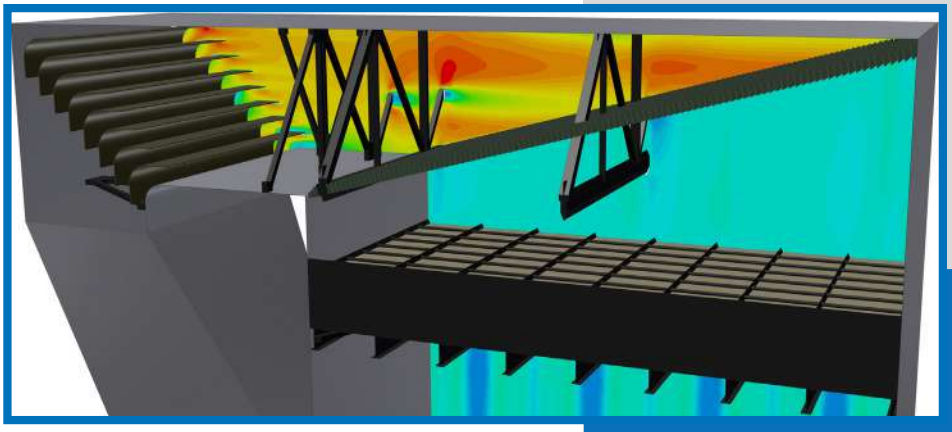
SCR Services

From SCR design to SCR systems services, we work with you to *maximize your SCR performance*

Fuel Tech, Inc has a broad range of engineering experience and "real world" operating know-how of selective catalytic reduction (SCR) systems and the design and supply of SCRs for the control of NO_X and ammonia (NH_3) slip emissions on boiler units, simple cycle and combined heat and power systems and incinerators firing coal, gas, oil, and other types of waste fuels.



Selective Catalytic Reduction systems help prevent the release of nitrogen oxides from a variety of power and industrial processes.

Our primary focus centers around optimizing process design and improving the performance of SCR systems on coal- and natural gas-fired utility units. Our experience base also spans the full range of SCR applications, including industrial and MSW systems. The design of SCR systems, catalyst selection and evaluation, installation and start up support, ammonia injection grid tuning, performance testing, trouble shooting and operation and maintenance support are among the many services offered.

Fuel Tech's experience includes the design, operation and maintenance of SCRs, including more than 55,000 MWs of SCR process design and 20,000 MWs of AIG Tuning services. Fuel Tech's services are targeted to diagnose operating problems and minimize the operating costs of the SCR system. The end result is to enhance overall performance and to assist end users in implementing the most comprehensive catalyst strategies.

After the SCR system has been installed and put into operation, Fuel Tech provides a full range of SCR Management Services that go beyond the typical services provided for catalyst management. Fuel Tech's comprehensive service program is not simply focused on the performance of the catalyst or the catalyst itself, but encompasses all of the systems and criteria that may impact the overall SCR system performance from flow distribution or ash layout through boiler operation and load curves. As such, our approach does not adhere to traditional catalyst management or catalyst supplier contractual concepts. We partner with owners and operators to ensure that NO_X removal objectives are achieved at the lowest cost without impacting the operating reliability of the units.

- Minimize operating costs of SCR systems
- Optimize SCR process design
- 55,000+ MW experience in SCR process design
- 20,000 MW experience in AIG tuning services

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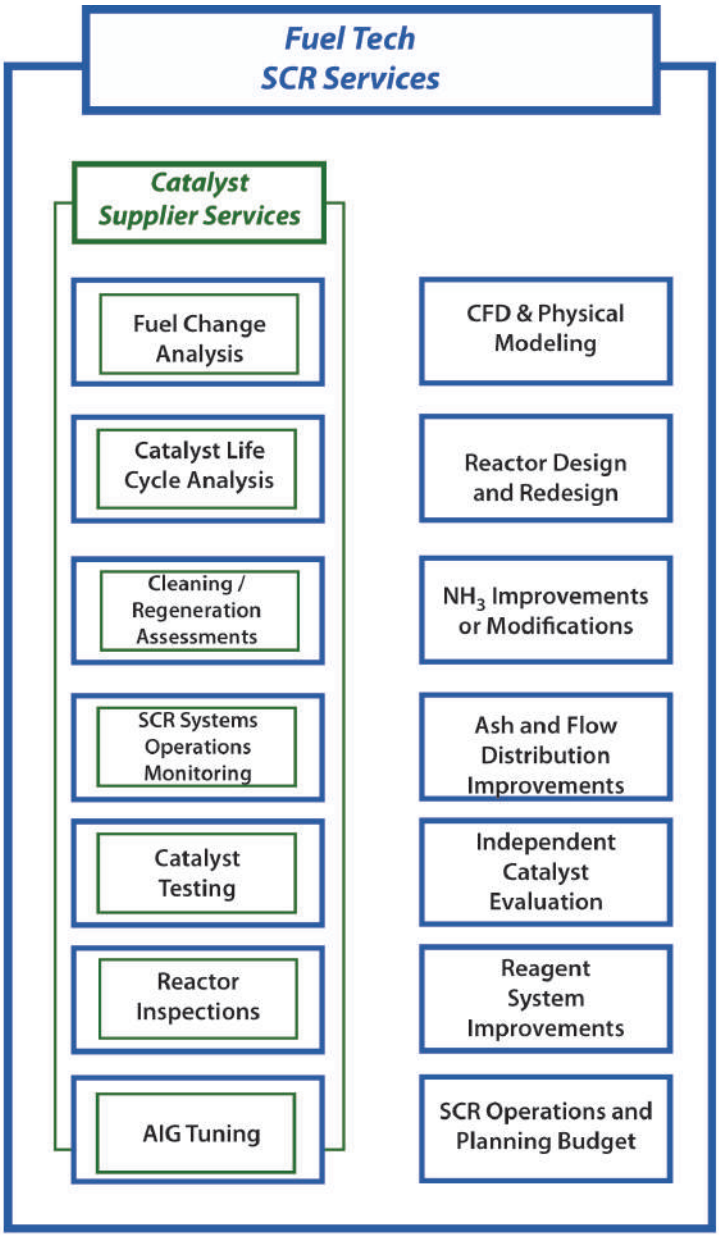

SCR Troubleshooting and Optimization

Fuel Tech assists operators in identifying on-going operational issues, while designing and applying improvements to the SCR system in order to enhance overall performance. Our specific services provided in this area include: system audits and inspections, catalyst test sample removal and analysis, field test measurements, catalyst cleaning and regeneration consulting, outage planning and supervision, fuel change evaluation with respect to effects on SCR behavior, and computational and experimental flow modeling and optimization.

Our comprehensive program of services regarding catalyst management and SCR system performance enhancements is one of a kind in the industry. The program is not simply focused on catalyst management, but encompasses overall SCR system management. Cost effective and reliable operation of the SCR systems for the owner's fleet is of the utmost importance to Fuel Tech.

The consulting services associated with Fuel Tech's programs are designed to compliment and supplement the performance guarantees and warranties provided by the SCR and/or Catalyst OEMs.

Fuel Tech offers an extensive array of SCR services, which are customized to specifically address your needs. Our team of engineers use a combination of field and theoretical studies to solve the SCR industry's most difficult problems.

Enabling SCR Performance to Exceed Expectations

Requirements for High Availability or Low Emissions SCR Operation

Fuel Tech can review SCR operational procedures to improve operation necessary to achieve high availability and lower emission rates. This includes all operating sub-systems of a typical SCR. Catalyst management plans can be updated accordingly to coincide with unit outage schedules.

Specification Review & Preparation

Fuel Tech has assisted many customers with the review and preparation of turnkey specifications with special attention paid to design data, guarantees, process design, equipment, catalyst design, and potential impacts on boiler and unit operation. Special attention is given to catalyst selection, ammonia injection grid design, flow modeling and flow correction requirements, reagent system requirements and performance guarantees.

Proposal Evaluation

SCR system and catalyst proposal evaluations are critical in determining that the client's needs are understood and being addressed. Fuel Tech's assistance in this area can range from a complete technical assessment of a proposed design and its compliance with the specification to an analysis of a specific technical issue. Fuel Tech will assist in the development of evaluation criteria, preparation of questions to the suppliers, and recommendation of the most qualified and cost competitive supplier.

SCR Process Arrangement & Component Design

Fuel Tech develops parameters for each SCR design to meet project requirements. Historical boiler operating data is reviewed and assessed to determine unit process data at full, mid and low loads. Fuel Tech assists clients in selecting SCR catalyst performance requirements so that the client's NO_x emission control strategy is effectively met with minimum negative impact due to NH_3 slip and SO_2 to SO_3 oxidation. This includes defining process distribution requirements so that long term performance and operational demands are achieved.

Clients include:

- Electric Utilities
- Independent Power Producers
- Engineering Firms
- OEMs
- Component Suppliers

Ash deposits are a common problem in SCR systems, which can be alleviated through the application of fluid dynamics and utilizing baffling and screening hardware.

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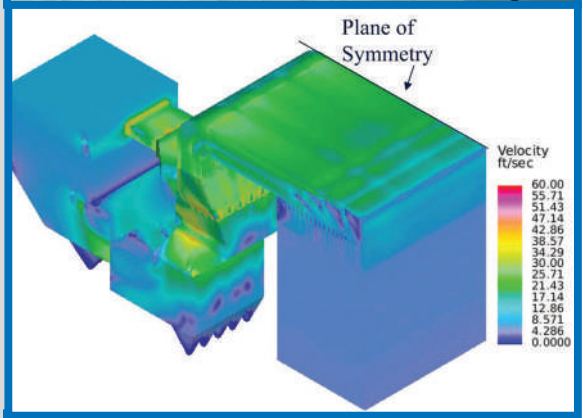

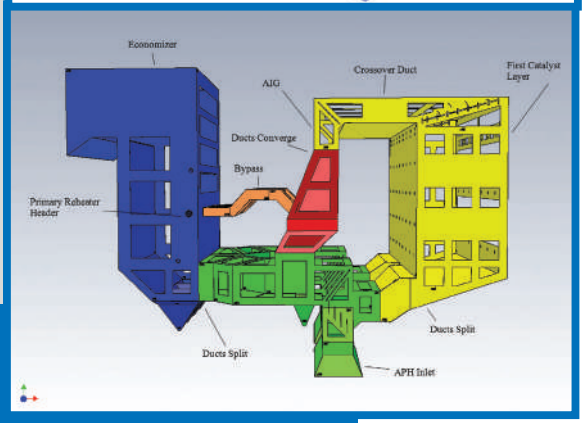

Three dimensional computer models allow for the design and testing of computational fluid dynamics and experimental fluid dynamics models. All are used to study the complex relationship between cause and effect in SCR systems.

CFD Modeling Services

With the use of Computational Fluid Dynamics (CFD) modeling, we recommend optimal arrangements of duct configuration and flow correction devices in order to maintain appropriate flue gas velocities, temperature distribution, fly ash distribution, and NH_3 to NO_X distribution within the SCR system. Fuel Tech provides our clients with the sizing, design, and configuration of the NH_3 injection grid, static mixer, large particle ash screen, GSG™ Graduated Straightening Grid, and turning vanes.

Physical Flow Modeling Services

For many years, Fuel Tech has performed physical (or experimental) flow modeling services for SCR systems. The material of construction for the physical model can be either carbon steel- or acrylic-based on the application requirements. Only state-of-the-art measurement devices are used during the modeling, including: hot-wire anemometers, pitot tubes, and photoionization detectors.

Modeling carried out using a three dimensional flow model similar in geometry to the full size SCR system can include the following:

- Boiler backpass from economizer inlet plane
- Boiler backpass economizer and ash hoppers
- Superheat pass and Reheat pass dampers
- SCR inlet ductwork complete
- Flow correction devices including flue gas flow straightening grids at SCR inlet
- LPA screen, ammonia injection grid
- SCR reactor - either single or dual reactors as required
- Catalyst
- Bypass system complete
- SCR outlet ductwork up to, and through, all airheaters
- Dampers and expansion joints
- Ductwork and reactor ash hoppers
- Internal structural members (grating, braces, gusset plates)

Testing Criteria

- System Pressure Loss
- Fly Ash Dropout
- Flue Gas Velocity Distribution Upstream of NH_3 injection
- Flue Gas Velocity Distribution Upstream of the Catalyst
- Velocity Distribution at Large Particle Ash Screen
- Velocity at Floors and Structural Members
- Flue Gas NO_x and NH_3 Distribution

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