

**FACILITIES INSTRUCTIONS,  
STANDARDS, AND TECHNIQUES  
VOLUME 5-9**

**MANAGEMENT AND SAFE  
HANDLING PROCEDURES FOR  
SULFUR HEXAFLUORIDE (SF<sub>6</sub>) GAS**

**MARCH 2004**

**UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION**



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**MANAGEMENT AND SAFE  
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SULFUR HEXAFLUORIDE (SF<sub>6</sub>) GAS**

**HYDROELECTRIC RESEARCH AND  
TECHNICAL SERVICES GROUP**

**UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION**

**MARCH 2004**

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## MANAGEMENT AND SAFE HANDLING PROCEDURES FOR SF<sub>6</sub> GAS

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### 1. INTRODUCTION

Bureau of Reclamation (Reclamation) facilities have more than 1,000 power circuit breakers; the most modern of them use sulfur hexafluoride (SF<sub>6</sub>) gas as an arc-interrupting/quenching and insulating agent. Breakers of this design are now the standard; for some applications, they are the only power circuit breakers available in the industry. Reclamation currently has some 65 power circuit breakers of the SF<sub>6</sub> design, as well as other SF<sub>6</sub> equipment (Appendix A). Reclamation plans to procure more SF<sub>6</sub> breakers in the future to meet its needs.

According to the Electric Power Research Institute (EPRI)<sup>1</sup>, SF<sub>6</sub> is a synthetic gas that was developed for use as an electrical insulating medium for the power industry. Originally, its outstanding insulation characteristics were used primarily to reduce power circuit breaker interruption time; reducing interruption time enhances power system stability. As concerns escalated regarding poly-chlorinated biphenyls (PCBs) that were found in insulating oil used in older breakers, the use of SF<sub>6</sub> insulated breakers grew.

SF<sub>6</sub> is chemically inert, nonflammable, and nontoxic. Although SF<sub>6</sub> gas is not detrimental to the ozone layer, it is a highly potent greenhouse gas. It is 23,900 times more effective at trapping infrared radiation than carbon monoxide and is stable in the atmosphere for some 3,200 years. Although the percentage of SF<sub>6</sub> found in the atmosphere is relatively small, the rate of growth is alarming.

Currently, there is no Federal legislation curtailing the use of SF<sub>6</sub>. However, the Environmental Protection Agency (EPA) sponsors and facilitates a program for a voluntary reduction of SF<sub>6</sub> emissions within the electric power industry. This program provides a forum for EPA and the electric power industry to work together to reduce SF<sub>6</sub> emissions to technically and economically feasible levels, thereby helping to reduce global climate change. Implied is that if voluntary programs are not successful, legislation may be required to restrict the use of SF<sub>6</sub>. Restricting the use of SF<sub>6</sub> would be extremely inconvenient to the power industry, including Reclamation and the Federal Power Marketing Administrations.

Although Reclamation has not signed a memorandum of understanding with EPA establishing official compliance with the program, Reclamation will voluntarily pursue a program of SF<sub>6</sub> management and handling that will help reduce SF<sub>6</sub> emissions and promote safety for employees and the public.

For more information on EPA's SF<sub>6</sub> Emissions Reduction Partnership for Electric Power Systems, visit its website at <[www.epa.gov/highwp1/sf6](http://www.epa.gov/highwp1/sf6)>

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<sup>1</sup> "SF<sub>6</sub> Gas Condition Assessment and Decontamination – Technical Report," June 2000, and "Practical Guide to SF<sub>6</sub> Handling Practices," February 2002, both by the Electric Power Research Institute, Palo Alto, California.

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### 2. SCOPE

Use of SF<sub>6</sub> circuit breakers and other SF<sub>6</sub> equipment does not come without consequences. In addition to the environmental concerns addressed in the Introduction, SF<sub>6</sub> gas and gas byproducts pose some risk to personnel.

SF<sub>6</sub> gas is heavier than air. In enclosed areas, such as in powerplants, it can displace breathable air. The toxic byproducts released when SF<sub>6</sub> gas interrupts the arc plasma in a circuit breaker are also of concern. Decomposition products in the form of metallic fluoride powder are toxic to humans who breathe or touch them, and adequate personal protective equipment (PPE) and training are essential for personnel safety.

This FIST volume outlines the basic requirements for SF<sub>6</sub> management and handling at Reclamation power facilities to address environmental and safety issues. Key elements include:

- ◆ Establishing and progressing toward local and Reclamation SF<sub>6</sub> emission reduction goals that meet EPA guidelines
- ◆ Developing and maintaining local records and reporting annually
- ◆ Developing and maintaining a local gas-handling plan that minimizes release of SF<sub>6</sub>
- ◆ Following guidelines developed and used by most of the power industry worldwide
- ◆ Providing proper training in recycling, using, handling, transporting, containing spills, and reporting SF<sub>6</sub> releases
- ◆ Developing and maintaining a local SF<sub>6</sub> and SF<sub>6</sub> byproduct catastrophic release emergency action plan
- ◆ Developing and using an SF<sub>6</sub> risk assessment and mitigation strategy
- ◆ Procuring electrical equipment that is “ultra-low leakage” and performing site installation that follows all environmental and safety considerations

Although most Reclamation SF<sub>6</sub> equipment currently in service is located outside of powerplants and, therefore, may result in lower gas concentrations, safety and environmental precautions still apply, and a local SF<sub>6</sub> plan is essential.

### 3. RESPONSIBILITY

The Power Resources Office, D-5400, is Reclamation’s lead office for addressing corporate SF<sub>6</sub> management issues and any coordination with EPA. Area and project offices are responsible for implementing adequate SF<sub>6</sub> management and handling practices to comply with this FIST volume and any applicable State and Federal regulations and statutes. Specific responsibilities are listed below.

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### **Power Resources Office, D-5400**

- ◆ Provide corporate guidance to field offices on current SF<sub>6</sub> regulations, statutes, policy, and practices
- ◆ Provide liaison with EPA, power marketing administrations, and other utilities as part of Reclamation's voluntary and unofficial participation in the EPA "SF<sub>6</sub> Emissions Reduction Partnership for Electric Power Systems"
- ◆ Establish Reclamation SF<sub>6</sub> emission reduction goals
- ◆ Report Reclamation's SF<sub>6</sub> status to EPA, including emission reductions, when appropriate

### **Area/Project/Regional Office**

- ◆ Establish and accomplish office SF<sub>6</sub> emission reduction goals
- ◆ Develop, maintain, and execute a local SF<sub>6</sub> Management and Safe Handling Plan in accordance with this FIST volume and EPA requirements
- ◆ Report annually to the Power Resources Office the status of the local SF<sub>6</sub> program
- ◆ Establish a schedule for accomplishing the requirements of this FIST volume and a process for peer reviewing generated documents

## **4. MANAGEMENT PLAN**

Each Reclamation facility with SF<sub>6</sub> equipment will develop an SF<sub>6</sub> Management and Handling Plan that clearly defines how SF<sub>6</sub> is to be managed locally. The plan will include:

- ◆ An SF<sub>6</sub> emission reduction goal and a strategy for accomplishing it
- ◆ An inventory of all SF<sub>6</sub> equipment
- ◆ A strategy for measuring changes in SF<sub>6</sub> inventory (and, thus, leakage) for tracking and reporting purposes
- ◆ A reporting process to advise the Power Resources Office, D-5400, of the current status of the local SF<sub>6</sub> plan
- ◆ An SF<sub>6</sub> Gas Safe Handling Procedure that is compliant with EPRI guidelines
- ◆ A training plan for staff engaged in SF<sub>6</sub>-related work
- ◆ A catastrophic-release plan
- ◆ A risk assessment and mitigation strategy



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- ◆ A commitment to recycling, disposal, environmental protection, transportation, and storage consistent with applicable regulations, laws, and industry best practices

The existence and adequacy of SF<sub>6</sub> Management Plans will be verified under the management portion of the Reclamation Power Review of Operation and Maintenance (O&M) Program.

### 5. EMISSION REDUCTION GOALS

A recent study indicated that Reclamation annually loses to emissions approximately 1,300 pounds of SF<sub>6</sub>, out of a nameplate and storage capacity of some 16,500 pounds (or approximately 7.9 percent). Emissions result from properly functioning equipment (because of static and dynamic operation), from leakage (because of old or deteriorated gaskets and seals), and from gas escaping into the atmosphere when gas is either transferred into equipment or extracted from it for disposal, recycling, or storage.<sup>2</sup>

Reclamation's goal is a 10-percent annual reduction in emissions from 2003 levels (a 40-percent reduction by 2007), where technically and economically feasible. This reduction will be achieved by replacing existing SF<sub>6</sub> breakers with "ultra-low" leakage breakers and by using more effective handling practices. Emission reduction goals beyond 2007 will be based on progress to date and emerging utility practices developed before that year.

Each Reclamation office with SF<sub>6</sub> equipment will establish written emission reduction goals and a strategy to support the Reclamation goal, including:

- ◆ Achieving a 10-percent annual reduction in leakage (from 2003 levels), where technically and economically feasible
- ◆ Replacing older, higher-emission SF<sub>6</sub> equipment with newer, "ultra-low" leakage designs
- ◆ Refurbishing existing equipment to meet "ultra-low" leakage criteria
- ◆ Improving maintenance and construction practices to control or reduce emissions
- ◆ Replacing or repairing existing equipment seals, gaskets, alarms, gages, monitoring devices, etc., to reduce leakage and allow for proper monitoring

### 6. EQUIPMENT INVENTORY

Each Reclamation office with SF<sub>6</sub> equipment will inventory all SF<sub>6</sub> equipment—including gas carts—to identify equipment designation, location, and nominal quantity of SF<sub>6</sub> in pounds. Equipment that is "sealed for life" or contains less than 15 pounds of SF<sub>6</sub> is exempt from this inventory.

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<sup>2</sup> Definitions of emission sources are from Bonneville Power Administration.

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Appendix A is a recent inventory of SF<sub>6</sub> equipment known to be at Reclamation facilities. This list should be considered informational only and must be supplemented with an official inventory.

### 7. EMISSION MEASUREMENT

According to EPRI, leakage for a sound SF<sub>6</sub> installation should be less than 1 percent annually. At least annually, each Reclamation office with SF<sub>6</sub> equipment will perform the required SF<sub>6</sub> inventory measurement using the protocol defined in Appendix B.

### 8. REPORTING REQUIREMENTS

Each Reclamation office with SF<sub>6</sub> equipment will report annually, by January 1, the status of the local SF<sub>6</sub> program, including the amount of emission in pounds and details of any catastrophic release. The reporting protocol and form found in Appendix B should be used for reporting purposes.

The Power Resources Office, D-5400, will report the status of the Reclamation SF<sub>6</sub> program to EPA, when appropriate, using the same protocol and format as shown in Appendix B.

In the first annual report to the Power Resources Office, due June 1, 2004, each office with SF<sub>6</sub> equipment will provide an update to the inventory in Appendix A. The update will establish a baseline of Reclamation's SF<sub>6</sub> equipment.

### 9. SAFE HANDLING PROCEDURES FOR SF<sub>6</sub> GAS

To achieve SF<sub>6</sub> emission reduction goals and to enhance employee and public safety, safe handling procedures must be developed and followed.

Existing SF<sub>6</sub> circuit breakers at Reclamation facilities were bought and installed with little consideration beyond that found in the manufacturer's instruction book and the limited information in the previous version of this FIST volume. Existing maintenance practices have developed in accordance with this limited knowledge. Better construction and maintenance handling procedures for SF<sub>6</sub> must be developed using today's accepted practices.

There are many technical considerations and procedures that must be taken into account for handling SF<sub>6</sub> gas safely. A comprehensive discussion of these requirements is included in a document entitled, "Practical Guide to SF<sub>6</sub> Handling Practices – Technical Report," Electric Power Research Institute, Palo Alto, California (February 2002).

Rather than re-creating extensive SF<sub>6</sub> handling procedures in this FIST volume, Reclamation endorses the EPRI document as the basis for safe handling procedures for

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SF<sub>6</sub> gas. Local SF<sub>6</sub> management programs should incorporate all considerations from the EPRI document including:

- ◆ Equipment classification
- ◆ Risks, warning signs, and written instructions
- ◆ Handling procedures
- ◆ Personal protective equipment
- ◆ Disposal and environmental protection
- ◆ Transportation and storage

Copies of the EPRI “Practical Guide to SF<sub>6</sub> Handling Practices” were made available to Reclamation power offices with the distribution of the 2004 revised version of this FIST volume. Additional copies of the EPRI document may be acquired by contacting:

EPRI  
3412 Hillview Avenue, Palo Alto, CA 94304  
PO Box 10412, Palo Alto CA, 94303  
1-800-313-3774 (select option 2)  
<askepri@epri.com>  
<www.epri.com>

Mention that you are with the Bureau of Reclamation, which is a member of EPRI through the Western Area Power Administration. Please reference Report No. 100945. There is no charge for EPRI documents produced in membership target areas. EPRI documents may also be obtained online at <www.epri.com>. If you are not presently an EPRIWEB user, you can request a password at <www.epri.com> by clicking on the “New Users Register” area (below the customer log-in box). At the next screen, follow the directions and fill in the information requested. EPRI documents acquired in this way are for Reclamation and Reclamation-contractor use only.

In addition to the above EPRI document, reference should be made to manufacturers’ instructions when adopting an SF<sub>6</sub> safe handling plan.

**10. TRAINING**

Only properly qualified and trained personnel should work with SF<sub>6</sub> and SF<sub>6</sub> equipment. Each Reclamation office with SF<sub>6</sub> equipment will develop and maintain an SF<sub>6</sub> training plan.

Training in proper handling procedures should always be provided by the contractor who furnishes and installs SF<sub>6</sub> equipment. SF<sub>6</sub> training in operation, maintenance, and safety procedures is available from the power marketing administrations (Western Area Power

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Administration and Bonneville Power Administration), who deal with SF<sub>6</sub> equipment extensively. Third-party commercial providers of SF<sub>6</sub> training include, but are not limited to:

- ◆ DILO Company, Inc. <[www.dilo.com](http://www.dilo.com)>
- ◆ AVO Training Institute <[www.avotraining.com](http://www.avotraining.com)>
- ◆ Associated Training Corp. <[www.atc-trng.com](http://www.atc-trng.com)>
- ◆ Mitsubishi Electric Power Products, Inc. <[www.meppi.com/service.asp](http://www.meppi.com/service.asp)>

Refresher training in SF<sub>6</sub> handling procedures should be accomplished annually after initial comprehensive training.

Since SF<sub>6</sub> enclosures should be treated as confined space, training in confined space practices is required to ensure that staff are aware of the risks and take proper precautions. Confined space training is available from established Reclamation sources.

### 11. CATASTROPHIC RELEASE PLAN

A catastrophic release of SF<sub>6</sub> is the result of sudden, severe failure—and possible destruction—of the equipment containing the gas. Catastrophic release will introduce into the environment SF<sub>6</sub> gas and SF<sub>6</sub> decomposition byproducts, in gaseous and powder form, complicating what might already be a bad situation, such as explosive porcelain failure, fire and smoke, debris, and unit outage.

A catastrophic release of SF<sub>6</sub> may be caused by an incident that requires reporting under the Reclamation Power O&M Incident Evaluation and Reporting Program (Directive and Standard FAC 04-02). The incident should also be reported immediately through proper channels via the Reclamation Emergency Notification Systems (ENS).

In addition to protective and mitigation measures described in EPRI's "Practical Guide to SF<sub>6</sub> Handling Practices" (section 5.4), each office with SF<sub>6</sub> equipment must have a plant-specific SF<sub>6</sub> Catastrophic Release Plan, including:

- ◆ Location and use of protective clothing and self-contained breathing apparatus
- ◆ Location and awareness of material safety data sheets (MSDS)
- ◆ Identification of areas where gas and powder might collect
- ◆ Location of air intakes and an evaluation of their potential to spread gases
- ◆ Consideration of additional ventilation to offset the presence of decomposition gases
- ◆ References to the Reclamation Emergency Notification System, the responsible Hazardous Materials and Safety Offices, and to a qualified industrial hygienist that is knowledgeable and trained in SF<sub>6</sub> hazard evaluation and clearance re-entry criteria.

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- ◆ A list of contractors able to provide cleanup, decontamination, and disposal
- ◆ Identification of the appropriate state environmental office for notification of release, where required
- ◆ Decontamination and neutralization procedures and materials and identification of sources of these materials or locations where they are stockpiled. As a minimum, these procedures must include decontaminating plant and power equipment and personnel, including neutralizing wash; vacuuming powder from clothing; neutralizing all test and maintenance equipment; and appropriately disposing of clothing and wipes. Decontamination procedures must be adequate to return the equipment, the plant, and all personnel to a decontaminated state

### 12. RISK ASSESSMENT AND MITIGATION

Each Reclamation office with SF<sub>6</sub> equipment will develop and execute an SF<sub>6</sub> risk assessment and mitigation strategy. This assessment and strategy will include:

- ◆ Risk of SF<sub>6</sub> emission (leakage and catastrophic release) to plant staff by identifying how and where gas could collect
- ◆ Review and proper distribution of MSDS for SF<sub>6</sub> and SF<sub>6</sub> decomposition products and communication of risks to staff
- ◆ Use of adequate, properly calibrated SF<sub>6</sub> gas detectors by maintenance staff to indicate presence or absence of SF<sub>6</sub> and SF<sub>6</sub> byproducts. The slight reduction of oxygen, measured by an oxygen meter, may not reflect the concentration of hazardous byproducts that may be present
- ◆ Permanent installation and use of SF<sub>6</sub> gas monitoring alarms, located where SF<sub>6</sub> gas could accumulate
- ◆ Proper use and response to SF<sub>6</sub> gas pressure or density alarms that are furnished with SF<sub>6</sub> equipment
- ◆ Strategy for evacuating SF<sub>6</sub> gas from accumulation locations
- ◆ Use of SF<sub>6</sub> warning signage in accordance with Section 4 of EPRI's "Practical Guide to SF<sub>6</sub> Handling Practices"
- ◆ Adequacy and availability of PPE, including protective clothing and respiratory devices. See Section 6 and Appendix B of the EPRI guide

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### 13. RECYCLING, DISPOSAL, ENVIRONMENTAL PROTECTION, TRANSPORTATION, AND STORAGE

Where technically and economically feasible, Reclamation offices will recycle (recover and reuse) SF<sub>6</sub> gas.

Reclamation will comply with all applicable Federal and State regulations and laws regarding disposal, environmental protection, transportation, and storage of SF<sub>6</sub> gas, gas byproducts, and contaminated equipment, tools, materials, clothing, and PPE. Refer to Sections 7 and 8 of the EPRI “Practical Guide to SF<sub>6</sub> Handling Practices” and Reclamation Safety and Health Standards for guidance.

### 14. PROCUREMENT OF SF<sub>6</sub> EQUIPMENT

When procuring SF<sub>6</sub> equipment, consideration must be given to mitigating future gas leakage. Procurements should address the following:

- ◆ Acquisition of sealed-for-life and “ultra-low-leakage” equipment, where feasible
- ◆ Acquisition and application of all available gas leakage monitoring systems, such as overpressure, refilling, and low-pressure alarms
- ◆ Acquisition and application of SF<sub>6</sub> gas and SF<sub>6</sub> decomposition product detectors, both portable (for maintenance use) and permanently installed (for plant alarm)
- ◆ Acquisition of an adequate “gas cart” for proper filling and evacuating of SF<sub>6</sub> equipment
- ◆ Provision by the contractor of adequate training in SF<sub>6</sub> operation and maintenance
- ◆ Provision by the contractor of appropriate leakage and spill containment and cleanup equipment and supplies

### 15. GAS CARTS

Gas handling apparatus (i.e., gas carts) are essential for filling and evacuating SF<sub>6</sub> equipment. See EPRI “Practical Guide to SF<sub>6</sub> Handling Practices,” section 5.1.1 for more information. Reclamation SF<sub>6</sub> gas carts should conform to EPRI guidelines in construction and be operated and maintained using EPRI’s recommendations.

Care should be exercised when handling and transporting gas bottles and carts because residual gas can be present. Proper evacuation procedures should be followed.

Gas carts require adequate maintenance and testing. Gas carts should be identified in MAXIMO as an individual piece of equipment requiring preventive maintenance. Job plans and work orders should be developed, with maintenance steps, in accordance with section 5.1.1 of the EPRI guidelines, including:

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- ◆ Cart preparation and conditioning
- ◆ Loss of pressure check
- ◆ Loss of vacuum check
- ◆ Scrubber testing
- ◆ Flowmeter testing
- ◆ Vacuum pump maintenance
- ◆ Moisture testing
- ◆ SF<sub>6</sub> percentage testing
- ◆ Byproduct tube inspection

Maintenance of gas carts will be verified under the electrical portion of the Reclamation Power Review of O&M Program.

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**APPENDIX A****SF<sub>6</sub> Location At Reclamation Facilities – 2003**Table 1.—SF<sub>6</sub> Location in and Near Reclamation Facilities - 2003

Region	Plant	Equipment type	Equipment designation	Pounds of SF <sub>6</sub>	Maintained by
PN	Coulee 500 switchyard	Circuit breaker	PCB 2092 G-20	1,570	Reclamation
PN	Coulee 500 switchyard	Circuit breaker	PCB 2192 G-21	1,570	Reclamation
PN	Coulee 500 switchyard	Circuit breaker	PCB 2292 G-22	1,570	Reclamation
PN	Coulee 500 switchyard	Circuit breaker	PCB 2496 G-24	1,570	Reclamation
PN	Coulee 500 switchyard	Gas cart	Limco PET2015	200	Reclamation
PN	Coulee 500 switchyard	Gas cylinders	UN 1080	30x115	Reclamation
PN	Coulee 230 switchyard	Circuit breaker	PCB 6084 Bus Tie	330	Reclamation
PN	Coulee 230 switchyard	Circuit breaker	PCB 6582 CSY #1	330	Reclamation
PN	Coulee 115 switchyard	Circuit breaker	PCB 2172 Trans. Bkr.	200	Reclamation
PN	Coulee 115 switchyard	Circuit breaker	PCB 2372 LC #6	200	Reclamation
PN	Coulee 115 switchyard	Gas cylinder	UN 1080	115	Reclamation
PN	Coulee PG Plant	GIS	KP10A 3080, 3180, 3280, 3081, 3181	400	Reclamation
PN	Coulee PG Plant	Gas cylinders	UN 1080	2x115	Reclamation
PN	Coulee industrial area	Switch	UIAHA2	13.1	Reclamation
PN	Coulee industrial area	Gas cylinders	UN 1080	2x115	Reclamation
PN	Green Springs	Circuit breaker	JX1A	25	Reclamation
PN	Palisades	Circuit breaker	1062	115	Reclamation
PN	Minidoka	Circuit breaker	562	80	Reclamation





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Table 1.—SF<sub>6</sub> Location in and Near Reclamation Facilities - 2003

Region	Plant	Equipment type	Equipment designation	Pounds of SF <sub>6</sub>	Maintained by
LC	Hoover	Circuit breaker		100	Reclamation
LC	Hoover	Circuit breaker		100	Reclamation
LC	Hoover	Circuit breaker		100	Reclamation
LC	Hoover	Circuit breaker		100	Reclamation
LC	Hoover	Circuit breaker		100	Reclamation
LC	Hoover	Gas cylinder		119.1	Reclamation
LC	Hoover	Gas cylinder		117.3	Reclamation
LC	Hoover	Gas cylinder		116.5	Reclamation
LC	Hoover	Gas cylinder		50.5	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Circuit breaker		36.74	Reclamation
UC	Glen Canyon	Gas cart	Dilo D320		Reclamation
UC	Glen Canyon	Gas cylinder		90	Reclamation
UC	Glen Canyon	Gas cylinder		5	Reclamation
UC	Pinabete Substation	Circuit switch		15	BIA
UC	Gallegos PP	Circuit switch		15	BIA
UC	Gallegos PP	Circuit switch		15	BIA
UC	Gallegos PP	Circuit switch		15	BIA
UC	PP A0.8L	Breaker		15	BIA
UC	PP A0.8L	Breaker		15	BIA
UC	PP A0.8L	Breaker		15	BIA

## MANAGEMENT AND SAFE HANDLING PROCEDURES FOR SF<sub>6</sub> GAS

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Table 1.—SF<sub>6</sub> Location in and Near Reclamation Facilities - 2003

Region	Plant	Equipment type	Equipment designation	Pounds of SF <sub>6</sub>	Maintained by
UC	PP A0.8L	Gas cylinder		12	BIA
UC	PP A0.8L	Gas cylinder		13	BIA
GP	Mt. Elbert	Circuit breaker	U1A	15.8	Reclamation
GP	Mt. Elbert	Circuit breaker	U2A	15.8	Reclamation
GP	Mt. Elbert	Circuit breaker	JV2A	132	WAPA
GP	Mt. Elbert	Circuit breaker	JV3A	132	WAPA
GP	Mt. Elbert	Gas cart	Cryoquip 2BC	115 capacity	Reclamation
GP	Green Mountain	Circuit breaker	JZ1A	15	Reclamation
GP	Green Mountain	Circuit breaker	JZ2A	15	Reclamation
GP	Green Mountain	Circuit breaker	JZ3A	15	Reclamation
GP	Green Mountain	Circuit breaker	JZ5A	15	Reclamation
GP	Green Mountain	Gas cylinder	Four cylinders	4x20	Reclamation
GP	Flatiron	Circuit breaker	U1A2	15.8	Reclamation
GP	Flatiron	Circuit breaker	U1A3	15.8	Reclamation
GP	Flatiron	Circuit breaker	U2A2	15.8	Reclamation
GP	Flatiron	Circuit breaker	U2A3	15.8	Reclamation
GP	Flatiron	Gas cart	Cryoquip HC series	0	Reclamation
GP	Flatiron	Gas cylinders	Two cylinders	2x5	Reclamation
GP	Mary's Lake	Circuit breaker	JYA	77	Reclamation
GP	Seminole	Circuit breaker	JY2A	60	WAPA
GP	Seminole	Gas cart		115 capability	Reclamation
GP	Seminole	Gas cylinders		2x115	Reclamation
GP	Kortes	Circuit breaker	JY1A	60	WAPA
GP	Kortes	Circuit breaker	JY4A	60	WAPA
GP	Kortes	Gas cylinders		2x115	Reclamation

**MANAGEMENT AND SAFE HANDLING PROCEDURES FOR SF<sub>6</sub> GAS**

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**APPENDIX B****SF<sub>6</sub> Emissions Inventory Reporting Protocol and Form**

This protocol provides a template for reporting annual SF<sub>6</sub> emissions based on annual changes in SF<sub>6</sub> inventory. Use of the protocol to complete the SF<sub>6</sub> Emissions Reporting Form requires the following data:

- ◆ SF<sub>6</sub> gas in inventory at the beginning of the reporting year
- ◆ SF<sub>6</sub> gas in inventory at the end of the reporting year
- ◆ SF<sub>6</sub> gas additions to the inventory (e.g., purchases)
- ◆ SF<sub>6</sub> gas subtractions from the inventory (e.g., sales or returns)
- ◆ Changes in nameplate capacity

Gas in inventory refers to SF<sub>6</sub> gas contained in storage cylinders, gas carts, and other storage containers. **It does not refer to SF<sub>6</sub> gas held in operating equipment.**<sup>3</sup>

Gas additions and subtractions refer to SF<sub>6</sub> gas placed in or removed from the stored inventory, respectively. Gas additions also include SF<sub>6</sub> provided by equipment manufacturers with or inside new equipment.

Complete tables 1 and 2 to estimate annual emissions. Use the Comments box to describe the means used to obtain a specific quantitative value (e.g., measured, estimated using rough data, or other comments including perceived accuracy of the form entries). Add additional comment sheets if necessary.

**Accounting for Acts of Nature and Other Non-Preventable Events**

An act of nature (e.g., lightning or earthquake) or other nonpreventable event of equipment failure (e.g., from a severe electrical fault) that destroys or damages a piece of equipment might result in a sudden, “catastrophic” loss of SF<sub>6</sub> to the atmosphere.<sup>4</sup> If SF<sub>6</sub> loss to the atmosphere occurs as a result of an act of nature or other non-preventable event, this loss should be reported on the form kept separate from normal annual emissions.<sup>5</sup>

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<sup>3</sup> Reporting is required only on the change in inventory, not the absolute value. This method assumes gas is being added to equipment as needed to ensure adequate insulation.

<sup>4</sup> The term “nonpreventable” does not include releases from properly functioning equipment (caused by static and dynamic operation) or leakage (e.g., caused by deteriorated and leaking gaskets or seals).

<sup>5</sup> Such an event may also require reporting according to the Power Operation and Maintenance Incident Evaluation and Reporting Program and the Emergency Notification System.

## MANAGEMENT AND SAFE HANDLING PROCEDURES FOR SF<sub>6</sub> GAS

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### SF<sub>6</sub> EMISSIONS REPORTING FORM

Date:	Office:	Contact:	
<b>Table 1</b>			
Inventory		Amount (lbs)	Comments
A	Beginning of year		
B	End of year		

<b>Table 2</b>		
Additions to Inventory		
	Amount (lbs)	Comments
1. Purchases of SF <sub>6</sub> (including SF <sub>6</sub> provided by equipment manufacturers with or inside new equipment)		
2. SF <sub>6</sub> returned to the site after off-site recycling		
<b>C: Total Additions</b> (add items 1 and 2)		
Subtractions from Inventory		
	Amount (lbs)	Comments
3. Sales of SF <sub>6</sub> (to other entities, including gas left in retired equipment)		
4. SF <sub>6</sub> returned to supplier		
5. SF <sub>6</sub> taken from storage or equipment and disposed of		
6. SF <sub>6</sub> taken from storage or equipment and sent off site for recycling		
<b>D: Total Subtractions</b> (add items 3-6)		
Change to Nameplate Capacity		
	Amount (lbs)	Comments
7. Total nameplate capacity of new equipment		
8. Total nameplate capacity of retiring equipment		
<b>E: Change to Nameplate Capacity</b> (subtract item 8 from item 7)		

**Total Annual Emissions = A – B + C – D – E**

<b>Release from Act of Nature or Other Unpreventable Event</b>			
Type of Event <sup>1</sup>	Equipment damaged	Amount released (lbs)	Comments

<sup>1</sup> Lightning, earthquake, electrical fault, vandalism, etc.