

Comprehensive Environmental Excellence

Air Quality Control Systems
for Thermal Power Plants



Joint Venture Partners – The Power of Two

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.



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).

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

Basic & Detail Engineering

Owner's Engineering

Lender's Engineering

Power System Studies

Special Consulting Studies

Substation Engineering

Renewable Energy Services

Renovation and Modernisation

AQCS Consulting Services

Air Quality Control Systems

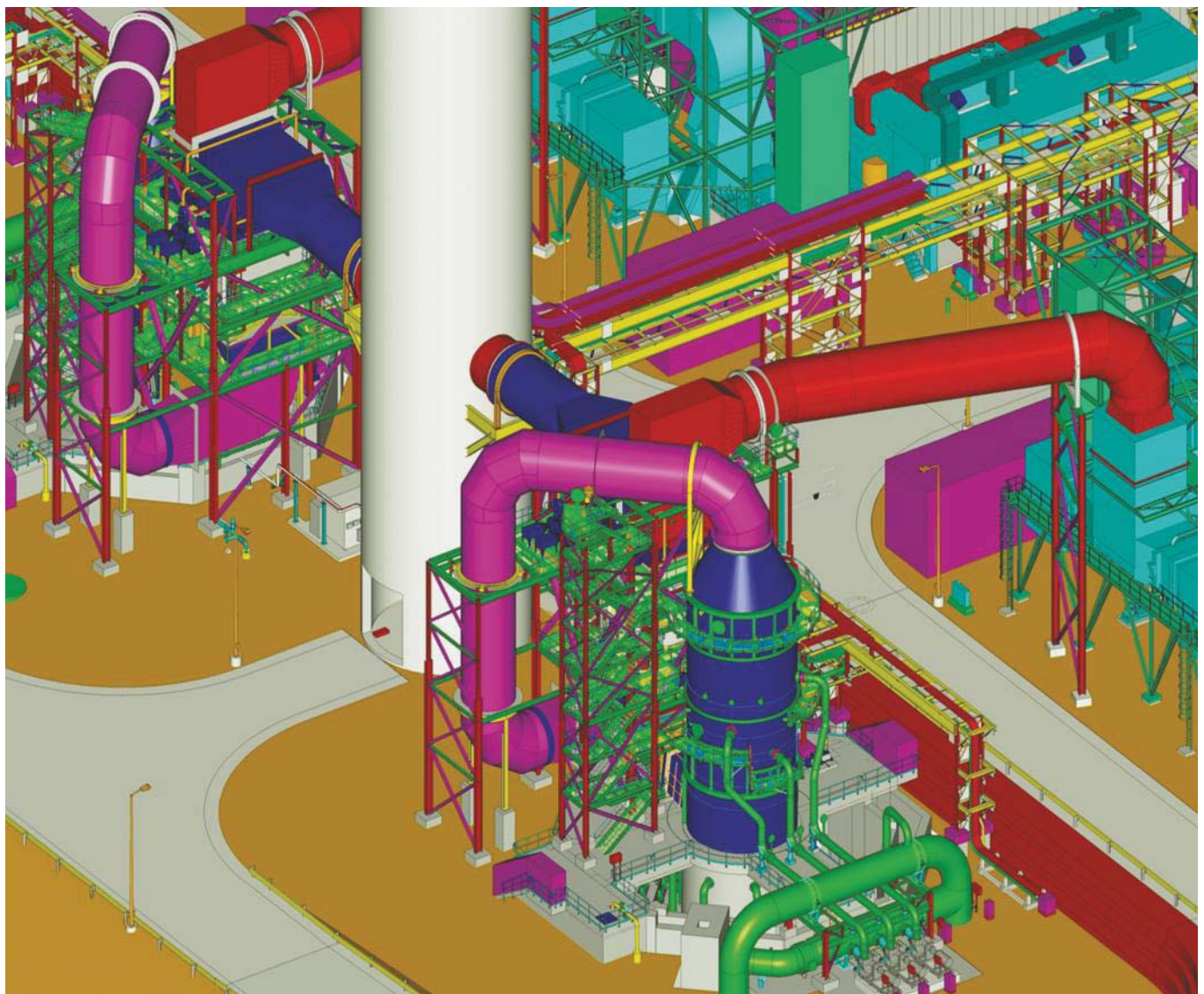
L&T-S&L and Sargent & Lundy (S&L) offer a wide range of Air Quality Control System (AQCS) Services to reduce PM, SO_x, NO_x and Hg emissions in coal-based power plants across the world.

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.

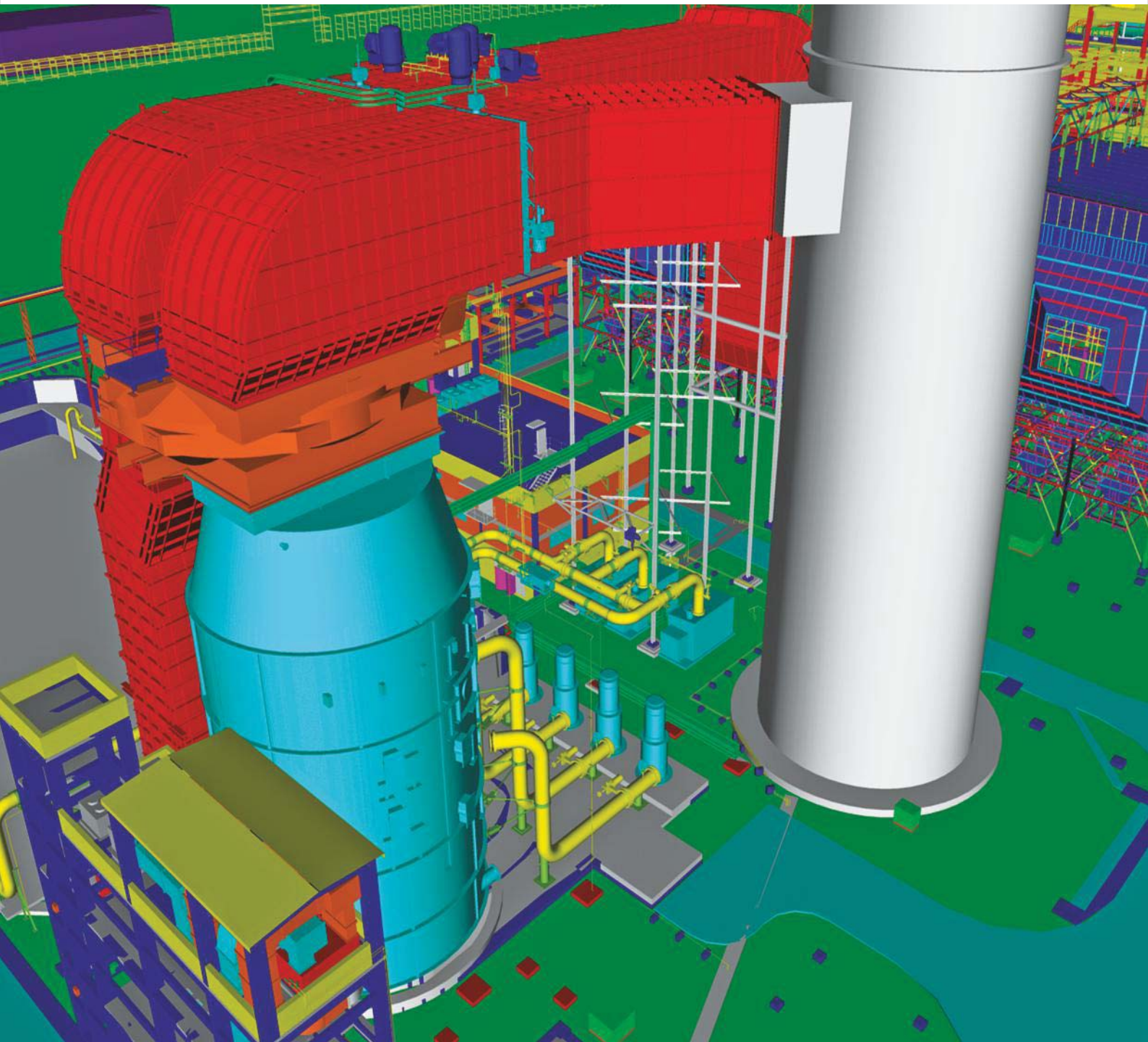
S&L's expertise and knowledge-base enables L&T-S&L to provide comprehensive and proven engineering services to meet the emerging needs of stringent environmental emission control norms.

S&L's Environmental Retrofit Experience Summary

Technology	Units	MW
Selective Catalytic Reduction	>58	>30,800
Selective Non-Catalytic Reduction	>30	>11,500
Dry Flue Gas Desulphurisation	>35	>16,600
Wet Flue Gas Desulphurisation	>43	>21,400
Flue Gas Desulphurisation System Upgrades	>32	>27,600
Mercury Control – Activated Carbon	>136	>61,200
Mercury Control – Co-benefit analysis	>70	>31,600
Dry Sorbent Injection – SO ₂	>28	>15,100
Dry Sorbent Injection – SO ₃ / HCl	>41	>19,700
Fabric Filter	>64	>26,200
Electrostatic Precipitator	>48	>23,400



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

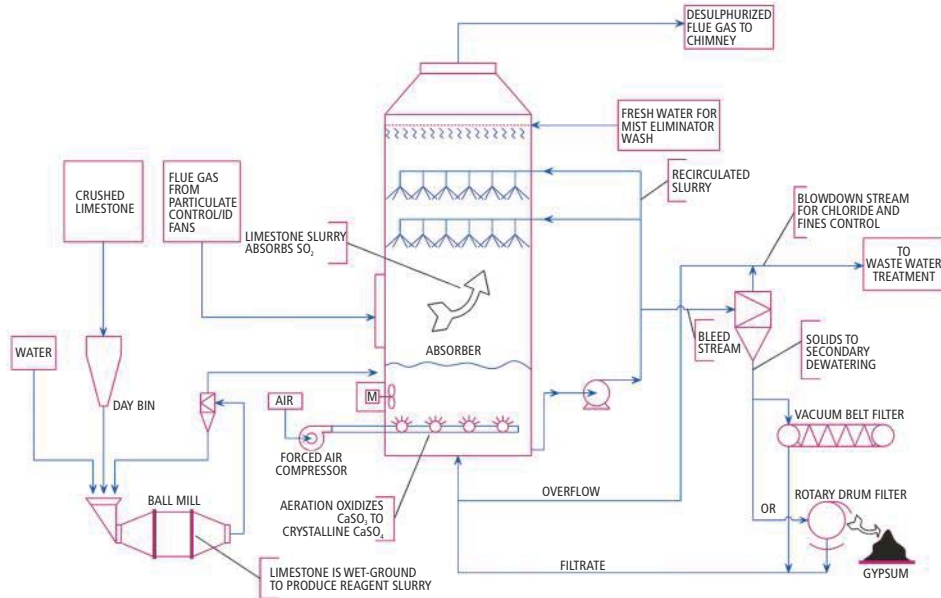
- Project Management
- System Design
- System Integration
- Procurement Support
- Detail Engineering
- Vendor Drawing Review
- 3D Modelling Review
- Performance Test Procedure
- Commissioning Support

AQCS Technology

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.

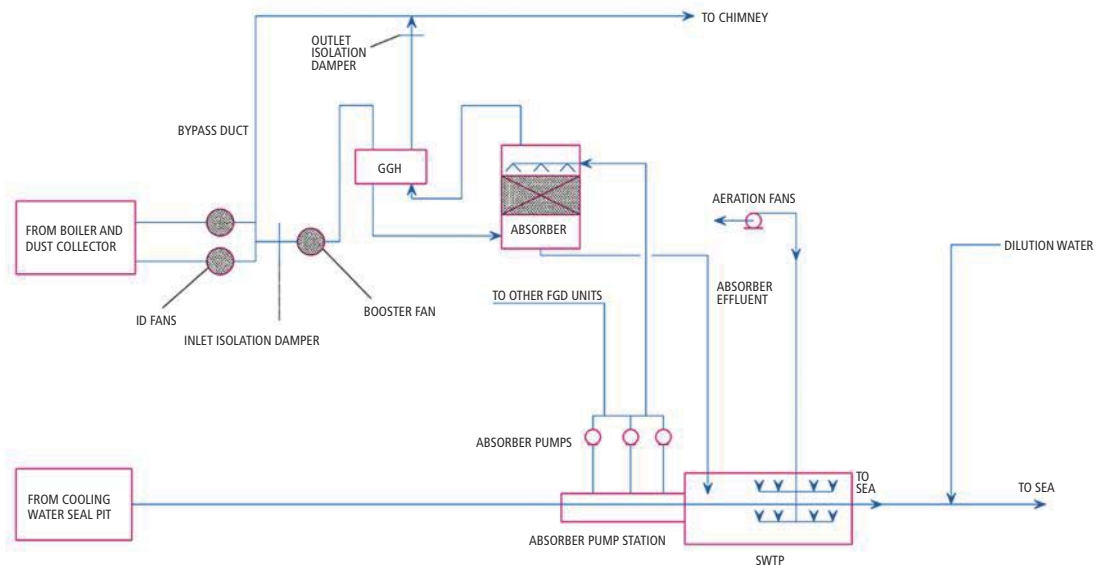
SO₂ CONTROL – FLUE GAS DESULPHURISATION SYSTEMS

LIMESTONE-BASED WET FGD SYSTEM

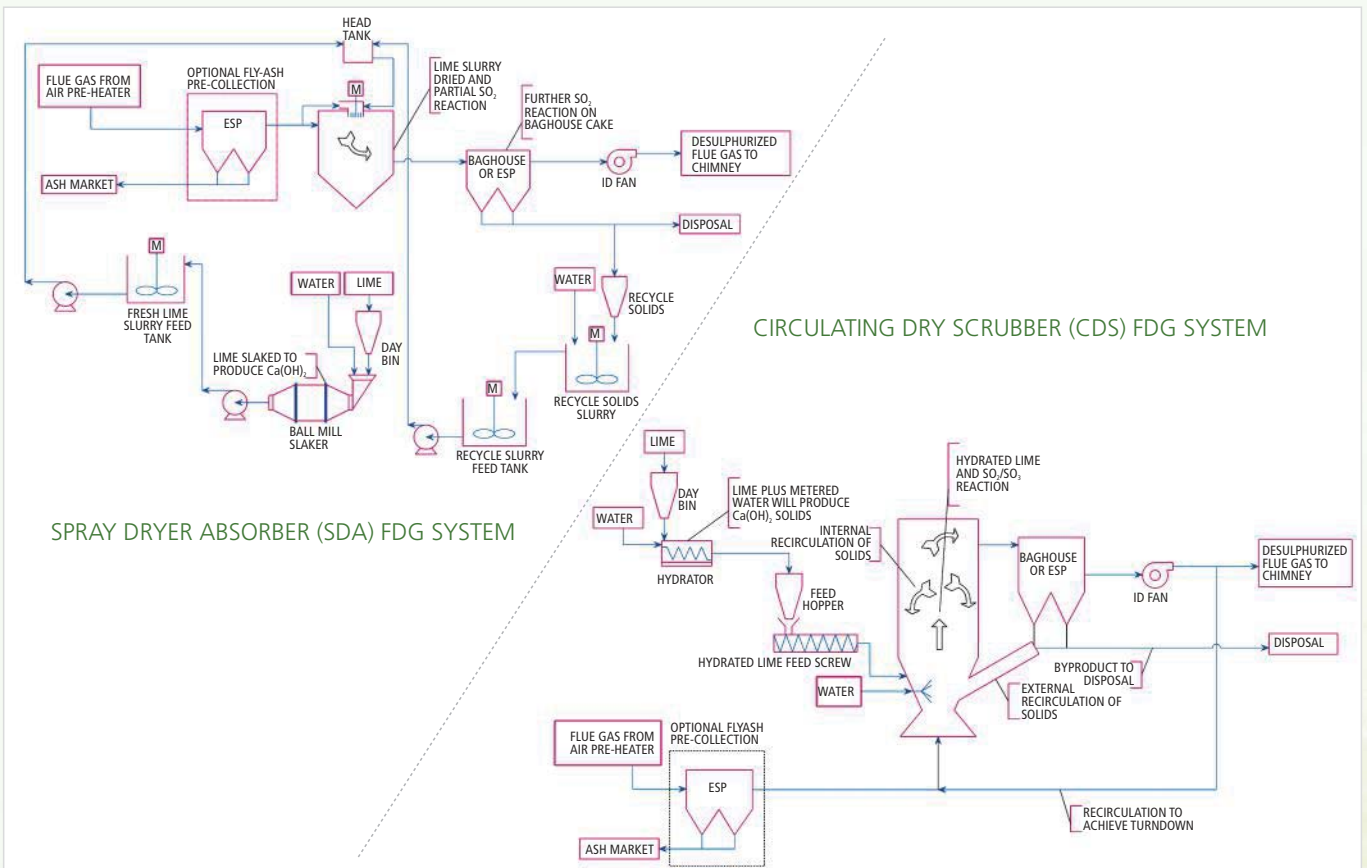


- Can accept a wide variety of fuel sulphur levels
- Highly efficient at removing SO₂ and other acid gases
- Can reduce mercury emissions
- Can produce a saleable byproduct (gypsum)

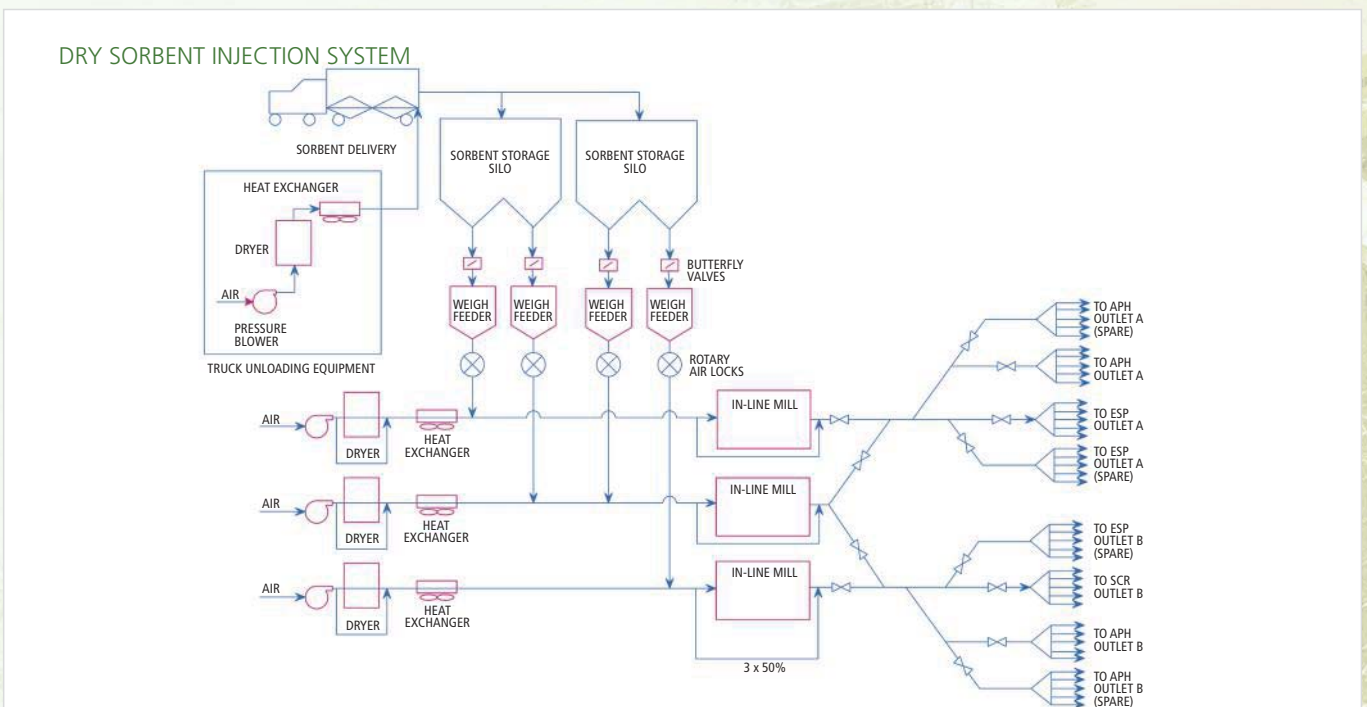
SEAWATER FGD SYSTEM



- 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



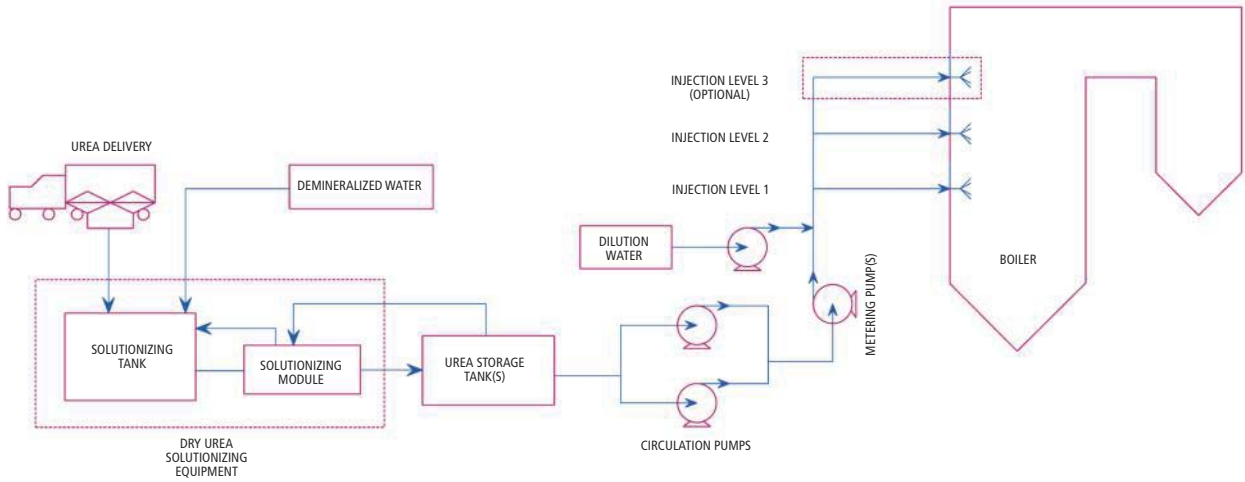
- Lower capital costs due to carbon steel absorber metallurgy and dry stack operation
- CDS Systems have shown SO₂ removal efficiencies close to wet FGD
- Very efficient at removing fine ash particles or sulphuric acid mist
- Are limited in low-load operation
- Less complex to operate
- Requires a smaller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



- 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

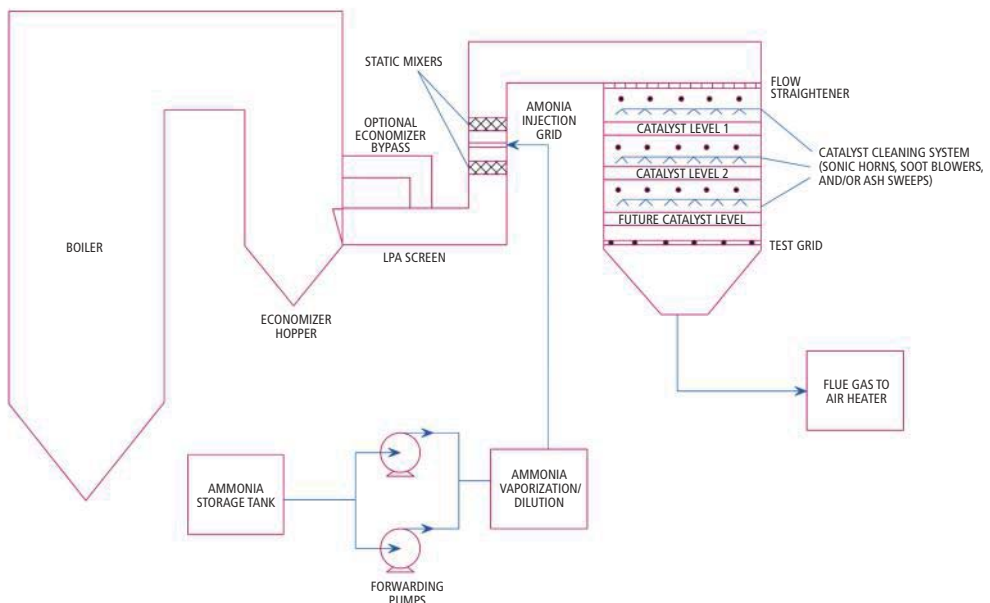
NO_x CONTROL-SELECTIVE CATALYTIC AND NON-CATALYTIC REDUCTION SYSTEMS

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_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_x reduction reaction.

Select References

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.

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.

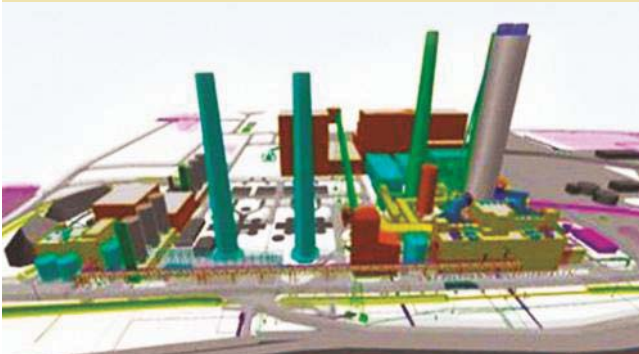
S&L's scope of work for this 1580 MW coal-based plant included full engineering, design, project controls, procurement services and construction management oversight for installation of low-NO_x burners, particulate baghouses, wet scrubbers, activated carbon injection (ACI) for mercury removal and SO₃ 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 NO_x emissions, including advanced low-NO_x burners and modifications to the overfire air and underfire air.
- Installing SCR (Selective Catalytic Reduction) technology for Unit 2

Select References

Leland Olds 1 and 2 FGD project, Stanton, North Dakota



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:

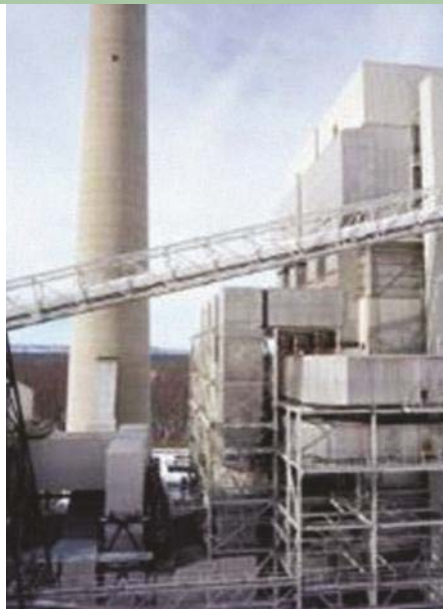
- Conceptual design and planning
- Detail design and engineering services
- Procurement
- Expediting and invoice approval
- Cost-tracking
- Construction management
- Commissioning and startup
- Project controls

Naughton 1 and 2 AQCS project - Clean Air Initiative Program, Western U.S.



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.

Madgett Unit 6 SCR Project, Alma, Wisconsin



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.

Select References

Conemaugh Units 1 and 2 SCR Project, New Florence, Pennsylvania

This was an 1800 MW supercritical power plant at New Florence Pennsylvania, based on bituminous coal. S&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&L prepared specifications for the system and equipment.

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.

Dry Fork Station Unit 1 SCR Project in Gillette, Wyoming

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&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&L was recognised for the project's accomplishments.

PACO Units 1 and 2 FGD Project Punta Rincon, Panama

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&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.

Duke Cayuga, Gibson and Miami Fort FGD projects

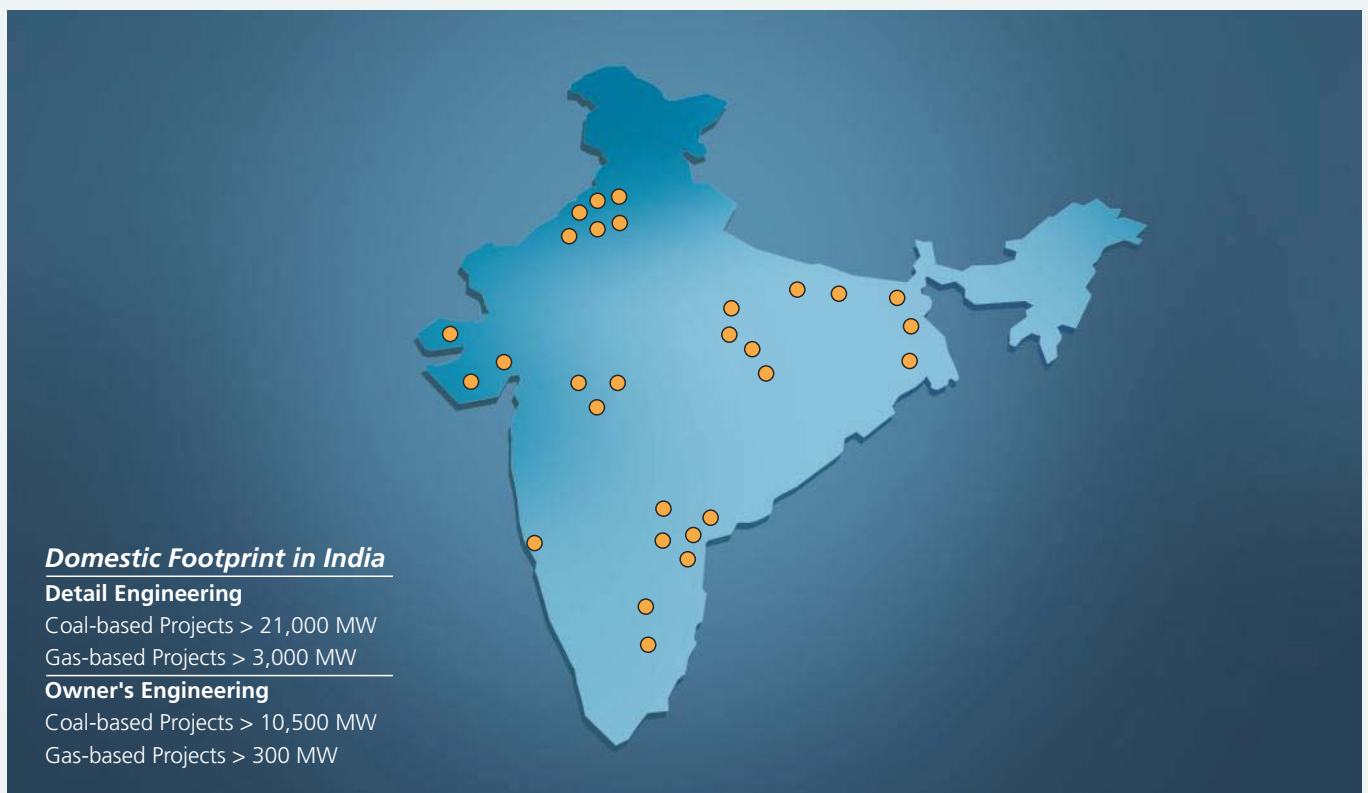
Over the past eight years, S&L supported Cinergy with the development of an environmental compliance planning strategy for nitrogen oxides (NO_x), sulphur dioxide (SO₂), mercury (Hg) and particulate control for their Indiana, Kentucky and Ohio generating stations. The compliance strategy for NO_x resulted 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&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&M cost estimates and project schedules.

Hayden Unit 1 SCR Project in Colorado

This 205 MW Hayden Unit 1 is in compliance with the latest legislatively-imposed Clean Air-Clean Jobs Act in Colorado. S&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.

Global Footprint

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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