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Waste Minimization and Pollution Prevention Initiatives Within Argonne National Laboratory-East (ANL-E) Boiler House Operations

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Abstract

The mission of ANL-E Plant Facility and Services-Utilities and Systems (PFS-US) is to operate and maintain utility services in a cost-effective manner, while utilizing new and innovative methods whenever possible.

PFS-US operates an on-site coal burning boiler plant that generates steam for use throughout the Laboratory as a source to heat buildings, as well as for use in research experiments. In the recent past, PFS-US has embarked upon a series of initiatives to improve operating efficiency of boiler house operations. The results of these projects have had the following impacts on boiler house performance and operations: 1) boiler house efficiency and operations have improved, 2) boiler house operating costs have been reduced, 3) specific operating and maintenance costs have been avoided or eliminated, and 4) the amount of waste and pollution generated has been reduced. Through the implementation of these initiatives, over $250,000 of revenue and cost savings have been incurred by ANL-E. In addition, the Laboratory and DOE will benefit annually from revenues, cost savings, and the reduction of environmental liability resulting from these initiatives.

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Waste Minimization and Pollution Prevention Initiatives Within Argonne National Laboratory-East (ANL-E) Boiler House Operations

DESCRIPTION OF WORK

Boiler House

An inventory of high and low sulfur coal totaling 42,303 tons (21,512 tons of high and 20,791 tons of low) was on hand. The inventory contained a large amount of fines, which in most cases went unburned. When coal was charged into the boiler, the fines were too small to be spread by the stoker and spilled into the ash pit and trucked out with the waste stream or went unburned as small particulate. There was also more excess air used to keep the fines in suspension to burn them. The excess air added to NO_x emissions.

To reduce the fines, a power screen was first rented and then purchased. The first affect on #5 Boiler was that excess air was reduced from an average of 45% to 30%. NO_x was reduced from approximately .550#/mmbtu to under .400 #/mmbtu. By screening the coal, the boiler was able to run without as many upsets. Due to caking of the coal, the feed of coal is more even and a steady steaming rate is achieved. This also proves very effective during extremely cold weather. When fines are removed, the coal does not cake into large, unwieldy pieces or stick in the chutes, which adds to additional operating and maintenance problems.

Prior to sifting coal to reduce the fines, an outlet was established through our supplier, Illinois Coal. Two downstate Illinois cement kilns were contacted; both were very agreeable to purchasing and using the fines for fuel in their operations. Two prices were established — one for high sulfur and one for low sulfur. High sulfur sells for $6.00 per ton, and low sulfur sells for $12.35 per ton.

High sulfur coal was burned off first, bringing this fuel to a zero inventory. Low sulfur (sulfur content <1%) coal is now the only type used and meets EPA emissions criteria. This also allowed the Scrubber to be idled, but still exhaust waste gases through the baghouse. The idling of the scrubber yielded a $147,000.00 annual cost avoidance due to reducing/landfill charges (because of elimination of lime spraying), plus additional electrical operating costs.

Following the consumption of high sulfur coal, low sulfur then becomes the fuel of choice. High sulfur fines were separated from this inventory and yielded $8,714.00. After the coal yard inventory was substantially reduced, the coal yard "base" was excavated, screened, and sold as "fines." The coal yard base consisted of 6 to 12 inches of coal that over the years had become driven into the ground. Coal yard base that was removed and recycled yielded $27,744.00. The modified and current operating practice is to screen coal and to sell the fines. This is an on-going practice that has generated total revenue for the Laboratory of well over $100,000.00 to this point.

In addition, prior to reducing on-site coal inventory, there was storm water run-off from the Coal Yard to Saw Mill Creek because the elevation of the outfall is at yard level. Preventing such run-off was accomplished by constructing run-off ditches approximately 4-feet deep and bordering the north and east boundaries of the coal storage yard. This eliminates any National Pollutant Discharge Elimination System (NPDES) violations.

Through the monitoring of NO_x via the continuous waste gas analyzer, PFS-US was able to identify the accumulation of additional infiltrated air that affected boiler efficiency and drafting. The induced draft fan had to run at a higher rpm to maintain draft in the furnace, which also required more steam for the turbine drive. In the Spring of 1993, all the economizer access panels were removed and refitted. This was the major source of infiltrated air. The induced draft fan then began to operate in mid-range instead of maximum, thereby reducing energy costs and steam consumption.

Coal Inventory

Currently, there is approximately three to four months of coal on site. PFS-US is currently working toward the goal of an inventory system where coal is remotely stored and trucked on-site as needed. This just-in-time delivery system will reduce run-off contamination and fugitive emissions. The previous coal storage yard became pressed for storage space and could not accommodate such an operating plan. Where inventory has been reduced to 7,000 tons, a supply of 15 days on-site is being evaluated. Recently, a dock terminal has been located that is capable of storing and trucking coal within the framework of ANL's operating criteria.

Dealkalizer

During October 1995, the Dealkalizer for the Boiler House make-up water was returned to operating condition after a substantial rehabilitation and modification. The unit was inoperable for over ten years.

The function of the Dealkalizer is to reduce the Bicarbonate alkalinity in the make-up water. The end result is reduced boiler blowdown to the waste stream, which reduces chemical costs, and ultimately reduces fuel inputs. Chemical costs for the 1st Quarter FY96 have been reduced by 55% per million pounds of steam. An estimated savings of $25,000.00 has been achieved. —

Internal Boiler Cleaning

Currently, scheduled boiler maintenance on all five boiler internals are cleaned with high-pressure water. This procedure successfully removes scale that had accumulated in the boiler tubes over a period of time. High-pressure water cleaning is preferable to acid cleaning because it does not generate another waste stream of spent acid.

Removal of the scale increased the heat transfer rate to generate steam and effectively reduced fuel rates. Initial cost avoidance was $60,000.00 annually. This is an on-going practice (or as needed) for both fire sides and water sides of the boilers.