

O&M Considerations in SCR Reactor Design

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Southern Company's approach is to design SCR reactor and balance of plant components while optimizing capital and O&M costs. For the purposes of this presentation we shall limit the discussion to catalyst management plan and reactor damper design.

A unit's catalyst management plan is a primary factor in SCR project costs. The catalyst management plan for a given application is contingent upon a number of issues including the following: unit size, NO_x reduction efficiency, ammonia slip, unit fuels, catalyst guarantee life, operating temperature, and SO₂ oxidation.

In regards to the impact of unit fuels, Southern Company has faced a challenge familiar to other utilities in relatively high arsenic content. The subject unit is a 700 MW pulverized coal fired unit. The average ratio of As/CaO in this unit's fuels is almost 200, whereas the ratio for Southern Company's typical SCR application is 50. Southern Company considered five different catalyst management options to mitigate the impact of catalyst deactivation due to arsenic poisoning. These options included blending limestone with the fuels, increasing the reactor catalyst volume, reducing the catalyst guarantee lifetime (original design was 16,000 hrs), and combinations of increased catalyst volume and reduced lifetime. The incremental catalyst life cycle costs ranged from \$4.3 million to \$7.0 million. Ultimately, Southern Company chose an option increasing the catalyst volume by 39%, reducing the guarantee catalyst life to 12,000 hours and adding an incremental NPV catalyst life cycle cost of \$6 million.

Southern Company evaluates the catalyst lifetime for each SCR project. Consider the evaluation for a 240 MW unit with an SCR performance of 55% NO_x reduction, 5 ppm ammonia slip, and 1% SO₂ oxidation. This unit was evaluated for a catalyst life of 16,000 hours and 32,000 hours over 20 years. The 16,000 hour catalyst required a capital cost of \$876,000 and a NPV of \$1,820,000 in comparison with a capital cost of \$ 1,089,000 and NPV of \$2,134,000 for the 32,000 hour catalyst.

The SCR reactor operating temperature significantly impacts the catalyst management plan. Operating temperature determines the need for supplemental heating of the SCR reactor inlet gas to maintain operation above the ammonia bisulfate formation temperature. The operating temperature also affects the catalyst design. For a Southern Company SCR application a 6% increase in operating temperature resulted in a 69% increase in SO₂ oxidation, 15% increase in catalyst life, 6% increase in catalyst pressure loss, when maintaining the NO_x reduction and ammonia slip.

Selection of reactor dampers must weigh the importance and costs of degree of isolation, seal air consumption, and maintainability. Southern Company has compared double louver, guillotine and diverter or flap dampers for SCR applications. After qualitative and quantitative comparisons, Southern Company has chosen diverter dampers.