L&T has played a critical role in the development of technology & capabilities for the Indian nuclear power sector from its very beginning. ECC, L&T’s construction Division has the capability to construct critical and complex structures for nuclear power plants to international standard specifications. Moreover, it has the distinction of having participated in the construction of a majority of nuclear power plants and heavy water plants in the country.

This has opened several avenues for L&T to sign cooperation agreements / MoUs and forge alliances with leaders of nuclear technology across the world, such as: Westinghouse Electric Company (WEC), USA for Pressurized Water Nuclear Reactors with modular construction technology; Atomic Energy of Canada Limited (AECL) for cooperation on Advanced CANDU Reactor ACR 1000. Recently it signed the MoU with Atomstroyexport (ASE) of Russia for cooperation to supply Russian VVER 1000 type reactors for the Kudankulam nuclear power project.

L&T has been a partner in the development of Indian Nuclear power programme and it has been playing an active role in the construction of major nuclear plants in different parts of the country. As a part of the operations of L&T’s Infrastructure OC, we take pleasure in highlighting our contributions to this sector along with irrigation projects executed by us.

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*Kaiga Atomic Power Project (Unit 1 & 2)*
L&T began its journey into construction of Nuclear power projects in a modest way, by undertaking the construction of office facilities for the Atomic Energy Establishment and laboratories for Bhabha Atomic Research Centre at Trombay during mid 60s. The construction of Main plant civil works at Kalpakkam for the 220 MWe Madras Atomic Power Project Unit 1&2 during 70s was the first major project in the nuclear segment. Subsequently, the Main plant civil works for the 220 MWe Kaiga Nuclear Power Project (Unit 1&2) in Karnataka was executed by L&T. Erection of almost all heavy water plants in India are executed by L&T.

Realising the vast potential and business opportunities in this segment the Nuclear Business Unit was formed by L&T in the year 1999-2000 when it secured the 540 MWe Tarapur Atomic Power Project, Unit 3&4. It should be mentioned that Tarapur Atomic Power Project was one of the major projects for L&T, where different business units of L&T were actively involved in the execution of the project - Nuclear, Electrical & Instrumentation BUs of ECC Division; Heavy Engineering Division; Nuclear BU of E&C Division to name a few.

Achievements

Some of the notable achievements in Nuclear segment include:

• Out of the total installed capacity of 7280 MWe of nuclear power (both commissioned and ongoing); L&T is involved in almost all Nuclear power projects in the country extending up to 5280 MW.

• Successful completion of main plant civil works of 2x540 MWe Tarapur Nuclear Power project in a record 60 months from the first pour of concrete is considered as a great achievement - One among the six reactors in the world to achieve this feat.

• Successful completion of Primary Piping Package (the heart of the nuclear plant) on time including other mechanical packages in the Country’s maiden 2 x 540 MWe Tarapur Nuclear Power Project. This helped L&T in understanding the criticality, stringent quality requirements, etc and as a sequel, it secured major mechanical packages in Kudankulam Nuclear Power Project 1&2.

L&T is involved in the execution of India’s first 2x1000 MWe Nuclear Power Project at Kudankulam, which is one of the most prestigious projects undertaken by Government of India in collaboration with Russian Government. Initially, L&T’s participation in civil works involves construction of infrastructure facilities and auxiliary buildings only. However, the scenario changed, when L&T secured four major mechanical packages which involve technology certifications, being done for the first time in India, etc.

This apart, auxiliary systems such as Induced Draft Cooling Towers, HVAC, Service Water Systems, etc are being constructed on EPC basis.

L&T is also involved in many Reactor back end projects, that is construction of fuel reprocessing related facilities such as Additional Waste Tank Farm, Spent fuel Storage Facilities, Power Reactor Fuel Reprocessing facilities, etc at various locations in India. Thus, making L&T an all rounder when it comes to execution of almost the entire spectrum of activities involved in the construction of nuclear power projects.

On the whole L&T is playing a critical and significant role in the India’s Nuclear Power sector.
Nuclear power projects are considered as one of the sustainable energy projects of the future. The Nuclear Power Corporation of India Limited (NPCIL) presently operates 17 nuclear power plants in the country at different locations. India has made a strong beginning in the field of Nuclear Power. Today it is quite self-sufficient from technology and resources point of view and NPCIL has ambitious plans of achieving 20,000 MW by 2020, improving from the current installed capacity of 4120 MW.

Over the past five decades, ECC has constructed many nuclear-related structures and played a major role in this sector. It has the capability to construct critical and complex structures for Nuclear Power generation. ECC has the distinction of making constructive contribution to almost all the Nuclear power plants in the country. Some of the important projects are Madras Atomic Power Project, Kaiga Atomic Power Project, Tarapur Atomic Power Project, Rajasthan Atomic Power Project and Kudankulam Nuclear Power Project. ECC has also been involved in other nuclear field related projects such as heavy water plants, nuclear waste management, rare materials project, etc falling under the purview of DAE/ BARC. In fact, ECC’s association with DAE started in the early 60s, when it was awarded with design and construction works for radiological and modular laboratories at Trombay.

ECC’s major involvement in nuclear power projects started at MAPP in 1970 when it was entrusted with the construction of the reactor and turbine buildings for MAPP. The contract for civil construction included the reactor building with 40m high and 45m dia structure topped by a dome, sub-structure for service building, cooling water system and outfall structure, demineralisation plant, central stores, PHT purification buildings, Fast breeder test reactor building, radio-metallurgical & radio-chemistry laboratories, active control fuel assembly building, free stack (100m) and ventilation stacks (75 m & 65 m tall). The reactor wall and dome were of prestressed concrete construction requiring high accuracy. Another salient feature of MAPP is the double containment wall with outer random rubble masonry wall to a height of 34 m, which was done for the first time in India. ECC has also been involved in design, installation and commissioning of 33kV switchyard catering to the entire power requirement of the Reactor Research Centre at Kalpakkam. Subsequently electrical installations for the two research laboratories – RCL & MDL were done by ECC.

NPCIL once again demonstrated its confidence in L&T by awarding the complete civil works for Units 1 & 2 of Kaiga Atomic Power Project. Kaiga was literally a greenfield project necessitating, in many cases, even basic infrastructure development. The site was a natural bowl-shaped terrain surrounded by hills with deep lush green forest and the site was accessible in fair weather through a forest road and access to the site was difficult during monsoon till all the access roads were ready. ECC’s scope of work included construction of reactor, turbine, service, control, reactor auxiliary,
Reactor building at Madras Atomic Power Project, Kalpakkam diesel generator, spent fuel buildings, 140m high ventilation stack, area drainage, excavation, area grading and miscellaneous structures. During execution of main civil works, ECC was awarded additional works such as construction of circulating water pump houses, safety related pump house, fire water pump house, de-mineralisation, filtration and chlorination plants, make-up water pretreatment facilities, CW Intake structures and tunnel, domestic water tank, approach channel to intake structures and outdoor & indoor piping works.

Some of the advanced construction methods used at Kaiga site included climbing formwork system for prestressed containment walls, slipform for ventilation stack and formwork for other structures. A special formwork supporting structure was designed to support the formwork of inner containment dome of the reactor. Construction of Kaiga nuclear power project was highly challenging, considering the remoteness of the site, unfriendly weather conditions and other complexities. Despite the hardships, ECC met the challenges and successfully completed the project as per the requirements of NPCIL.

L&T is proud of its association with NPCIL, which has celebrated its Golden Jubilee Year and wishes to continue its commitment and contribution for the development of Nuclear Power Generation in India.
Endeavours at Tarapur Nuclear Power Plant

B.SUNDARAMOORTHY,
Project Manager

VISHVA MOHAN SHRIVASTAVA,
Planning Engineer
Tarapur Atomic Power Station

The Tarapur nuclear power station houses two 200 MW Boiling Water Reactors (BWRs). The new series of 540 MWe nuclear reactors are developed indigenously from 220 MWe Pressurized Heavy Water Reactors (PHWR). At present, this power station has the largest nuclear power reactor in the country. It was commissioned seven months ahead of schedule by the Nuclear Power Corporation of India.

BARC Installations, Tarapur

The Bhabha Atomic Research Centre (BARC) – India’s primary nuclear research facility supports India’s nuclear power and research programme. BARC’s installations at Tarapur support the operations of Tarapur Atomic Power Station.

L&T’s Role

L&T has executed the 2 x 540 MWe at Tarapur and was involved in almost all the disciplines of engineering of a Nuclear Power Project. L&T was involved in main plant civil works, service water system, reactor piping, composite chilled water and HVAC packages, electrical works and instrumentation works – which demonstrated the capability of L&T in broad spectrum engineering construction. The heavy engineering division of L&T had supplied the calandria, steam genertaors while the Engineering & Construction division supplied the Primary Steam Piping system. ECC involved in the mechanical erection of these structures.

The scope of main civil works package covered construction of reactor, service, station auxiliary, reactor auxiliary, control buildings, pipe & cable bridges, ventilation stack, potable water tank, roads, site grading, fabrication & structural steel erection, EPs and other miscellaneous structures. The gestation period for nuclear power projects today is considerably reduced by commissioning TAPP 3 & 4 in 60 months. This is an international benchmark achievement. At TAPP 3&4, the challenge of completing the total project in 60 months was achieved by deploying innovative construction methods. Some of them include pumping of heavy concrete, casting of 7m high columns in single lift, use of self climbing formwork for inner containment wall, casting of 3.5 m high wall for OC wall, prefabrication of calandria vault liner, use of threaded coupler for reducing reinforcement congestion and wastage, easy handling etc.

Design, procurement and construction of service water system, composite chilled water and HVAC packages include supply of some critical equipment such as vertical turbine pumps to work
in sub-marine environment, 3050 TR capacity centralized chillers and 60 lakh CMH capacity ventilation system.

The primary piping package executed by ECC (in association with E&C division of L&T) at TAPP 3&4 is meant for nuclear steam supply system (NSSS) which consists of reactor assembly, the moderator system and the primary heat transfer system. The reactor assembly system is the most important part of NSSS and it consists of calandria, end shields, calandria tubes, coolant tubes, end fittings, fuel bundles and reactivity control devices. The fabrication and erection of primary piping system is to be carried out in dust free environment. Extreme care need to be taken for maintaining clean room conditions not only in the fabrication stage, but also during erection.

The order for electrical and instrumentation works is probably the single largest order awarded to any contractor by NPCIL. These packages involve design, manufacture, supply, erection, testing and commissioning of various critical electrical and field instrumentation items required for a nuclear power plant.

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<tr>
<td>Concrete</td>
<td>cu.m</td>
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<tr>
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<tr>
<td>Formwork</td>
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<tr>
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<tr>
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<td>Fabrication and installation of 300 cu.m SS 304L tanks</td>
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<tr>
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<tr>
<td>Erection of SS piping</td>
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Fresh Orders from BARC, Tarapur

On completion of the major works at Tarapur, ECC was entrusted with construction of Additional Waste Tank Farm (AWTF) and Spent Fuel Storage Facility (SFSF). Both packages are of composite nature and covers all civil, mechanical, electrical, control & instrumentation systems. Scope of work covers civil works, manufacturing/fabrication, procurement, inspection/testing at shop, supply, unloading and handling at site, erection/installation, testing at site, start up and commissioning, performance guarantee test run, training and handing over the complete facilities. Tata Consulting Engineers, Mumbai were the consultants for this project.

Additional Waste Tank Farm (AWTF)

To receive and store the highly radioactive liquid waste, eight identical vertical storage tanks each with 300 cu.m capacity was planned.

AWTF project includes construction of waste storage tanks in the partially underground RCC vaults with associated utilities like waste off gas and blister off gas systems. There are two RCC
shielded vaults (V-1 and V-2) with 4 tanks each and two cells (Cell-I and Cell-O) accommodating the in-routing, out-routing and sump tanks. Each sub-vault has a sump in the vault raft. Necessary sloping was provided in each sub vault with a channel. The floors at all sub-vaults and its walls up to height of 1.5m are lined with 5 mm SS 304L plates.

In between the two corridors above the vaults, rooms for sampling blisters and transmitter rooms are accommodated. The corridors also house the embedment for the services and utilities like headers, valves, instrument racks, cables for taking samples remotely and to open the vault entry. A monorail (10 t capacity) was provided in each corridor for lifting the plug of the vaults to enable service inspection.

**AWTF Annex Building**

The service building, known as the AWTF Annex is a two floor building. Vault exhaust fan room, ventilation air supply fan room, electrical room and change room are housed in the first floor. Second floor accommodates control room for monitoring and carrying out the operations of the AWTF, waste cooling water room, waste off-gas equipment and blower room.

**Spent Fuel Storage Facility (SFSF)**

SFSF was constructed to receive and store the spent fuel from nuclear power plants under water before sending it for further processing.

The SFSF project demanded partially underground, high performance concrete structures (lined with stainless steel plates) meant to store the spent fuel discharged from the Nuclear Power Reactors. SFSF is filled with de-mineralised water, supported by water-polishing system and a water-cooling system.

The scope of work covers constructing and installing all associated utilities like infiltration gallery, DM water plant, pool water polishing system, cooling water system including cooling towers, material handling system including 10 & 75-t EOT cranes, 2-t pool bridge crane, fire protection and alarm system, electrical and instrumentation and control panels, air conditioning and ventilation system.
**SFSF pool building houses**
- vehicle airlocks
- cask decontamination/storage area
- EOT cranes, pool bridge and hoists
- underground fuel pool
- spent fuel transfer bay along with underground duct to nearby reprocessing plant for hydraulic transfer of fuel bundles as per the requirement of BARC
- leak detection and collection facility for fuel pool
- pool water polishing unit
- domestic water tank
- approach road for trailer and truck movement
- local control panels

The SFSF pool building extension houses pumps for water cooling system and polishing; ventilation system in an exhaust fan room; disposal system for regenerate effluent (underground RCC tank with pump and piping) and stack for exhaust vent. The utility building houses air conditioning and ventilation system; DM water plant; electrical substation; change room, rooms for monitoring, air compressor, control and laboratory. Other areas include low level effluent storage and pumping facility, de-mineralised water storage tanks (atop fuel pool building) and security and access control system. The administrative office area has a good training and conference room with all gadgets.

Excellent quality ratings are achieved in this project, which enabled it to bag ECC Quality Trophy.

*A view of Polishing Unit of Spent Fuel Storage Facility*
Nuclear Reactor Containment Test Model 1:4 Scaled Pre-stressed Concrete Containment

B. SUNDARAMOORTHY, Project Manager

The main objective of the test model is to find out the behaviour of the Nuclear reactor’s containment structure under extreme pressure conditions. The model is pressurized three times more than the actual design pressure of the Nuclear Reactor. The model is also tested to establish and check the design parameters of the actual containment structures and to get better understanding of structural behaviour of the containment structure for future.

Test Model at Tarapur

The pre-stressed concrete containment test model is scaled down to represent the actual Pressurised Heavy Water Reactor of Tarapur Atomic Power station 3 & 4 at Tarapur, to a factor of 1:4. This model is constructed at Tarapur close to the existing BARC facilities.

Contented by the performance of L&T in Tarapur Atomic Power Project 3&4, NPCIL invited L&T to construct the model on nomination basis.

After the construction of the model, the same will be subjected to a pressure, which is approximately 4.5 to 6 kg/sq.cm or even higher. However, the actual failure pressure will be established after testing. In any case, it is expected that there will be nominal leakage at 5 kg/sq.cm.

Salient features

All the components of the actual reactor is scaled down to 1:4 including pre-stressing, critical openings etc.

Raft

The inner containment wall is supported on a raft having dimensions of:

- Diameter -15.60 m and
- Depth of 3 m
- Stressing gallery of size 1500mm x 1800mm below the inner containment structure with 4 access shafts

Inner Containment wall

- Thickness - 188 mm
- Height of the wall - 12.475 m above raft
- Constructed using 9 lifts
- The inner diameter of IC wall is 12.40 m

Ring Beam

- Height of ring beam is 1.2 m
- Average thickness is 450 mm
- IC wall, ring beam and dome are designed as monolithic structures

Completed view of the test model. Right: Sectional view
**Inner Containment Dome (IC Dome)**

The IC dome starts at 13.706 m height and springs up to the crown 15.750 m.

- Average thickness of IC dome is 164 mm
- Centre line diameter of the IC dome is 19.60 m
- Two radial Steam Generator (SG) openings of diameter 1.35m at the centre line are provided in the IC dome to simulate the Steam Generator openings of the prototype
- Inner containment dome was cast in single pour

**Sensors**

To monitor the response during prestressing of containment and dome, following sensors were used:

- 727 sensors were installed in concrete from raft to crown of the dome at pre-determined locations
- 89 sensors were installed on HT strands and stressing was analysed

Different type of sensors used in test containment included:

- Embedded type of Vibrating Wire Strain Gauge (VWSG)
- Pastable SMER 10 mm
- Spot weldable 51 mm, Weldable 203 mm and Earth pressure cell

Weldable type of sensors were installed on reinforcement bars whereas embedded type in concrete.

**Pre-stressing**

Inner containment wall and dome was subjected to prestressing using prestressing system 1T15. This involved:

- Total number of 313 cables, comprising of JO & JI, Vertical and Horizontal cables.
- 15.2 mm diameter high tensile strand for prestressing works
- HDPE sheathing of 25mm-OD/20mm-ID.
- Maximum load applied on HT strands was 21.20 t on each cable and
- Sheathing was cement grouted with temperature controlled cement grout

**Construction Joints-Fuko System**

Construction joints in the dome and the inner containment wall were sealed using Fuko system i.e. Re-injectable grouting system with injection of hydro swelling, water based, low viscous, thermo-setting resin. This is done after construction to make the joint leak tight for air and water.

**Challenges**

The work involved several challenges like:

- Placement of reinforcement, HDPE sheaths and tube units, due to congestion in scaled down thickness of walls and dome having stringent tolerances of +/- 3 mm.
- Installation and protection of 727 sensors in IC wall and dome during preparation of pours and concreting were tough tasks
- Utmost care was taken during installation and 99% of sensors are functioning well even today.
- Installation of instruments in wall and dome due to slender section i.e. 188 mm thick of wall and 164 mm thick of dome.
- Formwork
  - Nuts were not allowed through ties and coil
  - Slender sections
  - Complicated tailor made formwork system was used with prefabricated “C” shaped MS frames
- Difficulty in mounting large number of instruments in limited space around openings of Airlock Barrels.

Efforts required for the construction of the test model involved same amount of work or more than that required for the proto-type due to the limitation in scaled down dimensions.

**Health Safety and Environment**

Regular training and orientation programs for workmen were conducted to keep them alert at all times.

- Project has achieved zero accident
- Achieved 1.4 million safe man-hours

The project was successfully completed in December 2008 to the fullest satisfaction of the client.
India’s first 2 × 1000 MWe Nuclear power plant is coming up at Kudankulam. The project is located on the shores of Gulf of Mannar, on the Southeastern tip of India near Kanyakumari. It is located at Radhapuram taluk of Tirunelveli district in Tamilnadu state.

The site experiences a tropical climate with humidity ranging from 40% to 90% depending on the season and is subjected mainly to the winter monsoon during the months of October, November and December.

The Kudankulam Nuclear Power Project (KKNPP) consists of two units of 1000 MWe with two steam driven turbo generators supplied with turbine steam from two pressurized water VVER type reactors of Russian design. The design of various equipment, systems and structures are carried out in accordance with Russian and other International Standards.

The entire project capacity of 2000 MWe (2 × 1000 MWe) of power will be supplied to three southern states (Tamil Nadu, Karnataka and Kerala) and the Union Territory of Pondicherry. NPCIL has divided the whole project into number of packages and awarded to different contractors. The whole project cost is about Rs. 13,000 cr.

**Packages**

L&T has been awarded M2, M4, M5, C5 and E1 packages directly by NPCIL. M3 and I1 have been awarded to L&T by BHEL & ECIL.

**Mechanical:**

- Erection of Nuclear Steam Supply System (NSSS) and auxiliary systems (equipment, piping & tubing works) - M2 Package
- Seawater system (equipment & piping erection) - M4 Package
- Common service (piping & equipment erection) - M5 Package
- Erection of turbine - M3 Package

**Civil:** Radioactive waste processing and storage buildings - C5 Package

**Electrical:** Erection of electrical equipment and systems - E1 Package

**Technical Aspects**

Kudankulam Reactors are Water-cooled Water moderated Energy Reactor (VVER-1000) of Pressurized Water Reactor (PWR) technology, which is worldwide proven concept. VVER-1000 reactors are the most advanced reactors similar to the PWR’s of western design. Nuclear fuel is charged into the reactor where the fission takes place and the heat is liberated. The liberated heat in the reactor is carried away by the light water from the reactor to steam generator by the main coolant pump. De Mineralized (DM) water acts as reactor coolant. The coolant water is used in the steam generators to produce steam. The steam is allowed to pass through turbine blades with high pressure and velocity. The turbine then rotates receiving the kinetic energy of the steam. The generator, which is mechanically, coupled to the turbine also rotates and generates power. The back steam of the turbine is allowed to pass through the surface type condensers. The condenser will be having tubes through which sea water is allowed to flow and over which the steam flows. The sea water absorbs the heat from the steam and condenses the back steam. The condensate is recycled back to steam generator. The sea water after absorbing the heat from the back steam is discharged into sea and fresh water is drawn through inlet.
Mechanical works for India’s Largest Nuclear Power Plant

Larsen & Toubro has won all major mechanical erection and installation. This includes four mechanical packages and two electrical and instrumentation packages.

The scope of work in M2 package include handling, transportation, pre-fabrication, welding, erection, inspection & testing of piping, instrument tubing and erection of associated equipment along with accessories for nuclear steam supply systems and nuclear auxiliary systems for Unit 1 & 2. This main mechanical package involves heavy erection of critical nuclear equipment like Reactor Pressure Vessel, Steam Generators, Reactor Cooling Pumps, associated piping in reactor and auxiliary buildings, various safety systems like boron injection system, passive heat removal system and containment sprinkler system.

Erection and alignment of NSSS Equipment

In this M2 package, reactor equipment (2 x 316 t each) was erected in four stages. Being a nuclear project, high degree tolerances limit (0.01mm) was maintained. Another challenge during the erection was the clearance between the inner diameter of support structure and outer diameter of Reactor Pressure Vessel (RPV), which is only 10 mm and large volume of blue matching.

Steam Generator (8 x 307 t each) was erected in a confined space with the alignment in the range of 0.4 mm to 0.5 mm.

Pressurizer (2 x 222 t each) was also erected in confined walls with the tolerance of 8mm w.r.t containment wall and alignment in the range of 0.4 mm to 0.5 mm.

All the above erections were executed using highly precision optical tooling survey instruments viz., Jig Transit.

Main Coolant Piping (64 Joints of 990 mm OD) designed for a pressure of 176 kg/cm2 and temperature of 320°C has four quadrants. It is connected to reactor pressure vessel (RPV) assembly, steam generator (SG) and reactor coolant pump (RCP). The piping is used to recirculate the primary coolant thereby removing heat from reactor and transfer the same to steam generator.

Pipes are made out of low alloy steel having outer diameter of 990mm and 70mm wall thickness, cladded inside with austenitic stainless steel. The total circuit involves 32 weld joints per unit and the total weight of piping is about 260 t. The pipes were supplied in pre fabricated piping spool. For the first time in India, a unique and sophisticated welding method was adopted for Main Coolant piping at a nuclear power plant. Controlled and Induction Heating technique was adopted for the first time in India during the welding operation with
hot temperature radiography of weld joint at 200 deg centigrade using special fixtures and source protection measures.

The Scope of work involved
- Reactor Equipment - 13,125 t
- Stationary Equipment - 3,036 t
- Rotary Equipment - 652 t
- Piping (SS/CS) - 3,100 t
- SS/CS Valves - 1,180 t
- Instrument Tubing - CS/SS - 1,60,920m
- Tube Welding - CS/SS - 9,000 Nos.

Turbine Erection
M3 Package work involves handling at site store/storage yard, transportation to site of work, erection testing and commissioning of turbine generator, feed pumps, piping and its auxiliaries.

Alignment of the turbine was done using Optical Aligning instrument and Fronius was adopted for orbital welding.

Sea Water System
M4 Package work covers handling, transportation, pre-fabrication, welding, erection, inspection, testing and painting of sea water systems equipment and piping in Sea Water Pump house and Chlorination plant. The main work in this package include works in pump house like EP fabrication and erection, anti corrosive painting, erection of gates and screens, GRP piping, vertical pump erection, chlorination building works and tunnel piping. Again, using for the first time in India, Coupon Hycote paints was used for the internal painting of sea water pipes.

- Rotating equipment 1,432 t
- Stationary equipment 1,465 t
- CS piping 2,108 t
- SS piping 8 t
- Glass reinforcement piping 35 t
- Titanium piping 16.5 t
- Excavation and backfilling 56,000 cu.m
- Structural steel 500 t
- Cold insulation 1,183 sq.m
- Anti-corrosive painting 55,683 sq.m
- Coating and wrapping 4,000 sq.m
- Grit blasting and painting 9,000 sq.m

Common Service System
The scope of work M5 Package covers handling, transportation, pre-fabrication, welding, erection, inspection, testing of indoor and outdoor piping and equipment of common service systems. This consists of all indoor and outdoors piping, which includes HDPE piping for portable water, fire-fighting system (SGA, SGC, SGE), buried piping (coating and wrapping included), boiler associated works, DM plant associated tanks and piping, and all nuclear ancillary building piping and equipment.

- Rotating equipment - 450 t
- Stationary equipment - 2,612 t
- CS piping - 2,452 t
- SS piping - 405 t
- CI piping - 65 t
- HDPE piping - 150 t
- AC piping - 255 t
- RCC piping - 900 t
- Excavation and backfilling - 238000 cu.m
- Coating and wrapping - 7,000 sq.m
- Supply, fabrication and erection of structural steel - 500 t
The 1000MWe turbine, first of its kind is a steam condensing, four cylinder configuration (1 HPC + 3 LPC) with intermediate moisture separation and steam reheat, with rotational speed of 50 s⁻¹ (3000 rpm), designed to drive directly an alternating current generator, mounted on a joint foundation with the turbine. The total length of turbine without generator is about 40.65m. The turbine is provided with throttling steam admission. The steam from steam generator is supplied to 4 HP valve blocks each HP valve block consist of one stop valve and one governing valve through which the steam enters the HP cylinder.

HP rotor is an integrally forged rotor. LP rotors are also integrally forged rotors (blade length is 1200mm). All rotors are provided with rigid coupling and supported by two journal bearings. The thrust bearing, mounted between HP cylinder and LPC 1 serves as a fixed point for the rotor.

- The steam from 4th stage of each LPC is extracted by 3 LP heaters 1.
- The steam from 3rd stage of LPC 2 & 3 is extracted by LP heater 2.
- The steam from 2nd stage of LPC 1 is extracted by LP heater 3.
- HPC turbine is of double flow cylinder having 5 stages in each flow.
- The steam is extracted from second, third and fourth stages of each flow for feed water heating by HP heater 5,6 and deaerator respectively.
- From HPC exhaust steam is extracted by LP heater 4.
- The steam from exhaust of HPC enters moisture separator re heater.
- After separator re heater the steam enters LP cylinder through LP valve blocks which consist of 1 stop valve and 1 governing valve.
- LPC turbine are double flow cylinders having 5 stages in each flow.
- Mass of heaviest part of turbine is LP rotor - 80.5 t
- Mass of turbine - 1800 t

### Quantum of work

<table>
<thead>
<tr>
<th></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine</td>
<td>4,028 t</td>
</tr>
<tr>
<td>Generator</td>
<td>1,297 t</td>
</tr>
<tr>
<td>Condenser</td>
<td>2,609 t</td>
</tr>
<tr>
<td>Feedpump drive Turbine &amp; Aux</td>
<td>402 t</td>
</tr>
<tr>
<td>Feedpumps</td>
<td>169 t</td>
</tr>
<tr>
<td>Condensate Pumps</td>
<td>257 t</td>
</tr>
<tr>
<td>Cross over Pipes</td>
<td>283 t</td>
</tr>
<tr>
<td>Other Auxiliary Equipment</td>
<td>200 t</td>
</tr>
<tr>
<td>Other Piping</td>
<td>12 t</td>
</tr>
</tbody>
</table>

Two views of Stator (345 t) during erection for 1000 MWe Turbine Generator at Unit #2
All the pre-commissioning and commissioning activities were meticulously planned and implemented successfully. All the erection sequences and procedures were documented in 175 volumes. These different packages are progressing well, meeting the quality standards set by Russian authorities.

Apart from Mechanical packages – Instrument tubing works in reactor building also in L&T’s scope which involves 160 km tubing works.

**Electrical Scope**

**E1 Package - Technical Aspects**

- Main Power output system
- Auxiliary power supply system
- Classification of auxiliary power supplies
- GIS
- System grounding

**Important features of the plant**

- First 2 × 1000 MWe power plant in India under construction with single transformer unit of capacity 417 MVA
- First time in India having 4200m length of 400kV GIBD
- Fully inside lined reactor containment, a first time feature in India.
The tender specifications covered electrical system installation in all the buildings of KKNPP unit 1 & 2 such as 400kV GIS building, switchyard control room building, transformer yards, normal operation power supply building, common station power supply building, emergency power supply buildings and other main plant buildings such as reactor building, turbine building, reactor auxiliary building, pump house etc. as well as supply of some electrical equipments, hardware, accessories required for the installation works.

**System Description**

The electrical system for the two units of Kudankulam nuclear power plant, each of 1000 MW, mainly consists of power output system and auxiliary power supply system. The power output system is designed for evacuation of power generated at NPP. The auxiliary power system provides the power to NPP auxiliaries to carry out their assigned functions, in all operating modes of NPP.

**Power Output System**

The electrical power generated by the turbine generators at 24 kV, three phase and 50Hz is stepped up to 400 kV by the generator transformer and is evacuated through four 400 kV transmission lines. For reserve source of power to auxiliaries of NPP, Kudankulam NPP is connected to Tuticorn, SR Pudur and Kayathar through 230 kV lines. 400 kV and 230 kV lines are connected through interconnecting transformers. 400 kV and 230 kV switchgear are of SF6 gas insulated considering the saline atmosphere at Kudankulam site. 400 kV is designed as one and a half bus scheme. 230 kV is designed as two main bus schemes.

Major components of the power output system for KKNPP include:

- 24 kV 1000MW generator
- 24 kV 31.5KA Isolated Phase Bus duct (IPDB)
- 24 kV 28KA generator circuit breaker (GCB)
- 3 X 417 MVA, 24/400kV generator transformer (GT)
- 400 kV 2000A gas insulated bus duct (GIDB)
- 400 kV gas insulated switchgear (GIS)
- 400 kV transmission lines
- 315 MVA, 400 kV /230 kV interconnecting transformer (ICT)
- 230 kV gas insulated switchgear (GIS)
- 230 kV transmission lines
- 1 phase 26.7 MVA shunt reactors (6nos)

**Auxiliary Power Supply System**

The main function of the auxiliary power system is to ensure the availability of sufficient power supply to the auxiliary system equipments during all modes of plant operation i.e. normal plant operation, shutting down the reactor, maintaining the reactor in safe shut-down state, containment isolation, reactor core cooling, preventing significant release of radioactive material to the environment and any other necessary functions.

For start up as well as for normal shutdown of both units of plant, station auxiliary power is drawn from the 400kV network through generator transformer and unit auxiliary transformers with the GCB open.

During normal plant operation, station auxiliary power is drawn from the main generator from the tap-off to 24kV bus duct through the UATS.

The reserve power supply is derived from 230kV grid through 230/6.3-6.3kV RATS and is used as backup power during non-availability of power supply from UATS.

The common station auxiliary power supply feeding the common station auxiliary loads is derived from 230kV grid through 230kV/6.3-6.3kV CSATS and is backed up by the RATS.

The system mainly consists of 6kV, 0.38kV and 220 V DC power supply sources to supply to unit auxiliary loads and common station auxiliary loads.

Auxiliary power supply system envisaged for KKNPP is categorized as per their functional requirements detailed below.

- Normal auxiliary power supply for each unit system including common station auxiliary supply system for the plant.
- Reliable auxiliary power supply of normal operation for each plant.
- Emergency auxiliary power supplies system for safety systems for each unit.


**Electrical Works**

### Installation, testing and precommissioning of

<table>
<thead>
<tr>
<th>Description</th>
<th>QTY</th>
<th>UOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>24KV, 2800A SF6 Generator Circuit Breaker</td>
<td>2</td>
<td>Nos</td>
</tr>
<tr>
<td>420/24 KV 417MVAGenerator Transformer</td>
<td>7</td>
<td>Nos</td>
</tr>
<tr>
<td>24KV 31500A single phase Isolated Phase Bus Duct</td>
<td>1120</td>
<td>m</td>
</tr>
<tr>
<td>315MVA 400/230/33kV interconnecting transformer</td>
<td>2</td>
<td>Nos</td>
</tr>
<tr>
<td>63/31.5-31.5MVA, 24/6.3/6.3kV UAT/RAT/CSAT</td>
<td>9</td>
<td>Nos</td>
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<tr>
<td>27MVA 420kV Single phase Shunt reactors</td>
<td>6</td>
<td>Nos</td>
</tr>
<tr>
<td>400kV 3150/2000A Single phase SF6 bus duct</td>
<td>4200</td>
<td>m</td>
</tr>
<tr>
<td>230kV 2000A single phase SF6 bus duct</td>
<td>900</td>
<td>m</td>
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<tr>
<td>6KV 6.3MW Diesel Generator Sets</td>
<td>10</td>
<td>sets</td>
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<tr>
<td>6KV 3150A Isolated phase bus duct</td>
<td>2400</td>
<td>m</td>
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<td>6KV 3150/1600A Switchgear Panel</td>
<td>522</td>
<td>Nos</td>
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<td>6KV/0.4kV 1000KVA/400KVA Dry Type Aux. Transformer</td>
<td>107</td>
<td>Nos</td>
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<tr>
<td>0.38kV MCC Single Front Panel</td>
<td>444</td>
<td>Nos</td>
</tr>
<tr>
<td>0.38kV MCC Double Front Panel</td>
<td>668</td>
<td>Nos</td>
</tr>
<tr>
<td>Cable Tray &amp; Supports</td>
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<td>t</td>
</tr>
<tr>
<td>Cables</td>
<td>7800</td>
<td>km</td>
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<tr>
<td>HT &amp; LT Termination</td>
<td>12900</td>
<td>Nos</td>
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<tr>
<td>Light Fittings</td>
<td>21285</td>
<td>Nos</td>
</tr>
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### Supply, erection, testing and commissioning of

<table>
<thead>
<tr>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Line Protection Panels</td>
<td>7</td>
<td>Sets</td>
</tr>
<tr>
<td>Lighting /Power Distribution Board</td>
<td>672</td>
<td>Nos</td>
</tr>
<tr>
<td>Light Fittings</td>
<td>7331</td>
<td>Nos</td>
</tr>
<tr>
<td>GI Conduits</td>
<td>344</td>
<td>km</td>
</tr>
<tr>
<td>650/1100V FRLS PVC Wire</td>
<td>800</td>
<td>km</td>
</tr>
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</table>

**Classification Of Auxiliary Power Supplies**

Depending on the degree of reliability for requirement of safety, the power supplies are classified into three groups.

**Group-1:** loads that require uninterruptible power supply are kept in group-1 class. These can be intermittent but not more than 20 seconds.

These are supplied from 220 V DC, 380 V and 220 V AC power supplies normally derived from group-3 or group-2 power supply sources and whose back up source of power is from the battery banks.

The major components of auxiliary power supply system are given as below.

- 63 MVA, 24/6.3-6.3kV UAT
- 63 MVA, 230/6.3-6.3kV RATS
- 230/6.3-6.3kV CSAT
- 6.3 MW, 6kV DG
- 6kV switch gear
- 1000 kVA & 400kVA, 6/0.4kV and 6/0.43kV auxiliary transformers
- 0.38kV and 0.415 kV switchgear/ MCCs
- Rectifiers
- 220 V DC & 110 V DC batteries
- Inverters
- 220 V DC distribution boards
- 220 V/380 V AC distribution boards
- 110 V DC distribution boards
- Cabling
- Cable penetrations

**Group-2:** AC supply to the loads, which can tolerate short interruption for a time defined by the conditions without effecting safety of the reactor, under all modes of the plant, including the condition of loss of supply from all off-site sources, is called the group-2 loads.

![](image)
These are supplied from 6kV, 380V and 220 V AC, 50Hz supplies normally derived from group-3 power supply and whose back up source of power is from DG sets.

**Group-3:** power supply to the plant auxiliary loads normally required under all modes of plant but which can tolerate prolonged interruption in the power supply, without affecting the safety of the plant, and do not require obligatory availability of power supply even after the actuation of the reactor trip system is called the group-3 power supply.

These are fed from 6kV, 380V and 220 V AC, 50Hz supply derived from UATS, RATS or CSAT.

**Principles of Control, Monitoring and Relay Protection System**

During operation, a system is understood as a set of devices of relay protection, control and monitoring of the electrical equipment, structurally and functionally involved. At Kudankulam NPP, independent system of control, monitoring and relay protection system are provided for many of the systems.

**Gas Insulated Substation**

Here switchgear apparatus for 220kV and 400kV equipment use the SF6 as dielectric media due to many of its advantages.

- Though SF6 was developed in 1900, it was used as dielectric medium only after 1940
- It is a powerful dielectric medium
- Its dielectric strength is 2.35 times to that of air
- It is 5 times heavier than air
- It is non-toxic in pure form
- Its dielectric strength is proportional to the pressure that it operates
- This is well suited for HV switchgears and GIS.

The gas passing through the isolated bus duct acts as a powerful insulation media and this compacts the size of the switchgear.

**Grounding and Lightning Protection**

To achieve the requirements, a grid consisting of 70 sq.mm tinned stranded copper conductor has been laid by the civil contractors at a depth of not less than 0.5 m below the foundation, with a mesh size of 25m × 25m in the outdoor area and about 6m × 6m mesh size beneath the buildings. GI earthing conductors run to walls and floors inside the buildings, which form the main grounding lines are connected to the buried copper conductors. All the metal components inside the building are connected to the grounding network.

Lightning protection conductors in a mesh formation are provided over the building surface, along outer perimeter walls and on the roof and are connected to the grounding grid. Lightning arresters are installed on the stack top.

**Instrumentation**

I1 package involves executing the entire instrumentation work under the supervision of ECIL. Scope of work includes calibration and installation of 18,000 instruments such as Pressure, Flow and Level transmitters, RTD and Thermo couples, Pressure and Temperature gauges, Analytical instruments, Level sensors, Seismic sensors and Radiation monitors, Installation of 3000 instrument support stands, fabrication and erection of 200 t steel, 50 km of GI perforated tray for field routing and 176 km of cable laying and glanding work.

**Civil Works**

C5 package involves 65000 cu.m of concreting works to construct De-Mineralized Plant (DM Plant), Boiler House, Solid radioactive waste building, Chiller units building, Compressor building and Diesel storage pump House including NPCIL’s Main Administration Building.
L&T-ECC is in the verge of completing, the procurement, construction contract of civil structure incl. 75 M High RCC stack and electrification work for PREFRE-3A project (Power Reactor Fuel Recycling) in the phase II for BARC's premises at Kalpakkam on the Chennai – Puducherry coastal highway. Valued at Rs.65 Crore, the scope of work are as follows:

- Excavation: 67500 cu.m
- Reinforcement: 5400 t
- Concrete: 27740 cu.m
- Formwork: 90290 sq.m
- Brickwork: 3160 cu.m
- Plastering: 50000 sq.m
- Painting: 75311 sq.m

Site team has received appreciation letter for achieving 4 million safe man hours. And has got excellent customer relation ship, TCE Consulting Engineers are the consultants for this project. Work commenced in August 2005 and expected to be completed by May '09 in all respect.

These civil structure and electrical works are used for Nuclear fuel recycling received from designated Nuclear plants in India.

PREFRE-3A Facility is being developed as an expansion to the existing KARP (Kalpakkam Atomic Recycling plant) on the south side. On completion the newly constructed structures will be merged with KARP for enhance the recycling capacity. The very objective of Recycling programme is to get to recover materials like Plutonium, etc in the process to reuse in non-conventional nuclear Power generation programme like FBR (Fast Breeder Reactor).

L&T–ECC Division is engaged in construction works at Madras Atomic power station (MAPS) Kalpakkam from 70’s and has the credit of constructing 40m high and 45m dia dome reactor, turbine buildings, 100m, 75m & 65m RCC stacks for NPCIL.

**Scope consist of as many as 14 structures and the details are as follows:**

<table>
<thead>
<tr>
<th>Name of structures</th>
<th>Dimension</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>High block</td>
<td>60 x 30 x 25 m high</td>
<td>4 storey main structures of the plant</td>
</tr>
<tr>
<td>Low Block</td>
<td>60 x 26 x 20 m high</td>
<td>4 storey building</td>
</tr>
<tr>
<td>Intermediate Transfer facility</td>
<td>24 x 24 x 10 m high</td>
<td>6m substructure and 3 floors constructed using 19° C temp. concrete</td>
</tr>
<tr>
<td>75m high RCC stack</td>
<td>75 m high x 3.6 m dia</td>
<td>Ventilation stack</td>
</tr>
<tr>
<td>Delay tank</td>
<td>24 x 30 x 6 m below</td>
<td>RCC tank of seven chambers below GL. 19° C concrete</td>
</tr>
<tr>
<td>Substation 'C'</td>
<td>30 x 24 x 10 m high</td>
<td>2 storey structure</td>
</tr>
<tr>
<td>Exhaust Fan main plant</td>
<td>50 x 18 x 10 m high</td>
<td>2 storey structure</td>
</tr>
<tr>
<td>Exhaust control Room</td>
<td>19 x 17 x 10 m high</td>
<td>2 storey structure</td>
</tr>
<tr>
<td>Connecting corridor</td>
<td>25 x 6 x 25 m high</td>
<td>5 storey structure</td>
</tr>
<tr>
<td>Fuel Handling Area extn.</td>
<td>21 x 6 x 7 m high</td>
<td></td>
</tr>
<tr>
<td>RCC Ventilation Duct</td>
<td>60 m long 2 x 2 m box</td>
<td></td>
</tr>
<tr>
<td>Compressor House</td>
<td>18 x 12 x 7 m</td>
<td></td>
</tr>
<tr>
<td>Boiler House</td>
<td>15 x 16 x 7 m</td>
<td></td>
</tr>
<tr>
<td>FOST (Fuel oil storage tank)</td>
<td>13 x 11 m</td>
<td></td>
</tr>
</tbody>
</table>
L&T signs MoU with
World Leaders in Nuclear Power Sector

AECL for ACR 1000 Reactors

L&T and Canadian based Atomic Energy of Canada Limited (AECL) have signed a Memorandum of Understanding for co-operation on Advanced CANDU Reactor ACR1000. This agreement is subject to final approval by the governments of India and Canada, of a bilateral Nuclear Co-operation Agreement between the two countries.

Pressurized Water Nuclear Reactors (PHWR) design is one of the most highly competitive nuclear technologies in the world with regard to capital cost, safety & efficiency. The unique design allows refueling online which eliminates the periodic refueling outage required by other designs.

The ACR1000 is AECL’s generation III+ reactor design that utilizes the proven concepts of the PHWR. L&T and AECL have joined hands to develop a competitive cost model for the ACR 1000. Upon completion of the indicative cost/scope model AECL and L&T agree to begin discussions to develop Nuclear Power Plants in India on EPC basis and utilize the collective expertise of the Parties in global markets.

Westinghouse for Modular Nuclear Power Reactors

L&T and US-based Westinghouse Electric Company (WEC) have signed a MoU for co-operation to effectively address the projected need in India for Pressurized Water Nuclear Reactors with Modular construction technology. Westinghouse technology is in use in over forty per cent of the operating nuclear power plants in the world.

Whereas L&T has been playing a lead role in equipment manufacture, construction and project management for Pressurized Heavy Water Reactors in India’s domestic program, this MoU with Westinghouse represents a major step forward for L&T in Pressurized Water Reactors of modular design. It will enable L&T as well as WEC to utilize indigenous capabilities for the Turnkey Construction of nuclear power plants including supply of reactor equipment and systems, valves, electrical & instrumentation products and fabrication of structural, piping and equipment modules for the Westinghouse AP 1000 plants.

Atomstroyexport

For Nuclear Power Reactors, L&T and Atomstroyexport (ASE) of Russia have signed a MoU for co-operation between the two companies for Russian design reactors VVER 1000.

The MoU will form the basis of co-operation between the companies and address needs for equipment & other services arising from the agreement signed between India & Russia on 5th December 2008, for four additional reactors KK3-6 at Kudankulam, Tamil Nadu and other Russian reactors at new sites in India.

L&T is the only Indian company to be accredited by ASME (American Society of Mechanical Engineers) to use its ‘N’ and ‘NPT’ stamps for critical nuclear reactor equipment. L&T played an important role in construction, piping & erection services for the KK1-2 VVER’s at Kudankulam.

According to the signed document L&T and ASE will develop co-operation in the construction of Kudankulam new power units, as well as during construction of plants under the Russian designs with VVER reactors at new sites in India, and also in other countries.

This MoU with ASE represents a major step for L&T into VVER component & systems manufacturing & services. It will enable L&T as well as ASE to utilize indigenous capabilities for nuclear power plants including supply of equipment and systems, valves, electrical & instrumentation products and fabrication of structural and piping and construction for the Russian VVER plants in India and in other global locations.
Indira Sagar
Right Main Canal Project

SAJID FAROOQ MOHAMMED
Project Manager
The Indira Sagar (Polavaram) project is located in Andhra Pradesh on the river Godavari near Polavaram Village above 34km upstream of Kovvur, Rajahmundry. The Polavaram project is contemplated as multipurpose project envisaging irrigation benefits for the upland areas of East Godavari under Left Main Canal and West Godavari and Krishna District under Right Main Canal.

Right Main Canal

The Indira Sagar (Polavaram) Right Main Canal project is taking off from the Godavari River on the upstream of Indira Sagar Project (Polavaram), Rajahmundry and runs for a length of 174.000 km in West Godavari and Krishna Districts of Andhra Pradesh. The Right main Canal at 174.000 km gets linked up with Krishna River through the existing Budameru Diversion Channel. This Right Main Canal is contemplated to irrigate an ayacut area of 129259 hectares (Ha) in the upland area of West Godavari and Krishna District. This canal provides for diversion of 80TMC of Godavari water to the Krishna River to meet the irrigation requirements of Krishna Delta.

Contract

As a part of the ambitious and most prestigious ‘Jalayagnam Projects”, the Irrigation & Command Area Development (I&CAD) Department, Government of Andhra Pradesh divided the 174.000 km length Right Main Canal into 7 Packages and awarded the 7th Package to ECC, L&T’s Construction Division on EPC turnkey basis for a value of Rs. 181 crores.

Location

Chainage 156.500 km - 174.00 km of package 7 begins at Nunna village, 25 km from Vijayawada. The main canal traverses through thick mango fields, reserve forest, hills, deep cut quarries, ponds, lakes and small villages. The project is fully surrounded by long stretches of green fields. The 17.5 km long canal passes through 9 small villages and terminates on the upstream side of Budameru regulator at Velagaleru village.

Scope of Work

Construction of this 17.5 km Right Main Canal involves detailed investigation, survey, preparation of land plan schedules, design and engineering, earthwork excavation, formation of embankments, lining of main canal, construction of CM & CD structures and plantation on both sides of main canal.

Construction

The construction of main canal involves the following important stages.

Detailed Investigation and Survey

The entire stretch of the 17.5Km was studied in detail by conducting various other alternative alignment surveys. To the extent possible, the alignment was done in FSL Contour to avoid embankments. For finalizing the alignment and to mark the route in thick reserve forest, bushes and mango fields, GPS Navigators and Total Stations were used.

Land Plan Schedule and Land acquisition

The village-wise Land Plan Schedules were prepared for acquiring about 1000 acres of land involving Private Lands, Revenue Govt. Lands and Forest Area. About 3.25 km of main canal passes through the reserve forest of area of 120.68 acres and the balance part of the alignment traverses through mango fields and cultivated lands. Digital Cadastral drawings showing the boundaries of each Village, extent of land and area to be acquired were some of the important issues involved in preparation of Land Plan Schedule and in Land acquisition.

Design and Engineering

The design and engineering for the entire package was done by ECC’s Engineering Design & Research Centre (EDRC) at HQ, Chennai. The design scope involved preparation of Bore log sheet, preparation of Hydraulic particulars of main canal, km-wise LS & plan of main canal, design & drawings of cross masonry and cross drainage structures.

The part of the alignment from km 163.150 to km 163.700 has been designed as Flumed Section with a bed width of 65.50 m considering the deep cut excavation and alignment passing between the hills. Standard Penetration Test and Plate Load Tests were conducted at each structure to ascertain the bearing capacity of soil.
Hydraulic Particulars of Main Canal

- Length of main canal: 17.50 km
- Bed width of main canal: 73.25 m
- Top width of main canal: 88.85 m
- Full supply depth: 4.2 m
- Freeboard: 1.0 m
- Side slopes: 1.5H : 1V
- Bed fall: 1 in 20,000
- Designed discharge: 318.48 Cumecs
- No. of structures as per HP’s: 24

Earthwork Excavation

The 73.25m bed width canal involves about 85 lakh cu.m of earthwork excavation and 10 lakh cu.m of embankment. The soils met with on the course of the alignment were generally red earth and hard gravel.

The depth of earthwork excavation in normal section ranges from 5-7 m depending upon the ground level. A 40 m deep cut hard rock excavation at flumed section is one of the most critical and adventurous one.

Lining of Main Canal

Profile Walls shall be laid at 8.75m and 17.5 m intervals in curve portion and straight portion respectively for formation of Subgrade before laying the Lining Concrete. More than 600 workmen
were deployed for Subgrade preparation. In addition, Graders and Rollers were also deployed for formation of Subgrade.

The lining for the main canal was done with M10 grade of concrete with 40mm maximum size of aggregates. 100mm thick lining concrete was laid for the entire bed width of 73.25m with slopes on both sides up to a height of 4.95m from the canal. On the whole the work involved 1.8 lakh cu.m of lining concrete.

Contraction Joints at 5m intervals were provided in both transverse and longitudinal direction. This apart, suitable construction joints, concrete sleepers, transverse drains, longitudinal drains, and porous plugs were also provided in lining Concrete.

**Cross Masonry & Cross Drainage Structures**

A number of streams and small village roads cut across the main canal at different locations. To provide access to the villagers as well as to allow the streams to pass across the main canal for irrigation facilities etc., different types of structures were proposed in the alignment of the main canal.

Thus, 24 different structures were constructed in the canal alignment for meeting various requirements.
Jindal Dam - L&T’s maiden venture into construction of full-fledged dams

G. BHASKARA RAO
Planning Manager
Indal Power Limited, a leading power generation company, and a subsidiary of Jindal Steel has set up a 1,000 MW super thermal power plant at Tamnar in Raigarh district, of Chhattisgarh. For the consumptive water use in the power plant, a dam has been built across river Kurket, near village Rabo, which is about 33 km from the power plant. This 200 m long 18.5m high dam supplies about 40 cu.m per minute of water to the power plant and meet the consumptive and circulating requirements of the power plant.

Apart from being the full fledged dam project undertaken by ECC, this unique and landmark project was fraught with several social and environmental problems. Braving all the odds, L&T successfully completed the project and the flood gates were formally opened and inaugurated by Mr. Saraff, President – Jindal Power Limited on July 13, 2007.

Salient features
• Main earthen dam in the Riverbed - 200m long, 18.5m maximum height
• Right bank dyke of 1150m long and 2 to 15 m height
• Left bank dyke of 201 m long and 2 to 6 m height
• Spillway dam and energy dissipation arrangement –145m long with 10 vertical gates of size 12m x 8.5m and 2 stop logs with operating system
• Intake and pump house with stop log and trash rack of 4m x 11m
• River diversion works
• Complete hydro-mechanical equipment
• Approach roads to the project with illumination

Major Scope of Work
- Excavation in ordinary soil - 5,80,246 cu.m
- Excavation in rock (all types) - 3,42,500 cu.m
- Concrete (all grades) - 57,772 cu.m
- Reinforcement - 1534 t
- HM works (Gates and Hoist) - 800 t
- Grouting material (cement) - 3,243 bags
- Bentonite for diaphragm wall - 27 t
- Excavation of cut off trench - 55,500 cu.m
- Filling of cut off trench - 55,500 cu.m
- Earth work filling in embankment - 48,2407 cu.m
- Rip-rap works - 30,917 cu.m
- Metalled road at the top of dam facilities - 2.60 km
- Electrical fittings and illumination

Remote Location
As the site was located at 35 km from Raigarh, a 11km approach road to site was strengthened before commencement of the work. In addition, L&T had to establish V-sat connection as there were no communication networks available in the vicinity.

Diaphragm wall
Initially, the diaphragm wall for the main dam was an RCC structure. After the work was awarded, the consultant changed the structure from a rigid D-wall to a flexible D-wall using plastic concrete and doing away with the reinforcement. The Foundation Engineering Competency Cell of ECC took this challenge and developed a new design mix for this type of plastic concrete. The formula worked perfectly and the work was executed successfully.

Achievements
Major portion of project excavation for spillway, concrete for spillway, fabrication, erection & commissioning of spillway gates and earthen dam in the river portion including rip-rap works, were completed in the stipulated time of 25 months and handed over to clients. This project received Prashansha Patra from National Safety Council of India – (Safety Awards – 2007) for achieving 4 million safe man-hours without any lost time due to injury. Site also received Annual Quality trophy.
Veligonda Dam

The engineering marvel

A. R. NERURKAR
Project Manager

PANKAJ KESHAV GURSALE
Planning Manager
Arid landscapes, barren fields and dusty tracklands define the upland areas of Prakasam, Nellore and Kadapa Districts in the State of Andhra Pradesh, which fall under the severe drought prone zone. With the completion of four ongoing irrigation projects – Veligonda, Gundlakamma, Ramatheertham and Palair, the scenario is changing. These four projects increased the irrigation potential of this region from the present 7.45 lakh acres (3.01 lakh hectares) to 13.45 lakh acres (5.44 lakh hectares) in a couple of years. This quantum jump of 80 per cent will be achieved after the completion of Rs.4000 crore projects under the “Jalayagnam” programme.

A huge reservoir, called the Nallamala Sagar, is being formed and three dams are being constructed at Gottipadia, Sunkesula and Kakarla. Water is drawn from Kollamvagu foreshore on right bank of Srisailam reservoir through 18.80 km long tunnel by gravity and thereafter diverted to Nallamala sagar through a 23.36km feeder canal. The canals are proposed from Sunkesula gap, Gottipadia gap and Kakarla gap and envisages to draw 43.50 TMC of flood water from river Krishna upstream of Srisailam reservoir to irrigate 4.38 lakh acres (1.7 lakh hectares) in 29 mandals, mostly in Prakasam district and marginally in Nellore and Kadapa districts.

L&T is entrusted with the construction of one of these dream irrigation projects – The Veligonda Dam. The project will provide irrigation benefits to upland areas of the district besides providing safe drinking water to 15 lakh people, who have been consuming groundwater with excess fluoride content for decades. L&T’s scope of works comprise construction of dam at Gothipadia and excavation of Gottipadia Canal including construction of cross masonry and cross drainage works, distributory system for 9500 acres. L&T secured this contract in 2005 from Irrigation & Command Area Development Department of Andhra Pradesh against stiff competition.

Valued at Rs. 395 crore, this is the first major concrete dam project executed by L&T on an EPC (Engineering, Procurement and Construction) basis. The scheme comprises construction of dam from EL 162 to EL 230 having a base width of 57.96m and top width of 12m, canal length 11.40 km and distributory system for 9500 acres.

**Salient Features**

- Height of the dam from the deepest level - 87m
- Total length of the dam at the top - 600m
- Slope of the downstream face - 1 : 0.662
- Slope of the upstream face - 1 : 0.045

ECC’s major scope of work includes 10,00,000 cu.m of excavation, 9,21,181 cu.m and 1,00,000 cu.m of concreting in two stages, 1600 t of reinforcement, 2,30,000 sq.m of formwork, 58,000 Rmt drilling for grouting, 51,000 cement bags for grouting.

**Concreting**

- Total concreting is 10,21,181 cu.m in two stages
- Total duration of concrete pouring - 24 months
- Average rate of concrete pouring achieved - 1500 cu.m per day
- Peak rate of concrete pouring achieved - 2903 cu.m per day

The project had a huge requirement of concrete, which was to be poured at a temperature of 15 degree celsius. The herculean task of achieving and maintaining the standard of concreting was managed with meticulous planning. As the height of dam started increasing, earthen ramps up to 30m height was created for the movement of concrete. Later, conveyor was used for shifting concrete from the batching plant to the top. As the project required steel formwork, the entire shuttering was designed and schemed in-house at site. Hydra cranes were used for handling the forms. To reduce the cycle time, the shutters were combined (4.8 m combined width) with structural steel channels. The whole sequence of operations, from aggregate production to concreting was mechanized thereby ensuring accuracy and maximum output. The client awarded commendation certificates for the highest concreting (46000 cu.m) in the month of February 2006.
Engineering Challenges

Veligonda dam project is the first dam project designed by the Engineering Design and Research Centre (EDRC). EDRC looked at the opportunity as a challenge and successfully completed the design of concrete dam. The internal arrangements within the dam body like gallery, adit, shaft, and lift were designed with precision. The dam consists of around 2 km of gallery within it for inspection and grouting. Planning and aligning this multi level gallery and the interconnection of the galleries with access adits were really brain racking. Like in any other dam, ‘A’ holes and ‘B’ holes for grouting were designed to improve the impermeability of dam base. The dam base was grouted with a total drill length of around 22 km. Different types of instruments were embedded in dam body to monitor the dam in terms of settlement, plumb and thermal. The monitoring was reviewed with a computerized data acquisition system.

Resources

Remoteness of the project posed the biggest challenge as management of materials was a critical task. Except for the aggregates, the minimum distance for sourcing of other materials was around 200 km away from project site. Interacting with the vendors and convincing them to deliver as per the schedule was one of the most critical activity for the smooth progress of the project.

Sourcing of aggregates was another major issue. Markapur is famous for slate rock formation which cannot be used as aggregates because of its hard and soft rock combination. The site has established a rapport with a local quarry for uninterrupted supply of aggregates.

Identifying and sourcing the total requirement of boulders (22 lakh mtp), was a major issue during the initial phase as the local terrain had affinity
to slate rock. Two crushers with a combined capacity of 450 tph are installed to cater to the aggregate production. Sand impactors are used to enhance the quality of the aggregate output. This mechanized system of aggregate operations was instrumental to achieve the planned output.

Sourcing of river sand also was a challenging task as the nearest supplier was around 220 km away from project site.

**Plant & Machinery**

The initial review of similar dam sites was instrumental in planning the machinery requirement for the project. The methodology involved in concreting was through dump trucks, transit mixers and tower cranes. Two 125 tpd chilling plants, 250t of refrigeration, two ice plants were installed for getting the required concrete pour. During summer, the temperature crossed 50 degree celsius and maintaining concrete pour at 15 degree celsius was the most critical challenge through out the execution.

Specialized major P&M deployed include 120 cu.m/hr concrete batching plants with aggregate individual weighing system for the best accuracy.

**Quality and Safety**

The project site followed the norms of ISO 9000 and has been reviewed by various audit systems at regular intervals. Safe methodology was incorporated in all activities of the project. Daily pep talks and regular orientation programmes ensured the communication of safety issues and awareness is created down the line across various departments. A system of automated house keeping was implemented, where before commencement of work, the workmen ensure appropriate environment is maintained.

Some of the safe methods employed at sites included three lockwork permit systems for rotating parts, cordless communication system for tower cranes, and sensor alarm in hydra cranes.

**Innovations**

Innovations and in-house alternatives are the hallmarks to the speedy execution of this project. Buckets of 3 cu.m capacity for concreting and vibrator needles were locally fabricated which resulted in considerable saving of time. Gantry for handling of Formwork was designed by Construction Methods and Planning Cell (CMPC).

**CSR**

As part of the corporate social responsibility, two additional class rooms for the local government school was built by L&T. An environment friendly zone is being nurtured at the project site. About 892 saplings were planted during HHL Centenary Celebrations. Three more class rooms were constructed for the Government school at Kaolabhimanipadu village.

The project team maintained cordial relationships with the locale population, which was instrumental in the smooth flow of work. Veligonda Project contributed to reconstruct a temple which had to be relocated due to the dam construction.
Rs. 605 Cr. Orders from Water & Steel Sectors

Larsen & Toubro (L&T) has bagged fresh orders worth Rs.605 Crores from the Water and Steel Sectors in the last quarter of FY 09. L&T secured three orders aggregating Rs.416 Crores from the Water Sector and another order of Rs.189 Crores from the Steel Sector. The Metallurgical, Material Handling & Water Operating Company of L&T’s Construction Division will be executing these orders.

**Water Sector:** The company bagged a Rs.165 Crores order from the Rural Water Supply & Sanitation Department, Government of Andhra Pradesh, for supply of potable water to 152 habitations in the Ananthapur district of the state. The project is to be completed in 15 months. At present, L&T is already executing water supply projects worth Rs.319 Crores in Ananthapur district.

L&T has also won a Rs.133 Crores EPC contract from Delhi Jal Board for design & laying of MS pipeline from the Dwaraka Water Treatment Plant to various areas of Dwaraka, Nazafgarh, Daulatpur, Ujwa and IGI airport (Package 3). The project is to be completed in 21 months. At present, L&T is executing the Dwaraka water supply scheme (package 1A) in Delhi for Rs.248 Crores.

The company has also secured a Rs.118 Crores order from Utkal Alumina International Limited for design & construction of raw water intake structure, raw water transmission pipeline & reservoir works at their Alumina Plant at Rayagada District, Orissa, to be completed in 17 months. L&T is already executing Civil & Structural Works for this Alumina Plant for Rs.455 Cr.

**Steel Sector:** In the steel sector, the company has won an order of Rs.189 Crores from SAIL-IISCO Steel Plant for Civil Works for Rolling Mill, BOF, CCP LDCP Complex, Lime Dolomite Plant at Bumpur, West Bengal, to be completed in 12 months. L&T is already executing the Sinter Plant & Raw Material Handling plant on EPC basis. Securing this new order reinforces the confidence placed on L&T by SAIL, one of its major customers.

Rs.1,143 Cr. orders from TATA Steel

L&T has bagged two orders totaling Rs. 1143 Cr. from TATA Steel.

This comprises a Rs. 689 crore order for turnkey construction of Dry Crushing & Material Preparation Plant (DCMP) at Joda Mines and Engine-on-Load (EOL) Scheme at Noamundi Mines and another Rs. 454 crore order for Iron Ore & Pellet Handling System at Jamshedpur. The Metallurgical, Material Handling & Water Operating Company (MMH&W) of L&T’s Construction Division will execute these orders.

L&T’s scope of work for the projects include basic & detail engineering; complete civil & structural works; supply and erection of mechanical, electrical & instrumentation works including testing & commissioning.

These turnkey projects are to be executed in a schedule of 30 months for DCMP Project, 24 months for EOL scheme and 23 months for Iron Ore & Pellet Handling System.

L&T is already implementing Blast Furnace & Pellet Plant packages for 3 MTPA expansion project of TATA Steel at Jamshedpur which is progressing at a fast pace. With these orders, L&T has emerged as the major partner of TATA Steel in the implementation of 3 MTPA expansion project. Moreover, this covers the complete chain from material preparation at mines to receipt & handling of iron ore & pellet and delivery to the blast furnace.

Rs. 1,100 Cr. Electrical Orders

L&T has bagged a slew of large-value orders aggregating Rs.1,100 crores in the electrical construction sector in the fourth quarter of 2008-09.
The orders have come from leading public sector organizations – the Power Grid Corporation of India Limited and the Rail Vikas Nigam Limited and involves setting up high end transmission lines and substations as well as a project for the Indian Railways.

Mr K. V. Rangaswami, President (Construction) and Member of the Board said: “The 800 kV HVDC Transmission Line project and the 765 kV substation orders represent technological breakthroughs and they auger well for our growth potential in these critical segments.”

The order secured from the Power Grid Corporation of India (PGCIL) involves construction of a part of the country’s first ± 800 kV HVDC transmission system for transmitting power from the north east to the northern and western parts of India. Extending across 190 km, this HVDC bi-pole transmission line, valued at Rs.169 crores will be executed for the section between Nidhaura Village to Agra in Uttar Pradesh on the main line between Biswanath to Chariyali. This is the first 800 kV transmission line system of its kind in India and signifies a major step forward in high end electrical project execution. Other orders secured include a Rs.190 crores order from Power Transmission Corporation of Uttarakhand Limited for 400 kV double circuit Transmission Line between Loharinagpala to Koteshwar, a Rs.175 crores order from Rail Vikas Nigam Limited for the Bharuch-Dahej Railway Construction Project., and a Rs. 83 crore order from PGCIL for the construction of 765 kV single circuit transmission line from Agra to Jatikalan.

Meanwhile, in a major foray into the high end 765 kV segment of substations, L&T secured three major orders from PGCIL valued at Rs. 480 crores for the construction of 765 kV Substations at Balia, Lucknow and Satna along with associated transformer packages. The entire project will be executed within a tight schedule of 27 months. It involves detailed engineering and construction of 51 bays of 765kV system including supply and installation of 35 numbers of 500MVA Auto Transformers.

The 765 kV orders were secured against stiff international competition, through a consortium with Areva SA (France) and Hyosung (Korea) for 765kV switchgear and transformers respectively. These projects will be executed by the Electrical & Gulf Projects Operating Company of L&T’s Construction Division.

Rs. 1,438 Cr. Gulf Orders in T&D sector

L&T has bagged three new orders worth Rs 1438 crores. Two orders worth Rs 1130 crores were booked in the Gulf Region and a third, worth Rs. 308 crore, was bagged from the West Bengal State Electricity Distribution Company.

L&T has bagged an EPC order valued at Rs. 800 crores (USD 164 million/ AED 600 million) from the Al Ain Distribution Company (AADC) for the construction of 7 electrical substations, associated MV cabling and overhead transmission line in the Al Ain city of Abu Dhabi.

This is one of the single largest value orders received by L&T in the UAE, for Power Transmission & Distribution Sector.

According to the terms of the contract, L&T will Design and Build these 33/11kV primary substations to the specifications of the international consultant PB Power & will be completed within 24 months.

Each substation consists of 33 kV gas insulated switchgear, 11 kV air insulated switchgear, 15/20 MVA 33/11 kV transformers, Substation Control and Monitoring System, Protection and telecommunication system, DC system and auxiliaries. The contract encompasses design and construction of civil buildings with complete set of utilities such as air conditioning, fire protection and lighting systems.

L&T has also received another EPC order for Augmentation & Expansion of 33 kV Power Transmission Network with a value of Rs 330 crores (USD 67 million / AED 247 million) from Abudhabi Distribution Company (ADDC). The scope covers design, supply & construction of 300 km of 33 kV Transmission line network in the western region of Abu Dhabi, with the contract completion of 22 months.

These orders were secured against stiff international competition and will be executed by the Power Transmission & Distribution Sector of L&T Abu Dhabi. At present L&T is already executing 20 substations of various capacities in Al Ain, Abu Dhabi and Dubai areas of UAE.
In another development Larsen & Toubro has bagged a Rs.308 crores order from West Bengal State Electricity Distribution Company Limited (WBSEDCL) for Rural Electrification Works in Jalpaiguri and North 24 –Parganas districts of West Bengal State. As part of the contract, L&T will carry the 11 kV distribution lines to electrify 2274 villages in these districts, to benefit the citizens of Below Poverty Line (BPL). The project will be completed within 18 months.

**Rs.1,245 Cr. Hydropower Project order**

The Infrastructure Operating Company of Construction Division has bagged a contract of Rs.1245 crores for the construction of the Dam Package, a part of the 1200 MW Punatsangchhu-I Hydroelectric Project in Bhutan.

The project is being set up by the Punatsangchhu-I Hydroelectric Project Authority which has been constituted through an agreement between the Government of India and the Royal Government of Bhutan. It is located across Punatsangchhu River, about 80 km from Thimpu, the capital of Bhutan.

To be executed in 66 months, the scope of work involves construction of the diversion tunnel, dam, intake and desilting arrangement including hydro-mechanical works. L&T won the order through a competitive bidding process. WAPCOS Limited is the engineering and design consultant of the Project.

This is the first of a series of 10 hydropower projects jointly identified by the governments of India & Bhutan and to be implemented for a total installed capacity of 11,576 MW by 2020.

For L&T, this is the second hydroelectric power project in Bhutan - the first one was the 1020 MW Tala Hydroelectric Project, which was completed ahead of schedule.

**Rs.1,162 Cr. Order for Buildings & Factories OC**

L&T’s Buildings & Factories Operating Company – part of its Construction division – has bagged new orders aggregating around Rs.1162 crores in the fourth quarter of 2008-09 for the construction of factories and residential projects.

L&T has bagged a major design & build order valued at Rs. 605 crores from the Andhra Pradesh Rajiv Swagruha Corporation Limited for Rural Electrification Works in Jalpaiguri and North 24 –Parganas districts of West Bengal State. As part of the contract, L&T will carry the 11 kV distribution lines to electrify 2274 villages in these districts, to benefit the citizens of Below Poverty Line (BPL). The project will be completed within 18 months.

L&T has also received major orders aggregating to Rs. 557 crores for the construction of cement plants and other strategic factory buildings.

The cement plant construction orders have been received from major players like The KCP Ltd for the construction of their 4000TPD green field cement plant at Krishna District, Andhra Pradesh and from Lafarge India Pvt Ltd for the expansion of the grinding for their Jojobera cement plant at Jamshedpur, Jharkhand. The projects are to be completed in 15 months time.

These orders further enhance the order book of the Company which has already secured major design-&-build orders in the airports, IT Parks and commercial space. L&T has a significant market share in these segments.

**Rs. 345 Cr. Order for Critical Equipment for Nuclear Project**

L&T has won the prestigious first order for design, manufacture and supply of 4 Nos. steam generators for 700 MWe Pressurized Heavy Water Reactors (PHWR) from the Nuclear Power Corporation of India Limited (NPCIL).

The steam generators are critical & long lead equipment to be supplied to Kakrapar Atomic Power Project – 3 & 4.

These will be the largest steam generators built in India so far, and will enable an increase in the size of future indigenously built nuclear power projects from 540 MWe to 700 MWe. L&T has played a critical role in the development of technology & capabilities for the Indian nuclear power sector.

L&T is also rapidly emerging as a leading supplier of plant & equipment for the thermal power sector. It serves the power sector across the entire spectrum from design services to equipment manufacture, erection and commissioning of complete projects.
World Skills Development Summit

Mr. J. Ganguly, EVP & Head – Divisional Strategic Service, L&T and Mr. S. Natarajan, Head – Construction Skills Training participated in the World Skills Development Summit on January 29, 2009, organized by Sri Ramakrishna Mission Vidayala at Belurmath, Howrah. Mr. Ganguly chaired the session and gave an overview on employment generation through Construction Skills. Mr. Natarajan made a presentation on the skills development initiative by L&T in the construction sector. The other topics covered in the summit by eminent speakers from various industries were Skill Development - a priority issue for urgent initiative; Industry’s expectation of Soft Skills from students, World Skills 2007, Japan. The programme was well attended by academicians, members from industry, students and media.

L&T CSTI as Knowledge Partner

Builders Association of India – Kovai Chapter and Sri Ramakrishna Mission Vidyala signed a Memorandum of Understanding in January 2009 to establish training institute basically for skill development in the field of construction trades. Accordingly, L&T Construction Skills Training Institute (CSTI) are associated as a Knowledge Partner for this joint venture. During the “Training for the Trainers Programme”, conducted by L&T-CSTI, eight faculties from BAI attended the programme held between 9th and 13th March 2009 at Chennai. They were thus inducted into the process of training workmen in a structured and organized way.


This paper addressed the design aspects of Gas Insulated Substations (GIS) with special focus on 765 kV system GIS, which is being implemented in India. The salient design aspects, system requirements, auxiliary and mechanical systems required to be considered for the 765 kV GIS were elaborated in the paper.

The paper also dealt with the electrical and civil layout aspects of 765 kV GIS with comparison made vis-à-vis conventional Outdoor 765kV switchyards. The aim of this paper was intended to give insight into the basic design considerations for Gas Insulated Substations’ for designers.

This conference had participation from major international companies, utilities and academic institutions such as POWERGRID, AREVA T&D, GE Energy, Schweitzer Engineering, KEMA T&D and Arizona State University.
A two day seminar on “Heavy Lift Transport & Lifting” was organised for the benefit of Heavy Lift Engineers at the Convention Centre, Chennai on January 8-9, 2009. There were 51 participants from different business units, who are involved in various heavy erection works and maintenance of heavy lift equipment.

Mr. Richard L. Krabbendam of Jumbo Shipping & Heavy Transport Company from Netherlands was the expert faculty of this programme. A world renowned Heavy Lift Specialist, Mr. Richard was associated with some of the most interesting & difficult operations carried out globally. His association with Van Seumeran-a Dutch Heavy Lifting company and sharing views on critical assignments added more flavour to the programme.

The programme gave an insight to all participants on the global practices and knowledge learnt in different complex projects, which could be used as ‘upfront knowledge’ in most of the current job sites. During the programme, Mr. Richard interestingly explained the process and methodology with many case studies and insisted the need for a thorough knowledge, common sense and presence of mind for safe execution of the Heavy Lifts. At the end of the programme, a test was also conducted to evaluate the learning of every participant and certificates for the independent assessment were e-mailed.

Mr. K.P. Raghavan, EVP & Head – Divisional Corporate, L&T in his key note address shared his earlier days experience in Heavy Lifts, when there was little or no sophistication and highlighted different sophisticated techniques and state-of-the-art equipment presently available for the safe and speedier execution. Mr. N. Srinivasan, Head – Plant & Machinery, L&T impressed upon the importance of this programme and the benefits it will bring in, to widen the knowledge base for the organisation in his introductory session.
A specialized mining equipment - 700 L bucket wheel excavator - manufactured and supplied by L&T for the Mines II Expansion Project of Neyveli Lignite Corporation (NLC) was inaugurated by Mr. A.R. Ansari, Chairman & Managing Director, NLC on March 22, 2009. This 700L Bucket Wheel Excavator will be put into trial operation at bottom bench for a period of 2 months before conducting Take Over Test for its rated capacity.

Prior to this Bucket Wheel Excavator, L&T has successfully supplied and commissioned three 11000 TPH mobile transfer conveyors and three 1400L Bucket Wheel Excavators (BWE). The Bucket Wheel Excavators and Mobile Transfer Conveyors are working successfully in the open cast mines and achieving desired designed output and help NLC’s plans to augment lignite production capacity from 10.5 MTPA to 15 MTPA.

700L Bucket Wheel Excavator, which move on rough surface with ease is used for excavation and conveying of overburden / lignite and lignite bench at the mines. It has a large rotating bucket wheel mounted on the boom. In the outer edge of the wheel, there are 14 buckets with teeth. As the wheel rotate, the bucket removes soil / lignite from the target area and carry it to the back side of the wheel, where it falls on to a bucket wheel boom conveyor. The rotary plate carries it to the receiving chute located at the center of the machine. The conveyor discharges the soil / lignite through discharge chute to the discharge boom conveyor. The discharge boom conveyor carries the soil / lignite and pass it to the receiving boom of the Mobile Transfer Conveyor. Bench Conveyor System then convey the material to the filling / ultimate location.

### Specifications

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L&T reaffirmed its commitment to social welfare with a new Health & Artificial Kidney Dialysis Centre at Thane.

The facility was inaugurated by Mr. R. N. Mukhija, President - Electrical & Electronics Division and Member of the Board in the presence of Mr. D. B. Raju, Executive Vice President - Corporate Infrastructure & Services, Dr. K. J. Kamat, Director, Medical & Welfare Services and Dr. Mrs. Usha Krishna, Medical Advisor. Speaking on the occasion, Mr Mukhija emphasized that L&T’s commitment “remains as strong as ever.”

This facility is equipped with 4 dialysis units as well as 3 consulting rooms for consulting specialists in various branches like Ophthalmology, Cardiology, Skin, and Pediatrics.

This Centre will remain open from 9.00 am to 5.00 pm on all days except Sundays. Employees, their families as well as the community at large can avail of the facilities at the new Centre. Dialysis services will be provided to the needy at minimal cost.

Since it is subject to dynamic forces during operation, high level of dimensional accuracy in manufacturing, erection and commissioning conforming to the international standards was maintained throughout the process.

L&T’s scope involves design, engineering, manufacture, supply, erection, testing and commissioning in collaboration with Sandvik, Austria as a design partner. This is for the first time that an Indian company is supplying bucket wheel excavators of this kind, which was earlier supplied by European Companies. L&T is also maintaining the 1400L Bucket Wheel Excavators and 11000TPH Mobile Transfer Conveyors inside the Mines of NLC.
For the last seven decades, L&T has been addressing the needs of communities and taking initiatives in the areas of health, education and community development. On April 9, 2009, the Construction Division of L&T made a humble beginning and a major green initiative to save our Mother Earth.

L&T has resolved to grow 50,000 saplings in the next 18 months and plant it in different projects in and around Chennai. As a first step, a nursery was set up to grow 10,000 saplings in the first phase.

This initiative was kick-started in the evening on April 9, 2009 by Mr. K.V. Rangaswami (KVR), Member of the Board and President (Construction), L&T by planting the first seed in the mother bed.

The guests and the audience were thrilled with the venue of the function as it was conducted under the shade of trees, which is one of the many benefits of a tree. To the delight of everyone, the chief guest and senior colleagues were welcomed with the saplings instead of bouquet. Impressed with this idea, KVR requested to follow this practice in all future functions.

Welcoming the guests, volunteers and the audience, Mr. V.S. Ramana, Head – Corporate Communications highlighted the fact that though we come from suburbs, over the generations, we have become city bred people and lost the connectivity with greening, plants, saplings and the earth. To get back and reconnect with this link, he said that, ECC has taken concrete steps to initiate “Project GreenHands”, in collaboration with Isha Foundation. He stated that, “As a construction company, L&T perhaps gets perceived as builders of concrete jungle. But it is not true of the company’s image; rather the company has a lot of passion for greenery.”

Mr. Ashraf, a volunteer from Isha Foundation elaborated the effects of global warming and how
this kind of initiative to build the green cover help to prevent the nation from disasters.

Mr. S. Kanappan, Vice President & Head – EDRC (B&F OC) in his speech focused on how ECC is contributing to the Green Concept by way of planting 10 trees for every one tree cut down during construction. He brought to notice the water consumption on campus and how this water is treated for irrigation of the trees and added that, “Today efforts are being made in order to reduce carbon emission from power plants and buildings because of the threats that environment is facing.”

Mr. R.C. Swamy, Vice President and Chennai Center Head for L&T Infotech spoke about the various activities of “Vidiyal” - a Special Interest Group, concentrating on Infotech’s CSR activities. He also urged everybody to do their part in effective waste disposal by reducing, segregating and reusing waste materials.

Mr. Rangaswami in his speech said “The phenomenon of global warming is something which is real, not a distant future, but in the foreseeable future. Today the whole country is going through a movement of road building which is very much required, and we are ourselves engaged in 20 and odd projects, and one of the main aspects of road building project is cutting tree, but as a part of one of our projects in Gujarat, some millions of trees had to be planted! So the government knows that it has to be done. We also know, for the development of our campus some trees have to go, but we had to ensure that the number of trees (cut) is restricted to the minimum, and an equally important initiative is building up (the green cover), I say if one tree is cut, at least 20 trees must be planted, that is the ratio I would like to give.”

This memorable function was concluded with a vote of thanks from Mr. B. Ramakrishnan, Vice President (Finance, Accounts & Admn.), Divisional Corporate.

Green Camps

On Sunday, April 5, 2009, around 40 L&T-ites joined together to visit a nursery run by Isha Foundation in Kodungaiyur at the outskirts of Chennai. Entering the nursery, the group saw a big table with varieties of saplings titled in Tamil and English. Soon they were explained about the various timber, fruit, flowering and fodder species. The special characteristics of the trees like the medicinal properties of neem, the rain making capacity of the thoongu vaagai, the Ozone generating properties of the Arasan (peepal) and the fact that the monetary value generated by a fifteen year old peepal tree is around 10-12 lakhs per year, were all astounding and thought provoking.

Followed by the orientation, the experts from Isha Foundation demonstrated the sand-manure mix.
After learning the tricks of the trade in the first camp, another team of 40 people participated in the second camp at L&T Nursery on April 19, 2009. All the participants enjoyed their time and were immensely satisfied for their contribution. The third camp was unique as it was celebrated on May 1st as initiation day of L&T. May 1, 1938,
71 years ago, our founding father, Mr. Henning Holck-Larsen, Mr. S.K. Toubro sowed a seed that has grown today as a large banyan tree. From a humble beginning, L&T has over the years become a giant in India’s Corporate Sector, which offers direct employment to over 40000 people and indirect employment to about 4 lakhs with 10 million shareholders!

75 people comprising men, women and kids participated in the nursery activity in the full morning session. During the break, they took part in games, which took them back to their younger days. After sharing their experience and narrating the touching aspects of the green initiative and concept, they enjoyed the music, mimicry and dance performances at the end of the day. It was a fruitful and fun-filled camp.

As part of the “GreenHands” campaign, L&T-ites at Coimbatore Project site have taken the initiative and planted 100 trees in and around the factory campus on April 8, 2009. Mr Sarkar, Head of L&T Growth Centre inaugurated the camp by planting the first sapling. They will be expanding the activity progressively and are planning to achieve their target of 1000 trees in the near future.

**L&T Wins Six RoSPA Awards**

In recognition of its continuous efforts to achieve excellence in the field of Occupational Health and Safety, L&T has won six RoSPA Awards from the Royal Society for the Prevention of Accidents (RoSPA), UK.

ECC’s Bakreswar Thermal Power Plant Project – (BMH BU); Bisaipur Water Supply Project – Jaipur (WET BU); Hooghly Met Coke Power & Co. Ltd Project – Haldia (M&M BU) and DMRC Green Park Project -(Infra OC) have won the Gold Award for 2009 while L&T (Oman) LLC’s SBG Palm Garden Township and Oxy Mukhaizna Water Treatment Plant Project have won the Silver Award.

The Royal Society for the Prevention of Accidents (RoSPA) is one of the longest running and most highly respected occupational awards programmes. The scheme is open to organizations of all sizes, from the full spectrum of work activities and from all over the world. The prestigious awards recognize and celebrate health and safety achievements, offer ideal way of showing commitment to raising standards, share good practice and allow benchmarking and provide a prime opportunity for gaining positive publicity.
Mr. Naik featured yet again in BusinessWeek’s ‘India’s 50 Most Powerful People’

Prestigious global magazine – BusinessWeek – has once again highlighted the achievements, influence and impact of our Chairman & Managing Director, Mr. A. M. Naik. In the latest issue of the magazine, Mr. Naik finds a place in a select group of ‘India’s 50 Most Powerful People’. The group comprises top flight industry leaders, political luminaries and sports stars.

BusinessWeek said its survey was an effort to “pinpoint the shifts in power that defined India in the past year, and to predict the players to watch for in the next year.”

Mr. Naik had first featured in Business Week’s ‘Power List’ in 2007. US-based BusinessWeek is one of the world’s most reputed business publications. Its global edition is widely read around the world.

IMS Certification for B&F OC

Buildings & Factories Operating Company of L&T received accreditation for its integrated Management System (IMS) by qualifying for following International Standard Certifications.

- OHSAS 18001:2007 (Occupational Health & Safety Assessment Series),
- ISO 14001:2004 (Environmental Management System)

The Certificates were presented by Mr. D.K.S. Moorthy of M/s DNV (DET NORSKE VERITAS), the Certification Body to Mr. S.N. Subrahmanyan (SNS), Executive Vice President & Head – B&F OC at ECC HQ, Chennai, on March 6, 2009, in the presence of Section Heads.

SNS acknowledged the efforts of HSE Team in establishing the IMS system and getting it certified in short duration. He also emphasized the need for such recognition.

This Management System Certification will add value to the B&F OC businesses by:

- Integrating HSE in all its processes through a risk focused approach
- Providing external recognition for the systems
- Improving HSE Standards and Performance to International standards

Incidentally, this is the first of its kind certification in L&T where all the three standards have been certified simultaneously.
With an aim to recognise and felicitate infrastructure companies for their contribution towards the Indian economy, E18 - a division of Network 18 in association with Essar Steel and CNBC-TV18 organised the Infrastructure Excellence Awards in New Delhi.

This initiative received an overwhelming response from the industry and over 50 infrastructure development companies submitted their nominations for over 110 projects in various categories. After short listing, the entries were presented to an eminent Jury of industry experts and decision makers for selecting the who’s who of Infrastructure sector. And, L&T was declared:

- the WINNER in the “Infrastructure Company of the year” special award category and
- Co-winner along with GMR in the AIRPORTS Sector for the Hyderabad International Airport project

The awards were given away on March 25, 2009 at a grand gala function, organised at The Taj Palace, New Delhi. While Mr. V.B. Gadgil, Senior Vice President & Head - E&GP OC received the “Infrastructure Company of the year” award, Mr. S.N. Subrahmanyan, Executive Vice President, B&F OC picked up the co-winner award for the Rajiv Gandhi International Airport at Hyderabad.
Mr. Naik Receives Padma Bhushan from President of India

The national honour that was announced on Republic Day, and for which every L&T-ite waited in joyous anticipation, finally came to pass within the hallowed precincts of the Rashtrapati Bhawan this morning.

‘Padma Bhushan Shri Anil Manibhai Naik’, said the official announcer. To a loud burst of applause, our CMD rose from the front row of the distinguished gathering and walked towards the President of India, Smt. Pratibha Patil.

A respectful namaste, a slight bow from Mr. Naik, and then - the President pinned the Padma Bhushan on our Chairman & Managing Director. The President also presented Mr. Naik a certificate wound into a casket.

Mr. Naik has been magnanimous in sharing with us the accolade he has received. He said: “Leading a company that is helping to build the nation is a matter of pride in itself. To receive high national recognition for this service is indeed heartening. It is my privilege to accept the Padma Bhushan on behalf of all the employees of the Company for whom the L&T story is always interwoven with the larger interests of India”.

All L&T-ites have a reason to feel doubly honoured. How many other companies have two Padma Bhushan awardees? Our co-founder Mr. Holck-Larsen received the Padma Bhushan in 2002. Now, seven years later, Mr. Naik will bring home the high national honour once again. Thank you, Mr. Naik for making us all stand tall.

L&T wins D&B-Rolta Top Indian Company Award

L&T has bagged the award for Top Indian Company in a survey of India’s 500 leading companies conducted by Dun & Bradstreet.

Mr. J. P. Nayak, President (Machinery & Industrial Products) and Member of the Board, received the award at the presentation ceremony in Mumbai on March 23, 2009. L&T features in the Engineering & Capital Goods sector.

The D&B-Rolta Corporate Awards seek to recognise the twin virtues of size and growth in corporate India. The final ranking of the companies was based on a composite score of eight weighted parameters: total income; net profit; net worth; net profit margin; return on net worth; average market capitalization; growth in total income; and growth in net profit.

Dun & Bradstreet, headquartered in USA, is a leading provider of global business information.