

SF₆ Emission Reduction Partnership for Electric Power Systems

2003 Annual Report

July 2004



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Preface—The SF₆ Emission Reduction Partnership for Electric Power Systems

Sulfur hexafluoride (SF₆) is 23,900 times more effective per molecule in trapping infrared radiation in the Earth's atmosphere than an equivalent amount of carbon dioxide (CO₂) over a 100-year period. With an atmospheric lifetime of 3,200 years, this virtually indestructible gas is accumulating in our atmosphere and contributing to the threat of global climate change.

Nearly 80 percent of all SF₆ produced is used by the electric power industry in high voltage equipment such as electrical switchgear and circuit breakers. Because of its extremely stable molecular structure, high dielectric strength, powerful arc quenching abilities, and excellent insulation properties, SF₆ is the industry's preferred chemical used in high-voltage equipment applications and designs.

With a high global warming potential (GWP) of 23,900, SF₆ is the most potent greenhouse gas.

The U.S. Environmental Protection Agency (EPA) launched the voluntary SF₆ Emission Reduction Partnership for Electric Power Systems in 1999 to assist utilities in developing and implementing cost-effective options to reduce SF₆ emissions. As part of a suite of voluntary industry program offerings within EPA's Climate Change Division, the SF₆ Emission Reduction Partnership is based on the premise that companies can reduce their greenhouse gas emissions through sound management principles in a cost-effective manner.

This annual report documents the Partnership's fourth year of progress in abating SF₆ emissions through cost-effective practices and technologies. Cumulative SF₆ emissions avoided by partners since 1999 are presented, as well as the latest results reported by partners for 2003.

Three major groups or types of high GWP gases exist: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).¹

In 2002, SF₆ emissions from the electric power industry accounted for approximately 11 percent of the total high GWP emissions from industrial processes.²

¹For more information on high GWP gases, visit EPA's Web site: <http://www.epa.gov/hgwp/index.html>.

²EPA. 2004. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2002." U.S. Environmental Protection Agency. EPA 430-R-04-003.



Partner Accomplishments

In 2003, companies in the SF₆ Emission Reduction Partnership continue to make important accomplishments in reducing SF₆ emissions. Partners cite various measures that have enabled them to achieve emission reductions. Successful strategies and activities include tracking company uses of SF₆ annually, establishing an emission reduction goal, developing SF₆ management protocols, training employees on the handling of SF₆ gas, identifying and repairing SF₆ leaks, replacing older, leaking equipment with newer, tighter gas-insulated equipment, and implementing SF₆ recycling. This section presents the results of Partners' efforts for 2003 and overall.

2.1 Partner-Reported Emissions

In 2003, over 80 percent of Partners reported. SF₆ emissions from these utilities totaled 444,424 pounds; total reported nameplate capacity reached 4,268,148 pounds. Table 1 provides a summary of total nameplate capacity and SF₆ emissions for all reporting Partners between 1999 and 2003.

The emission rate, calculated by dividing total emissions by total nameplate capacity, equals 10.4 percent for 2003, down slightly from the previous year's rate of 11 percent. The continuing decline of this metric illustrates the continuing success of Partners in implementing strategies that reduce SF₆ emissions. Since the number of reporting

Partners varies from year to year, the emission rate is a valuable assessment of Partnership trends because it normalizes SF₆ emissions relative to the total amount of SF₆-containing electrical equipment used by the utility. Figure 1 illustrates the declining trend of emission rate since the Partnership's inception in 1999.

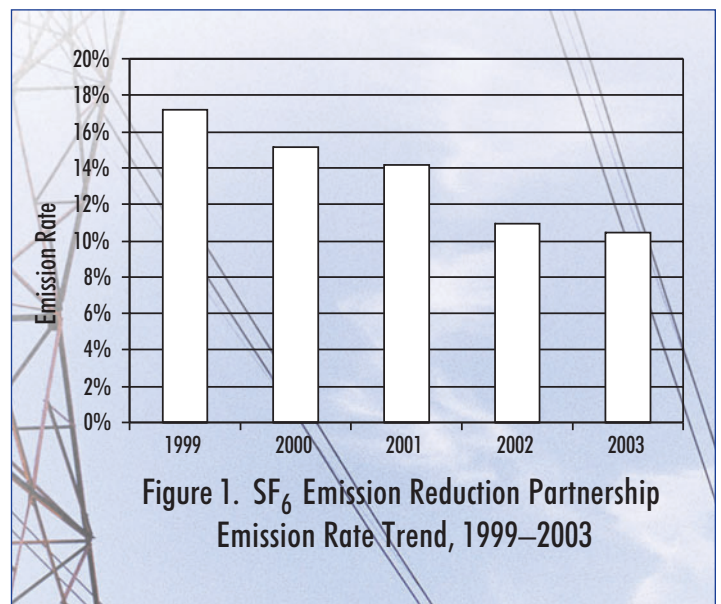


Figure 1. SF₆ Emission Reduction Partnership Emission Rate Trend, 1999–2003

Table 1: Aggregated Statistics for all Reporting Partners

	1999	2000	2001	2002	2003
Reporting Partners	79%	82%	85%	74%	84%
Total Name-Plate Capacity (lbs.)	3,465,872	3,858,884	3,918,809	4,382,961	4,268,148
Total SF ₆ Emissions (lbs.) ¹	594,902	583,523	555,867	478,299	444,424
SF ₆ Emission Rate	17%	15%	14%	11%	10%

¹Since several reporting Partners have not provided data for consecutive years, the aggregated statistics should not be used to compare annual SF₆ emissions.

Table 2 presents a summary of total annual SF₆ emissions reductions achieved by Partners through 2003. The information presented is derived by evaluating emissions data provided by reporting Partners for each year (see Table 1), and is not adjusted to account for Partners who have not reported consecutively. Emissions reductions are also presented in terms of million metric tonnes of carbon dioxide equivalent (MMT_{CO₂e}) and assume that 1999, the start of the Partnership, is the baseline year.

As shown in Table 2, 2003 SF₆ emissions from reporting Partners are 25 percent lower than emissions in 1999. These Partners have reduced SF₆ emissions by 1.63 MMT_{CO₂e} in 2003 from the Partnership's emission baseline; since 1999 cumulative emission reductions have totaled 3.44 MMT_{CO₂e}.

These successes translate into remarkable environmental benefits. The emissions reductions reported by Partners have significantly contributed to improving the environment by decreasing the amount of greenhouse gas emissions released to the atmosphere and, subsequently, decreasing the electric power industry's impact on climate change.

The 2003 Partner-reported SF₆ emissions reduction of 1.63 MMT_{CO₂e} are equal to:

- 353,000 Passenger cars NOT driven for one year; or
- 13,370 Acres of forest preserved from deforestation; or
- 209,375 Household electricity use for one year (no. of households).³

From 1999 through 2003, Partners have saved \$1.9 to \$2.9 million dollars¹ in SF₆ purchases by preventing the escape of 3.44 MMT_{CO₂e}, or 317,495 pounds of SF₆, into the atmosphere.

¹Assuming SF₆ costs between \$6.00 to \$9.00 per pound.

Table 2: Partner-Reported SF₆ Emissions Reductions

	1999 ¹	2000	2001	2002	2003
Total Partner-Reported SF ₆ Emissions (lbs)	594,902	583,523	555,867	478,299	444,424
Total Partner-Reported SF ₆ Emissions (MMT _{CO₂e})	6.45	6.32	6.03	5.18	4.82
Reduction from Baseline (MMT _{CO₂e})	—	0.12	0.42	1.26	1.63
Percent Reduction from Baseline	—	2%	7%	20%	25%

¹Baseline year.

³Source: <http://www.usctcgateway.net/tool/>

2.2 2003 Emission Reduction Activities

This year, several Partners shared information on activities that contributed to significant SF₆ emission reductions. The following observations were noted for each activity:

▶ **Equipment — Leak Detection and Repair**

Ten Partners mentioned the use of various leak detection devices including soap and water solutions, snoop, hand-held halogen leak detectors, and laser leak detection cameras. Equipment is monitored and inspected on a routine basis; for example, one respondent noted that the pressure of SF₆ circuit breakers is routinely checked while others noted that the re-filling of equipment with SF₆ was closely tracked. Partners reported that leak detection activities have enabled them to repair minor gas leaks, justify the replacement of older leaking equipment, and identify leaks in equipment that were previously overlooked, such as gas carts and gauges.

▶ **Equipment Upgrades and the Replacement of Old with New Equipment**

Nine Partners cited conducting equipment upgrades and replacing numerous SF₆ circuit breakers as effective SF₆ emission mitigation strategies. One respondent stated that equipment replacement was the biggest factor in reducing SF₆ emissions. When equipment is deemed impractical for repair, respondents reported replacing faulty equipment with low volume breakers; one respondent reported a replacement of an old leaking SF₆ substation.

▶ **Training of Employees to Safely Handle, Manage, and Monitor SF₆**

Twelve Partners reported that training is provided through various measures including on-the-job, at department meetings, and in classroom settings. Apprentice electricians, foremen, and journeymen were cited as those employees who receive training, which covers servicing and monitoring SF₆ equipment, emergency response procedures for breaker failures, safety precautions, and operating gas carts. Respondents noted that these factors all contribute to SF₆ emission reduction.

▶ **Other Emission Reduction Strategies**

Ten Partners offered information on other activities that contributed to significant SF₆ emission reductions. The most common “other” strategy provided by respondents was the purchase and use of SF₆ gas recycling carts, followed by sending contaminated gas to a disposal facility or the gas supplier for recycling. Respondents also noted the benefits of carefully tracking the use of SF₆ gas cylinders and returning partial cylinders to vendors.

Employee Training SF₆ Management

Equipment Replacement & Repair



3 Partnership Update

In 2004, EPA is working to continue to grow the Partnership and provide technical information on successful strategies for reducing SF₆ emissions to Partners through new studies and upcoming conferences. This section details the latest in these advancements.

3.1 New Partners

EPA is continuously seeking new Partners to continue to target reductions of SF₆ emissions from the electric utility industry in the United States. Over the past year, EPA has been actively identifying companies to join the SF₆ Emission Reduction Partnership for Electric Power Systems, meeting with representatives, and explaining the financial and environmental benefits that can be achieved through the power of voluntary action.

In late 2003 and early 2004, EPA welcomed the following three new Partners into the SF₆ Emission Reduction Partnership for Electric Power Systems:

1. Arizona Public Service Company (APS)—Phoenix, AZ

2. MidAmerican Energy—Des Moines, IA

3. National Grid—Westborough, MA

The parent company to a current Partner, Niagara Mohawk, National Grid signed an MOU with EPA for seven additional of its subsidiaries located throughout Massachusetts and one in Rhode Island.

The Partnership now totals over 70 partners. For a current list, please refer to Appendix A.

3.2 SF₆ Field Study

In early 2004, EPA launched a study examining SF₆ leak rates in circuit breakers manufactured between January 1998 and December 2002. The objective of the study is to investigate equipment leak rates and to help both electric utilities and equipment manufacturers better understand the size and common sources of leaks in new equipment operating in the field. The study is anticipated to be completed by the end of 2004; results from the study will be presented at this year's conference.

3.3 The 2004 International Conference on SF₆ and the Environment

Companies from the electric utility and magnesium industries will come together again this year for the Biannual International Conference on SF₆ and the Environment. Sponsored by the EPA, the U.S. Department of Energy (DOE), the International Magnesium Association (IMA), the Electric Power Research Institute (EPRI), and the National Electrical Manufacturer's Association (NEMA), the conference will take place on December 1st through 3rd in Scottsdale, Arizona. Partners are encouraged to participate and share their experiences.

Conference breakout sessions specific to the use of SF₆ in electrical switchgear and circuit breakers include:

- SF₆ Management Services
- SF₆ Gas Analysis
- On-site vs. Off-site Recycling
- SF₆ Equipment Field Study
- Equipment Issues: Repair vs. Replacement

The Partnership's Web site houses up-to-date information on this year's conference including key dates for submitting abstracts and making reservations. For more information, please visit www.epa.gov/electricpower-sf6/workshops.html



4 Conclusion

The SF₆ Emission Reduction Partnership for Electric Power Systems is successfully reducing SF₆ emissions from electrical transmission operations by implementing cost-effective and technically feasible measures. Cumulative emission reductions since 1999 total 3.44 MMTCO_{2e}, the potential environmental value of which is equivalent to 28,210 acres of forest preserved from deforestation. As the SF₆ Emission Reduction Partnership enters its fifth year, EPA not only supports but strongly encourages Partners to continue to implement SF₆ emission reduction activities in order to further abate emissions of this potent greenhouse gas. In accomplishing this goal, electric utilities are also improving operational efficiency, saving money, and providing reliable power in an environmentally responsible manner.

For additional information please contact:

Jerome Blackman
Program Manager
U.S. Environmental Protection Agency
Climate Change Division
Washington, DC 20460
Tel. (202) 343-9630
Email: Blackman.Jerome@epamail.epa.gov
www.epa.gov/electricpower-sf6



Appendix: List of Partners (as of July 2004)

Allegheny Power

Greensburg, PA

American Electric Power

Columbus, OH (including West Texas Utilities Co – Abilene, TX and Southwestern Electric Power Company – Shreveport, LA)

Arizona Public Service Company (APS)

Phoenix, AZ

Athens Electric Department

Athens, AL

Austin Energy

Austin, TX

Bangor Hydro-Electric Company

Bangor, ME

Big Rivers Electric Corporation

Henderson, KY

Bonneville Power Administration

Portland, OR

CenterPoint

formerly Reliant Energy HL&P

Central Maine Power Company

Augusta, ME

Central Vermont Public Service Corporation

Rutland, VT

Cinergy Power Generation Services, Inc.

Cincinnati Gas & Electric Company—Cincinnati, OH
PSI Energy, Inc.—Cincinnati, OH

City of Monroe

Monroe, NC

Columbia River People's Utility District

St. Helens, OR

Commonwealth Edison

Chicago, IL

Commonwealth Electric

Wareham, MA

Connecticut Light and Power Company

Berlin, CT

Consolidated Edison Company of New York, Inc.

New York, NY

Crisp County Power Commission

Cordele, GA

Duquesne Light Company

Pittsburgh, PA

Edison International

Rosemead, CA

El Paso Electric Company

El Paso, TX

Eugene Water and Electric Board

Eugene, OR

FirstEnergy Corporation

Akron, OH (including GPU Energy – Reading, PA)

Florida Power and Light Company

Juno Beach, FL

Fort Pierce Utilities Authority

Fort Pierce, FL

Grand Island Utilities Department

Grand Island, NE

Hastings Utilities

Hastings, NE

Kings River Conservation District

Fresno, CA

Lower Colorado River Authority

Austin, TX

Maine Public Service Company

Presque Isle, ME

Manitowoc Public Utilities

Manitowoc, WI

Memphis Light, Gas & Water Division

Memphis, TN

Menasha Electric and Water Utilities

Menasha, WI

MidAmerican Energy

Des Moines, IA

Montana Power Company

Butte, MT

Muscatine Power & Water

Muscatine, IA



Appendix: List of Partners (continued)

Nashville Electric Service

Nashville, TN

National Grid

Granite State Electric—Northborough, MA
Massachusetts Electric—Northborough, MA
Nantucket Electric—Nantucket, MA
Narragansett Electric—Providence, RI
Niagara Mohawk Power Corporation—Syracuse, NY
New England Power Co.—Westborough, MA
New England Electric Transmission Corp.
(NEET)—Salem, MA
New England Hydro-Transmission Electric Co. Inc.
(NEHTEC)—Westborough, MA

Nebraska Public Power District

Doniphan, NE

New York Power Authority

New York, NY

North Atlantic Energy

Juno Beach, FL

Northeast Utilities Services Company

Connecticut Light and Power Company—Berlin, CT
Public Service Company of New Hampshire—Manchester, CT
Western Massachusetts Electric Company—
West Springfield, MA

Northern Indiana Public Service Company (NIPSCO)

Merriville, IN

Oklahoma Gas and Electric Co (OG&E)

Oklahoma City, OK

Oncor, formerly TXU

Dallas, TX

Pacific Gas and Electric Co.

San Francisco, CA

Paragould City Light & Water

Paragould, AR

Public Utility District No. 1 of Douglas County

East Wenatchee, WA

Public Utility District No. 1 of Pend Oreille County

Newport, WA

Rochester Gas and Electric Corp.

Rochester, NY

Salt River Project Power District

Phoenix, AZ

San Antonio City Public Service Board

San Antonio, TX

Silicon Valley Power

Santa Clara, CA

South Carolina Electric & Gas Company

Columbia, SC

Southern Company

Atlanta, GA

Tennessee Valley Authority

Knoxville, TN

Texas Municipal Power Agency

Bryan, TX

Village of Prairie du Sac

Prairie du Sac, WI

Wallingford Electric Division

Wallingford, CT

Wellton-Mohawk Irrigation & Drainage Dist.

Wellton, AZ

We Energies, formerly Wisconsin Electric Power Co.

Milwaukee, WI



U.S. Environmental Protection Agency
Climate Change Division
Washington, DC 20460