

73 Post-Combustion NO_x Control

Program Overview

Program Description

The objective of this program is to minimize total costs and maximize reliability and performance of selective catalytic reduction (SCR) and other post-combustion NO_x control systems. The program develops operations and maintenance (O&M) guidelines and documents best practices and procedures consistent with optimal SCR operation. Assessments, methodologies, and databases provide plant owners and operators with the tools to make informed choices, comply with regulatory mandates, and capitalize on NO_x credit markets. Two new interest groups were initiated in 2008—one to share best practices in SCR catalyst management, and one to assess mitigation methods for large particle ash (LPA).

Industry Needs and Issues Addressed

- SCR operability issues affecting system reliability and performance, such as large particle ash (LPA), sulfur dioxide (SO₂) oxidation, and ammonia slip
- Best SCR O&M practices and strategies, including catalyst regeneration options, catalyst management, utilization of advanced sensors, and test protocols
- Enhanced NO_x reduction from existing SCR systems to comply with future regulations (e.g., Clean Air Interstate Rule, or CAIR) and take advantage of the emerging NO_x credit market
- Assessments of alternative post-combustion control technologies to comply with future “near-zero” regulatory requirements and offer more cost-effective alternatives to SCR

Impact

- Development and implementation of best practices and operational improvements for SCR systems.
- Lower O&M expenditures, optimized operation, and reduced downtime for units equipped with SCRs
- Enhancements to existing SCR systems, which will allow members to profit from emerging NO_x credit market

Key Accomplishments

- Performance assessments of SCR catalyst reconditioning
- Protocol for laboratory testing of SCR catalyst samples
- Annual SCR workshops and webcasts on key issues
- Assessments of improved performance achieved through enhanced ammonia / NO_x mixing and advanced catalysts
- SCR O&M guidelines, updated annually
- Laboratory and field assessments of continuous ammonia monitors
- Catalyst management software and best practices for total minimization of total cost of operation
- Predictive tool for deposition of ammonium bisulfate (ABS) and subsequent fouling of air heater surfaces
- Case studies of impacts of fuel quality considerations (e.g., Powder River Basin and lignite) on catalyst performance and longevity
- Objective assessments of near-commercial NO_x control technologies

Current Year Objectives

- SCR catalyst reconditioning, recycling, and disposal guidelines and economics
- Best practices and considerations of year-round operation
- Large particle ash mitigation methods
- Annual updates of web-based SCR guidelines
- Quantifiable assessments of catalyst management options
- Annual SCR workshops, including technical presentations, panel discussions, plant tours
- Webcasts on key SCR issues
- Demonstration of enhanced SCR performance through advanced ammonia/NO_x mixing
- SCR O&M cost database
- Studies on new generation catalysts and flue gas impacts to optimize SCR performance
- Review of emerging post-combustion NO_x control technologies

Industry Involvement

- Estimated 2009 funding: \$2.5M

Program Technical Lead

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Summary of Projects

Project Number	Project Title	Value
P73.001	Operating and Maintenance Guidelines for Post-Combustion Systems	Develops tools, guidelines, and best practices critical to optimum SCR operation, including catalyst management considerations, catalyst reconditioning options, SCR test protocols, and resolution of critical operability issues including large particle ash (LPA), ammonia, and catalyst deactivation.
P73.002	Evaluation of Advanced SCR and Emerging Post Combustion NO _x Control Technologies	Allows members to significantly lower NO _x emissions with existing SCR systems through improved ammonia/NO _x mixing technologies and the latest advanced catalysts (higher efficiency, lower cost), and to find cost advantages for the most promising emerging NO _x control technologies through compliance with near-term regulations and probable future regulations.

Project Descriptions

P73.001 Operating and Maintenance Guidelines for Post-Combustion Systems (050267)

Issue

The industry needs reliable SCR O&M guidelines and resolution of critical operability issues for SCR and other post-combustion systems to minimize costs and maximize system performance.

Description

This project will produce guidelines, technical reports, software, webcasts, and conferences aimed at minimizing costs and maximizing performance of SCR and other post-combustion NO_x control systems. Specific efforts will include assessments of reconditioned catalysts (including activity, mercury, and SO₂ oxidation); catalyst management options; understanding and mitigation of large particle ash (LPA) impacts; year-round SCR operation; protocols for catalyst testing; advanced instrumentation for monitoring ammonia, NO_x, and SO₃ (including tunable diode laser and Fourier Transform Infrared

Spectroscopy [FTIR]); catalyst disposal and recycling alternatives; prediction and resolution of air heater fouling; web-based SCR guidelines; and webcasts on specific subjects of interest. In addition, members of this program can attend the annual 2½-day EPRI SCR Workshop, to find out about the latest developments in SCR technology, information sharing, and pertinent issues.

Value

- Substantial reduction in the cost of SCR operation, achieved through best O&M practices and resolution of critical operability issues such as large particle ash
- Minimization of system costs through selection of the optimal SCR catalyst management strategy, including consideration of catalyst reconditioning options
- Minimization of SCR downtime
- Capitalization of NO_x credit market by minimizing outlet NO_x levels

How to Apply Results

Members responsible for SCR operation and performance can use the tools and guidelines developed through this project in optimizing their SCR systems with respect to O&M practices, auxiliary hardware choices, testing procedures and protocols, and catalyst management strategies.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
SCR O&M Guidelines Update: Key topics covered in the SCR O&M guidelines will be annually updated.	12/31/2009	Technical Update
SCR O&M Web Casts: Three webcasts will be conducted focusing on key SCR O&M topics.	12/31/2009	Technical Resource
SCR Catalyst Reconditioning Guidelines and Economics: This report will include additional data and findings on regenerated catalyst activity, mercury oxidation, SO ₂ /SO ₃ (lab, pilot, and full scale), and longevity, including catalyst replacement strategies.	12/31/2009	Technical Update
Annual SCR Workshop and Proceedings: This project sponsors an annual SCR workshop, which includes presentations on recent operating experiences from end users and content on key issues such as SO ₃ mitigation, large particle ash, catalyst management strategies, latest developments from manufacturers, panel discussions, and a plant tour.	12/31/2009	Technical Report
Large Particle Ash Mitigation Methods: Continuation of the previously developed knowledge base provides insights into possible root causes and mitigation methods. In addition, site-specific case studies will be conducted. The LPA Interest Group will be continued as a forum in which best practices can be shared and R&D priorities identified.	12/31/2009	Technical Update
Disposal and Recycling of Spent SCR Catalysts: This project provides further study of cost-effective options to manage the old fleet of spent catalyst including catalyst reuse, recycling, and disposal.	12/31/2009	Technical Update

Product Title & Description	Planned Completion Date	Product Type
Boiler/SCR Performance Optimization Methodology: A methodology will be developed to enable SCR operators to determine the SCR inlet NO _x level that results in the optimum combination of boiler- and SCR-related NO _x control operating and maintenance expenses. The methodology weighs SCR-related expenses, such as reagent and replacement catalyst, against boiler-related expenses, such as potential waterwall wastage associated with high levels of combustion staging.	12/31/2009	Technical Update

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Annual SCR Workshop and Proceedings: This project sponsors an annual SCR workshop, which includes presentations on recent operating experiences from end users and content on key issues.	2010	Workshop, Training, or Conference
SCR O&M Webcasts: Three webcasts will be conducted focusing on key SCR O&M topics.	2010	Workshop, Training, or Conference
SCR O&M Guidelines Update: Key topics covered in the SCR O&M guidelines will be annually updated.	2010	Technical Update
SCR Catalyst Reconditioning / Recycle Guidelines and Economics: Long-term data will be developed on performance of reconditioned SCR catalysts including NO _x , SO ₂ oxidation, and mercury oxidation.	2010	Technical Update
Large Particle Ash Mitigation Methods: This report will provide documentation of performance and best practices for LPA mitigation.	2010	Technical Report
Spent SCR Catalyst Recycling and Disposal Options: Demonstrations will be conducted of spent catalyst treatment options.	2010	Technical Update

P73.002 Evaluation of Advanced SCR and Emerging Post Combustion NO_x Control Technologies (046821)

Issue

To comply with anticipated regulations and to capitalize on the emerging NO_x credit market, the performance of existing SCR systems will need to be enhanced through advanced catalysts, enhanced NO_x-to-ammonia mixing methods, and advanced instrumentation. In addition, alternative NO_x mitigation technologies (e.g., to SCR and selective noncatalytic reduction [SNCR]) need to be objectively evaluated and demonstrated.

Description

This project will develop and demonstrate technologies that significantly reduce NO_x in existing SCR systems. In addition, this project will identify, assess, and demonstrate post-combustion NO_x control technologies with potentially cost-effective intermediate NO_x control capability (e.g., between SNCR and SCR). Engineering evaluations and assessments will provide unbiased information about new vendor offerings with respect to the costs and capabilities of nearly and recently commercialized novel NO_x control technologies.

Value

- Significant reduction in NO_x emissions from existing SCR systems through improved ammonia/NO_x mixing technologies and advanced catalysts, resulting in higher efficiency and lower cost
- Cost advantages for the most promising emerging NO_x control technologies through compliance with near-term regulations and probable future regulations
- Capitalization of NO_x credit market by minimizing outlet NO_x

How to Apply Results

Members responsible for SCR performance can use information and findings developed through this project to enhance the NO_x reduction capabilities of their existing SCR systems through improved ammonia-to-NO_x mixing, superior catalysts, and other means. In addition, documented performance demonstrations of emerging post-combustion NO_x control technologies will help members to make informed decisions regarding future NO_x control systems needed for ratcheted NO_x levels and to capitalize on the emerging NO_x credit market.

2009 Products

Product Title & Description	Planned Completion Date	Product Type
Interlayer Ammonia / NO_x Mixing: This report will provide documentation of full-scale demonstration of Interlayer Ammonia/NO _x Mixing.	12/31/2009	Technical Report
Review of Emerging Commercial NO_x Control: Objective assessments will be provided of performance and operational impacts of emerging post-combustion NO _x control technologies, which will be added to EPRI's Post-Combustion Emerging Technologies website.	12/31/2009	Technical Resource
Portable SCR Test Facility: Data will be compiled from an in situ device for online measurement of SCR catalyst activity. The device will be used at demonstration sites to enable Program 73 members to obtain data for effective catalyst management programs.	12/31/2009	Technical Update
Demonstration Results of Advanced SCR Catalysts: This project will include assessments and evaluation of the next generation of SCR catalysts, which, in addition to offering greater NO _x removal efficiency, will increase mercury oxidation while minimizing SO ₂ oxidation.	12/31/2009	Technical Update
Automated Ammonia Injection Grid: This project will provide an assessment of benefits and implementation requirements for automated ammonia tuning system concepts, with the goal of enabling on-line system tuning in support of year-round SCR operation.	12/31/2009	Technical Update

Product Title & Description	Planned Completion Date	Product Type
Multipoint FTIR / TDL Monitors: Assessments will be made of continuous monitor performance (NH ₃ , NO _x , or SO ₃), along with case-study evaluations of implementation approach, operational benefits, and associated costs. Follow-on efforts will include studies of how continuous multipoint data can be integrated within process control and the use of optimization systems.	12/31/2009	Technical Report

Future Year Products

Product Title & Description	Planned Completion Date	Product Type
Intermediate NOx Control Technologies Field Assessments: This project will provide field assessments and data on emerging post-combustion NO _x control technologies.	2010	Technical Report
Ammonia Injection Grid: A demonstration will be conducted of automated ammonia injection for optimized SCR performance.	2010	Technical Report
Portable SCR Test Facility: Long-term data will be collected from a portable SCR test facility at multiple sites.	2010	Technical Report
Multipoint monitors: Long-term data will be collected on tunable diode laser (TDL) and FTIR monitors for ammonia, SO ₃ , and NO _x . Research will explore attainable resolution for ammonia concentration contours through implementation of intersecting multi-path measurements.	2010	Technical Report
Integration of multipoint monitors for process control: A demonstration will be conducted of continuous multipoint data integrated in process control and/or optimization systems.	2011	Technical Report
Demonstration of advanced catalysts: A full-scale demonstration will be conducted of advanced SCR catalysts.	2011	Technical Report