Project Management Institute

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CASE *STUDY*

A Shining Example of Project Success

NTPC Ltd. wins PMI India award for exemplary use of project management to complete 5MWp grid connected solar PV plant in Port Blair in record time

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India is aggressively diversifying into renewable energy to reduce overdependence on conventional sources such as coal, natural gas, and oil. New projects are being undertaken to use renewable, clean sources such as wind and solar to meet the country's growing demand for energy.

NTPC Limited, formerly known as National Thermal Power Corporation Limited, commissioned a 5MWp grid connected solar Photo Voltaic (PV) power plant project in Port Blair, Andaman & Nicobar (A&N) Islands as part of its corporate plan to establish its footprint in the renewable energy sector. NTPC is India's largest power generating public sector Maharatna Company, a status conferred by the Government of India on the basis of the size and profit margins of a company.

With this first greenfield, renewable energy project, NTPC made its debut in the A&N Islands. The project was executed by NTPC on a build-own-operate basis through a memorandum of understanding it signed with the A&N Islands administration.

The solar PV project is located on the outskirts of Port Blair, the capital of A&N Islands. It is located about 1,190 km from Chennai and 1,250 km from Kolkata, the closest two ports in mainland India. The project is spread across a 10-hectare plot that has been leased out for a period of 25 years by the A&N electricity department, who is the plant's customer.

NTPC awarded the Engineering, Procurement, and Construction (EPC) contract to Hyderabad-based Photon Energy Systems Ltd. The project was completed within six-and-a-half months from the date of handing over of the land, in spite of several challenges.

NTPC won PMI India's Best Project of the Year – Small (<Rs. 100 crore) in 2014 for the exemplary use of project management techniques.

Project Objectives

The isolated A&N electrical grid operated primarily on diesel, an expensive fossil fuel. NTPC set out with the objective to produce environment-friendly, sustainable energy that would assist in saving diesel, reducing and saving foreign exchange outflow, and reducing the country's carbon footprint.

The project would be a Clean Development Mechanism registered project under the United Nations Framework Convention on Climate Change (UNFCC), qualifying to earn Certified Emission Reductions (CERs), which are tradable emission reduction units.

Energy Export Targets

Net energy to be exported - 69,38,000 kilowatt hour (kWh) units per annum, i.e. 6.938 million units per annum

(Equivalent to the requirement of around 6,000 dwelling units)

Annual Capacity Utilization Factor (CUF) on net export basis – 15.84%

A Few Project Highlights

- 4,440 micro pile foundations
- 450 metric tons of galvanized iron support structures (888 structures)
- 21,312 mono crystalline solar PV modules of 235 Wp each
- 1164 DC lightning arresters (Franklin Rods)
- About 100 km of power/control cables and optical fiber cables
- 6 outdoor type inverters of 800 kW each
- Supervisory Control and Data Acquisition system
- Control room building of 250 sq meter
- About 3 km of internal roads

Total manpower employed during peak construction time –100 approximately

"This was a highly complex project because of the challenges associated with a compressed project schedule and working in a remote island that is separated from the nearest port by over 1,000 km. We adopted robust project lifecycle methodologies even before the project was awarded to the time it was commissioned," said A. K. Jha, chairman and managing director (CMD), NTPC Ltd.

Project initiation activities involved identification of the project site, defining the plant size based on solar resource and land availability, conducting topographical and geo-tech investigation, obtaining statutory clearances, finalization of power evacuation plans, and preparing an estimate of the project cost.

After completion of a project feasibility report that NTPC prepared with the help of United States Agency for International Development, it floated a tender for the EPC contract based on competitive bidding. Photon Energy Systems Ltd. won the EPC contract.

The EPC contractor, in consultation with the NTPC engineering team, finalized the plant layout, foundation and structure plans, procurement plans, and quality plans. The project was monitored and controlled with the help of a proven project monitoring system to avoid any slippages.

Plant Performance during First Year (2013-14) & Second Year (2014-15) of Operation

Net energy exported - 64,78,843 kWh (2013-14) & 69,58,398 kWh (2014-15)

Actual CUF on net export basis – 14.79% (2013-14) & 15.89% (2014-15)

Net energy export target achieved – 93.38% (2013-14) and 100.29% (2014-15)

Role and Responsibilities of Critical Stakeholders

No.	Stakeholder Name	Role	Responsibilities	Project Phase
1	A&N electricity department	Customer	Land lease agreement and acquisition, signing power purchase agreement, obtaining initial statutory clearances	Initiation
2	NTPC	Developer/owner	Feasibility studies, project evaluation and investment decision, tendering & award of EPC contract.	Initiation
	NTPC	Developer/owner	Review and approval of drawings from the EPC contractor, approval of vendors & sub-vendors and quality plans, pre-dispatch inspecti on & clearance, monitoring and expediting supplies. Site supervision & field quality assurance of civil and erection works, timely payment to contractor etc.	Planning, execution & control
	Photon Energy Systems Ltd	EPC contractor	Mobilization at the site, detailed engineering, project procurements and placement of orders on sub-vendors, civil constructions, erection of mechanical and electrical equipment, interconnection cables, quality control, plant commissioning	Execution & control
3	Local government		Law and order	Planning & execution

The Challenges

The primary challenge was to execute the project that was away from the mainland within the time schedule (within FY 2012-13). Detailed below are the various other project specific challenges:

Project Schedule

NTPC signed the land lease agreement with the A&N electricity department that implicitly stated that the land was available for the project without any claims and disputes. However, once the EPC contract was awarded and work was about to commence at the site, the local office of a central government organization staked claim on the land. It claimed that the person from their organization, who had earlier given consent, was not competent to do so. Fresh approval was now required from the higher authorities before work could commence. Almost nine months, out of a total project schedule of 12 months, went into sorting out this land acquisition issue.

Scope

The feasibility study was based on historical annual irradiation data obtained from the US-based National Aeronautics and Space Administration (NASA). However, chances of surprises on the field could not be ruled out as the satellite-based data by NASA might not be accurate as the mean value undergoes yearly changes.

Logistics in Supply Chain

An island-based project meant immensely complex multi-mode logistics involving a route from land to sea to land, or road to air to road, or to sea to reach the project site. Transportation by ship from Chennai to Port Blair also faced a bottleneck as ships sailed from Chennai to Port Blair only on specified days of the week. This also caused delays; certain equipment reached the site just one week before the project was commissioned.

Suppliers

During project execution, one critical supplier of module structures was not able to adhere to the schedule. Its manufacturing capacity could not keep to the quantity required and its process facility was inadequate to meet the specification and quality requirements. The project team had to scout for an alternate source for this structural member.

Human Resources

Port Blair did not have an adequate number of skilled workers. There was a shortage of electricians, cable jointers, and riggers. Coordination between multiple project teams that were geographically scattered was also a challenge, considering that the team had only six months to execute the project.

Communication

This was a project that required NTPC to collaborate at different levels – with the EPC contractor, sub-vendors, the customer, the local administration, and the local community. Limited communication facilities in Port Blair, including slow Internet speed due to limited bandwidth allocation, posed serious communication bottlenecks during the peak of project execution.

Other Challenges

Inclement weather/heavy monsoon rains for almost a month during the peak project construction period of six months added to construction woes.

The project, located in the vicinity of the Port Blair airport, also had to abide by a height restriction of a maximum of two meters from the ground that is imposed by the Airports Authority of India. The highest points of the super structures such as the control room building, security room, lightning arrester, area lighting poles, and fencing poles had to adhere to this restriction.

Project Management Techniques behind Project Success

Mr. R Venkateswaran, regional executive director (South), NTPC Ltd. said, "We followed our internal, Integrated Project Management Control System (IPMCS), which is in line with international standards such as PMI's *A Guide to Project Management Body of Knowledge (PMBOK® Guide)*. IPMCS helped us transition the project smoothly across its lifecycle through close monitoring, coordination, interface management, and timely decision-making. It was one of the major contributors behind the project's success in a limited time frame."

Project Schedule

To overcome the initial nine months' schedule delay, NTPC adopted the Work Breakdown Structure technique to decompose project tasks into level 1 known as master network operating at the project level, level 2 network at the EPC contract level, and level 3 at the responsibility center level, i.e. engineering, quality assurance and inspection, dispatch, and site works. Clear responsibilities were assigned at each level. A general manager level executive was identified as the project manager who was responsible for the total project execution/site activities. He and his small team of four executives ensured coordination among the various stakeholders and agencies.

The project team obtained special permission from the A&N administration to proceed with preliminary works such as topographical survey and geo-tech investigation to complete the basic design, layout, and engineering works even before sorting out the land dispute. This helped commence civil works immediately after the land was available, thus recovering around two months out of the nine months of schedule delay.

Scope

NTPC overcame scope challenges with a detailed "sensitivity analysis" to determine changes in the annual energy generation because of changes in the irradiation level. For the annual generation figure, NTPC based its estimates on the worst scenario case to provide a margin of safety while determining the project viability.

Logistics in Supply Chain

There was close coordination between manufacturing and supplies. To save time on shipments, six main inverters and one spare set were airlifted from Germany to Chennai, and thereafter transported by ship to Port Blair.

One person was identified at the Chennai port to oversee all the coordination, port handling, and sea transportation of the plant's equipment. This helped in timely loading, unloading, and dispatch of consignments.

The control room and foundations for equipment were constructed ahead of time, thereby enabling direct unloading of the equipment on the foundation.

Suppliers

Special teams were deputed at the sites of major vendors to inspect, clear, and follow-up on critical supplies and equipment due for dispatch. Teams used imaging technology and electronic transfer of documents and images for speedy submission and approval of vendor drawings, data sheets, and work documents.

A particular supplier was not able to adhere to the schedule due to shortfalls in its manufacturing capacity. Part of that order was offloaded to another vendor.

Human Resources

A full-time Project Management Office (PMO) was set up during execution, which was headed by a project manager of the general manager level and assisted by executives from different domains such as civil, mechanical, electrical, and field quality assurance across geographies. Due to workforce shortfall in Port Blair, the PMO sourced people from other places to work at the project site.

Strict implementation of NTPC's field quality assurance system, safety standards, and commissioning procedures in Port Blair ensured workforce safety. Workers' safety and well-being were also enforced through regular site visits and interactions with supervisors. There was strict implementation of safety rules such as wearing of personnel protective gear at the site, training on safety aspects and regular inspection to ensure the work area was healthy and hygienic. Besides, it was ensured that workers received their wages on time.

Communication

The project management team conducted regular monitoring of the project's progress. Periodic audio/video conferences and monthly reviews by the regional executive director and general manager/project manager, and contract review meetings with the EPC contractor, subcontractors, and project teams ensured timely resolution of issues. Meetings by the NTPC senior management primarily focused on the evaluation of schedule delays and identification of critical path activities.

All design and engineering activities including preparation, submission, review, revision, and final approval were fully automated through paperless, Internet-based applications. Close follow-up and every mile acceleration, including last mile acceleration without time and cost overruns, further accelerated the project activities. Project time, cost, and scope (with quality and safety) were always on top focus.

Supplementary Solutions

Since the low lying areas on the island are always water-logged due to regular, heavy rainfall, extensive arrangements were made to clear out the area throughout project execution.

Excavators and rock cutters for earth pits, and drill machines for laying foundations and cable trenches in rocky terrains were used.

To solve the issue of height restrictions on the super structures, special designs were adopted for the structures. The control room was shifted to a low-lying area. Special Franklin Rods were used, instead of conventional high rise lightning masts.

This project was executed 24x7 under floodlights powered by diesel generators. This approach received accolades.

Lessons Learned

- To ensure that the land is in physical possession without any encumbrance well before the EPC contract is awarded.
- To create adequate buffer time for dispatch and delivery activities for projects in remote locations that require multi-mode logistics.
- To provide for adequate stock of spares of construction machinery at the site to avoid delays due to machinery breakdown.

NTPC has used the design, engineering, and execution experience from this project in other projects to enhance its internal processes. These have been used to make improvements in design, standard operating procedures, and commissioning checklists to reduce costs and cycle time of project operational activities. NTPC has documented and shared these best practices, industry standards, and safety measures for use in subsequent solar projects.

Benefits

The NTPC solar PV project supplies clean and green solar energy to the A&N grid that supplies power to the island. It helped reduce carbon dioxide emission by 6,173 metric tons during the first year of operation.

Lieutenant General (Retd.) Mr. A K Singh, PVSM AVSM SM VSM, honorable lieutenant governor, A&N Islands, adds, "It's a pleasure to visit the solar PV plant. There is scope to enhance the use of non-conventional energy resources in our islands, provided they are efficient and not cost prohibitive. We, in the A&N administration, are committed to encouraging the use of such energy resources."

As a UNFCC registered plant, it received 6,173 CERs during the first year of operation (2013-2014). These tradable CERs have provided NTPC an additional source of revenue in the CER market.

The project was completed not only within the time, cost, and quality prescribed but also with a safety record of zero accidents during the construction and operations phases.

In the first year of operation, the plant has helped save about 1,800 kilo liter of diesel.

Mr. V S Verma, former member, Central Electricity Regulatory Commission, New Delhi says, "The 5MWp solar PV plant commissioned by NTPC at Port Blair in a record time frame of about six months is a classic example of dedicated approach adopted by NTPC with limitations in the availability of labor, challenges in work conditions, and logistics. Kudos to the NTPC management and the project site engineers."

The project went on to win NTPC's Swarn Shakti Award for excellence in project management for renewable projects that was instituted for the first time in 2012-13.