

EFCOG Workshop for Achieving Excellence in Facility Maintenance - August 29 to September 1, 2011

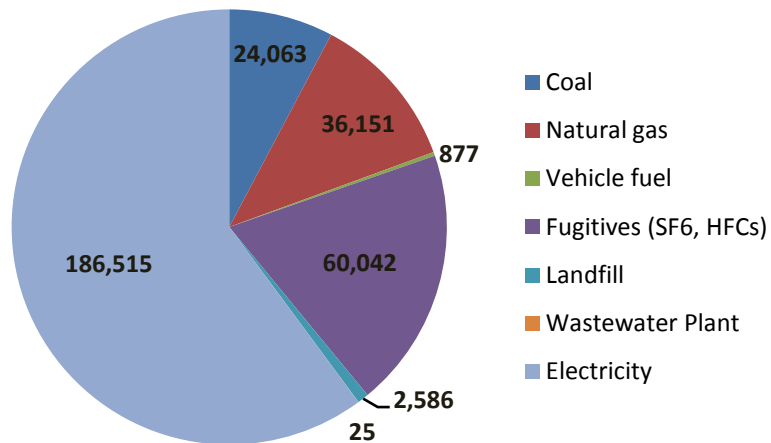
Managing SF₆ Emissions at Argonne National Laboratory

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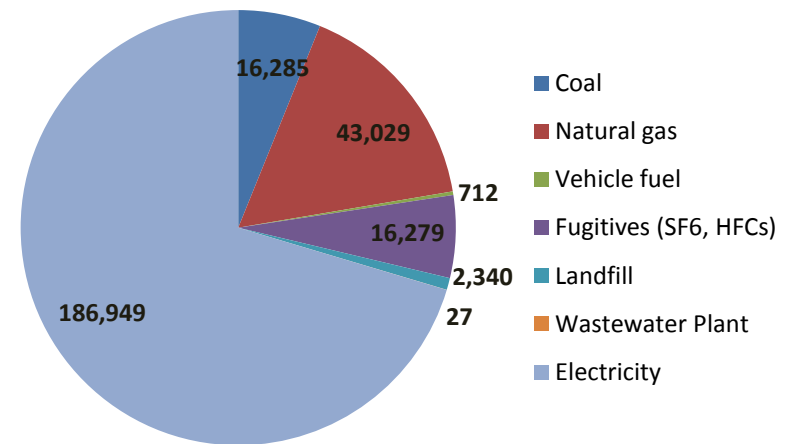


Argonne National Laboratory Scope 1 & 2 GHG Emissions

2008
310,260 mt CO₂e



2010
265,621 mt CO₂e



Uses of SF₆ at Argonne

- Electrical switch gear
- Electron Microscopes and the Sub-Angstrom Microscopy and Microanalysis (SAMM) facility
- Accelerators (Argonne Tandem Linac Accelerating System (ATLAS), Wakefield, Advance Photon Source)
- Van de Graaff Generators



Argonne Tandem Linac Accelerator System (ATLAS)



- Started in 1985, ATLAS is the world's first superconducting linear accelerator for heavy ions.
- Energy domain best suited to study the properties of the nucleus.
- The program hosts 200 to 300 users per year.
- The unit holds 7.5 tons of SF₆.

Argonne Tandem Linac Accelerator System (ATLAS), cont.



Wakefield Accelerator



- The Argonne Wakefield Accelerator research focuses on the physics and technology of advanced methods to accelerate charged particles.
- The goal is to identify and to develop techniques leading to more efficient, compact, and inexpensive particle accelerators.
- Currently, the system holds ~ 25 lbs. of SF₆.
- System is undergoing an expansion; SF₆ volume will be ~ 125 pounds.

Argonne's Electron Microscopy Center (EMC)



- Operates and administers 7 full-time user instruments.
- Includes the Sub-Angstrom Microscopy and Microanalysis (SÅMM) facility. State-of-the-art lab space for advanced electron microscopy.
- Conduct materials research using advanced micro structural characterization methods.
- The Tecnai is the EMC's current premier analytical transmission electron microscope.
- Resolution to 0.05 nanometers.
- On average the systems hold about 18 pounds of SF₆.

Argonne's Electron Microscopy Center, cont.

High Voltage Tank for the Tecnai Electron Microscope



SF₆ Cylinder Supply System



Advanced Photon Source

- Nation's most brilliant hard x-ray beams
- Materials science, chemistry, biology, protein crystallography, earth & environmental science, physics...
- 42 beamlines in operation
- Over 3000 users each year
- Operates year-round, more than 5000 hours/year
- Reliability over 95%
- Innovative x-ray instrumentation and operating modes



Advanced Photon Source

Existing SF₆ Recovery System to be Upgraded



SF₆ Cylinder Supply System



SF₆ Reduction Activities – 2010

- Inspected major SF₆ users facilities
 - Purchased leak detection equipment with P2 funds
 - Performed leak detection of systems
 - Replaced worn parts; tightened fittings and connections
 - Identified actions for further reduction of leaks
- Better determination of SF₆ losses by mass balance instead of SF₆ purchases
 - Provides more accurate determination of losses
 - Pinpoints location of losses



SF₆ Emissions – FY 2010

- SF₆ purchased in 2008 was 7,800 lbs.
- A 115 lb cylinder of SF₆ costs about \$1,200
- Approximately 1400 lb SF₆ emitted in FY 2010
 - Argonne Wakefield Accelerator (AWA) (805 lb)
 - Materials Science Division (MSD) accelerator/electron microscopes (357 lb)
 - Facilities Maintenance (123 lb)
 - ATLAS accelerator (115 lb)
- MSD and ATLAS accelerators have recovery systems
- Wakefield operations required periodic shutdowns and opening of system resulting in SF₆ emissions (no recovery)

SF₆ Reduction Strategies – 2011

Argonne Wakefield Accelerator

- Wakefield Accelerator was Argonne's largest SF₆ emitter in FY 2010
 - Emitted 805 lb SF₆ in FY 2010
 - Equivalent to 9,620 tons CO₂
 - Emissions caused by need to open system on a periodic basis and leaks
 - All gas placed in the system is eventually lost
 - Volume of emissions and facility expansion (5X) made this system a priority for SF₆ emission control

Wakefield SF₆ Recovery

- Dedicated SF₆ recovery system
 - Automated system has compression ratio of 10,000:1
 - Recovery could be close to 100%
 - Cost of system (DILO) - \$77K
- Loss of SF₆ expected to be minimal
 - 805 lb (9,620 tons CO₂e) in FY 2010
 - Due to system expansion, future losses estimated to be ~ 7,000 lbs. without recovery system



SF₆ Program – Additional Emission Reduction Actions

- Use of scales to weigh full cylinders and cylinders to be returned
 - “Empty” SF₆ cylinders can have 0.6 – 1.0 lb residual (psi=0)
 - Improve mass balance calculation (take credit for heel weights returned to vendor in “empty” cylinders)



SF₆ Program – Additional Emission Reduction Actions



- Evaluating the purchase of a portable SF₆ recovery system for smaller users (e.g., electron microscopes).
- Conducted a brief survey of SF₆ users to keep the focus on reducing emissions and to keep the dialogue going.

SF₆ Users Information Survey

- 1. Name
- 2. SF₆ Facility
- 3. How many cylinders (including weight) have you purchased to date in FY 2011?
- 4. How much SF₆ have you used (put into a system) to date in FY 2011?
- 5. Have you instituted any new leak detection and repair or other methods in FY 2011 to decrease SF₆ emissions?
- 6. Could you weigh SF₆ cylinders upon receipt and prior to returning to vendor (to calculate heel weights) if a scale were provided?
- 7. Could you recover SF₆ currently emitted if a recovery system (portable or dedicated) were available?
- 8. Do you anticipate your SF₆ usage in the future to increase, decrease, or remain the same?
- 9. What future changes in your facility could affect future usage of SF₆?
- 10. Any other comments or information.

Survey Responses

- The leak detector helped identify input lines and valves to replace. Placed an order for a gas recovery system. Without the recovery system all of the SF₆ in place in the system will be lost.
- The leak detector helped us identify and seal most leaks. We identified equipment that needs to be modified or replaced. A pipefitting contractor is needed to address remaining leaks.
- MSD plans to fix leaks and add a second vacuum pump to the recovery system so that no gas is vented during recovery.

Questions?

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