SULFUR HEXAFLOURIDE (SF_6) GAS EMISSIONS REDUCTION PARTNERSHIP WITH EPA

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Bonneville Power Administration (BPA) recognizes SF_6 gas as a "greenhouse gas" with a high potential to have a global warming effect. SF_6 gas is also a vital insulating and extinguishing gas in high-voltage equipment. SF_6 technology has significantly improved reliability and reduced the cost of high-voltage equipment. Presently, there is no substitute for SF_6 gas in the high-voltage application. BPA staff worked with personnel at the Environmental Protection Agency's (EPA's) Office of Air and Radiation during the development of a national voluntary SF_6 reduction program. As a charter partner, we understand the significance of reducing SF_6 releases from our electric power system to the atmosphere and support the objective of this partnership. BPA, as a federal agency, is committed to be at the forefront on environmental issues.

On April 1, 1999, BPA signed a memorandum of understanding (MOU) with EPA. An exception was made for direct measurement protocol, rather than Attachment B's inventory reporting protocol. There are several reasons for not making the beginning/ending year inventory protocol. First, with more than 300 substations spreading over a service area of more than 300,000 square miles, it is not very feasible to track gas bottle inventory or gas carts, and some residual gas bottles may be left at the substations and not accounted for in the inventory record. Also, gas capacity on equipment nameplates is not always accurate. Gas carts are not approved by the Department of Transportation (DOT), making it illegal for them to be transported via public highways, and carts are intended for temporary gas storage during maintenance only. And it is difficult to know how much gas is added to a breaker from a cart. Lastly, the data from the inventory protocol could be misrepresenting the actual gas emissions.

BPA prefers reporting to EPA the "direct" measurement on gas added to high-voltage equipment. The actual emission amount is recorded by weighing the filling gas bottle on a floor scale before and after filling. These data are input into a central database. Direct measurement helps identify the leaking equipment and establish a record. This information is valuable to BPA maintenance in prioritizing repair or replacement of the equipment.

The annual report submitted to EPA consists of the following:

1. The total amount of SF_6 contained in high-voltage equipment in service on the BPA system.
2. The amount (lb.) of SF_6 gas added to return high-voltage equipment to normal full pressure.
3. The average leakage rate during the past year.

4. The cumulative average leakage rate during the total period since the MOU was signed.
5. A list of SF_6 equipment replaced with more modern equipment during the reporting year and to date.
6. As requested, BPA will furnish its SF_6 policy documents and any changes in policy or procedures concerning SF_6.

To achieve reliable SF_6 emissions data protocol, BPA personnel invested much time and effort in properly coordinating the information, which was completely collected for 1999 and submitted to EPA. The total emissions for 1999 will serve as the beginning year baseline. The following information indicates the operation equipment and corresponding SF_6 leak rate within BPA's electric power system for the year 1999:

- SF_6 gas filling of leaking equipment = 3,737 pounds
- SF_6 in operating breakers = 191,768 pounds
- SF_6 in operating high-speed ground switches = 534 pounds
- SF_6 in operating current transformers = 49,034 pounds
- SF_6 in GIS equipment = 176,489 pounds
- The leak rate for 1999 is 0.89 percent

To minimize SF_6 gas release into the atmosphere, BPA has adopted the following policies regarding the use of SF_6 gas:

- BPA will report the amount of SF_6 in pounds required for refilling all leaky equipment. Using a weight scale is recommended to determine the amount of SF_6 released by the equipment. (Handling the heavy gas bottles properly and with hand-truck assistance is necessary.)

- All SF_6 handlers are required to take the SF_6 gas-handling course at BPA or be trained by someone who has taken this course.

- Used SF_6 gas shall be recycled.

- All new SF_6 gas applications shall allow recycling.

- Prevent release of SF_6 gas or faulted SF_6 gas into the atmosphere.

- SF_6 gas losses from electrical equipment are to be reduced by 1) improved equipment design; 2) timely intervention by electricians to repair gas leaks; 3) development of improved gas-handling techniques.

- At the end of every calendar year, BPA will accumulate the SF_6 emissions records from all leaking equipment and submit the data to EPA.

The BPA Transmission System has approximately 15,000 miles of power lines with 357 substations scattered throughout the states of Washington, Idaho, Oregon, and part of

Montana. High reliability is very important to the BPA system. Limiting the SF_6 leaks in equipment is also critical to the reliability. Maintaining more than 700 SF_6 gas breakers in a large system is not a simple task. The first alarm point is typically set for when SF_6 pressure loss reaches about 5 percent below full pressure. Achieving low leakage in the system will minimize long-distance travel for maintenance crews.

An aggressive breaker replacement program has been established to reach BPA's reliability objective. The criteria for replacement are based on environmental, safety, reliability, maintenance, and performance factors. Some high-pressure breakers, such as the air-blast or two-pressure SF_6 type, can have catastrophic failure and can launch bushing fragments long distances. BPA is purchasing the more reliable modern SF_6 breaker design with only one interrupter instead of the multiple complex interrupters. Older breakers of the 1960s and 1970s vintage are high in maintenance requirements, due to corrosion, lack of spare parts, and other problems. A significant number of the older manufacturers are out of business, so no customer service is available. Over the past several years, many older live-tank breakers have been replaced with more modern dead-tank SF_6 breakers that consume less gas and have better seismic design. We anticipate this replacement program to change out most of the unreliable old breakers by 2006. Last year, 12 older SF_6 two-pressure breakers were replaced at a cost of approximately $5 million. Upgrading the breaker system eases the maintenance workload and eliminates loss of revenue resulting from power outages.

BPA is very interested in state-of-the-art technology on SF_6 leak detection instruments. A laser-imaging camera for leak detection has been leased several times to find leaks in substations with substantial leakage. If the laser-imaging camera is determined to be a feasible tool for our operations, BPA may consider purchasing an SF_6 detecting system. Since 1996, a maximum leakage rate of 0.5 percent has been established in our new 230 kV and below breaker specification.

In closing, the heightened concerns about global warming have prompted BPA to initiate an even more proactive approach in preventing SF_6 releases. It is a privilege to be a charter member of EPA's partnership program. BPA will strive to become a "greenhouse gas-conscious agency" and will do its part to reduce SF_6 releases into the atmosphere!