Somerset SCR Experience after Three Operating Ozone Seasons

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Summary

AES Somerset Station added an SCR system to Unit 1 over the winter of 1998/1999 to further reduce NOx emissions. This was the first large coal-fired SCR retrofit installed in the U.S. and was placed in service in June 1999. The Somerset SCR system has operated during three ozone seasons. This summary describes the Somerset SCR system and provides an update to the operating experiences along with the alterations and improvements that have been incorporated into its operation and hardware. The summary includes the major lessons learned in the areas of ammonia vaporization, NOx monitoring, and other operating issues. Outage inspection findings in the reactor, flues, and ammonia injection grid areas are noted, and catalyst performance activity results are provided.

The Somerset Power Station consists of a 675 MW B&W radiant boiler firing eastern bituminous medium sulfur coals and a GE steam turbine/generator. Formerly know as the Kintigh Station, owned and operated by the New York State Electric and Gas Company, Somerset was purchased by AES in May 1999 and AES became the operator of the plant. Somerset was originally placed in service in 1984 with an electrostatic precipitator and wet flue gas desulfurization system to meet New Source Performance Standards for particulate and SO_2. Dual register low NOx burners were used for NOx control.

Since Somerset in 1998 was the single largest source of NOx emissions in the state of New York, AES decided to further reduce emissions by installing an SCR system. Babcock & Wilcox designed, fabricated, and installed this retrofit SCR system in just nine months from contract award to in-service date. This SCR was designed for 90% NOx reduction with an ammonia slip of 3 ppm after 24,000 operating hours. Plant NOx emissions were reduced to 0.055 lb/MBtu from a design operating NOx level of 0.55 lb/MBtu. The reactor houses 897 m^3 of 6 mm plate-type catalyst in three of its four stages. Additional design criteria included the use of anhydrous ammonia, an SO_2 oxidation limit of 0.75% across the catalyst, and a fuel sulfur content of 2.5–3.0%. The reactor and connecting flues were located in the preferred arrangement with the reactor above the flues that connect the air heaters to the precipitators. This is a single reactor with a division wall combined with dual inlet and outlet flues that contain isolation dampers and bypass flues with dampers. The system was designed with an economizer bypass for temperature control and can be isolated in the non-ozone season with a full bypass. A zone flow control system with multiple nozzles was the ammonia injection grid basis of design.

The SCR system for Somerset was specified and designed for base load operation, the perceived plant mode for the foreseeable future in 1998. With a pressure drop limitation to avoid ID fan revisions for the short project schedule, there were no static mixers installed before and after the ammonia injection grid. The size of the economizer bypass flue was limited to the available openings of the boiler structural steel and below the existing coal conveyor system to achieve the specified schedule.

Somerset's SCR system has operated successfully through the first three years, including significant non-ozone season operation. Approximately 16,000 hours of SCR operation have been accumulated at the time of this summary submittal. Current catalyst activity level indicates another two years of expected operation with the existing catalyst and no significant increase in ammonia slip.

Startup and operation have produced a series of lessons learned and findings. For auxiliary equipment, early operation indicated difficulties in the ammonia vaporization system. This system is a closed loop design in the storage area. In order to achieve the reliable flow of vaporized ammonia to maintain storage tank pressure, revisions to the electric vaporizer outlet piping were required. The storage tanks are located about 2500 feet from the ammonia flow control and injection equipment.

Like many other SCR projects, Somerset experienced difficulties with the NOx analyzer system. An extractive NOx analyzer system that extracted flue gas from multiple points across the inlet and outlet flues for a composite average sample was originally installed. After many attempts to remedy and salvage the original design, the solution was to replace the analyzers and extractive system with an in-situ opto-electronic type analyzer system. The new system has provided reliable and accurate NOx monitoring for ammonia flow control.

After some initial periods of operation there was some internal binding of the large louver dampers located in horizontal flues. Some vertical deflection of the damper outer frame assembly was causing the internal binding. Reinforcement of this outer frame and seal readjustment resolved the problem.

Initial internal inspections after the first ozone season indicated some material deposits inside the ammonia injection grid piping. Deposits were removed and changes were made in the operation of the dilution air fans during low load and non-ozone season operation. Subsequent inspections have indicated no additional deposits. Ammonia injection grid nozzle inspections have revealed minimum accumulations and only a few scattered deposits surrounding the nozzles with no pluggage. The internal flue and reactor inspections have shown minimum deposits indicating that the gas flow is sweeping the horizontal surfaces clean. There have also been no ash deposits laying out on or within the catalyst indicating adequate flow distribution/direction entering the reactor and adequate cleaning by the steam sootblowers.

Catalyst activity and overall SCR performance have been monitored very closely since startup. Catalyst poisoning from coal constituents like arsenic in this eastern bituminous coal was of some concern. Catalyst sample analysis of both the coupon type and full length plates has indicated activity levels that exceed those expected for the period of operation and will result in the catalyst meeting performance past the 24,000 hour design.

Occasionally, ammonia has been detected when precipitator flyash is wetted with FGD sludge and mixed with quick lime for landfill. While this detection is not attributed to increased ammonia slip, some injection grid adjustments have eliminated any further detection in the landfill process. AES is considering the installation of additional mixers to add flexibility to operation.

SCR effects on downstream equipment have not been a problem at Somerset. After three ozone seasons, AES has not experienced a noticeable increase in pressure drop across the air heater indicating minimum deposits from ammonia bisulfate formation. Also, with the low SO_2 oxidation across the catalyst only minimal differences to the wet stack emissions have been detected with the SCR in service.

Many lessons have been learned from the early operating experiences at Somerset. This SCR system has been successfully integrated into the plant operation and is providing the desired overall NOx reduction.