ITC Transmission Case Study

ITC Transmission is the nation’s first fully independent electricity transmission company. With a service territory of approximately 7,600 square miles, the company delivers electricity to nearly 4.9 million people in southeastern Michigan. The company is focusing on enhancing operation, maintenance, and investment in its transmission infrastructure. As an important step toward improved operation, ITC Transmission recently implemented several initiatives that reduced sulfur hexafluoride (SF₆) emissions by 79 percent within a two-year period, and in the process, also reduced annual expenditures to replace and manage SF₆ gas losses.

Company Profile

In April 2004, ITC Transmission became the first, fully independent electricity transmission company in the United States, following the transfer of ownership from DTE Energy to its parent company, ITC Holdings Corp. ITC Transmission owns a fully regulated, high-voltage system that transmits electricity to local electricity distribution facilities. The company currently serves a population of approximately 4.9 million throughout 13 southeastern Michigan counties, including the Detroit metropolitan area. With the combined service areas of ITC Transmission and Michigan Electric Transmission Company, LLC (METC), ITC Holdings Corp. is operating the largest transmission system in Michigan’s Lower Peninsula. Additionally, on December 20, 2007, ITC Midwest LLC, a subsidiary of ITC, completed the acquisition of the transmission assets of Interstate Power and Light Company (ILP), a subsidiary of Alliant Energy Corporation. The transaction included the purchase of 6,800 miles of IPL transmission lines at voltages of 34.5 kilovolts and above, and 170 stations and substations in portions of Iowa, Minnesota, Illinois, and Missouri.

Seeking to improve its operations, ITC Transmission is exploring opportunities to enhance the transmission system’s integrity and reliability. In 2007 the company joined the U.S. Environmental Protection Agency’s (EPA) SF₆ Emission Reduction Partnership for Electric Power Systems. The Partnership is a voluntary program between government and electric utilities with a focus on developing and implementing cost-effective operational and technical solutions to reduce SF₆ emissions and improve SF₆ handling and maintenance.
Initiatives to Reduce SF₆ Emissions

ITCTransmission is reducing its SF₆ gas emissions through two key programs: (1) an infrastructure improvement program, which addresses equipment replacement, and (2) a preventive maintenance program, which targets equipment repair. ITCTransmission has made a strong commitment to reduce emissions by accelerating the repair and, when appropriate, early retirement of leaky equipment. Tracking the costs associated with repair operations including replacement gas and labor, as well as the costs associated with installing new equipment, facilitates decision-making.

1. Infrastructure Improvement Program

The utility’s infrastructure improvement program consists of two equipment replacement projects, targeting circuit breakers and gas insulated switchgear (GIS).

Benefits of Joining the Partnership

ITCTransmission joined the SF₆ Emission Reduction Partnership for four reasons:

• To institute an industry standard for reporting of emissions and inventory tracking, resulting in reduced SF₆ gas purchases and related cost savings;

• To implement best practices in SF₆ gas handling, resulting in emissions reductions on the transmission system;

• To collaborate with other utility Partners and EPA in developing and improving industry best practices in SF₆ gas handling and maintenance; and

• To be recognized nationally for efforts and successes in reducing greenhouse gas emissions.

Circuit Breaker Replacement Project

ITCTransmission has an ongoing circuit breaker replacement project that began in 2003. Under this project, the utility tracks the frequency of maintenance of its gas breakers to help prioritize which ones should be replaced. In making the decision to replace equipment, maintenance costs and performance records of leaking breakers are reviewed and compared to the costs to replace the breakers. The utility also considers other benefits associated with new breakers, such as greater equipment reliability. To date, the company has selected variations of SFMT models supplied by Mitsubishi Electric as its equipment replacements, chosen in part due to their quality of design and leak-tight construction. The Mitsubishi SFMT models have low gas leak rates, from 0.1 percent to 1 percent per year.

Since beginning the circuit breaker replacement project, ITCTransmission has replaced or decommissioned 57 leaking circuit breakers, varying in size and designed for 120 kV to 345 kV transmission systems with a vintage range from 1964 to 1982. With the new circuit breakers installed, the manufacturer conducts periodic checks to verify that gas system pressure, quality, and moisture are normal. In the event of a low-pressure alarm signal, the manufacturer investigates any evidence of leaks under warranty. As a result of these replacement efforts, ITCTransmission reduced its SF₆ gas emissions and continues to operate the successful replacement program. To date, no detectable SF₆ leaks from newly replaced equipment have occurred.

1 With the recent acquisition of METC by ITC Holdings Corp., the SF₆ emission reduction initiatives implemented by ITCTransmission are beginning to be implemented by METC.

2 Typical circuit breakers to be replaced include: Westinghouse 145SF / 3450SF; General Electric ATB-362-7Y, 7, and 5; and ITE 230-GA20-20B / 242GA-40-20C / 145GA-30-20C / 145GA-63-20C / Delle Alsthom FB-2A.

3 Regarding outdoor circuit breakers, there is an agreement between the supplier and the utility that the breaker will maintain a maximum permissible leak rate of 1 percent per year, otherwise the breaker will be repaired for free by the supplier.
GIS Infrastructure Replacement Project

The second major project in the Infrastructure Improvement Program focuses on replacement of GIS. The utility’s transmission system acquired four in-service GIS sites manufactured between 1970 and 1972: St. Antoine (ITE), Caniff (Delle Alsthom–Cogenel), Midtown (Delle Alsthom–Cogenel), and Cato (Delle Alsthom–Cogenel). Following the transfer of ownership and commencement of independent operation in 2004, ITCTransmission determined that these substations were a significant source of SF6 emissions. The leaks and intensive maintenance required for each site prompted the decision to replace the aging GIS with newer equipment.

In 2005, the utility initiated a plan to replace these installations over a period of four to six years. The maintenance-prone, dual-pressure gas circuit breakers at the St. Antoine facility were of particular concern, and, therefore, this site was targeted first.

By the second quarter of 2007, equipment in the St. Antoine and Caniff substations had been replaced with new equipment supplied by Mitsubishi Electric that has a combined SF6 nameplate capacity of 8,050 pounds.4 Workers recovered the gas remaining in the replaced GIS, verified that the gas met acceptable criteria for reuse, and then returned the recovered gas to ITCTransmission’s inventory for future use.

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4 The written commercial contract stipulates the replacement GIS has a leak rate of less than 0.1 percent per year and if it fails to meet these specifications it must be repaired for free by the supplier.
A total of 25 bottles or 2,875 pounds of SF₆ gas was recovered and added to inventory. The Midtown and Cato substations, with a combined SF₆ nameplate capacity of 5,000 pounds, have replacement pending.

The GIS replacement project at the St. Antoine (ITE) site alone enabled the company to eliminate approximately 104 man-hours of labor in the winter and 24 man-hours in the summer. Additionally, the company has eliminated the need to purchase approximately 16 cylinders of SF₆ gas annually (about 1,840 pounds) to replace losses from the leaking equipment.

2. Preventive Maintenance Program

ITCTransmission’s equipment replacement programs are complemented by an aggressive maintenance plan launched in 2004, which includes repairing leaks in equipment not ready for replacement. ITCTransmission’s workforce has since taken on a number of repairs including installing bolted-on clamp/seal rings around leaking gas breaker bushings, repairing gas breaker tube fittings, replacing seals at interrupter flanges, and replacing leaking underground pothead flange valves. Generally these repairs are being made on equipment manufactured between the 1970s and 1990s.

Company Achievements

Through the initiatives described above, ITCTransmission is implementing industrial best practices and maintenance techniques in handling SF₆ gas into its standard operating procedures—achieving significant emissions reductions and operational efficiencies.

- In 2005, the first full year for which the utility tracked its SF₆ gas emissions, ITCTransmission calculated a total annual emissions estimate of 13,725 pounds, using EPA’s recommended mass-balance method. In 2006, the utility calculated 6,546 pounds of annual emissions—an impressive emissions reduction of 52 percent. This significant reduction is largely due to the replacement of leaking equipment and the aggressive preventive maintenance program.

- In 2007, ITCTransmission further reduced SF₆ emissions to 5,743 pounds, representing a 58 percent reduction from baseline SF₆ emissions.

- With standard reporting and inventory tracking, ITCTransmission is now able to identify and forecast SF₆ gas requirements, facilitating cost savings on SF₆ purchases. As a direct result of its efforts, ITCTransmission reduced the need to purchase SF₆ from gas suppliers as ITCTransmission’s reliance on its own inventory increased.

For more information on the SF₆ Partnership go to:
www.epa.gov/electricpower-sf6

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