Engineering Procurement & Construction (EPC) of Solar Hybrid Power Solution to GSM BTS Telecom Sites

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Abstract— Solar Energy is becoming an important source of energy all over the world and especially in India .Solar powered base station is a new concept in India. However this concept is not much technically developed to execute such a system nor is there enough awareness amongst the cellular operators. This paper presents the Project Implementation details & various factors for Installation of Solar Roof top to power BTS stations. This paper presents real data obtained from working Site and elaborates on how such a system could allow better energy management of a tower site, along with reduce emissions and proceed towards sustainable energy. In this Paper,it covers all the Design, Purchase & Execution Related data & Parameter which has been considered during Project. Being running project during real time execution it has been covered all the aspects/problems which comes during implementation of a Solar Rooftop PV project

Index Terms— Base Transceiver stations (BTS), Battery equalizer, Charge Controller, Survey Phase.

1 INTRODUCTION

In India the annual global solar radiation is about 5 KWh/ sqm per day with about 2300-3200 sun-shine hours per year is available in most parts of the country except some pockets in north-east. Solar radiations represent the earth's most abundant energy source. As such solar power (SPV) decentralized system can be considered for the telecommunication network in rural areas in most parts of the country. One of the critical infrastructure in India is Telecommunications networks that needs assured power Supply 24x7

Many people in emerging markets like India live in rural areas with limited access to the electricity grid. Hence significant barrier to expanding network coverage in these areas as mobile phone base stations rely on a secure supply of power. Even in areas connected to the grid, the power supply can be unstable and expensive. Use of diesel generators to power base stations require regular maintenance and are expensive to run. Fortunately solar power is available in almost every location no matter how remote. By exploiting solar power to run the base stations will not only allow operators to reduce their operation costs to a bare minimum but also allow deeper penetration of mobile networks.

Solar powered base station is a new concept in India. There is however not abundant of technical expertise present to execute such a system neither there is enough awareness amongst the cellular operators. This paper outlines the technical feasibility of such a system. It presents real data obtained from an operating site and explains on how such a system could allow better energy management of a tower site and also to reduce emissions and move towards sustainable energy.

The main Philosophy behind set-up of Solar Powered Base Stations in India are:-

- India is Second Largest in Telecom sector after China with large number of consumers.
- More than 60% of 6, 00,000 Base Transceiver sites (BTS) in India are faced with Lack of Power Supply.
- Consumption of More than 2 billion liters of Diesel & Emit over 5 metric tonnes of CO2.
- Since the Set-up, fuel and maintenance cost for DG sets are high.

Since we can clearly see from below graph about major portion of telecom sector is in Urban Subscriber. It's because of this reason Solar Powered BTS are more focused.

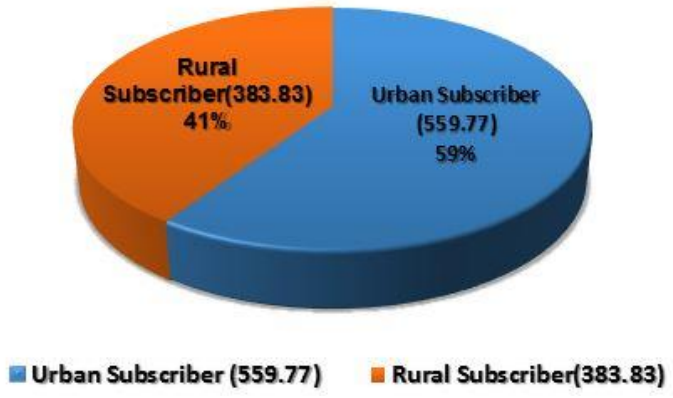

Fig 1.1:- Percentage of Rural & Urban Telecom Subscriber

A Solar Powered BTS project at various location in Bihar was awarded to a EPC Firm. The details about project is mentioned below along with various locations detail in Bihar. At each Location 5KWp Rooftop Solar PV system needs to be installed for running BTS load. A detail layout of different location for BTS site is

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Fig 1.2:- Different location of Projects

Being shown below in fig 1.2. The various locations of District are **Bhojpur, Patna, Gaya, Vaishali, Darbhanga, Bhagalpur, and Kathihar**

2 PHASES IN THE PROJECT

Various Phases of Project is shown below:-

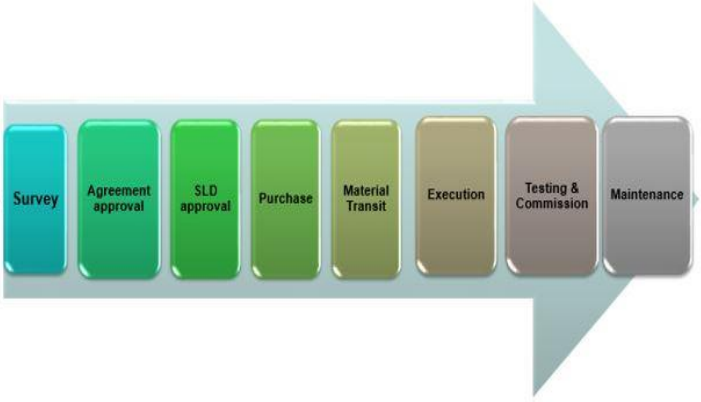

Fig 2:- Different Phases of Projects

2.1 Survey Phase of Project

Survey is one of the important phase where feasibility of the project is being checked. The location of a site and the day of the year play an important role in determining the power usage at a BTS site. The ambient temperature profile for each geographical location determines the cooling load on the air conditioner and the sun's irradiance determines the amount of power that a solar panel, if used, would provide. The simulation has hourly temperature and solar irradiance (also called insolation profile) as input parameter. Certain parameters which are required in order for installation of Solar PV system for BTS Sites.

a) **Name & Area Location of Site:** - The detail will give about general description about site like locality, accessibility and other parameters.

b) **Co-ordinates**:- This is one of important parameter which will help to obtain meteorological data of the particular location which will be helpful in calculation of amount of solar energy which can be harness from particular site.

c) **Building Availability**: - This parameter will consider about the space requirement for the installation of panel. Since rooftop scheme needs availability of building for installation of panels, hence dimension must also be considered in order to select proper alignment space. Battery which needs to be installed during the time of execution require space hence site must be clearly observed in terms of space availability.

d) **Water Availability:** - This is one of the major parameter which needs to be considered as sufficient quantity of water is required during execution of project.

e) **Orientation:** - This plays major role in calculation of maximum amount of energy can be harness from particular location of site.

f) **Fuel Consumption Per day**:- This data is required in order to obtain cost benefit analysis after implementation of project.

g) **Obstacles details:** - This parameter is one of the most important parameter which needs to be considered as this parameter can lead to rejection of site. If any obstacle found in southern side of site then it makes a critical impact on site. Hence each obstacles which make impact on site must be clearly mentioned in site report.

h) **Life of Building:-** This Parameter is to determine the strength of equipment which is to be placed over the roof of building.

2.2 Agreement approval in Project Stage

Before start of execution work, a agreement needs to be signed between contractor & client. A list of documents needs to submit. Agreement is a document proof that client has no objection & has allowed to install the solar PV plant on site. List of documents which needs to be submitted are:-

- Purchase Order copy.
- Agreement Performa.
- Site Survey Report.
- Authorization letter Copy.
- Authorization letter for signing of Contract.

Agreement Performa includes the format which is provided in tender document. This includes various term and conditions which needs to fulfill during project execution. All these documents are submitted for each sites & after verification of documents the agreement will be signed on stamp paper

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2.3 Project Design

Single line diagram of Solar BTS Rooftop Solar PV plant installation is shown below In a particular Project BSNL as a client has fixed below mentioned parameters in the Tender:-

1. Solar PV module rating: - 250 Wp.
2. Battery Capacity: - 200 AH.
3. Output voltage & Current: - -48 V, 35 Amp.

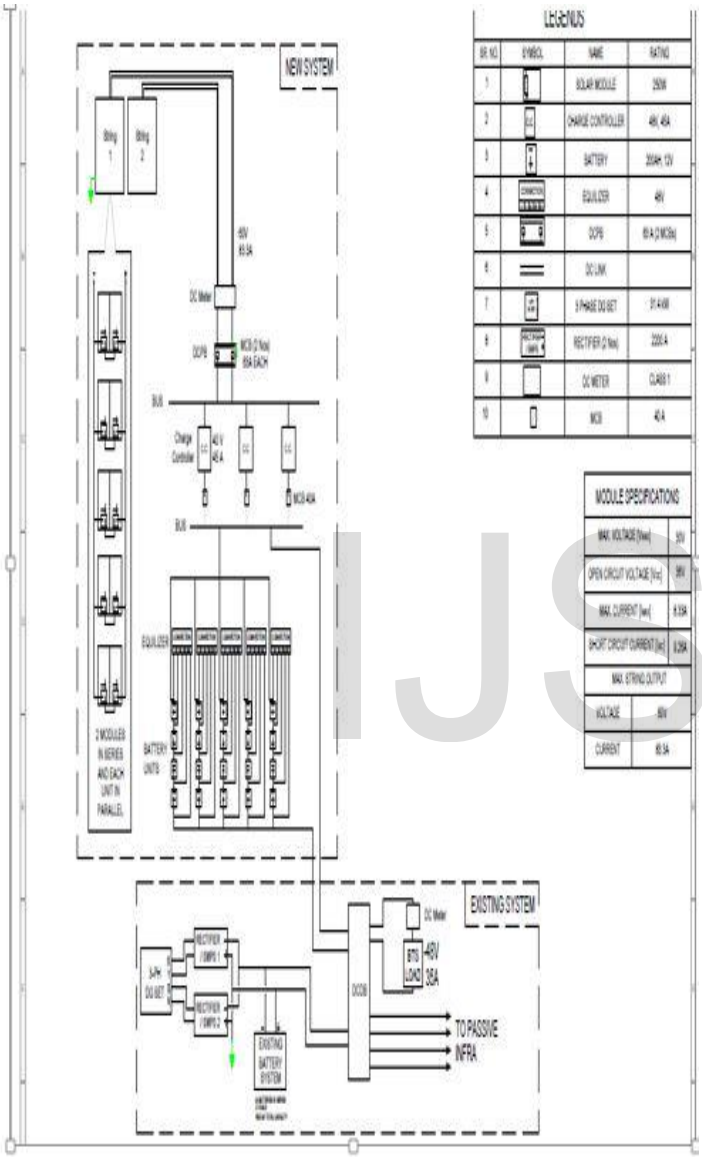

Fig 2.3:- Single line Diagram of Solar BTS Rooftop PV Projects

Various process in the SLD has been shown below:-

- 20 numbers 250 Watt peak solar Panel has been selected as our total capacity is to be 5 Kilowatt peak.
- In order to obtain required output modules are connected in parallel as output voltage is not so high.
- Each Panel has its maximum current & voltage rating i.e 30 Volt & 8.33 Amp.
- The output voltage & Current at the terminal of Panel is 60 Volt & 83.3 Amp.
- Now the DC side current after considering factors & according to NEC will be (2.5*41.65) i.e. 104.125 amp.
- 3 charge controller has been used whose maxing current rating is 45 Amp & 45 Volt

- Battery Equalizer enhances the battery's life by preventing under charging & over charging of the batteries.
- Solar Cable 1Core 6 sq mm armored Copper cable is being used to carry current from solar Panel to charge controller.
- Cable of size 1 Core 16 sq mm armored Copper cable is being used to make the battery bank connections.
- MCB & Meters is also being used for measurement & protection purpose.
- The output current & voltage is being terminated at existing DCDB terminal of BTS plant.
- As per the requirement of client 12 Volt 200AH battery is being used.
- Since at output terminal we have to maintain 48Volt & 35 Amp hence 4 battery are connected in series with 5 no's of bank in parallel.

2.4 Material Used in the Project

a) Solar Panel:- The Solar Panel used is of Lubi make 250 Watt peak. Depending upon wattage rating different types of panel is being available in the market. In this project polycrystalline PV panel is being used.

b) Charge Controller: - This is used to control the rate of flow of charge in the battery. This equipment will help to maintain proper amount of flow of charge in the battery. In this project 48V 45 amp charge controller being used .

c) Battery equalizer: - This equipment play major role in the case when we have store energy in the battery bank. Battery equalizer enhances the battery's life by preventing under charging and over charging of the batteries. It provide perfect voltage matching of the batteries during both charge & Discharge, bringing longer life cycle, lower rate of failure and easy maintenance.

Benefits of battery equalizer:-

- When there are more than 2 batteries in series it will equalize the voltage in them and ensure they do not have different voltages.
- Protects your batteries from under charging & overcharging, which reduces their working life.
- Increases battery life and capacity.
- Minimize frequency of battery replacement, thus reducing cost & saving money.
- Simple installation with batteries connected in series.
- It basically operates in all three modes: battery charging, discharging or idle mode.
- Compact size, low weight

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Fig 2.4.1:- Battery Equilizer

d) Battery: - Batteries are a group of cells that store electrical energy and, through a chemical reaction, can deliver power to loads. This is one of the important part of Solar Powered BTS. A battery backup is provided for the BTS load as it has to work for 24 hours. Battery comes which different types. There are certain technical parameter needs to be considered while
selecting batteries.
Deep-cycle batteries (described in the earlier "Going cellular" section) are designed to deliver nearly all of their stored energy to loads in a PV system, but limitations exist. The phrase depth of discharge (DOD) describes the amount of energy drawn from the battery. The maximum Depth of Discharge for most deep cycle batteries is 80 percent, meaning we remove 80 percent of the stored capacity from the battery. Although deep-cycle batteries are designed to deliver as much of their stored energy as possible, if the DOD frequently reaches a high value, that is 80 percent, the overall battery life will be reduced. Therefore, increasing a battery bank's overall life while delivering as much energy for the loads.
Batteries are broadly classified as two types:-

a) Flooded Lead Acid Batteries.
b) Valve Regulated Lead Acid Batteries.

LA batteries are so popular in PV systems due to their relatively low cost, robust design, and ability to achieve a high depth of discharge.Due to its robust construct & less maintenance Lead Acid Batteries is mainly used.

Other materials also used like solar cables, galvanized structures, Earthing Materials Etc. A tentative cost of 5 Kwp Solar rooftop PV installation on a BTs site is shown below including Purchase of Material, Installation Cost.

S.no	Item	Unit	Qty	Unit Rate	Total Rate
1	250Wp Lubi make Solar Panel	nos	20	8953	1,79,060
2	Solar Cable 6 sq mm	mtrs	100	49	4900
3	1 Core 16 sq mm armoured Copper Cable	mtrs	20	126	2520
4	Solar Tubular Batteries 180 AH	nos	20	13900	2,78,000
5	Charge Controller 48V -45A	nos	3	4500	13,500
6	Battery Equilizer 48 V	nos	5	1800	9000
7	Structures	sets	70	400	28,000
8	Foundation Nuts & bolts	sets	1	300	300
9	PVC pipe	sets	1	200	200
10	Earthing Pipe	sets	3	90	270
11	Copper Lugs	sets	1	500	500
12	Cable accessories like tie,bent etc	sets	1	300	300
13	Installation Cost Including Civil Work	nos	1	68000	68,000
14	Rubber Mat	nos	6	225	13,500
	Overhead(10%)				58,590
	Total Cost for 5 KW plant				6,44,490

Fig 2.4.2:- Total Cost of 5 KW Plant

3 KEY FINDINGS:-

Solar Powered BTS provides benefits in many ways. Some of the environmental & social advantages are:-
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S.no	Item	BTS without Solar Powered	BTS after Solar Powered	Savings
1	30 KVA DG Set Running.	14 Hrs	4 Hrs	10 Hrs
2	30 KVA DG Set Running.	2100 Units/Month	600 Units/Month	1500 Units/Month
3	Fuel Consumptions Per Month.	1050 Litres/Month	300 Litres/Month	750 Litres/Month
4	Cost of Fuel.	Rs 63,000 Per Month	Rs 18,000 Per Month	Rs 45,000 Per Month
5	Carbon Emissions.	2793 Kg/Month	798 Kg/Month	23940 Kg/Annum
	Total Savings			Rs 5,40,000 Per Annum

Fig 3:- Key findings

From above we can clearly see the savings in terms of money and other environmental benefits. The above benefit is for 1 site. Similar-

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ly all 12 sites will make a great impact in the system. Due to all this benefit this type of project is being implemented in all regions of India. Carbon emissions reduction is one of the prime focus and hence this type of project will put a great impact in reduction of carbon emission. **While calculating carbon emission emission factor of diesel is taken as 0.00266**

4 CONCLUSION

The solar-powered technology is more widely used in different areas worldwide, mainly in telecommunication industry, for base stations with or without poor power grids. Most of microwave and relay stations, are gradually replacing the traditional D.G supply with solar powered solution.

Various other advantages mentioned below are:-

- One of best alternative to provide Green energy solutions to power rural telecom BTS.
- Powering of cellular BTS by renewable energy source is found to be technically Feasible and financially viable
- Payback period from the cost analysis of DG operated system versus 5 KWp SPV system is around **1.5 years**.
- Reduction of Green House Gas (GHG) emissions due to a substantial reduction in diesel generator operating hours and savings of fossil fuel as well, without sacrificing the QOS.

Various key finding mentioned above also helps to reduce carbon emission targets.Solar Powered BTs projects is being boomed in telecommunication industry & seeing the future growth of Solar it can be clearly estimated that this types of projects will make huge growth in coming years.

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