Economic Optimization of SNCR at the Scrubgrass Power Plant

Philip A. Jones
Scrubgrass Generating Plant, PG&E National Energy Group, 2151 Lisbon Road, Kennerdell, Pennsylvania 16374
E-mail: **phil.jones@neg.pge.com;** Telephone: (814) 385-6661 x14; Fax (814) 385-6704

Summary

Two 400,000 lb/hr circulating fluidized bed (CFB) boilers at the Scrubgrass Generating Plant in Kennerdell, Pennsylvania went into operation in 1993. The two units provide steam to a single turbine/generator, the output from which is 83 MWe (net). In response to the Environmental Protection Agency's (EPA's) NOx Budget Program, a selective Non-Catalytic Reduction (SNCR) ammonia injection system was installed in 1999 and went into operation in June of that year. The installed system made it possible for the plant to reduce its NOx emissions by as much as 80%, from uncontrolled rate of roughly 0.15 lb/mmbtu to 0.30 lb/mmbtu depending on the characteristics of the fuel burned.

The Scrubgrass SNCR system is operated during the NOx trading season each year, from May through September. It has been operated for a total of 7500 hours through September of 2001. A 19% solution of aqueous ammonia is injected through 3 air-assist atomizing nozzles in each of the two cyclones serving each boiler. Cyclone inlet temperatures at Scrubgrass range from the high 1500s F to the low 1700s F. The maximum ammonia flow rate to each boiler is 200 gallons/hour. As the uncontrolled NOx varies significantly with the fuel being burned, ammonia usage can vary significantly as well. Ammonia slip was measured with the NOx reduction rate running in the 50% or higher range, and was found to be very low – 0.35 ppm to 1.5 ppm. No ammonia salt plume has been sighted above the stack during operation of the ammonia injection system at Scrubgrass, and no ammonia smell has been detected in the ash.

The point of the SNCR system is to cost effectively reduce NOx emissions during the NOx trading season. To help accomplish this goal from a tactical standpoint, the control system has been programmed to continuously adjust the ammonia flow rate based on ammonia costs relative to NOx allowance prices. Unit costs for ammonia (dollars per gallon) and prices for NOx emissions allowances (dollars per ton) are entered into the plant's distributed control system (DCS). The DCS is programmed to hunt for the lowest total cost of ammonia added plus NOx generated by periodically adjusting ammonia flow rate up or down, in response to the results obtained by the previous two changes.

From a strategic standpoint, as NOx allowance prices rise and fall, it can be advantageous for an organization to sell NOx allowances in advance. In order to determine the optimum number of credits that should be sold in advance at a given NOx allowance price and ammonia cost, it is necessary to have a good understanding of the relationship between NOx production and ammonia injection rates. At Scrubgrass, the DCS automatically runs a weekly test showing the effect of ammonia flow on NOx emissions. The ammonia flow rate is varied from 0% to 100% and back down to 0% in steps of 10%. The flows are held steady for 10 minutes as each step is made so that the effect on the NOx emission rate can be determined. The information gained from this testing program was used to determine that the economic optimum number of NOx allowances that the Scrubgrass plant should sell in advance for the 2003 through 2007 ozone trading seasons was 700. The SO_2 emission rate that the plant's boilers will have to achieve during the NOx trading season to make this number of allowances available is 0.051 lb/mmbtu.