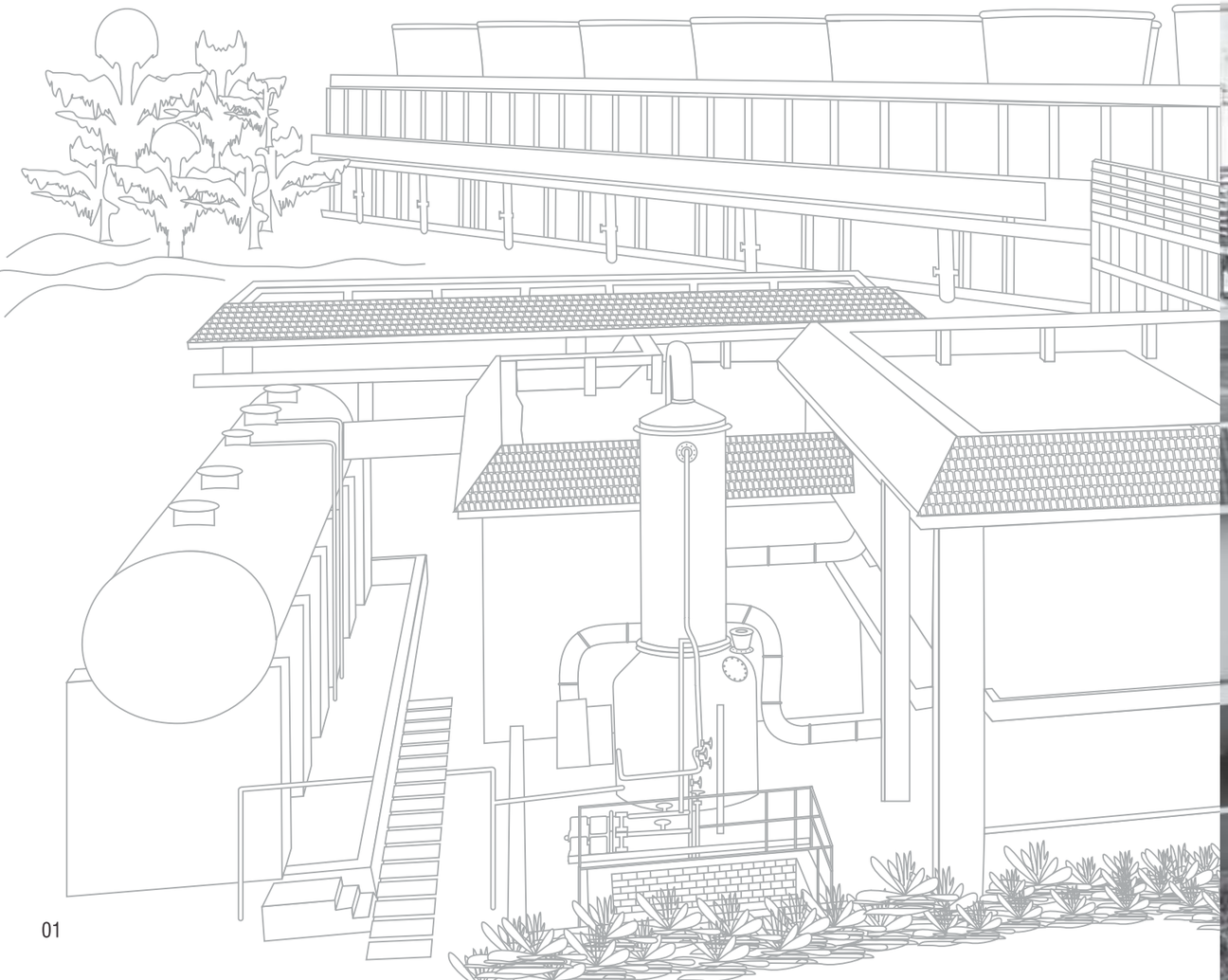
ENGINEERING SUCCESS

L&T-S&L

L&T-Sargent & Lundy Limited

As the demand for power surges, so does the challenge of producing it in an efficient, profitable and sustainable manner. L&T-Sargent & Lundy provides innovative solutions through qualified expertise to overcome these challenges in an effective way.

With over 18 years of experience in delivering state-of-the-art power plant engineering services, L&T-S&L offers deep domain expertise, internationally aligned processes, and a unique 3D modelling technology to converge engineering services with engineering success.



ENGINEERING STRONG FOUNDATIONS

In-depth Consulting. Comprehensive Engineering.

The synergy created by coming together of Larsen & Toubro, an engineering and construction conglomerate, and Sargent & Lundy, a consulting giant, has enabled L&T-S&L to consistently deliver solutions which are technically sound and operationally efficient.

Joint Venture Partners

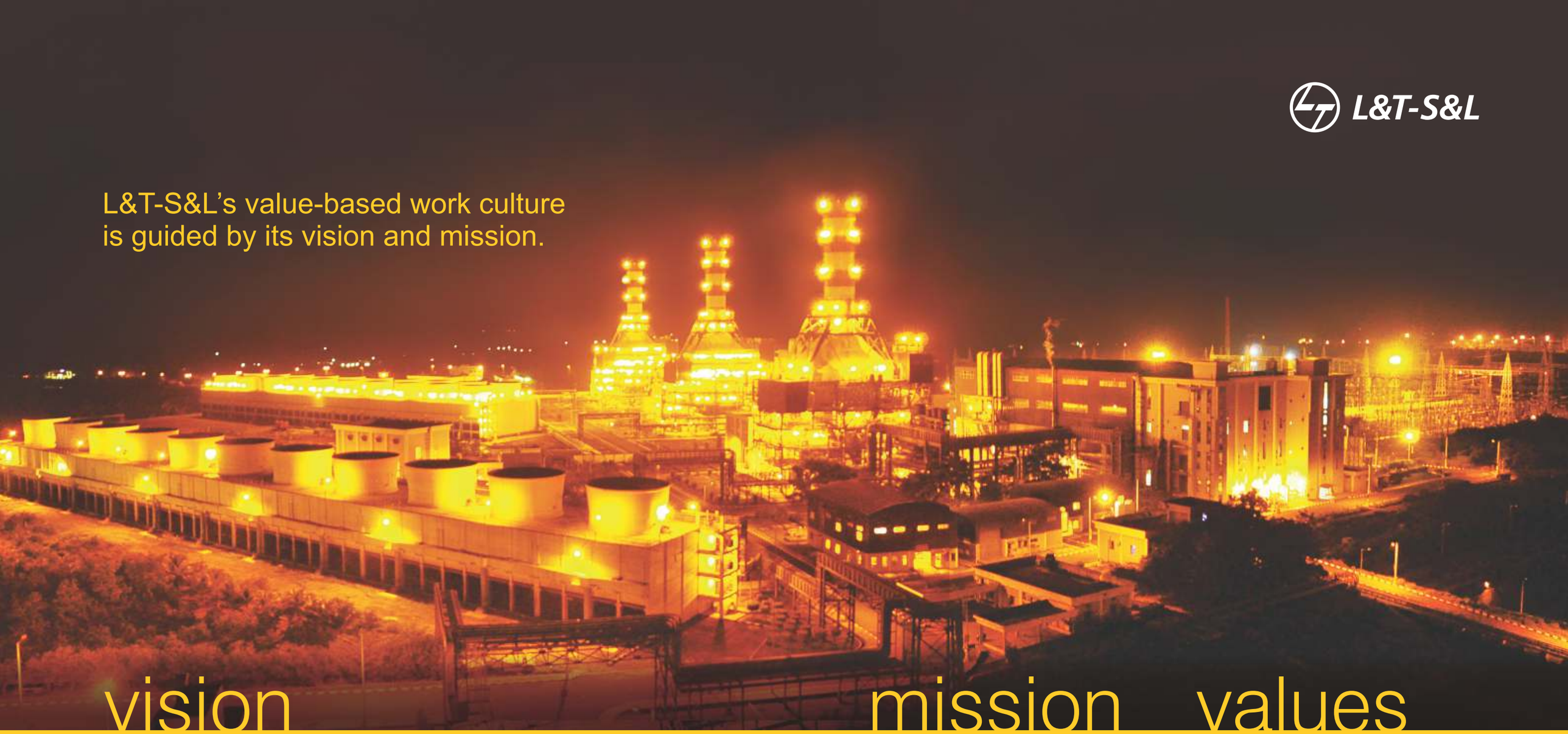
Larsen & Toubro Limited (L&T) is a technology, engineering, construction and manufacturing conglomerate. It is one of the largest and most respected companies in India. More than seven decades of a strong, customer-focused approach and a continuous quest for world-class quality has enabled it to attain and sustain leadership in all its major lines of business.

Sargent & Lundy[LLC] (S&L) – With over 120 years of experience in providing engineering services exclusively focused on power, S&L is acknowledged as a premier force worldwide. Based in Chicago, USA, S&L has an extensive and credible consulting experience in project development services for all types of fossil-fuel, nuclear, and renewable power generation and power delivery projects.

2x600 MW Anpara 'C'
Thermal Power Station Extension
Sonebhadra, Uttar Pradesh, India

L&T-S&L

L&T-S&L's value-based work culture
is guided by its vision and mission.



vision

To be one of the globally admired and leading integrated engineering solution providers in Power Sector continuously creating value for the stakeholders

mission

- Be responsive to customer needs, deliver optimal solutions and value added services expeditiously
- Ensure sustainable growth and professional excellence using state-of-the-art technology, process driven approach, eco-friendly solutions and IT enabled tools
- Foster a culture of mutual trust, respect, teamwork, continuous learning, innovation, challenge and employee empowerment to provide a conducive workplace
- Adhere to fair, transparent and ethical practices in interactions with all stakeholders and be a good corporate citizen
- Be flexible and agile to continually adapt to changing business environment

values

- Customer Centricity
- Commitment to Quality
- Entrepreneurship
- Ethics & Integrity
- Honouring of Commitments
- Humility
- Passion for Learning
- Proactive & Innovative Thinking
- Respect for Individuals
- Responsibility & Accountability
- Socially & Environmentally Responsive
- Speed

ENGINEERING SINGLE-WINDOW SIMPLICITY

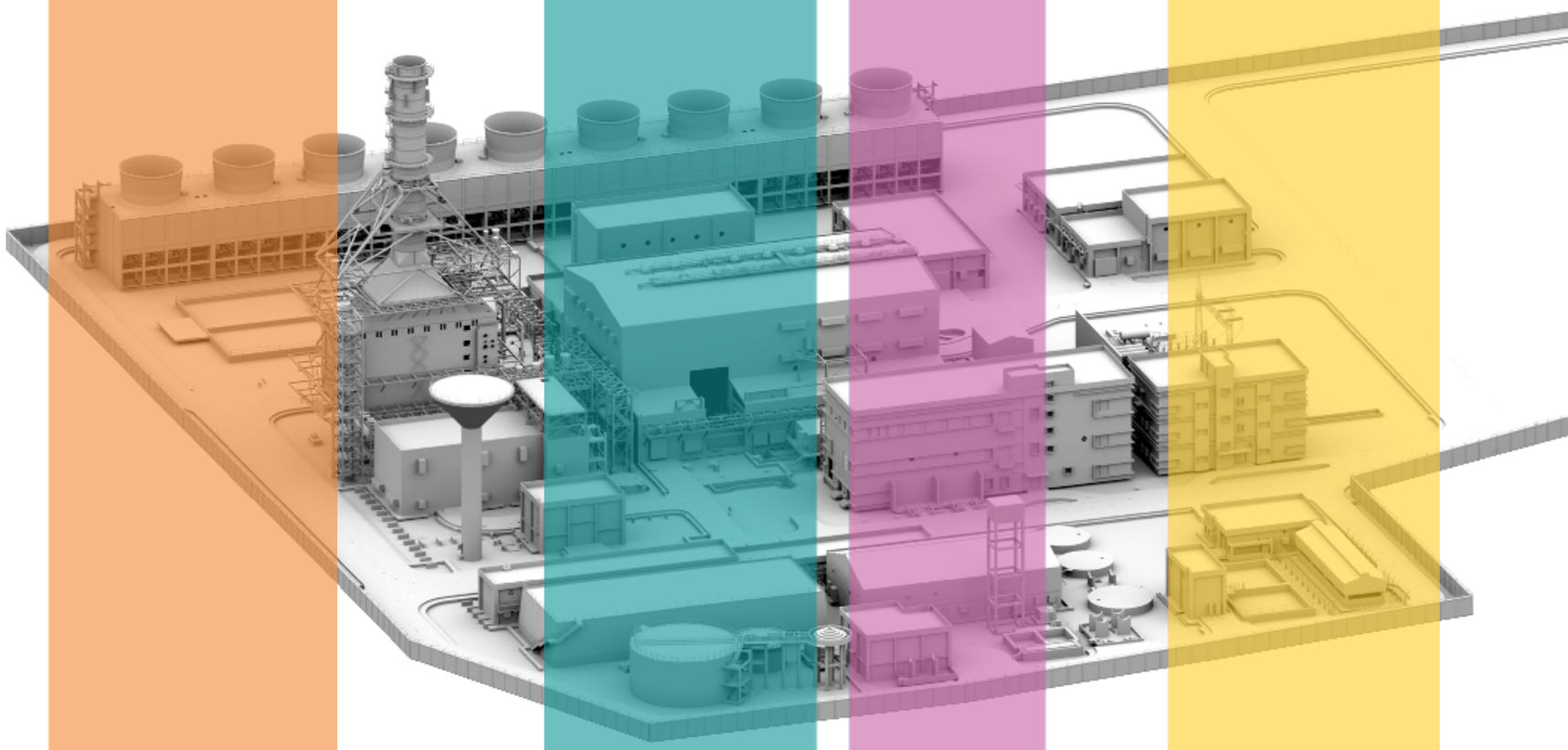
Comprehensive Service. Smoother Execution.

Be it site selection, project conceptualization, feasibility reports, detail engineering services, field engineering services or renovation and modernization services, L&T-S&L offers the complete gamut of Power Plant Engineering and Consultancy Services ranging from concept to commissioning and beyond.

The Company caters to a broad spectrum of stakeholders in the power sector and its portfolio of services includes:

Detail Engineering
Owner's Engineering
Independent / Lender's Engineering
Renovation & Modernization
Special Engineering
Transmission & Distribution

1x388.5 MW Phase-I
2x384 MW Phase-II
Combined Cycle Power Plant
Vemagiri, Andhra Pradesh, India



Detail Engineering

- Pre-bid Engineering Support
- Post-award Engineering
- Basic Engineering
- Detail Engineering Services
- Site Engineering Support
- Commissioning Support

Owner's Engineering

- Site Assessment Study
- Feasibility Study
- Detailed Project Report
- Tender Specification
- Bid Evaluation and Finalization
- Review Engineering
- Inspection
- Performance Testing
- Commissioning Support
- Project Management
- Site Supervision Services

Independent / Lender's Engineering

Addressing the needs of international and national financial institutions, government bodies, banks, private equity players and corporate enterprises, our independent / lender's engineering services include:

- Technical and Financial Due Diligence (Pre-financial Closure Phase)
- Construction Monitoring (Implementation Phase)
- Performance Testing (Start-up & Testing Phase)
- Operations Monitoring (Post-commissioning Phase)

Renovation & Modernization

- Energy Audits including Boiler Performance Evaluation Test
- Steam Path Audits
- Remaining Life Assessment (RLA)
- Detailed Project Report
- Preparation of Techno-commercial Specification
- Evaluation of EPC Bids and Order Finalization
- Supervision of R&M Work as OE

Special Engineering

- Special Consulting Assignments
- Performance Testing
- Repowering Studies
- Technical Training
- Renewable Energy (Wind / Solar / Biogas)

Transmission & Distribution

- Basic and Detailed Engineering Indoor / Outdoor / GIS Substations
- Power System Studies
- Distribution System Design

ENGINEERING EXCELLENCE

Diverse Technologies. Specific Solutions.

Be it open / simple cycle plants, combined cycle plants, co-generation plants, and coal-based plants - both subcritical and supercritical technology, L&T-S&L excels across the technology continuum. Advanced 3D modelling techniques and cutting edge IT further reinforce the Company's capabilities to deliver effective solutions that meet client objectives.

2x800 MW
Sri Damodaram Sanjeevaiah
Super Thermal Power Plant
Krishnapatnam, Andhra Pradesh, India

Rich experience in each technology and proven performance has established L&T-S&L as the preferred engineering partner in the ever-evolving power market.

Coal based Supercritical and Subcritical Plants

Thrust on clean coal technology and higher cycle efficiency have made supercritical units extremely reliable and cost effective. L&T-S&L has gained substantial foothold in engineering of supercritical units.

- 2x660 MW Balkhash Super Thermal Power Plant, Kazakhstan with Dongfang Electric make Supercritical Boilers
- 1x700 MW Super Thermal Power Plant, Thailand with Doosan make Supercritical Boilers
- 2x660 MW Chhabra Super Thermal Power Plant, Rajasthan, India with L&T-MHI make Supercritical Boilers
- 2x700 MW Rajpura Super Thermal Power Plant, Punjab, India with L&T-MHI make Supercritical Boilers
- 2x660 MW Jaypee Nigrie Super Thermal Power Plant at Nigrie, Madhya Pradesh, India with L&T-MHI make Supercritical Boilers
- 3x660 MW Koradi Super Thermal Power Station Expansion, Nagpur, Maharashtra, India with L&T-MHI make Supercritical Boilers
- 2x800 MW Sri Damodaram Sanjeevaiah Super Thermal Power Plant at Krishnapatnam, Andhra Pradesh, India with L&T-MHI make Supercritical Boilers
- 2x660 MW Krishnapatnam Super Thermal Power Plant of NCC Limited, Andhra Pradesh, India with Harbin make Supercritical Boilers
- 3x660 MW Barh–I Super Thermal Power Plant, Bihar, India (Architectural, Civil & Structural Engineering Services) with Technoprom make Supercritical Boilers

L&T-S&L has successfully engineered a variety of subcritical and CFBC Boiler based power projects for LANCO Group, NTPC, BHEL, Thermax, SK E&C - South Korea to name a few.

- 2x150 MW PACO Coal fired Power Plant in Panama, Central America with SeenTec make Subcritical Boilers and Skoda make Steam Turbine Generator
- 2x600 MW Lanco Anpara ‘C’ Thermal Power Station Extension, Uttar Pradesh, India with Dongfang make Boilers and Steam Turbines
- 2x600 MW MPPGCL’s Shree Singaji Coal based Thermal Power Project, Madhya Pradesh, India with BHEL make Boilers and Steam Turbines
- 2x600 MW D B Power Coal based Power Plant, Chhattisgarh, India (BOP and BTG Civil) with BHEL make Boilers and Steam Turbines
- 2x300 MW Lanco Amarkantak Mega Thermal Power Station at Pathadi, Chattisgarh, India with Dongfang Electric make Boilers and Steam Turbines
- 2x150 MW CFBC Boiler based Thermal Power Plant at Krishnapatnam, Andhra Pradesh, India with Thermax make CFBC Boilers
- 1x210 MW Amarkantak Coal Based Thermal Power Plant for BHEL, Madhya Pradesh, India with BHEL make Boilers and Steam Turbines

Gas Based - Simple and Combined Cycle Plants

L&T-S&L has engineered landmark gas turbine based power projects in India and Middle East. Listed below are a select few that stand testimony to L&T-S&L’s expertise in handling large gas-based projects across the globe.

- One of world's largest gas-based IPP - 4000 MW Qurayyah IPP Ph-I & II Combined Cycle Power Plant, Saudi Arabia, with Siemens make Gas Turbines and Steam Turbines and BHI make HRSGs
- 1890 MW Qurayyah Simple Cycle Power Plant and conversion into 3190 MW Combined Cycle Power Plant, Saudi Arabia with GE make Gas Turbines and Steam Turbines and Doosan make HRSGs
- Single Shaft 375 MW Dhuvaran Phase III Combined Cycle Power Plant, Gujarat with SCC5 4000F SS Siemens make Turbine Train and L&T make HRSG – one of the first single shaft projects in India executed by a non-OEM contractor
- 370 MW Amman East Combined Cycle Power Plant, Jordan with Ansaldo make Gas Turbines, Doosan make HRSGs and Fuji make Steam Turbines
- 1x500 MW Charles Poletti Combined Cycle Power Plant, New York, USA (and similar four projects in USA with GE) with GE make Gas Turbines and Steam Turbines and NEM Holland make HRSGs

- 1x168 MW AES Kelanitissa Combined Cycle Power Project at Colombo, Sri Lanka with BHEL make Gas Turbine and Steam Turbine and L&T make HRSG
- 255 MW Open Cycle Power Plant at Salalah, Oman with GE make PG 6581 B Gas Turbines
- 1x388.5 MW and 2x384 MW GMR Rajahmundry Energy Combined Cycle Power Project (Phase I & II), Andhra Pradesh with GE make Gas Turbines, L&T make HRSGs and Alstom make Steam Turbines
- 445 MW Konaseema Combined Cycle Power Plant, Andhra Pradesh with Siemens make Gas Turbines, L&T make HRSGs and LMZ make Steam Turbines

CASE STUDY

Multiple Requirements. Unique Solutions.

The engineering of 238.35 MW + 228 TPH Co-generation Captive Power Plant at IOCL's Panipat Naphtha Cracker Project (PNCP) was a challenge that gave L&T-S&L's engineering team a canvas to showcase their prowess. The project required L&T-S&L to design mechanisms that would ensure generation of power and steam even in case of trip or outage of gas turbines, steam turbines, utility boilers or station blackout.

The plant comprised of five (5) Hitachi make Gas Turbine Generators, L&T make HRSGs, two (2) Ansaldo make Utility Boilers, three (3) BHEL make Steam Turbine Generators and eleven (11) Drive Turbines. The plant was connected to Naphtha Cracker Unit at four (4) steam pressure levels with floating header concept.

The customer requirements were addressed in following ways:

The complete power cycle was simulated in the simulation software GATE CYCLE™ and heat and mass balance diagrams were worked out to establish equipment sizes.

The simulation also took into account the variation in performance of all equipment due to change in fuel from Regassified Liquidified Natural Gas to High Speed Diesel / Blended Fuel Oil.

The change over from one operating mode to the other was simulated in dynamic simulation software to check and ensure that transients were within controllable and operable range.

The co-generation plant was, thus, configured and designed for 32 different operating scenarios to provide uninterrupted steam to Naphtha Cracker Complex and meet power requirements.

Co-generation Plants

L&T-S&L has executed a number of complex co-generation power projects with varying power and process steam requirements for refineries as well as process plants.

Other significant co-generation plants engineered by L&T-S&L include:

116 MW

Haldia Combined Cycle Co-generation Power Plant, Haldia, West Bengal, India having EGT make Gas Turbines, L&T make HRSGs and ABB make Steam Turbines

90 MW

IPCL Co-generation Power Plant Gandhar, Gujarat, India with GE make Aero-derivative Gas Turbines and L&T make HRSGs

L&T-S&L's engineering success is due to the powerful amalgamation of state-of-the-art processes and technical expertise.

Engineering Systems & Software

PLADES

A Unified 3D Platform for Design Engineering

Plant Design System

PLADES (PLAnt DESign System), developed by Sargent & Lundy[LLC], is an integrated project management, engineering and design automation system for all aspects of power plant design, analysis, optimization and 3D modelling. This system builds accuracy and completeness of information into the engineering deliverables and generates reports for project management, preliminary design, system engineering and physical design. All project information is stored in a central database, which is shared by project teams. The project database, coupled with graphic model, forms the foundation for visualization and interference resolution, enabling accuracy in physical design activity.

3190 MW
Qurayyah Combined Cycle Power Project
(1890 MW SCPP + 1300 MW conversion)
Kingdom of Saudi Arabia
Snapshot of 3D model

Information Systems

The state-of-the–art IT infrastructure forms the backbone of L&T-S&L's operations. It helps add value to services. Thus it is no surprise that the Company's IT infrastructure includes the most contemporary technology for servers, workstations and communication. Design offices in Vadodara and Faridabad are connected through high bandwidth leased lines to facilitate file transfer, video and audio conferencing. A responsive in-house IT team monitors the latest software and products available in the market and ensures that L&T-S&L is always ahead on the technology curve.

Concurrent Engineering

Concurrent Engineering is a novel concept wherein L&T-S&L design offices in Vadodara and Faridabad can work on the same project in real time through distributed servers and replication. This helps derive maximum utilization of critical skills and expertise present across design centres as and when required. L&T-S&L's offices are also connected to Sargent & Lundy, Chicago through an International Private Leased Circuit (IPLC) to facilitate concurrent engineering between multiple locations, overcoming geographical barriers and enabling round-the-clock engineering for faster delivery.

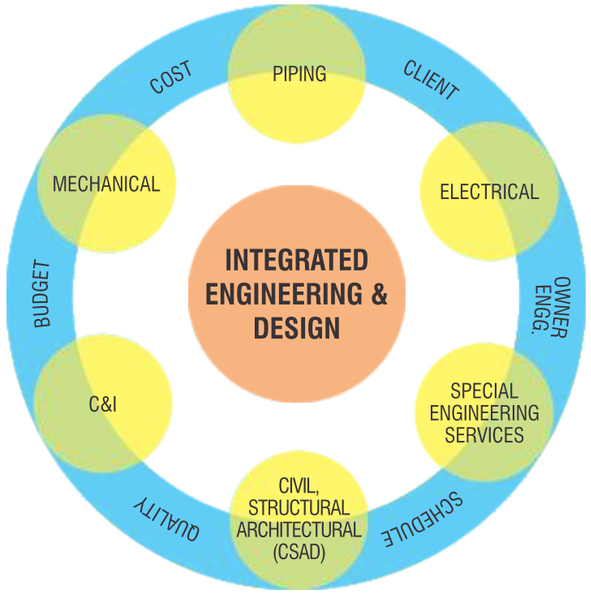
'BE INSPIRED' THOUGHT LEADERSHIP AWARD

for excellence in Design of Infrastructure Projects in the Innovation in Power Generation category was awarded to L&T-S&L in 2011. This award was instituted by Bentley Systems Inc., a world leader in the field of software solution for infrastructure life cycle.

During the final presentations held in Amsterdam, L&T-S&L exhibited its design capabilities for 3x660 MW Koradi Supercritical Thermal Power Plant.

Design Collaboration of all stakeholders of the project is possible through PLADES:

- 3D environment configured for project specific needs
- Modelling plan for responsibility distribution, integration & interface management
- Space planning for O&M, clearance & movement
- Model review with Client, Vendors, OEMs & Site



BENEFITS OF PLADES

- Coordinated and Controlled 3D Environment
- Creation of an Intelligent Plant System
- Better Interface Management
- Smarter Graphics with Effective Virtual Visualization
- Unified Platform for Plant Integration
- Latest Plant Design Data for Material Management

RESULTING IN

- Consistent Data Right from Conceptualization to Detailed Designs
- Collaboration of Geographically Separated Teams
- Elimination of Discrepancies and Interferences
- Optimized BOQs

Other Engineering Softwares

A variety of commercially available / in-house developed software other than PLADES are used at L&T-S&L.

PLADES provides seamless integration with many of these softwares.

- INTERGRAPH PDS
- GATECYCLE
- CAESAR
- ETAP
  Electrical Transient Analyzer Program
- SAFE
  Slab Analysis by Finite Element Method
- STAAD
  Structural Analysis And Design
- SAP
  Structural Analysis Program
- ISKETCH
- FRAMEWORKS
- ARROW
- CONVAL
- AUTOGRID PRO

Non Engineering Software

PRIMAVERA

IBOMIS
Integrated Business Operations & Management Information System (IBOMIS) - an inhouse developed ERP System

KIMS
Knowledge & Information Management System

People Power

L&T-S&L presently has an overall strength of around 650 professionals dedicated to consultancy services in the field of Power Plant engineering and Power Sector in general, based at Vadodara and Faridabad. We have a highly experienced pool of engineers offering their expertise in areas such as Mechanical Systems, Piping, Material Handling, Balance of Plant, Electrical, Civil, Structural and Architectural, Control and Instrumentation, Site Support Services, Project Management and Business Development. Additionally we have qualified professionals in Information Technology, Quality Assurance and Finance & Accounts.

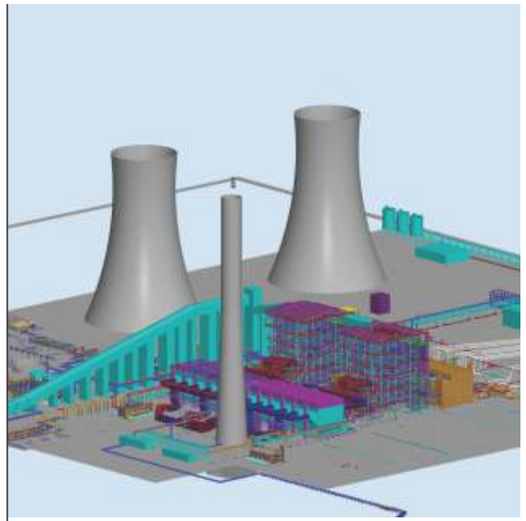
ENGINEERING SUSTAINABILITY

Powering Sustainability. Sustaining Power.

Planet Earth is suffering from alarming environmental challenges and citizens of the world are in constant search for technologies and fuels that can help mitigate these challenges and propel sustainable growth.

L&T-S&L is sensitive to these emerging needs and helps power project developers and EPC contractors deploy more environment-friendly power generating technologies and even assists them in migrating to renewable energy sources.

Engineering of Supercritical & Ultra Supercritical Technology-based Power Projects

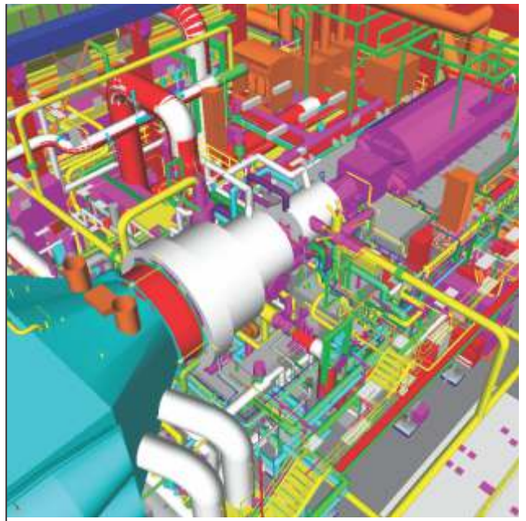


- Improved plant heat-rate and resultant lower coal consumption ensures lower pollution. The emission levels reduce up to 5% in case of supercritical power plant compared to subcritical power plant for generating same amount of power.
- L&T-S&L is pioneer in engineering of Supercritical and Ultra Supercritical technologies which make power generation from non-renewable energy sources like coal more sustainable.

Environment Friendly Engineering Solutions

- L&T-S&L's focus on design optimization and technological innovations help reduce capital and operating costs.
- Reduction in initial plant cost through use of open plant facilities, roof cladding, prefabricated structures and state-of-the-art construction methods.
- Optimized building layouts keeping in mind Operation and Maintenance requirements.
- Use of dry ash handling systems or air cooled condensers in areas facing severe water shortages.

Use of 3D Modelling and Plant Design



- Unlike any other power plant consultant in India, L&T-S&L uses PLADES – proprietary 3D-modelling software for layout engineering. This enables optimised utilization of land through interactive visualization ensuring ease of construction, operation and maintenance of the plant.
- It also helps ascertain the Bill of Quantities more accurately, which in turn translates to enhanced material efficiency and optimized use of resources like water, steel and cement.

Foray into Renewable Energy

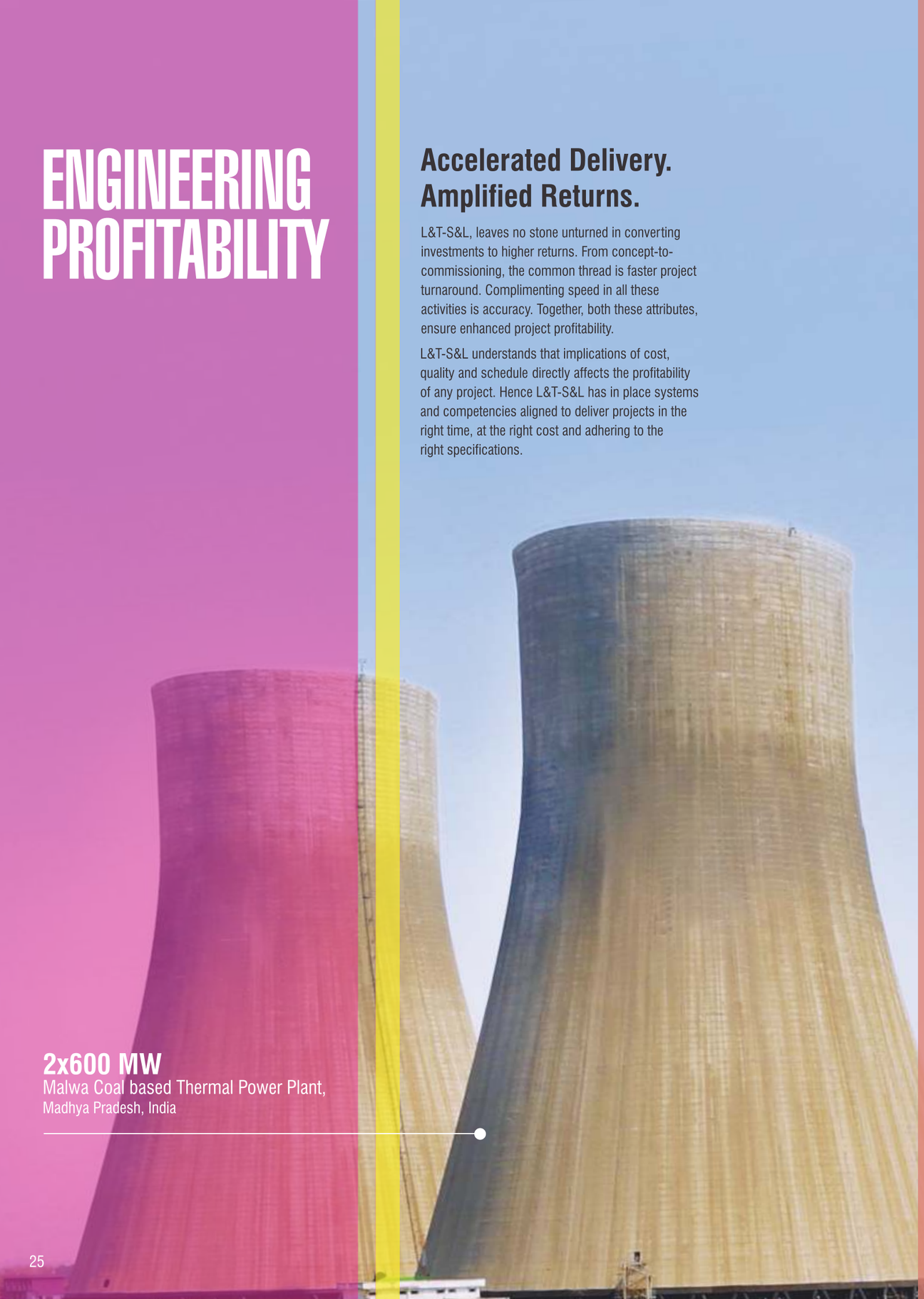
- L&T-S&L has developed capabilities to cater to renewable power projects based on wind, solar and biomass.
- Apart from rendering Owner's and Lender's Engineering services, L&T-S&L provides Detail Engineering support for green power projects in an attempt to harness the boundless energy of sun, wind and biomass for power / steam generation across the globe.

ENGINEERING PROFITABILITY

Accelerated Delivery. Amplified Returns.

L&T-S&L, leaves no stone unturned in converting investments to higher returns. From concept-to-commissioning, the common thread is faster project turnaround. Complimenting speed in all these activities is accuracy. Together, both these attributes, ensure enhanced project profitability.

L&T-S&L understands that implications of cost, quality and schedule directly affects the profitability of any project. Hence L&T-S&L has in place systems and competencies aligned to deliver projects in the right time, at the right cost and adhering to the right specifications.



2x600 MW
Malwa Coal based Thermal Power Plant,
Madhya Pradesh, India

A few illustrations from the L&T-S&L project portfolio that demonstrate this philosophy in practice.

375 MW COMBINED CYCLE DHUVARAN POWER PLANT GUJARAT, INDIA

- 3D modelling technique used for layout engineering enabled optimized space utilization
- With a single shaft combined cycle arrangement, the project is a first-of-its-kind to be executed by a non-OEM EPC Company in India
- The biggest benefit of single shaft turbine train arrangement is 30% reduction in size of power block area and number of equipment
- Use of deaerating condenser with bypass deaerator in place of the conventional deaerator helped reduce equipment cost considerably, increase power output and improve efficiency and reliability
- Civil and Electrical design of one of India's largest three-phase generator step-up transformer of 477 MVA
- Design of common foundation measuring 57m x 10m x 9m to accommodate the turbine train comprising gas turbine, generator, steam turbine and condenser on a single platform
- Interconnecting piping of OEM, engineered by L&T-S&L, reducing the overall cost and schedule of the project
- The entire plant including balance of plant facilities starts with a single Push Button mechanism from the plant control system designed by L&T-S&L

3x660 MW COAL BASED SUPER THERMAL POWER PLANT KORADI, MAHARASHTRA, INDIA

- Optimized layout, required area reduced by nearly 10%
- Reduction in distance between units
- Engineering cycle time reduced by 10%
- Efficient rework management through customized tools
- Effective integration of services among stakeholders
- Faster client approval
- Improved construction planning

370 MW AMMAN EAST COMBINED CYCLE POWER PLANT JORDAN

- Compact layout
- Engineering completion within shortest possible duration
- Simple cycle commissioned in 14 months and total plant commissioned in 24 months
- Minimized water requirements by installation of air cooled systems designed by L&T-S&L

2x384 MW GMR RAJAHMUNDRY ENERGY COMBINED CYCLE POWER PLANT (PHASE-II) ANDHRA PRADESH, INDIA

- Compact layout - reduction in area compared to Phase-I
- Reduction in distance between units
- Engineering cycle time reduced by 20%
- Effective integration of services among stakeholders
- Faster client approval
- Integrated construction planning
- Site training provided to owner

1x168 MW AES KELANITISSA COMBINED CYCLE POWER PLANT COLOMBO, SRI LANKA

- One of the most compact layouts for combined cycle plant of this size
- Innovative use of space
- Reduced engineering cycle time

ENGINEERING SATISFACTION

Leveraging Knowledge. Delivering Commitment.

L&T-S&L approaches every project as an opportunity to raise the bar. Each project presents unique challenges and motivates the team to come up with out-of-the-box solutions that efficiently meet and often surpass the pre-set goals. The commitment to go the extra mile generates a deep sense of confidence and satisfaction among customers.

INTERNATIONAL CUSTOMERS

- AJEC
- ALGHANIM
- Al-Toukhi
- Arabian Bemco
- Daleel Petroleum
- Doosan
- Dubai Aluminum
- General Electric
- GS E&C
- Hyundai E&C
- International Finance Corporation
- International Free Company
- Jubail Energy
- KKR Holdings
- L&T Electromech
- Oman Refinery
- Pec-Tech
- POSCO
- Ranhill
- Sargent & Lundy
- Standard Chartered
- Toshiba
- Zelan

DOMESTIC CUSTOMERS

- Alstom
- BHEL
- Blackstone
- CESC
- CRISIL
- Damodar Valley
- GSPC
- GSECL
- GACL
- ICICI
- IDFC
- IL & FS
- IOCL Panipat
- Jhajjar Power
- L&T Infrastructure Finance
- Lanco Infratech
- Larsen & Toubro
- MPPGCL
- NTPC
- NCC
- Panasonic India
- Power Finance Corporation
- Rural Electrification Corporation
- State Bank of India
- TATA Power
- Thermal Powertech
- Thermax
- Torrent
- Vedanta Group

International Footprint

DE - Detail Engineering I OE - Owner's Engineering I STPS - Super Thermal Power Station
SCPP - Simple Cycle Power Plant I CCPP - Combined Cycle Power Plant I FEED - Front End Engineering & Design
IPP - Independent Power Producer I HEP - Hydro Electric Plant

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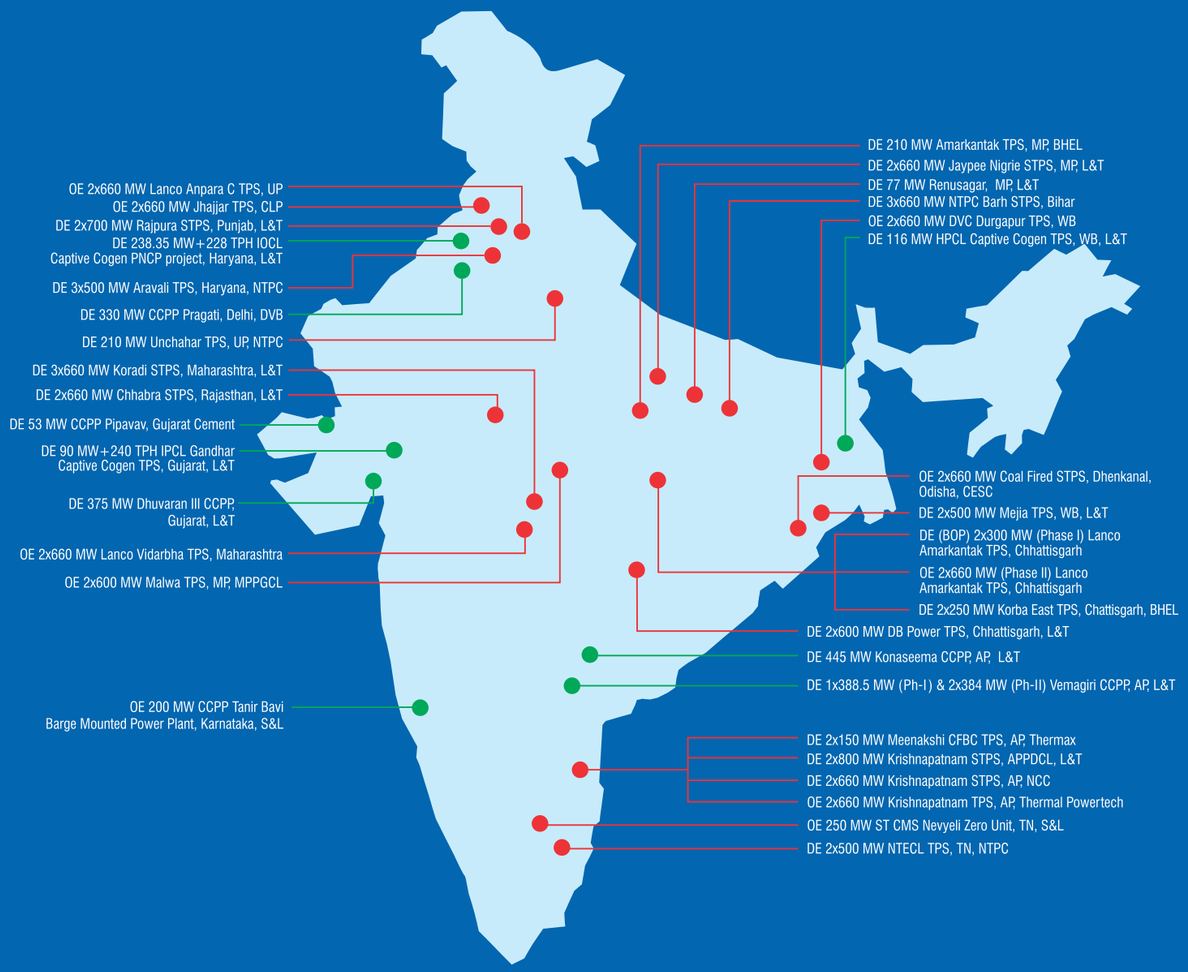
DE - Coal Based Projects > 2500 MW | DE - Gas Based Projects > 16000 MW
OE - Gas Based Projects > 3000 MW

Legends: Gas based Plants | Coal based Plants | Hydro-electric Plants

National Footprint



DE - Detail Engineering I OE - Owner's Engineering
TPS - Thermal Power Station I STPS - Super Thermal Power Station I CFBC - Circulating Fluidized Bed Combustion
SCPP - Simple Cycle Power Plant I CCPP - Combined Cycle Power Plant

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DE - Coal Based Projects > 20,000 MW | DE - Gas Based Projects > 3000 MW
OE - Coal Based Projects > 10,500 MW | OE - Gas Based Projects > 300 MW

Legends: Gas based Plants | Coal based Plants

PROJECT PORTFOLIO

L&T-S&L has offered a variety of services from basic and detail engineering to commissioning support in both national & international markets.

This CD gives a brief insight into the projects that stand testament to our capabilities in engineering success.

Contact Us

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L&T-S&L

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