 <b>Northeast Utilities System</b> <b>TD PROCEDURE</b>		<b>TD 710      Rev. 5</b> <b>Handling and Use of Sulfur Hexafluoride (SF6) Gas</b>	
Issue Date: 1\22\2010	<b>Effective Date:</b> 1\22\2010	Owner Department: Transmission Maintenance & Work Management SME Name, Department: Gregg Sauer, 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”:

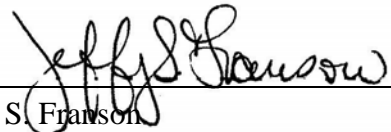
- TD 710 “Handling and use of Sulfur Hexafluoride Gas”, Rev 4, dated 04/21/08

**Roll Out Instructions:**

Prior to initial use of this procedure, immediate supervision is required to review these requirements with each employee assigned to perform a task described in this procedure.

**Approvals:**    **Transmission:**   
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**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 (SF<sub>6</sub>) gas. It specifies methods for handling SF<sub>6</sub> gas and removal, handling, and disposal of hazardous by-products.

### 1.2 Applicability

This procedure applies to all employees assigned to tasks involving equipment containing or operated using sulfur hexafluoride gas.

### 1.3 References

Unless otherwise specified:

- Forms are available through Lotus Notes NU Forms Catalog or NU Forms Catalog on the NUNet.
- Procedures are available at the following locations:
  - Lotus Notes Regulated Businesses Policies and Procedures database
  - Distribution Engineering Standards Bookshelf on the NUNet at: <http://rbgit-prod.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”

#### **Supporting References**

Documents that support performance of activities directed by this procedure:

- SH-02, Northeast Utilities Respiratory Protection Program
- SBST0607, Gas Release Reporting Requirements to CTDEP, MADEP, & NHDES
- 29CFR1910.1000, Air contaminants (OSHA regulation)
- 29CFR1910.134, Respiratory Protection (OSHA regulation)

#### **Supporting Programs and Databases**

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

- US Environmental Protection Agency SF<sub>6</sub> Emission Reduction Partnership for Electric Power Systems, <http://www.epa.gov/highgwp/electricpower-sf6/>

## 1.4 Discussion

### 1.4.1 Sulfur Hexafluoride (SF<sub>6</sub>) 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.

#### **WARNING**

Confined areas must be force-ventilated when working with SF<sub>6</sub> gas to eliminate a potential asphyxiation hazard.

The Occupational Safety and Health Administration (OSHA) regulation on air contaminants, 29 CFR1910.1000, 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.

Federal 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 (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 SF<sub>6</sub> 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 SF<sub>6</sub> Emissions, which requires monitoring and reporting of annual usage and leakage amounts (sec. 2.2.2).

SF<sub>6</sub> Emissions are further reportable to the individual state regulatory agencies as described in SBST-06-07 (sec. 2.2.1).

### **WARNING**

Exercise appropriate lifting and handling procedures for heavy objects when manually manipulating SF<sub>6</sub> gas cylinders.

Sulfur Hexafluoride Gas is normally supplied in 51” tall cylinders (s/c 0207159) which have a gross weight of approximately 230 lb. and contain a net 115 lb. of gas when full, or 32.5” tall cylinders (s/c 0206835, 0351897) having a gross weight of approximately 100 lb. and containing a net 38 lb. of gas 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 SF<sub>6</sub> gas.

When exposed to intense heat or electrical arcs, SF<sub>6</sub> 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 SF<sub>6</sub> equipment shall be sampled for gas purity and decomposition gasses prior to entry for maintenance purposes. In addition, all in-service SF<sub>6</sub> Equipment subjected to internal arcing (Circuit Breakers, Circuit Switchers, or faulted equipment) shall be assumed to contain decomposition by-products, requiring decontamination in accordance with section 2.6.

A vacuum cleaner equipped with high-efficiency particle air (HEPA) filters (s/c 0193602) must be used to remove solid decomposition byproducts.

Proper Personal Protective Equipment (PPE) shall be worn whenever handling of decomposition by-products is required (ref. section 2.6). PPE shall include as a minimum:

- Chemical-resistant Gloves, Coveralls, and Boots:

ITEM	S/C
Glove, Solvent And P.C.B., Large	0189176
Glove, Solvent And P.C.B., X-Large	0189178
Coveralls, Disposable, Flame/Chemical Resistant, Med.	0424799
Coveralls, Disposable, Flame/Chemical Resistant, Lg	0424800
Coveralls, Disposable, Flame/Chemical Resistant, XL	0424802
Coveralls, Disposable, Flame/Chemical Resistant, XXL	0424803
Coveralls, Disposable, Flame/Chemical Resistant, XXXL	0424805
Coveralls, Disposable, Flame/Chemical Resistant, XXXXL	0429574
Coveralls, Disposable, Flame/Chemical Resistant, XXXXXL	0429575
Boot, Pullover, Small (Size 3 – 5), Disposable	0186525
Boot, Pullover, Medium (Size 6 – 8), Disposable	0186521
Boot, Pullover, Large (Size 9 - 11), Disposable	0186522
Boot, Pullover, X-Large (Size 12 - 13), Disposable	0186523

- Respirator with two HEPA cartridges for organic vapor/acid gas:

ITEM	S/C
Respirator, Half Face, Silicone, Small	0191704
Respirator, Half Face, Silicone, Medium	0191221
Respirator, Half Face, Silicone, Large	0191705
Respirator, Full Face, Silicone, Small	0134343
Respirator, Full Face, Silicone, Medium/Large	0191485
Cartridge, Respirator, Yellow/Magenta	0187861

\* 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.

If a half-face respirator is used, also include:

- Chemical splash resistant goggles, indirect vent, anti-fog, clear lens [s/c 0403452] or grey lens [s/c 0189094]

An emergency eyewash station (eyewash, station, portable, 5 gal, free standing [s/c 0185047]) shall also 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

*Maintenance Manager or designee:*

2.1.1 MAINTAIN SF<sub>6</sub> gas inventory at a designated facility identified below:

State	Distribution Inventory	Transmission Inventory
CT	CMS – Berlin	Deming Rd.
MA	East Springfield *	N/A
NH	Hooksett	Sutton Circle

\* Inventory maintained at the East Springfield facility is used for both Distribution and Transmission purposes.

2.1.2 MAINTAIN an accurate account, by weight, of SF<sub>6</sub> gas retained in inventory using the form provided in attachment 2.

2.1.3 SHIP or DELIVER SF<sub>6</sub> 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 per section 2.2.2.

### CAUTION

SF<sub>6</sub> gas shall not be voluntarily discharged into the atmosphere.

### 2.2 Sulfur Hexafluoride Gas Emission Reporting Requirements

*Transmission Supervisor or  
Environmental Coordinator*

2.2.1 Immediate reporting:

- a. When it is determined that an emissions of SF<sub>6</sub> Gas to the environment has occurred, it shall be reported to the respective state environmental regulatory body as identified in the following matrix:

Incident Type	Action, By State		
	Connecticut	Massachusetts	New Hampshire
Operational Release	Report if release > 1.0 lb. per 24-hours *	No Report	No Report
Catastrophic Release	Report	No Report	No Report
Fire / Explosion	Report	Report	Report

- \* Determine release rate by dividing quantity of gas added to equipment by number of days since last addition.

*Assigned Employee:*

- b. If the notification threshold is exceeded based on the above matrix, immediately NOTIFY the individual identified below:
  - 1) for Distribution Equipment: Environmental Coordinator, Central Maintenance Services, or after hours – the On-Call Environmental Coordinator
  - 2) For Transmission Equipment: the appropriate Maintenance Supervisor, or after hours - the On-call Maintenance Supervisor.

*Transmission Maintenance Supervisor or Environmental Coordinator:*

- c. NOTIFY the appropriate state environmental agency as soon as possible as indicated below:
  - Connecticut Department of Environmental Protection: 860-424-3338
  - Massachusetts Department of Environmental Protection: 888-304-1133
  - New Hampshire Department of Environmental Services:  
603-271-3899 (Mon.-Fri. 8am – 4pm); 800-346-4005 (after hours)
- d. PROVIDE the following information:
  - Your name, company and title
  - Location & amount of release in pounds
  - Date & time of release
  - Cause of release
  - Equipment type & nomenclature
  - Corrective action & status
- e. RECORD the report number provided by the state agency.
- f. (CT Only): COMPLETE Form OP 4608-1: Hazardous Substance Spill Report the next work day and forward a copy to Transmission - Safety & Environmental Programs Administrator or Distribution - Central Maintenance Services Environmental Coordinator as appropriate.

2.2.2 Annual Reporting:

*EPA Partnership Representative or designee:*

- a. OBTAIN beginning-of-year and end-of-year inventory amounts from designated central facilities.
- b. COMPLETE the annual inventory emissions report using the EPA-approved protocol, available on the EPA's SF<sub>6</sub> Emission Reduction Partnership website at <http://www.epa.gov/highgwp/electricpower-sf6/>.
- c. SUBMIT completed annual report to the EPA by the end of the first quarter of the following year.

## 2.3 Filling Equipment with Sulfur Hexafluoride Gas

### WARNING

It is preferable to de-energize equipment prior to adding SF<sub>6</sub> gas. If it is necessary to add gas to equipment while energized, obtain approval from the Maintenance Director responsible for the equipment and obey all company safety rules and manufacturer's recommendations to prevent possible personnel injury or equipment damage.

#### *Maintenance Supervisor*

2.3.1 OBTAIN a SF<sub>6</sub> 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 SF<sub>6</sub> gas.

### NOTE

An approved Halogen Detector (s/c 0439477) or SF<sub>6</sub> Gas Detector shall be available whenever work is performed on equipment containing SF<sub>6</sub> Gas.

#### *Assigned Employee*

2.3.2 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 (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 SF<sub>6</sub> gas in the vicinity of the connection to the gas compartment valve using an approved halogen detector (s/c 0439477 or SF<sub>6</sub> Gas Detector).
- 4) SEAL all fittings as soon as SF<sub>6</sub> gas is detected.
- 5) OPEN gas compartment valve.

2.3.3 FILL and PRESSURIZE the equipment per manufacturer's instructions.

2.3.4 Using an approved halogen leak detector (s/c 0439477) or SF<sub>6</sub> Gas Detector, CHECK the gas compartment and associated devices for any SF<sub>6</sub> gas leaks into the atmosphere.

2.3.5 REPAIR all leaks to prevent discharge of SF<sub>6</sub> gas.

2.3.6 CLOSE gas compartment valve and source valve.

2.3.7 DISCONNECT hose from gas compartment valve and cap hose fitting.

2.3.8 CHECK gas compartment valve and fittings to ensure there are no leaks.

## 2.4 Sampling Sulfur Hexafluoride Gas

### WARNING

Smoking and use of open flames or high-temperature heat sources are prohibited while working with SF<sub>6</sub> gas.

### NOTE

An approved Halogen Detector (s/c 0439477) or SF<sub>6</sub> Gas Detector shall be available whenever work is performed on equipment containing SF<sub>6</sub> Gas.

### WARNING

It is preferable to de-energize equipment prior to sampling SF<sub>6</sub> gas. If it is necessary to sample gas while equipment is energized, obtain approval from the Maintenance Director responsible for the equipment and obey all company safety rules and manufacturer's recommendations to prevent possible personnel injury or equipment damage.

2.4.1 Use of manually-regulated sampling instruments (e.g., COSA, Shaw, etc.):

**CAUTION**

Use of this type of equipment may result in a gas discharge in excess of the reporting requirements stipulated in 2.2.1 if flow rates or sample durations outlined below are exceeded. Manually-regulated sampling equipment **SHALL NOT** be used without a suitable flow meter.

*Assigned Employee*

- a. CONNECT all PTFE or flexible Stainless Steel sample tubing and instrumentation in accordance with manufacturer's instructions.
- b. CONNECT sample inlet to a dry air or nitrogen cylinder.
- c. OPEN the cylinder regulator to establish flow through the instrument not exceeding maximum flow indication on flowmeter or 10.0 l/min., whichever is lower.
- d. PURGE the instrument and tubing for 5 – 8 minutes until a stable dewpoint below -50°C is achieved.
- e. Immediately RE-CONNECT the sample inlet to the SF<sub>6</sub> connection on the equipment to be tested.
- f. Slowly OPEN the equipment valve to admit gas to the sample instrument at a rate of 0.5 – 2.0 l/min.
- g. MAINTAIN gas flow until a stable reading is obtained (no longer than 5 minutes).
- h. SECURE sample flow and record final reading.
- i. DISCONNECT sample instrumentation.
- j. CHECK equipment valve and fittings to ensure there are no leaks.

**NOTE**

Use tubing or regulating products containing rubber components may result in erroneous high moisture readings

2.4.2 Use of auto-regulated multi-purpose SF<sub>6</sub> sampling instruments (e.g., Dilo):

*Assigned Employee*

- a. CONNECT all PTFE or flexible Stainless Steel sample tubing and instrumentation in accordance with manufacturer's instructions.
- b. Turn instrument(s) "ON" and allow to stabilize.
- c. OPEN gas compartment valve to admit gas to instrument.
- d. SELECT measurement menu on instrument.
- e. VERIFY checklist menu to begin sample process.

**NOTE**

The sample process will run for a pre-determined duration, after which the results will be displayed.

- f. RECORD sample results

**NOTE**

Use tubing or regulating products containing rubber components may result in erroneous high moisture readings

- g. CLOSE Gas Compartment Valve and disconnect all tubing and instrumentation.
- h. CHECK gas compartment valve and fittings to ensure there are no leaks.

## 2.5 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 SF<sub>6</sub> gas.

### NOTE

An approved Halogen Detector (s/c 0439477) or SF<sub>6</sub> Gas Detector shall be available whenever work is performed on equipment containing SF<sub>6</sub> Gas.

#### *Assigned Employee*

- 2.5.1 VERIFY that equipment is properly de-energized, isolated, and grounded.
- 2.5.2 CHECK the gas compartment and associated devices, prior to removal of gas, for leaks, using an approved halogen leak detector (s/c 0439477) or SF<sub>6</sub> gas 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.
- 2.5.3 ATTACH the hose from the SF<sub>6</sub> Processing Cart to the gas compartment valve.
- 2.5.4 DRAW a vacuum on the hose to remove air and moisture.
- 2.5.5 OPEN the gas compartment valve.
- 2.5.6 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.
- 2.5.7 While gas is being removed, CHECK the Processing Cart for leaks using an approved halogen leak detector (s/c 0439477) or SF<sub>6</sub> gas detector.
- 2.5.8 DRAW a vacuum on the gas compartment to complete the SF<sub>6</sub> gas removal process.
- 2.5.9 BREAK vacuum with nitrogen or dry air as applicable.

*Maintenance Supervisor*

2.5.10 KEEP SF<sub>6</sub> 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 SF<sub>6</sub> gas to DOT-approved cylinders for return to the central facility.
- b. RETURN cylinders of SF<sub>6</sub> 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.

**2.6 Removal of Hazardous Solid By-Products**

**CAUTION**

After the SF<sub>6</sub> gas has been removed from the gas compartment and prior to opening the gas compartment cover(s), the equipment specified in section 1.4.2 shall be available at the work site for the personnel to perform the following steps. If any required equipment is not available, an Environmental Services contractor shall be contacted to perform the necessary clean-up. Refer to Section 2.2 for SF<sub>6</sub> Emission Reporting Requirements.

*Assigned Employee*

2.6.1 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 0419532) to verify oxygen content of 19.5 – 23.5%, combustible gas content less than 10% of the Lower Explosive Limit (LEL), and toxic gas content less than the Permissible Exposure Limit (PEL).
- b. Using an approved halogen detector (s/c 0439477) or SF<sub>6</sub> Gas Detector, PERFORM checks at various low points within the gas compartment to determine any presence of SF<sub>6</sub> gas.

- c. VENTILATE in low point areas until the detector indicates that SF<sub>6</sub> gas has been purged.
- 2.6.2 REMOVE powdery deposits using an approved vacuum cleaner equipped with high-efficiency particle air (HEPA) filters.
- 2.6.3 CLEAN UP any powdery residue using wipes moistened with denatured alcohol.
- 2.6.4 PLACE powdery deposits contained in the vacuum cleaner disposal bag along with any wipes and other contaminated materials in a plastic waste bag.
- 2.6.5 SEAL all covers of the gas compartment upon completion of maintenance and/or repair work.
- 2.6.6 REMOVE personal protective equipment.
- 2.6.7 Place disposable clothing, boots, and respirator cartridges, and any other contaminated materials in the plastic waste bag.
- 2.6.8 SECURE bag with filament tape.
- 2.6.9 PLACE plastic waste bag in a 55 gallon drum.
- 2.6.10 WASH face and hands following completion of work and before eating or drinking.

*Maintenance Supervisor*

- 2.6.11 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.

*Environmental Coordinator*

- 2.6.12 ARRANGE for disposal of the drum in accordance with federal and state regulations.
- 2.6.13 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 0 - Effective date 10/15/99**

Initial Release

#### **Revision 1 - Effective date 01/30/03**

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 - Effective date 01/04/06**

- 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

#### **Revision 3 - Effective date 09/01/06**

- Added Warning regarding filling of energized equipment
- Added step (2.3.1) to ensure equipment is de-energized prior to removal of gas.

#### **Revision 4 - Effective date 4/21/08**

- Added new Section 2.2 for guidance on Reporting of SF<sub>6</sub> Emissions and removed attachment 2 – MOU Text.
- Added inventory form (Attachment 2)
- Revised stock-coded item list

#### **Revision 5 –Effective date 1\22\2010**

- Added Effective date to Revision dates per an Audit request.
- Added stock code for approved HEPA vacuum cleaner to section 1.4.2.
- Added requirement to contact an environmental services contractor to Caution statement in section 2.6.

## 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 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.

**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.

