₆ gas from the gas compartment via the processing cart filtration system as described in the processing cart operating/maintenance instruction booklet.
- 2.3.6 DRAW a vacuum on the gas compartment to complete the SF₆ gas removal process.
- 2.3.7 BREAK vacuum with nitrogen or dry air as applicable.

Supv. CL&P, PSNH, TCT&M, WMECO

- 2.3.8 KEEP SF₆ gas that is to be reused on the same equipment in the processing cart until maintenance is complete.

NOTE

Gas kept for reuse shall be checked for purity and moisture content prior to being returned to the equipment. Gas that fails this check shall be returned to the applicable central facility for reprocessing or disposal.

- a. If equipment is to be retired from use, TRANSFER SF₆ gas to DOT-approved cylinders for return to the central facility.
- b. RETURN cylinders of SF₆ gas from retired equipment to the central facility along with a log indicating cylinder net weight and the nomenclature of the equipment from which the gas was removed.
- c. DO NOT TRANSPORT reservoir-equipped gas carts over public roadways if gas pressure exceeds 25 psig unless the cart is properly certified for transportation of compressed gas.

2.4 Removal of Hazardous Solid By-Products

CAUTION

After the SF₆ gas has been removed from the gas compartment and prior to opening the gas compartment cover(s), all personal protective equipment specified in section 1.4.2 shall be worn.

AQE

2.4.1 OPEN the cover(s) to gain access to the gas compartment.

NOTE

If, upon opening a gas compartment, an excessive amount of solid byproduct (e.g., more than a moderate dusting) is found, consideration should be given to having an Environmental Services contractor perform the necessary clean-up.

- a. TEST the compartment with an approved air monitor (s/c 419532) to verify a minimum of 20.9% oxygen and no presence of combustible gases or carbon monoxide.
 - b. Using an approved halogen leak detector (s/c 0439477), PERFORM checks at various low points within the gas compartment to determine any presence of SF₆ gas.
 - c. VENTILATE in low point areas until the detector indicates that SF₆ gas has been purged.
 - d. CONTINUE ventilation while work is being performed.
- 2.4.2 REMOVE contaminated powdery deposits using an approved vacuum cleaner equipped with high-efficiency particle air (HEPA) filters.
- 2.4.3 CLEAN UP any powdery residue using wipes moistened with denatured alcohol.
- 2.4.4 PLACE powdery deposits contained in the vacuum cleaner disposal bag along with any wipes and other contaminated materials in a plastic waste bag.
- 2.4.5 SEAL all covers of the gas compartment upon completion of maintenance and/or repair work.
- 2.4.6 REMOVE personal protective equipment.
- 2.4.7 Place disposable clothing, boots, and respirator cartridges, and any other contaminated materials in the plastic waste bag.
- 2.4.8 SECURE bag with filament tape.
- 2.4.9 PLACE plastic waste bag in a 55 gallon drum.
- 2.4.10 WASH face and hands following completion of work and before eating or drinking.

Supv. CL&P, PSNH, TCT&M, WMECO

2.4.11 LABEL the side of the drum with Hazardous Waste sign (s/c 0191045).

- a. LEAVE the drum in a safe location at job site for proper disposal.
- b. INFORM the responsible Environmental Coordinator that a drum containing Hazardous Waste is at the job site and is ready for removal.

Env. Coord.

2.4.12 ARRANGE for disposal of the drum in accordance with federal and state regulations.

2.4.13 RETAIN copies of all manifests in a central file.

End of Section

3. SUMMARY OF CHANGES

Changes to TD Procedures are controlled by TD 001 “Writing, Revising, and Publishing Transmission & Distribution Procedures”.

- **Revision 1**

Procedure extensively revised as part of TD Procedure Upgrade Project initiated in June 2002, which included:

- Upgrading to new T&D procedure format
- Accommodating processes and NU organization in place at time of upgrade
- Reviewing applicable regulations and policies, and revising procedure based on that review

- **Revision 2**

- Added stock codes for approved items
- Added Caution statements for smoking and open flames, cold surfaces, heavy materials, etc.
- Modified field tracking method
- Added MOU text (Attachment 2) to describe responsibilities associated with EPA partnership

End of Section

Attachment 1

Definitions

SPECIFIC TO THIS PROCEDURE:

Processing Cart – A gas-handling unit equipped with a vacuum pump, storage tanks(s), and filtration equipment necessary to recycle SF₆ 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.

Transfer Cart – A cart used to invert and/or heat gas cylinders when filling equipment to ensure the cylinder is thoroughly emptied.

Voluntary Discharge – any manually-controlled discharge of gas from equipment or storage cylinders, not associated with required construction or maintenance procedures.

NOTE

Excluded from the above definition are discharges necessary for purposes of required Purity, Moisture, or other tests mandated by approved Construction, Commissioning, Test, or Maintenance procedures.

COMMON:

Additional Common Acronyms are listed on the System Engineering, General Information, Acronyms list on NU Net at <http://wwwrbgis.nu.com/standards/standard.pdf>.

DM - Distribution Maintenance

SERT - Skills Enhancement and Refresher Training

TCT&M - Transmission Construction Test & Maintenance

SF₆ – Sulfur Hexafluoride

Attachment 2

Text (w/o attachments) of the

MEMORANDUM OF UNDERSTANDING

Between

The United States Environmental Protection Agency

And

The Connecticut Light and Power Company,

Western Massachusetts Electric Company, and

Public Service Company of New Hampshire

I. PREAMBLE

- A. This is a voluntary agreement between the United States Environmental Protection Agency (EPA) and The Connecticut Light and Power Company, Western Massachusetts Electric Company, and Public Service Company of New Hampshire ("Partner") (collectively, the "Parties"), by which the Partner joins the SF₆ Emissions Reduction Partnership for Electric Power Systems.
- B. SF₆ (sulfur hexafluoride) is used for electrical insulation and for arc quenching and current interruption in equipment used in the transmission and distribution of electricity.
- C. The Partner and EPA recognize that the primary purpose of this agreement is to achieve environmental and economic benefits by reducing emissions of sulfur hexafluoride (SF₆) during the operation and maintenance of equipment used in the transmission and distribution of electricity.

II. COMMON AGREEMENTS AND PRINCIPLES

- A. SF₆ emissions from electric power systems are the result of releases from properly functioning equipment (due to static and dynamic operation), from leakage (e.g., due to old and/or deteriorated gaskets or seals), and from gas escaping into the atmosphere when gas is either transferred into equipment or extracted from it for disposal, recycling, or storage.
- B. The Partner and EPA acknowledge that only technically and economically feasible actions to reduce SF₆ emissions will be sought. The determination of what is technically and economically feasible will vary among Partners, and it is at the discretion of each Partner to make that determination.
- C. The Parties assume good faith as a general principle in fulfilling the obligations of this Memorandum of Understanding (MOU).
- D. The Parties agree to informally notify each other if any problems arise and to work together to maximize the effectiveness of the MOU.
- E. Nothing in this agreement constrains EPA or any Partner from taking actions relating to SF₆ that are authorized or required by law.

III. EPA RESPONSIBILITIES

- A. SF₆ has been identified by the Intergovernmental Panel on Climate Change as an extremely potent greenhouse gas. EPA believes that reducing emissions of this gas will help to address global climate change.
- B. EPA will provide a single representative for the Partnership. EPA will notify the Partner within 30 days of any change in the representative's identity.

- C. EPA agrees to serve as a clearinghouse for technical information on successful strategies for reducing SF₆ emissions, and to sponsor research relating to such strategies, contingent upon the availability of funds.

- D. EPA agrees to provide the Partner with recognition for its achievements in reducing SF₆ emissions and for its public service in protecting the environment. EPA also agrees to produce brochures, public service announcements (PSAs), and articles for publication describing the partnership and companies that have been successful in implementing the partnership. EPA agrees to obtain Partner's approval on any pieces, prior to publication, that discuss Partner's participation. EPA further agrees to conduct one or more technical conferences on issues relating to the Partnership and to recognize the environmental and technical leadership of those Partners whose contributions to reducing SF₆ emissions are particularly noteworthy.

- E. EPA will seek to establish Partnerships to reduce SF₆ emissions with all U.S. electric power systems that employ SF₆-bearing equipment.

- F. EPA will identify protocols to inventory and report SF₆ emissions. A detailed description of these protocols and an inventory reporting form is included in Attachment B of this MOU.

- G. Information submitted to EPA will be treated in accordance with the EPA regulations at 40 CFR Part 2, including the provisions on protecting confidential business information. EPA will treat any information not explicitly designated as confidential by the Partner as non-confidential.

IV. PARTNER RESPONSIBILITIES

- A The Partner agrees to appoint a single representative for the Partnership (designated in Attachment A of this MOU). The Partner will notify EPA within 30 days of any change in the representative's identity.

- B. The Partner agrees that it will, where possible, estimate its SF₆ emissions during one of the years between 1990 and 1998, choosing the year for which the most accurate information is available. The chosen year will serve as the starting year for the Partner's emission reduction efforts. The Partner will also include a written explanation of the method used to generate this estimate, indicating the accuracy and completeness of the estimate. The estimate will be included in the first Annual Report. Any changes to this estimate and/or the chosen year will be communicated to EPA in the subsequent Annual Report. The Annual Report, as referred to in this paragraph and subsequent paragraphs, is to be submitted during the first quarter of each year (between January 1 and March 31).
- C. The Partner agrees that in its first Annual Report it will provide EPA with the total estimated nameplate capacity of SF₆ (in pounds) of its SF₆-bearing equipment in service. This number will be updated as appropriate in subsequent annual reports. Equipment which is sealed-for-life or which contains less than 15 pounds of SF₆ is exempted from this agreement.
- D. The Partner agrees that it will, on an annual basis, inventory emissions of SF₆ and will report its emissions of SF₆ to EPA in accordance with a uniform reporting protocol identified by EPA and described in Attachment B. The Partner will use the form included in Attachment B to report its annual emissions to EPA as part of its Annual Report. The Partner will maintain records that could be used to verify the accuracy of data reported in the annual inventory of emissions, e.g., gas purchase and sale records, and gas returns to suppliers.
- E. The Partner agrees that, within one year of signing the MOU, it will develop and distribute a company-wide policy for the proper handling of SF₆. The policy will include, to the degree technically and economically feasible: a commitment to recycle (recover and reuse) SF₆; a commitment to establish a maintenance program for all equipment with a goal of reducing emissions; a replacement strategy for all SF₆ equipment that leaks to such an extent that leakage cannot be controlled through normal maintenance procedures; and a commitment to purchase and use equipment that eliminates or reduces the possibility of SF₆ leaks. A copy of the policy will be included in the Partner's first Annual Report to EPA, and updated as appropriate in subsequent years.
- F. The Partner agrees to establish and implement handling procedures for SF₆ within one year of signing the MOU. The Partner agrees that only knowledgeable personnel will handle SF₆ equipment. If the Partner hires outside parties for maintenance and/or recycling/disposal, the Partner agrees that those parties will follow in-house policies pertaining to maintenance, recycling and disposal. A description of the handling procedures will be included in the Partner's first Annual Report to EPA, and updated as appropriate in subsequent years.

- G. Within 18 months of signing the MOU, the Partner will establish an emissions reduction goal. This goal will be quantified relative to the Partner's emissions during the year chosen by the Partner as their starting year (see IV B), and should be expressed in terms of either pounds of SF₆ and/or the percentage reduction e.g., "the Partner commits to reducing SF₆ emissions X% and/or by X pounds from 199X levels [the starting year] by the year 200X." If the Partner does not choose a starting year as indicated in IV B, then the first year in which the Partner joins the Partnership and inventories its emissions will serve as the starting year. The emissions reduction goal will reflect technically and economically feasible options available to the Partner. The Partner will notify EPA of the goal with a letter outlining the goal's content and the rationale for choosing it. If, due to changing circumstances, the Partner decides to change its emissions reduction goal, the Partner will inform EPA of this change and provide a description of why the change was deemed necessary.
- H. The Partner agrees that it will share with EPA information about successful SF₆ emission reduction processes and technologies that the Partner considers non-confidential, and it will share such non-confidential information with others who operate electric power systems.
- I. The Partner agrees that participation in the Partnership, use of the Partnership logo, or any publicity relating to its participation in the Partnership does not constitute EPA's endorsement of the Partner for anything other than its participation in the SF₆ Emissions Reduction Partnership for Electric Power Systems and its commitment under Section IV of this agreement. The Partner agrees that it will not claim or imply otherwise. The logo and the logo use guidelines will be forwarded to the Partner as soon as the logo is created.
- J. The Partner agrees that the activities it undertakes connected with this MOU are not intended to provide services to the Federal government, and that the Partner will not submit a claim for compensation to any Federal agency.
- K. The Partner may, after collaboration with EPA, attach additional provisions to this MOU. Such additions must contribute to the goal of SF₆ emissions reduction and not conflict with any of the provisions contained in the MOU.

V. TERMINATION OF AGREEMENT

- A This agreement can be terminated by either the Partner or EPA 30 days after the receipt of written notice by the other Party with no penalties or continuing obligations. If either Party terminates the MOU, both Parties will refrain from representing that the Partner is participating in the partnership.

VI. SIGNATORIES

The undersigned hereby execute this Memorandum of Understanding on behalf of their parties. This agreement takes effect when signed by both parties.

For the United States Environmental Protection Agency:



On: 4/12/99

Paul M. Stolpman, Director

Office of Atmospheric Programs

For Partner:



On: 4/1/99

Roger Zaklukiewicz

Vice President, Transmission and Distribution Operations

Northeast Utilities Service Company

signing on behalf of

The Connecticut Light and Power Company,

Western Massachusetts Electric Company, and

Public Service Company of New Hampshire