Comprehensive Environmental Excellence
Air Quality Control Systems for Thermal Power Plants
L&T–Sargent & Lundy Limited (L&T-S&L) provides engineering and consulting services to electric power businesses across the globe. A joint venture of Larsen & Toubro Limited, India and Sargent & Lundy L.L.C, USA, the Company has been in operation since 1995. It combines deep domain expertise, internationally-aligned systems and processes, as well as unique 3D modeling techniques to converge technical consultancy with high-end solutions and delivery.

**Joint Venture Partners – The Power of Two**

L&T-S&L offers the complete gamut of power plant engineering and consultancy services – ranging from concept to commissioning and beyond.

**Larsen & Toubro Limited, India (L&T)** is a major technology, engineering, construction, manufacturing and financial services conglomerate, with global operations. L&T addresses critical needs in key sectors - Hydrocarbon, Power, Infrastructure, Process Industries and Defence. The Company’s products are exported to over 30 countries worldwide.

**Sargent & Lundy L.L.C, USA (S&L)**, with over 125 years of experience in providing engineering services exclusively focused on power, is acknowledged as a premier force worldwide. S&L has extensive and credible consulting experience for gas-based open and combined-cycle projects, coal-based and environment projects, renewable energy and nuclear projects. S&L has been continuously ranked among the top five US-based firms in Power by *Engineering News Record* (ENR).

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<tr>
<th>Basic &amp; Detail Engineering</th>
<th>Owner’s Engineering</th>
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<td>Lender’s Engineering</td>
<td>Power System Studies</td>
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<td>Renewable Energy Services</td>
<td>Renovation and Modernisation</td>
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<td>AQCS Consulting Services</td>
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L&T-S&L and Sargent & Lundy (S&L) offer a wide range of Air Quality Control System (AQCS) Services to reduce PM, SOx, NOx and Hg emissions in coal-based power plants across the world.

Over the past two decades, S&L has enabled many plant owners to develop strategic compliance plans to address myriad regulations at federal and state levels. These strategic planning activities have led to an industry-leading role for S&L in the engineering, design, construction, and deployment of emission control technologies across the U.S. utility industry.

S&L’s expertise and knowledge-base enables L&T-S&L to provide comprehensive and proven engineering services to meet the emerging needs of stringent environmental emission control norms.

**S&L’s Environmental Retrofit Experience Summary**

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<tr>
<th>Technology</th>
<th>Units</th>
<th>MW</th>
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<tr>
<td>Selective Catalytic Reduction</td>
<td>&gt;58</td>
<td>&gt;30,800</td>
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<tr>
<td>Selective Non-Catalytic Reduction</td>
<td>&gt;30</td>
<td>&gt;11,500</td>
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<tr>
<td>Dry Flue Gas Desulphurisation</td>
<td>&gt;35</td>
<td>&gt;16,600</td>
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<tr>
<td>Wet Flue Gas Desulphurisation</td>
<td>&gt;43</td>
<td>&gt;21,400</td>
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<tr>
<td>Flue Gas Desulphurisation System Upgrades</td>
<td>&gt;32</td>
<td>&gt;27,600</td>
</tr>
<tr>
<td>Mercury Control – Activated Carbon</td>
<td>&gt;136</td>
<td>&gt;61,200</td>
</tr>
<tr>
<td>Mercury Control – Co-benefit analysis</td>
<td>&gt;70</td>
<td>&gt;31,600</td>
</tr>
<tr>
<td>Dry Sorbent Injection – SO₂</td>
<td>&gt;28</td>
<td>&gt;15,100</td>
</tr>
<tr>
<td>Dry Sorbent Injection – SO₂/ HCl</td>
<td>&gt;41</td>
<td>&gt;19,700</td>
</tr>
<tr>
<td>Fabric Filter</td>
<td>&gt;64</td>
<td>&gt;26,200</td>
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<tr>
<td>Electrostatic Precipitator</td>
<td>&gt;48</td>
<td>&gt;23,400</td>
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Services offered for AQCS

**CONCEPTUAL DESIGN AND IMPACT ASSESSMENT**
- Design Basis
- Technology Selection
- Layout Optimisation
- ID Fan Draft Assessment
- Auxiliary Electrical Study
- Utility Consumption Study
- Preliminary Project Schedule
- Reagent Selection Study
- Make-up Water Treatment Study
- Byproduct Disposal Study
- Economiser Bypass Study
- GGH v/s Wet Stack Study
- DCS Integration Study
- Economic / Cost Estimates
- Bid Specification
- Bid Evaluation and Recommendation
- Feasibility Report & DPR

**EXECUTION PHASE**
- Project Management
- System Design
- System Integration
- Procurement Support
- Detail Engineering
- Vendor Drawing Review
- 3D Modelling Review
- Performance Test Procedure
- Commissioning Support
Comprehensive experience and technical acumen enable the environmental experts of L&T-S&L and S&L to help plant owners to comply with regulatory norms, while minimising the risk and capital expenditure. The following sections briefly describe the key technologies that would suit the specific requirements of your plant.

**AQCS Technology**

SO₂ CONTROL – FLUE GAS DESULPHURISATION SYSTEMS

**LIMESTONE-BASED WET FGD SYSTEM**

- Can accept a wide variety of fuel sulphur levels
- Highly efficient at removing SO₂ and other acid gases
- Can reduce mercury emissions
- Can produce a saleable byproduct (gypsum)

**SEAWATER FGD SYSTEM**

- Lower capital costs, since there is no limestone/lime processing, slurry circulation or waste-handling equipment.
- Less auxiliary equipment, which will require lower overall auxiliary power
- Requires the plant to be located relatively close to the sea
AQCS Technology

**CIRCULATING DRY SCRUBBER (CDS) FDG SYSTEM**

- Lower capital costs due to carbon steel absorber metallurgy and dry stack operation
- Less complex to operate
- CDS Systems have shown SO₂ removal efficiencies close to wet FGD systems
- Requires a smaller footprint area than wet FGD
- Very efficient at removing fine ash particles or sulphuric acid mist
- Requires a new particulate removal device, generally a new bag-house
- Are limited in low-load operation

**DRY SORBENT INJECTION SYSTEM**

- Very low capital cost
- Able to operate at all power plant loads
- Can be used in conjunction with electrostatic precipitators (ESPs)
- Limited in removal efficiency
**SELECTIVE NON-CATALYTIC REDUCTION SYSTEM (SNCR)**

The SNCR process requires injection of urea into the flue gas within a temperature window of 1870-1090 °C to reduce NO\textsubscript{x} to nitrogen and water.

**SELECTIVE CATALYTIC REDUCTION SYSTEM (SCR)**

SCR is a capital-cost-intensive, post-combustion technology that uses catalyst elements installed in the flue gas stream upstream from the air-preheater to promote the NO\textsubscript{x} reduction reaction.
S&L has a record of providing continual and substantial environmental compliance services since the early 1970s. It has established impressive and proven industry-recognised capabilities to provide integrated environmental and engineering services. Its experience comprises assignments for more than 100 clients on hundreds of power plants in 26 countries across six continents, enabling L&T-S&L to deliver projects efficiently. Select references are described below.

Select References

La Cygne Controls and Environmental Retrofits, La Cygne, Kansas

This major environmental controls retrofit for Kansas City Power & Light’s La Cygne Station, is an EPC project undertaken by La Cygne Environmental Partners (LEP), a joint venture of Kiewit Power Constructors and S&L.

S&L’s scope of work for this 1580 MW coal-based plant included full engineering, design, project controls, procurement services and construction management oversight for installation of low-NOx burners, particulate baghouses, wet scrubbers, activated carbon injection (ACI) for mercury removal and SOx control and selective catalytic reduction (SCR) systems for Unit 2.

Big Bend Units 1, 2, 3 and 4 SCR project, Tampa, Florida

This plant located in Tampa Florida, consist of Units 1 and 2 – 460 MW each, Unit 3 – 470 MW and Unit 4 – 490 MW based on bituminous PRB. S&L’s overall scope covered the detail design for retrofit SCRs on all four units at Big Bend. This included complete design and procurement of the SCR reactor and all ductwork, including duct internals. S&L was also responsible for all BOP design and procurement of all BOP equipment, including draft system modifications, foundations, steel, electrical, etc.

NIPSCO’s Wet FGD Project for Schahfer Units 14 and 15, Wheatfield, Indiana

The contract for detail engineering for wet FGD retrofits at Schahfer Units 14 and 15 (520 MW each) was awarded to S&L in April 2010. The overall project scope encompasses BOP engineering and design for a new wet limestone FGD system for both units and a common Waste Water Treatment System (WWTS) to treat FGD blowdown. The BOP activities include civil site work, roadwork, foundations, structural steel, ductwork, galleries, enclosures, BOP piping and supports and the electrical auxiliary power system, including equipment, raceways and wiring.

Coronado FGD and SCR project for Units 1 and 2, St. Johns, Arizona

S&L provided detail design, construction and start-up support for this multifaceted project to add additional, state-of-the-art environmental control measures at the plant. S&L’s overall scope included:

- Replacing the station’s existing first-generation horizontal scrubbers with new, state-of-art scrubber technology
- Boiler modifications to reduce NOx emissions, including advanced low-NOx burners and modifications to the overfire air and underfire air.
- Installing SCR (Selective Catalytic Reduction) technology for Unit 2
Since 2007, S&L has been supporting PacifiCorp’s Clean Air Initiative (CAI) program, which is a wide-ranging Air Quality Control Services (AQCS) effort underway for their diverse fleet of plant configurations and fuels. S&L’s support typically starts as a study effort on a particular unit, then progresses to implementation involving specification development, followed by a transition to the Owner’s Engineer role after EPC contract award.

The Leland Olds Station is a two-unit site of 220 and 440 MW, respectively that burns a combination of North Dakota Lignite and Powder River Basin coal. Flue gas desulphurisation systems (FGD) retrofitted on the site are provided by Babcock Power. S&L was appointed as the engineering consultant to carry out the following:

- Conceptual design and planning
- Detail design and engineering services
- Procurement
- Expediting and invoice approval
- Construction management
- Commissioning and startup
- Project controls

S&L’s work scope for the SCR retrofit covered detail design of the SCR reactor, ductwork, structural steel and BOP. This included procurement of the SCR catalyst, catalyst cleaning system and aqueous ammonia system storage and transfer equipment. S&L was responsible for BOP design and procurement of all BOP ancillary equipment, including flue gas system modifications, auxiliary steam modifications, ammonia supply, piles, concrete foundations, SCR reactor, ductwork, structural steel, electrical equipment, mechanical piping, etc.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
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<tr>
<td><strong>Conemaugh Units 1 and 2 SCR Project, New Florence, Pennsylvania</strong></td>
<td>This was an 1800 MW supercritical power plant at New Florence Pennsylvania, based on bituminous coal. S&amp;L’s scope included preliminary engineering and development of the project cost estimate and schedule; detail design of the foundations, structural steel and BOP for the SCR retrofit, start-up and commissioning. This scope also included the procurement of the SCR reactors, SCR ductwork and replacement of ID booster fans, plant start-up transformer and 13.8-kV switchgear. For the remaining BOP, S&amp;L prepared specifications for the system and equipment.</td>
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<tr>
<td><strong>Dry Fork Station Unit 1 SCR Project in Gillette, Wyoming</strong></td>
<td>The new 422 MW mine-mouth power plant uses low-sulphur Powder River Basin coal and is a zero-discharge (liquid) facility with minimum air emission. S&amp;L was selected to provide complete detail design, procurement and construction management services for the project, including procurement of SCR equipment and detail design of BOP equipment associated with SCR. The unit was named the ‘Best Industrial Project’ in the annual Engineering News Record (ENR) Mountain States Competition, and project engineer S&amp;L was recognised for the project’s accomplishments.</td>
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<td><strong>PACO Units 1 and 2 FGD Project Punta Rincón, Panama</strong></td>
<td>The PACO project consists of two identical 150 MW subcritical coal-fired units and associated steam turbine-generators, located on a greenfield site on the Caribbean coastline of Panama. Each unit includes a seawater flue gas desulphurisation (FGD) unit and once-through cooling of the STG exhaust using seawater. S&amp;L was responsible for the complete engineering of the FGD system as part of an EPC project and procurement of the FGD system and chimney, along with detail design of BOP equipment associated with the FGD and the entire plant. Commercial operation is anticipated in January 2017.</td>
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<td><strong>Duke Cayuga, Gibson and Miami Fort FGD projects</strong></td>
<td>Over the past eight years, S&amp;L supported Cinergy with the development of an environmental compliance planning strategy for nitrogen oxides (NO\textsubscript{x}), sulphur dioxide (SO\textsubscript{2}), mercury (Hg) and particulate control for their Indiana, Kentucky and Ohio generating stations. The compliance strategy for NO\textsubscript{x}, resulted in the installation of a total of eight SCRs at the 1060 MW East Bend (1), 1950 MW supercritical Gibson (5) and 1100 MW Miami Fort (2) stations. The Selective Catalytic Reduction (SCR) program began with initial engineering in 1999 and was completed in 2003, when the last of the eight SCR systems went into operation at the Gibson Station. S&amp;L’s scope included design optimisation studies, FGD technology island development and procurement, Balance-Of-Plant (BOP) interface design and procurement, site arrangement drawings, site development/underground utilities, capital and O&amp;M cost estimates and project schedules.</td>
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<td><strong>Hayden Unit 1 SCR Project in Colorado</strong></td>
<td>This 205 MW Hayden Unit 1 is in compliance with the latest legislatively-imposed Clean Air-Clean Jobs Act in Colorado. S&amp;L has been responsible for strategic planning and conceptual design, procurement of SCR and detail design of BOP. Additional controls to further reduce nitrogen oxide emissions at Hayden will also be installed on the Unit, making Hayden one of the cleanest coal-fired generating stations in the region with advanced emissions-control equipment.</td>
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**Multi-system Air Quality Control Retrofit, Otter Tail Power, Milbank, South Dakota**

Otter Tail Power Company authorised S&L to engineer a major AQCS retrofit project at their Big Stone Plant. S&L was awarded this project based on their credentials and competitive bid.

This 495 MW Powder River Basin (PRB) coal-based AQCS project included a circulating type dry FGD system, new baghouse to replace the existing installation, an SCR system, boiler modifications for separated overfire air and an ACI system for mercury control. S&L’s scope encompassed permitting support, detail design, procurement, construction and start-up support.
L&T-S&L excels across the technology continuum, offering solutions for open/simple cycle plants, combined cycle plants, co-generation plants, and coal-based plants – subcritical, supercritical and ultra-supercritical technology. Advanced modeling techniques and cutting-edge IT further reinforce the Company’s capabilities to deliver effective solutions that meet client objectives. The L&T-S&L footprint has been growing globally. The maps below indicate a few of our project locations.
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