Abstract:

SF_6 – PG&E's Experience or One Utility's Success Story

In the spring of 1999, PG&E Corporation signed the Memorandum of Understanding with the Environmental Protection Agency (EPA) to reduce the fugitive emissions of Sulfur Hexafluoride (SF_6). The corporation joined in the partnership basically for three reasons: to address the global issue of greenhouse gases; to identify leaking, possibly failing, utility equipment; and to corral the escalating cost of SF_6 gas purchases. An annual reduction goal of 50% in fugitive emissions from the target year of 1998 was to be achieved within three years.

This is the analysis of the benefits and challenges of meeting that goal by a utility that has faced deregulation, soaring electric demand, bankruptcy, and finally recovery. This paper focuses on a frank discussion of those lessons learned, the benefits achieved, and some challenges yet to be conquered. As a utility that serves one in twenty Americans our efforts can reach global proportions as we continue to strive for a better environment for all.

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PG&E has a long history of environmental excellence. Our environmental policy statement says it clearly:

> PG&E Corporation is committed to being an environmental leader by providing safe, economical, and reliable products and services in a responsible and environmentally sensitive manner.

PG&E demonstrates this by participating in collaborative ventures such as the California Climate Action Registry, the Energy Star Program, the Green Lights Program, and the Voluntary Reporting of Green House Gas Emissions and Reductions Program.

To fully understand the complexities of our SF_6 success story, it is important to get an understanding of who PG&E is. Pacific Gas and Electric Company and PG&E Corporation are two distinct entities. PG&E Corporation is the parent of the utility, Pacific Gas and Electric Company. The subsidiaries of PG&E Corporation primarily include the National Energy Group (power generation and gas transmission) and Pacific Gas and Electric Company (the utility). The Memorandum of Understanding (MOU) that was signed by the Corporation and the Environmental Protection Agency (EPA) was implemented within the utility with some additional involvement from the National Energy Group.

Pacific Gas and Electric Company (the utility) is located entirely within the state of California. It covers an area of about 70,000 square miles, serving 4.5 million electric customers on over 131,000 circuit miles of electrical lines. There are also 3.7 million gas customers served by 43,000 miles of natural gas lines. We do this with an employee force of 18,400 men and women. We sell gas and electric service to one in twenty Americans.

In 1998, when the discussion regarding partnering with the EPA first came about, electric deregulation was in its infancy in California. By 1999, as a condition of deregulation, PG&E had sold its fossil generating plants. In 2000, the California energy crisis was full blown. Projects previously on hold due to uncertain economic conditions became critical. The increased demand required additional installation of large gas circuit breakers. In addition, under these conditions, it became difficult to remove in-service circuit breakers. When the company filed Chapter 11 Reorganization in 2002, among the first projects funded were upgrades to the electric system in the form of new transformers and circuit breakers. Repair of leaking gas equipment was deemed highly cost effective and given a similar priority.

To meet the goals of the MOU, a team was put together from our Environmental Affairs (EA) and Electric Transmission Departments. EA was responsible for completing the EPA forms and assisting Transmission in developing the SF_6 handling policy and procedure. Transmission was responsible for educating those in the field and for implementing the SF_6 handling policy and procedure.

Under the MOU, PG&E agreed to two emission-reduction goals of reducing annual SF_6 emissions by:

1) 50% as compared to the 1998 base year by 2002;
2) 60% as compared to the 1998 base year by 2007.

While the second goal does not seem to be so difficult in comparison to the first, it should be understood that PG&E is increasing the quantity of in-service SF_6 by approximately

10% per year. In addition, the 60% reduction equates to roughly a 2% leak rate of the SF_6 equipment inventory.

In developing the initial baseline emission rate and associated emission rate reduction goals, it was quickly determined that were a number of challenges facing the team. These included:

- Determining the actual quantity of SF_6 purchased. At the time, multiple vendors serviced 24 maintenance headquarters. Their billing and the purchasing system did not always include SF_6 purchases, which were sometimes hidden within a vendor service fee.
- Determining the actual quantity of SF_6 sent for recycling or disposal. Again, depending on the specific vendor and maintenance headquarter, the billing may or may not have included a breakout of the SF_6 quantity sent for recycling or disposal.
- New or replacement circuit breaker purchasing contracts (also from multiple vendors) did not always specify if the supplied circuit breaker was fully charged or at some base or other pressure.
- Educating our operational employees regarding the need and benefits of the new SF_6 procedure.

To address these problems, the team endeavored to simplify the process and educate those on the front lines. This involved selecting one full-service SF_6 vendor with the understanding that the vendor and PG&E were partners in meeting the terms of the MOU. In addition to supplying the SF_6, and removing SF_6 for recycling from out-of-service circuit breakers, the vendor is also required to complete an annual cylinder inventory and coordinate the activities of the leak detection subcontractor.

Through this full-service vendor program, SF6 costs are no longer absorbed or hidden locally; PG&E has negotiated a bulk rate for SF_6 purchases including purchasing our own recycled SF_6 at a reduced rate; SF_6 transactions are tracked; and the annual SF_6 inventory is efficiently completed. Unexpected benefits include the elimination of cylinder

demurrage fees; greater communication between the maintenance headquarters (leading to reduced inventory demands); removal of numerous not-in-service cylinders from the facilities; and the establishment of a heel return program.

Under the heel return program, the vendor weighs the returned cylinders, calculates the SF_6 quantity removed, and charges for that amount, rather than the total quantity of SF_6 in the full cylinder. This program has increased the accuracy of our annual SF_6 emission rate calculations.

The leak detection program operates at the facility level through tracking circuit breaker "topping off" requirements. Once a leaking circuit breaker is identified, the leak detection subcontractor is brought in to use a laser to "shoot" the equipment or circuit breaker. The camera, in turn, displays the SF_6 plume via a real-time monitor. Leak detection protocol includes laser imaging all equipment containing SF_6 at given facility, not just the potential leaking breaker. Through this program, significant leaks have been identified in equipment that was previously considered gas-tight such as gas buggies and gauges.

To address the various circuit breaker vendors, PG&E is striving to reduce the number of suppliers and has revised purchase contract language to specify that the vendor is to supply circuit breakers with a minimal quantity of SF_6 rather than full.

In regard to circuit breakers to be removed from service, once the circuit breaker is identified, its SF_6 is immediately removed and sent for recycling. This is in contrast to past practices of removing the SF_6 in a less than timely fashion.

Finally, PG&E's Transmission Department initiated an ongoing campaign to educate the employees at the facility level on the negative impacts caused by SF_6 leaks, from both an environmental and cost perspective.

Regarding the success of the overall program, as noted in Figure 1, SF_6 emissions have decreased dramatically since program initiation. We are confident we will achieve our emission rate reduction goals. Additionally, implementation of the above changes have not only reduced the emission rate, but also saved PG&E's ratepayers roughly $300,000 in avoided replacement SF_6 costs since program inception.

New opportunities facing PG&E's SF_6 program include incorporating the Power Generation Department in the program and potentially banking the greenhouse gas reductions as a result of our efforts under the auspices of the California Climate Action Registry.

More importantly, while good work has been done and will continue to be done in reducing SF_6 emissions, the real opportunities lie in finding an environmentally less detrimental gas replacement for existing circuit breakers or a new transmission technology that does not require circuit breakers / insulating chemicals at all – the next generation.

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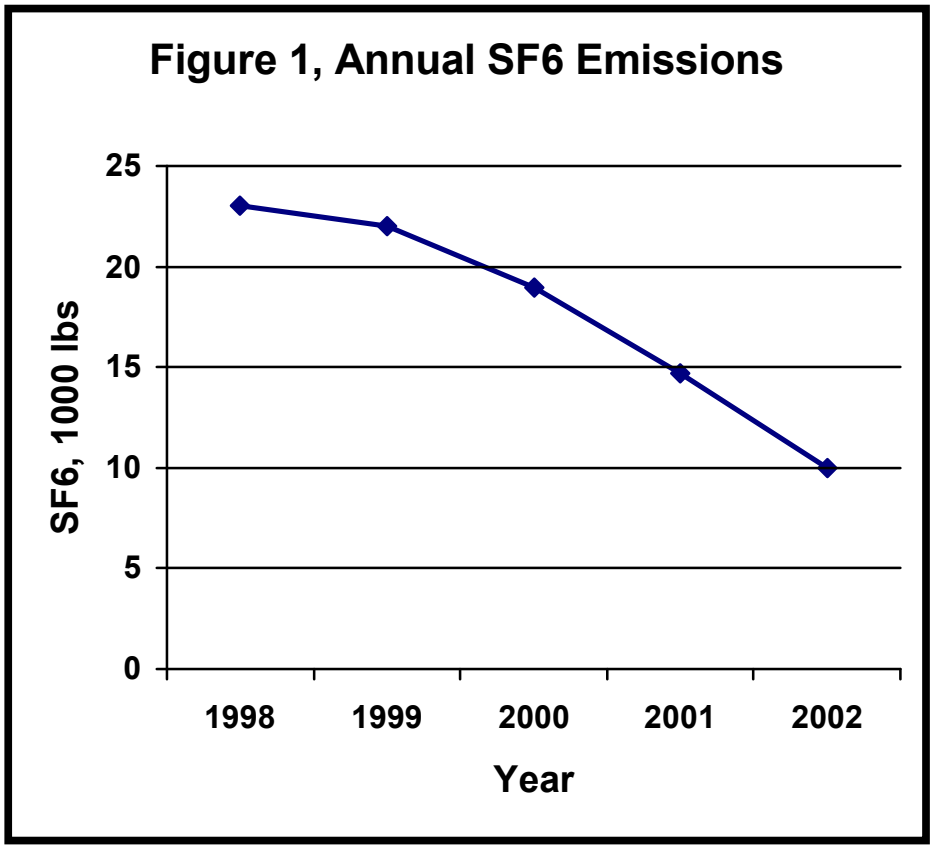
Figure 1, Annual SF6 Emissions
SF6, 1000 lbs
25
20
15
10
5
0
1998
1999
2000
2001
2002
Year

Speaker/ Author Biographies

Sven Thesen

Mr. Thesen has Bachelor of Science in Chemical Engineering from North Carolina State University. He has been employed with Pacific Gas and Electric (PG&E) for just over a year as a senior environmental consultant focusing on air related issues. Prior to PG&E, Mr. Thesen held various environmental positions in industry and consulting.

During his ten year career in the environmental field he has addressed a wide range of environmental issues including Part 70 and PSD permitting, solid and hazardous waste disposal and remediation, NPDES permitting, environmental auditing and due diligence, regulatory reviews and interpretations, SARA requirements, NSPS and MACT analysis and permitting, SDWA compliance and UST registration and removal. In addition, he is an avid backpacker and is considered a "Hiking God" by some for being the first to walk both the Appalachian Trail and the Pacific Crest Trail in one calendar year.

Sandra Olson

Mrs. Olson has a degree in Environmental Sciences from San Jose State University with an advanced certificate in Hazardous Materials from University of California, Santa Cruz. She has been employed with Pacific Gas and Electric for 20 years working first in the energy efficiency field and for the last ten years in the environmental arena.

While at PG&E, Sandra has managed the PCB compliance program for the utility in addition to her responsibilities for the respirator and ergonomics programs for her department. Spending seven years in the Transmission Department gives Sandy a firm grasp of the operational needs of a utility company while her educational training rounds out her skills as an environmentalist. She is an avid textile specialist spending her spare time between her state of the art sewing room of computerized sewing machines and attending to her first passion, her family.