CREATING MARVELS FOR THE PETROCHEMICAL INDUSTRY

L&T Hydrocarbon Engineering
Delivering Execution Excellence to Mega Petrochemical Projects

L&T Hydrocarbon Engineering (LTHE) is an engineering, procurement, fabrication, construction and project management company providing integrated ‘design-to-build’ solutions for large and complex Offshore and Onshore hydrocarbon projects worldwide.

A wholly-owned subsidiary of Larsen & Toubro Limited (L&T), the Company continues to draw on the parent Company’s organisational strengths and experience.

The Company caters to the needs of its client base in multiple geographies.

Integrated Project Execution

The Company’s end-to-end capabilities across the hydrocarbon value chain cover upstream oil & gas processing, refining, petrochemicals, fertiliser, cryogenic storage including LNG and pipeline sectors. Our project management teams efficiently execute all projects, meeting the most stringent targets of safety, quality, cost and time.

Global projects benefit from three decades of the Company’s in-house capabilities in engineering, procurement, fabrication, construction and commissioning (EPCC).

We also execute projects on a License + EPCC package basis, depending on customer’s requirements. These projects are executed through alliances with process licensors.

Delivering Execution Excellence to Mega Petrochemical Projects

The L&T Hydrocarbon Engineering Advantage

Customer focus and responsiveness
Proven track record and trusted industry leader

Cost-optimal solutions through integrated approach
Strong commitment to Quality and HSE

Dedicated project management resources
Technology, focus and specialized design & engineering expertise

Supply chain Management with sourcing expertise
Innovative construction with cutting edge technology

Capability for mobilization of large resources and quick ramping-up
Extensive IT-enablement for virtual, single-office operations

PROJECT DETAILS

Project Name: Normal Paraffin & Derivatives Complex Project
Project Location: Yanbu, The Kingdom of Saudi Arabia
Plant Capacity: 235,000 MTPA Paraffin
120,000 MTPA Linear Alkyl Benzene
82,600 MTPA Specialty Oils
30,000 MTPA Sulfonated Asphalt
33.6 MTPD Sulphuric Acid
Client: Farabi Petrochemicals Company
Licensor: UOP/Technithon/MECS
Project scope: Engineering, Procurement, Construction & Commissioning (EPCC)

Farabi Petrochemicals Company is one of the world’s leading producers of paraffins and linear alkyl benzene.

As part of its ambitious growth plan, it is establishing a new n-Paraffin and Linear Alkyl Benzene facility in the Yanbu industrial area of the Kingdom of Saudi Arabia (KSA).

In May 2017, L&T Hydrocarbon Engineering bagged the prestigious contract for setting up this greenfield petrochemical complex on a lumpsum turnkey basis. It is the first large-scale Petrochemical Complex Project undertaken by the Company in KSA on EPCC basis.

The project is scheduled to be completed in April, 2020.
L&T Chiyoda executed detailed engineering for this project in 18 months at its office at Vadodara in India. Farabi’s Integrated Project Management (Farabi IPMT) team was present during this phase, and expedited the process of engineering deliverables, engineering resolutions and faster approvals on the engineering documents.

The joint efforts of the LTHE and Farabi IPMT teams laid the strong foundation of the project with effective coordination with licensors and on-time completion of major engineering, including timely completion of approx. 25 special studies.

Global sourcing

One of the big challenges has been supplying approx. 1000 tagged equipment – reactors, compressors, air fin coolers, multi tube exchangers, towers, vessels, pumps and utility packages, such as waste water treatment package, boiler, cooling tower, DM plant, etc. Farabi also novated critical long-lead items, like heaters, 3.3 MW screw compressor and Packinox exchanger, to the Company.

Considering the quantity of equipment to be supplied, LTHE identified the items coming under the critical path and prioritized ordering accordingly. First-priority items (approx. 110) included reactors, switchgear, utility packages and compressors, and were ordered within three months from the date of the award of the contract. Second-priority items (approx. 160), included ICSS, telecom, multi-tube exchangers, columns, API and non-API Pumps, and were ordered within five months of the award of the contract. As the equipment were procured from different parts of the world – and at different times – the logistics management role assumed cruciality.

Construction

Multiple sub-contractors as well as in-house resources undertake construction. Considering peak manpower of almost 6000 personnel at site, sub-contract management is highly crucial.

Piping fabrication is undertaken at LTHE’s yard at Kattupalli. Materials Management is undertaken through IT tools such as e+ALPS (Activity Planning System) and spool management through AUTO Spool. The QR Code system is being used for piping and structural material for efficient handling from fabrication and storage to erection.

For various services, the project utilizes a wide variety of UG piping materials – HDPE, CPVC, GRE and CS+ FBE coating lines. All FBE-coated pipes (up to 82000 IM) are fabricated and FBE-coated by a KSA-based vendor, then sent to the site for erection.

Up to 5800 MT of the structural steel required for the plant was fabricated in prefabricated shops and supplied from the two agencies located in KSA. In order to reduce construction time, 21 shelters were considered as PEB (pre-engineered buildings).

Tank Farm

The tank farm contains 56 tanks with diameters varying from 6 m to 22 m. The tanks have different types of roofs, e.g. fixed-cone roof, floating roof and dome roof. The tank farm has state-of-the-art facilities like tank farm management system, fire-protection systems, etc.

Buildings

The complex contains several buildings - Process Area (five sub-stations & main control room) as well as Non-process Area (Admin Building technical, canteen, laboratory, fire station, flare houses). The entire plant is controlled from the main control room. Pre-casted roof slabs have been used for substations. To reduce construction time and provide the thermal protection required by KSA norms, all buildings are made of insulated bricks instead of conventional bricks.
In March 2016, Gujarat State Fertilizers and Chemicals Ltd. (GSFC) awarded to L&T Hydrocarbon Engineering a project for installation of a 40,000 MTPA melamine plant on EPCC basis at GSFC-Vadodara, India.

Casale SA is the technology licensor for this unique project, which involves an off-gas treatment section and a high-pressure melamine plant, both integrated, consequently optimizing energy and utility consumption. This is Casale’s first plant as a licensor for melamine using the high-pressure Borealis technology.

**PROJECT DETAILS**
- **Project Name**: Melamine Plant
- **Project Location**: Vadodara, India
- **Plant Capacity**: 40,000 MTPA
- **Client**: Gujarat State Fertilizers & Chemicals Ltd.
- **Licensor**: Casale, Switzerland
- **Project scope**: Engineering, Procurement, Construction & Commissioning (EPCC)

**PROJECT CHALLENGES**
- Space constraints necessitated a compact, vertical design. (OGT unit: 26.25 m x 64 m, Melamine unit: 44.75 m x 64 m)
- Three sides of the site were locked due to facilities at this brownfield project. This restricted movement and positioning of cranes.
- Licensor-specific vendors were mandated, largely from Europe (18 suppliers), for critical packages, equipment and instruments. These included a molten salt heater from APACO, Switzerland, a flash dryer from GEA Denmark / India, a vacuum drum filter from Andritz, Germany, a pneumatic conveyer by Geroldinger, Germany, a bagging plant from H&B Germany, level transmitters (zirconium diaphragm type) from WIKA, Germany, high-pressure reciprocating pumps from Peroni, Italy, axial flow pumps from Egger Switzerland, jacketed control valves from Parcol, Italy.
- The project involved placing 930 Purchase Orders on over 360 vendors – many for the first time for LTHE.
- Special metallurgy was involved (alloy-59, 25.22.2, urea grade) for which there are limited international vendors.
- Dedicated teams were required to expedite critical packages, equipment and exotic materials to ensure timely deliveries in order to meet the challenging construction sequence.
- Vertical plant construction posed challenges in sequential construction. Eight vertical levels in the plant with different equipment and piping were to be sequentially erected.
- Peak manpower was 1540 personnel with over 140 staff.
- High pressure, high temperature and harmful fluids made precommissioning and commissioning a major challenge. Maintaining the highest HSE standards in the field was of utmost importance.

**UNIQUE VALUE-ADDITION THROUGH EXECUTION STRATEGIES**
- As the plant was blocked on three sides, it was a unique challenge to position the cranes required. The Company mobilized a 650 MT ringer crane for heavy lift erection at site, positioning it on the main road of the GSFC plant for eight months.
- Unconventional methods were used for installation of plant and machinery. A tower crane was used to ensure continuous feeding of structural and piping material for erection at higher elevations.
- Quick movement across different levels in the plant was facilitated by construction elevators.
- Bar-coding was implemented for piping-spool storage, identification and erection.
- Early start of electrical & instrumentation activities was facilitated by a continuous front-generation drive.
- Completion of substation building on priority resulted in early energization.
- An average of 8% construction progress for six months during peak time resulted from micro-planning and monitoring.
- An early switchover was made from construction completion to system-based monitoring.
- Centenary Completion Management System (CCMS) expedited and monitored the system-based plant precommissioning and commissioning.
- Trouble-free start-up and reduced commissioning problems resulted from the implementation of the Flawless Project Delivery concept during installation in the areas of flange and valve management, cleanliness (‘Build it clean’), preservation and interface management.
In March 2010, L&T won the prestigious contract to execute the Mangalore Aromatic Complex Project (MARC) of ONGC Mangalore Petrochemicals Limited (OMPL) – a company promoted by ONGC and MRPL.

L&T was given the responsibility of executing all the nine process units of this project, viz. Naphtha Hydrotreating Unit, Continuous Catalytic Regeneration Unit, Platforming Unit, Parex Unit, Isomar Unit, Xylene Fractionation Unit, Shell Sulpholane Unit, Tatoray Unit and Benzene & Toluene Fractionation Unit.

In addition to the huge quantum of work involved in the project, Mangalore’s local conditions, including heavy rains and infrastructure constraints, added to the challenge. Various innovative measures were adopted to minimize the effect of rainfall on the progress and to limit any loss in productivity. As the project site is in rocky terrain, there were also several challenges in civil construction, such as the discovery of rocks at unpredictable depths, etc.

The project involved the shipment of over-dimensional consignment (ODC) from eight countries. Infrastructure challenges at the Mangalore port and the non-availability of proper facilities (roads, railway crossings, etc.) posed a major challenge during execution.

The project was executed in the following broad phases:

1. First phase included basic planning and conceptualization and substantial completion of civil work.
2. Second phase involved integration of equipment to the project and connecting them by way of piping and cabling, followed by testing.
3. Third and final phase included loop completion, pre-commissioning and commissioning activities.

The magnitude and complexity of the project can be gauged from the following:

- Engineering: >1 Million man-hours
- A workforce (6554 at peak) had to be mobilized
- Lack of access and infrastructure facilities and delay in availability of ODC route
- Unprecedented and extended monsoon
- Complex piping system with various metallurgies and high volumes
- Synchronized sequence of highly interconnected 9 process units

L&T is one among the few companies worldwide that has in-house capabilities to execute a project of this magnitude in an integrated manner.

L&T’s internal strengths were leveraged by the project management team, using the platform of SAP’s integrated network, multi-locational working, integrated 3D modeling and reviews, constructability studies and integrated EPC execution.

L&T’s project management philosophy, which revolves around the key concept of becoming a Centre of Excellence, enables the Company to maximize productivity and efficiency and allows for maximum integration. This, in turn, results in adherence to safety, quality, and timeliness standards along with the budgetary constraints.

The project was executed in the following broad phases:

1. First phase included basic planning and conceptualization and substantial completion of civil work and technological structures to make the plant ready for equipment and piping integration, with 85 to 90% engineering completion.
2. Second phase involved integration of equipment to the project and connecting them by way of piping and cabling, followed by testing.
3. Third and final phase included loop completion, pre-commissioning and commissioning activities. This is the phase where the construction work moves to process systems.

The challenges were managed through various project management philosophies and approaches such as:

- ‘First Time Right’ approach
- Dedicated expeditors at vendor shops to ensure timely delivery of equipment
- Effective Logistics Management
- Automation of construction activities
- Work-pack approach to planning and a construction-driven approach
- Management of workloads through use of various off-site fabrication facilities
- Smooth turnover of systems after mechanical completion to start-up and commissioning
In January 2003, Indian Oil Corporation Limited (IOCL) awarded an order to Larsen & Toubro (L&T) for a Purified Terephthalic Acid (PTA) plant of world-scale size at its Refinery & Petrochemical Complex at Panipat.

This is one of the largest single-stream PTA units in India. Technologically, this is one of the most advanced plants in the country, with the technology from DuPont, UK (now Invista). EIL was the Project Management Consultant (PMC).

This was L&T’s first major EPC LSTK project in the petrochemical sector and single largest LSTK order at that point of time. L&T formed an experienced task force to execute this challenging project, which had a stiff delivery schedule for mechanical completion.

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PROJECT DETAILS

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<tr>
<th>Project Name</th>
<th>Purified Terephthalic Acid Plant</th>
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<tbody>
<tr>
<td>Project Location</td>
<td>Panipat, India</td>
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<tr>
<td>Plant Capacity</td>
<td>553,000 MTPA</td>
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<tr>
<td>Client</td>
<td>Indian Oil Corporation Limited</td>
</tr>
<tr>
<td>Licenser</td>
<td>Invista, UK</td>
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<tr>
<td>Project scope</td>
<td>Engineering, Procurement, Construction &amp; Commissioning (EPC)</td>
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PROJECT CHALLENGES

The project involved global procurement, with 44 critical mandatory equipment (including 15 critical package systems). Most of the sourcing was from Europe, the Far East and North America. A large warehouse (420 m x 105 m) with state-of-the-art storage and bagging facilities was also a part of the overall project scope.

The engineering required a deep understanding of all fluid phases including gas, liquid, slurry and solid handling, and highly corrosive services including high concentration acid lines (acetic acid, hydro bromic acid, etc.). A variety of exotic metallurgies including titanium, hastelloy and duplex stainless steel were used, which required clean environment for welding and stringent quality control.

EXECUTION STRATEGY

The PTA Plant has two sections, viz. Crude Terephthalic Acid Section and Purified Terephthalic Acid Section, viz.

Crude Terephthalic Acid Section
- Oxidation Reaction Section
- Crystallization Section
- Separation & Drying Section
- Off-gases Recovery Section
- Solvent Recovery Section
- Catalyst Recovery Section

Purified Terephthalic Acid Section
- FEED Preparation Section
- Reactor Section
- Crystallization Section
- Separation & Drying Section
- PTA Storage & Warehouse

Being one of the Approved Design Engineering Contractors for Invista Technology, Aker Kvaerner (now Aker Solutions) undertook the residual process and detailed engineering for the project at their UK and Mumbai offices, under the supervision of L&T’s Engineering Management Team.

L&T implemented the project using innovative engineering and construction techniques, with Zero Lost Time Accidents, earning IOCL’s ‘Best Safety Award’ and ‘Silver Award for Occupational Safety’ from The Royal Society for the Prevention of Accidents (RoSPA), UK. The successful commissioning of the PTA plant in June 2006 affirmed L&T’s capabilities in helping mega projects move from concept to reality through its internationally benchmarked capabilities in engineering, fabrication, procurement and construction.