

100kW Solar Photovoltaic Power Plant at Tangtse (Durbuk) by Ladakh Ecological Development Group

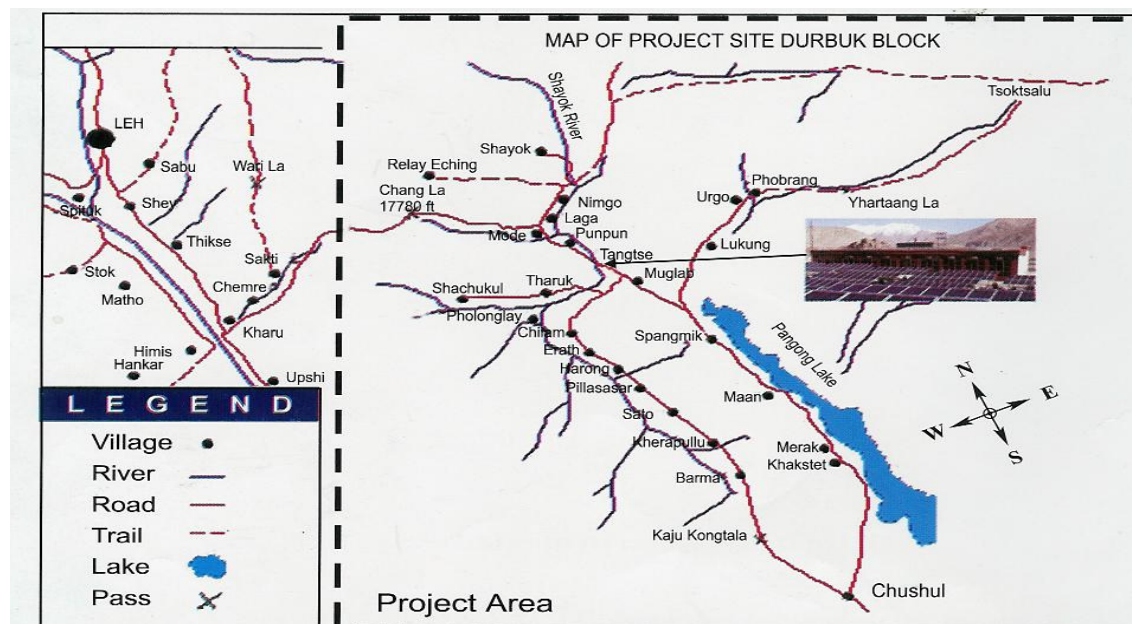
Present electricity power situation in Leh

The total number of hamlets in Leh district is 132, out of which over 50 are electrified. There are mainly two hydro power stations with an installed capacity of 7MWs that supplies electricity to the main town of Leh and villages nearby. There are also a number of micro hydroelectric power units installed by the government and LEDeG in the remote villages. The other source of electricity is 30 diesel generator sets with capacity ranging from 50KVa to 750KVa. These Diesel Generator sets are mostly installed in the progressive villages and towns.

There is a huge problem with distribution and transmission through power grid systems due to scattered nature of the villages and hamlets. The transmission lines are very long, resulting in poor voltage regulation and high distribution losses. Connecting to the grid requires huge capital investments, which is financially not feasible. Therefore, decentralized power generation is the best alternative for rural and far-flung areas of Ladakh.

About the project area (Durbuk)

Durbuk is one of the six administrative blocks of Leh district. It comprises of five revenue villages spread over 24 hamlets. Durbuk block is the smallest in terms of population of about 6000 and by far the most backward area in the whole region. It constitutes the north-eastern part of the district and shares the border with Tibet Autonomous Region. Being located on the India-China border, the development of the block has strategic and



political importance. The block headquarter is located at Tangtse which is about 120Kms from Leh, at an altitude of 14,500 feet above sea level.

There is no possibility of connecting the area with the power grid in Leh. Apart from solar energy, no other viable resource, renewable or otherwise, is available. Before LEDeG's intervention, the villagers were receiving electricity from a 250kVa diesel generator. The DG set was installed and managed by the Power Development Department (PDD) of the state government. There were regular breakdowns and hence, highly unreliable. Moreover, the diesels are transported across the difficult terrains of Himalayas, which makes it very expensive and unaffordable.

Technology: 100kW Solar Photovoltaic Power Plant

Durbuk, like other parts of Ladakh is blessed with an abundance of sunlight and high solar radiation. Harnessing solar energy into consumable electricity is highly effective and useful.



Salient features of the SPV Power Plant

1) Plant Capacity

- ✓ No. of units installed = 4
- ✓ Capacity of each unit = 25KWp

2) Array Details

- ✓ No. of Solar Modules = 1360
- ✓ Capacity of each Module = 75KWp
- ✓ Total Array Capacity = 102KWp
- ✓ No. of Module/Unit = 340
- ✓ Name of manufacturer = TATA BP Solar India Ltd.

3) Battery Banks

- ✓ No. of Battery Banks = 4
- ✓ No. of Battery Cells = 480
- ✓ No. of Cells/Battery Bank = 120
- ✓ Capacity of Battery cells = 1000Ah at C10
- ✓ Name of Manufacturer = M/s Southern Battery Company

4) Charge Controller

- ✓ No. of Charge Controller = 4
- ✓ Capacity of each charge controller = 25KWp
- ✓ Name of manufacturer = M/s Pulse Power Co.

5) Inverters

- ✓ No. of Inverters = 4
- ✓ Capacity of each inverter = 25KWp
- ✓ Name of Manufacturer = M/s Pulse Power Co.

6) AC Feeders Panels

- ✓ No. of Outgoing Panels = 4

Minimum and maximum load observed by the SPV power plant in 2005 and 2007

Solar Plant Parameter	Value	Units
Rated Capacity =	100	kW
Min. Load Observed =		
in 2005 @ start of plant =	38	kW
in 2007 @ present =	39	kW
currently in Summer =	39	kW
currently in Winter =	42	kW
Max. Load Observed =		
in 2005 @ start of plant =	42	kW

in 2007 @ present =	45	kW
currently in Summer =	43	kW
currently in Winter =	45	kW
Nos. of Battery Banks =	4	
Batteries in each Bank =	120	

Energy generation detail of 4x25KWp SPV Power Plant with effect from 26/2/2005

S.No.	Month & Year	Unit1 (Kwh)	Unit2 (Kwh)	Unit3 (Kwh)	Unit4 (Kwh)	Total
1.	March to May 2005	6122	4925	5822	5536	22405
2.	June 2005	1536	1404	1347	1266	5553
3.	July 2005	1413	759	990	1204	4366
4.	August 2005	1140	1367	1230	1277	5014
5.	September 2005	964	1394	1301	1295	4954
6.	October 2005	1440	1694	1326	1450	5910
7.	November 2005	1556	1737	1442	1543	6278
8.	December 2005	1555	1842	1493	1565	6455
9.	January 2006	1345	1608	1233	1355	5613
10.	February 2006	1308	1450	1243	1202	5203
11.	March 2006	1780	1867	1530	1679	6856
12.	April 2006	1378	1503	1190	1305	5376
13.	May 2006	1628	1667	1432	1568	6295
14.	June 2006	1302	1612	1346	1433	5693
15.	July 2006	1442	1598	1369	1375	5784
Cumulative generation upto 31/7/2006		25909	26494	24294	25053	101755 units.

Target group

For ensuring socio-economic development of the region there was a need to improve the energy situation. Providing the basic needs of lighting/electricity for other development activities, this ultimately ameliorates the standard of living of people of the area.

There has been an attempt by the State Govt. to meet the energy requirement by installing a 250kVa diesel generator at Tangtse which supplies electricity for 3-4 hours in the evenings. The DG set supplies power through a network of transmission lines extending over 19kms to the villages of Kargyam, Shachukul, Tharuk and Durbuk. The outlying

villages specifically those around Pangong Lake comprise of Chushul, Maan, Merak, Lukung and Phobrang have been provided with solar home-lighting systems and solar lanterns.

SPV power plant has completely replaced the 250kVa Diesel Generator and it is now supplying electricity to 10 hamlets in the block using the same transmission lines.

- ✓ No. of hamlets covered = 10
- ✓ No. of domestic consumers = 379
- ✓ No. of commercial consumers = 29
- ✓ Total consumers = 408

Implementation methodology

1. The project was successfully conceived and implemented by LEDeG, with technical support from TATA BP Solar India Ltd.
2. It used a participatory, bottom-up approach since the conceptualization of the project. All the villagers were involved in the activities of the project, including operation and maintenance of the systems. The power plant is now run and maintained by the REDCO, a local institution formed under the project. The project demonstrates the efficacy of bottom-up approach in rural development. This is not only be of great value to the villagers in the implementation of the future activities but also to convince the officials at various levels i.e. block, sub-division, district etc. for using participatory approach in all such activities at the official level.
3. Meetings were held with villagers/beneficiaries at the time of project design documentation; it was headed by the Counsellors, Sarpanchs and Naib Tehsildar. They welcomed the concept and expressed their consent to participate in the management process of the plant.
4. LAHDC and the District Administration played important roles in financing and supervision of the project. They were also actively involved in the proper execution of the project activities.
5. In addition, there was a high-powered project steering committee with the Chief Executive Councillor, LAHDC as Chairman and representative of MOEF, MNRE, ICEF and all members of Project Advisory Committee as members to take important policy decisions. The Committee met at least once every six months. The Executive Director of LEDeG and representative of TATA-BP were the joint conveners for the committee.
6. Order for design, manufacture, supply, erection, testing and commissioning of 4x25KWp stand alone SPV Power Plant was placed with M/s TATA BP Solar India

- Ltd, Bangalore with 10 years Comprehensive Maintenance Cost, amounting Rs.3.00lacs (Rs.3,00,000 per annum) on 22nd June 2004.
7. TATA BP completed the installation of the plant equipments in the month of December 2004 and started testing of individual 25KWp units.
 8. On 26 of February 2005 the SPV Power Plant was test commissioned and supply of power was made to the grid area by replacing the 250 KVA DG set. Since then, power is being supplied to these 10 villages/hamlets of Durbuk block falling under the grid area without any breakdown.
 9. As per advice of Shri S. P. Gonchaudary, Director WBREDA and Chairman JIB of MNRE, M/s TATA BP was asked to carry out the following tests: -
 - a) Maximum bank voltage during charging condition
 - b) Battery bank voltage under fully charged condition
 - c) Maximum charging current under deep discharging condition
 - d) Peak charging current
 - e) Inverter voltage trip set point
 - f) Inverter restarts voltage
 - g) Output voltage and frequency of inverter
 10. Solar Power Plant has been supplying uninterrupted power supply to the grid area w.e.f. 1st March 2005 and daily generation and supply of power has been recording.
 11. Power transmission and utilization features in the region have been improved through the following measures:-
 - a) Replacing the higher rated Transformers on the H.T. lines (which were originally used with the 250 KVA DG set) by lower rated ones to minimize the core losses.
 - b) 100W incandescent tubes and bulbs were replaced with 14W Compact Fluorescent Lamps (CFL)
 - c) Correcting internal wiring, faulty holders, switches in many households

Financing

The total expenditure incurred in the 100kW SPV power plant was Rs.3.28 crores. However, the whole project budget including other activities and components was Rs.772,58,600/-

Contributing organization	Amount (in Rs.)
India Canada Environment Facility (ICEF)	348,48,100
Ministry of New and Renewable Energy (MNRE)*	177,90,000
Ladakh Autonomous Hill Development Council (LAHDC)	170,20,500
Ladakh Ecological Development Group (LEDeG)	19,00,000

Beneficiaries	57,00,000
Total	772,58,600

* MNRE is previously known as Ministry of Non-conventional Energy Sources (MNES)

Results

1. The 100kWp SPV plant has totally replaced the 250kVa diesel generator. The DG set lies dysfunctional since the commissioning of the solar plant. It is supplying uninterrupted electricity to 10 hamlets, including 397 households and 29 commercial units. A total of 408 families receive electricity for 4 hours in the evenings.
2. Formation of Renewable Energy Development Cooperative Limited or REDCO. It is a local institution registered as a society, formed to take over the functions of managing the solar power plant from LEDeG after its formal commissioning in June 2006. It consists of 15 elected members (*including Councillors of the Durbuk and Chushul constituencies*) who take decisions regarding identification of beneficiaries and other project activities. REDCO is mainly responsible for:
 - Operation and maintenance of the SPV power plant
 - Decisions related to the functioning of the plant
 - Timely collection of monthly electricity tariff from the consumers
 - Ensuring supply of regular electricity to the consumers
3. Power transmission and utilization features in the region have been improved through following measures:-
 - a) Replacing the higher rated transformers on the High Tension (HT) lines (which were originally used with the 250KVa DG set) by lower rated ones to minimize the core losses.
 - b) 100W incandescent tubes and bulbs were replaced with 14W Compact Fluorescent Lamps (CFL)
 - c) Correcting internal wiring, faulty holders, switches in many households

Financial impacts

1. The SPV power plant at Tangtse has been functioning successfully since March 2005 and it is enabling the Power Development Department of government to save up to Rs.18,59,800 annually through diesel, transportation and Operation & Maintenance. That also includes costs of Engine Oil, Coolant and Operators' Salary and other miscellaneous expenses.

Average consumption of diesel: 48,000 litres per year

(= Rs.16,38,300 per year @ Rs.34 / liter)

Average maintenance cost: Rs.2,21,500 per year

Total: Rs.18,59,800 per year

2. Whereas, the cost of the SPV Plant, inclusive of cost of replacing the batteries after 5-6 years is Rs.3,60,00,000.

Environmental impacts

1. The plant will have no adverse environmental impact. By replacing the diesel station it will not only save nearly 48,000ltrs of diesel every year but also improve the status of environment by eliminating the harmful gases which the diesel station emits into the atmosphere.

Emission of pollutants from the use of high speed diesel (based on per year consumption of 48,000 liters / year)

S.No.	Gases	Emission in tones / year
1	Carbon dioxide	126.06
2	Nitrous Oxide	2.76
3	Hydrocarbons	0.24
4	Sulfur Dioxide	0.14
5	Carbon Monoxide	3.90

Social impacts:

1. Enhance quality of life and improve living conditions of the people.
2. By adopting a participatory approach in which women will take an equally important part, the project will strengthen the role of women in the socio economic activities of the area.
3. Photovoltaic will also enable the children to study for longer hours without spoiling the eye-sights.
4. Similarly women are able to engage themselves in the production of handicrafts with comfort and ease.

Sustainability

1. To uphold successful operation, maintenance and sustainability of the project a local institution called 'REDCO' is formed.
2. The project envisages a participating approach involving the villagers in all the activities of the project including operation and maintenance of the systems through

Electricity User Committee, demonstrating the efficacy of bottom-up approach in rural development.

3. Capacity Building of REDCO and EMC through:
 - a) Facilities for testing and repair by LEDeG at Leh
 - b) Training and building up of Rural Technicians with assistance of LEDeG staff to install and maintain the systems.
 - c) Setting up of the aforementioned 'REDCO' not only to monitor and maintain the systems but also to ensure prompt revenue collection and management.
 - d) Build up the capacity for institutional and technical management for sustainable development primarily by building capabilities in Solar Energy operations and maintenance and financial management of the system in the medium term and conceptualize such projects in the long term sustainable development.
4. Savings accrued to power house consequent upon the stoppage of Diesel Generator and revenue collected from the consumers @Rs.50 per household over a period of 5 years i.e. Rs.9.95 million will not only help offset the recurring expenditure but also enable allocation of Rs.2.05 million to corpus fund for investing on replications and sustainable development.

Lesson learned

1. The systems which are sophisticated are difficult to handle.
2. Rely on external organization like TATA BP to rectify the technical problems and unprompted actions from them.
3. Invertors and batteries are more prone to errors.
4. Load becomes uncontrollable with the introduction of new appliances and technologies like TV, radio, computers.
5. Low voltage causes damage to CFL bulbs, which is not easily affordable for a common man. A price of a CFL bulb is Rs.120.
6. The main purpose of the plant is to provide the basic requirement of lighting. We have to constantly check the load or discharge. The uses of electrical appliances are discouraged and because of that it is also a huge constraint.
7. The villagers pay the same amount of tariff (Rs.50 per month) as earlier, when DG set was functional. The plant suffered only one day of breakdown since its commissioning in 2005.

Replicable

1. Smaller size SPV power units (upto 20kW) are highly successful and there is a high potential for replications.

2. There is a need to do a serious analysis of the existing SPV power plants before replication of bigger size units.
3. Otherwise, technically, solar photovoltaic technologies are highly feasible, viable and can be easily replicated. The success with solar home-lighting systems and SPV units were experienced by LEDeG over the years.