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Environment and Social Impact Assessment Report

40 MW Operational Solar Power Project, Siddipet SS, Telangana

Hero Future Energies Private Limited

January 2020

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List of Abbreviations

µg/m^3	Microgram per cubic meter
AAQ	Ambient Air Quality
BMTPC	Building Materials and Technology Promotion Council
BOD	Biological oxygen demand
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CO	Carbon monoxide
COD	Chemical oxygen demand
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
CSPCL	Clean Solar Power (Chitradurga) Pvt Ltd
dBA	Decibel-A scale
DG	Diesel Generator
EPC	Engineering, Procurement and Construction
ESIA	Environment and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GBI	Generation Based Incentives
HR	Human Resources
IEGC	Indian Electricity Grid Code
IFC	International Finance Corporation
kg	Kilogram
KL	Kilolitres
kVA	kilo volt ampere
MNRE	Ministry of New and Renewable Energy
MoEF&CC	Ministry of Environment, Forest and Climate Change
MW	Mega Watt
O&M	Operation and Maintenance
PCA	Primary Census Abstract
PCU	Power Conditioning Unit
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
PS	Performance Standard
PV	Photo Voltaic
RPO	Renewable Purchase Obligations
REC	Renewable Energy Certificates
SC	Scheduled Caste
SPCB	State Pollution Control Board
ST	Scheduled Tribe
TSPCB	Telangana State Pollution Control Board
TSREDCO	Telangana State Renewable Energy Development Corporation Ltd.
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VDA	Village Directory Data

1. Introduction

1.1 Project Overview

M/s Clean Solar Power (Chitradurga) Pvt Ltd (hereinafter referred to as 'CSPCPL'), a Special Purpose Vehicle of Hero Future Energies Pvt. Ltd. (hereinafter referred to as 'HFE' or 'Client') has proposed to develop a 40 MW Solar Power Project (hereinafter referred to as 'Project') spread across three villages, Cheekode and Dubbak villages in District Medak and Maddikunta village in District Karimnagar[1], Telangana India. However, at present the area has been falling under Siddipet District as per recent changes in administrative structure of Telengana.

As per the Power Purchase Agreement (PPA) signed between CSPCPL and Southern Power Distribution Company of Telangana Limited (hereinafter referred to as 'DISCOM') dated 22nd February 2016, the switchyard has been connected to capacity grid substation of 220/132 KV at Siddipet, Telangana.

1.2 Background and Rationale of the Study

Hero Future Energies Pvt. Ltd., established in 2012, is an Independent Power Producer, and is a fully owned subsidiary of the Hero Group. HFE currently has ~1.2 GW installed project capacity, with wind, solar (Grid connected) and rooftop solar projects across ten (10) states in India.

M/s Clean Solar Power (Chitradurga) Pvt Ltd. (hereinafter referred as "CSPCPL"), a special purpose vehicle (SPV) of HFE is developing a 40 MW Solar Project (hereinafter referred as "project"). The proposed solar farm is spread across three (03) villages namely, Cheekode and Dubbak villages in District Medak and Maddikunta village in District Karimnagar, Telangana, India.

AECOM India Pvt. Ltd. (hereinafter referred as "AECOM") understands that HFE, CSPCPL, intends to develop a 40 MW solar power project with financial assistance from international lenders / multilaterals. In this context, the project requires evaluation of Environmental and Social risks associated with its construction and operations. Evaluating such risks will help determining mitigation measures to avoid adverse impacts identified as part of the study.

As HFE is seeking project finance from international lenders, it is required to comply with the applicable International Finance Corporation (IFC) guidelines relating to Environment, Social issues and Occupational Health and Safety matters, in addition to regional and national laws and regulations.

HFE has commissioned AECOM to undertake an Environment and Social Impact Assessment (ESIA) in order to meet requirements of the following reference framework:

- Applicable national, state and local regulatory requirements;
- IFC Performance Standards (2012);
- IFC/World Bank EHS General Guidelines (2007).

1.3 Objective and Scope of Work

The scope of work for the ESIA broadly includes the following,

Defining the Project/Project Description

The project information includes providing project description with focus on understanding the environmental and social setting and sensitivities for the solar power project. This also includes any associated facilities that may be required (e.g., access roads, transmission lines, etc.). Also, description of the larger setting in which the project is located.

Outlining Policy, Legal, and Administrative Framework

Discussing the policy, legal and administrative framework within which the assessment is carried out, including host country regulations, obligations under relevant international social and environmental treaties, agreements, and

[1] These Districts are as per the Telangana map at the time of the site visit i.e. January 2017 and as per the Detailed Project Report provided by the Client.

conventions and IFC Performance Standards. Subsequently, reviewing the Social and Environmental compliance requirements against these legislations and frameworks.

Generating Baseline Data

Collecting and generating relevant baseline social and environmental data (primary snf secondary) relevant to decisions about project location, design, operation, or mitigation measures. The baseline data generation is specifically focused on issues around a) cumulative impact assessment due to operation of existing solar power projects in the vicinity of the project, if any, b) traffic, c) water- its quality, availability and adequacy vis-à-vis the requirements during different operation phase of the project life cycle, d) land and landuse, e) ecology/ biodiversity, f) physical or cultural heritage (if any), g) other environmental sensitivities like wetlands, forests etc. Review of the land purchase process to assess any legacy or current/existing issues (like informal settlers, livelihood dependence, other usage etc.) on the purchased land is also assessed.

Consultation

Discussions with local community members was carried out to review the socio-economic condition and general overview of geographical condition.

Assessing Social and Environmental Impacts and Mitigation Measures

Evaluating potential Environment and Social impacts of the Project and its components (including associated facilities like transmission line, access roads etc. as per the details available) and developing mitigation measures and plans to maximize project benefits in consultation with affected communities including, potential assessment of Cumulative impacts (linked to development or other solar projects), if relevant and as appropriate.

The impact assessment will identify mitigation measures for any residual negative impacts that may not be mitigated and also evaluate impacts and risks from associated facilities and other third-party activities.

Analysing Alternatives

Comparing reasonable alternatives against project site, technology, design, and operation in terms of their potential social and environmental impacts is to be undertaken. The feasibility of mitigating these impacts, capital and recurrent costs, suitability under local conditions, and institutional, training, and monitoring requirements also has been considered. The resultant alternative will state the basis for selecting a particular site and project design by justifying recommended approaches to pollution prevention and abatement.

Providing Management Program

The final step includes formulating management plan for mitigation of impacts as identified during assessment. This also entails developing Environmental and Social Management Plan (ESMP) based on the ESIA and procedures development for mitigation and monitoring of environment and social impacts on an ongoing basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the ESIA.

Where the client identifies measures and actions necessary for the project to comply with applicable laws and regulations and to meet the Performance Standards, the management program will include an Action Plan, which is subject to be implemented by the Client.

1.4 Limitations

The ESIA study of the project has been undertaken in line with the pre-defined scope of work. It is limited to project information made available by the client, discussion with Client representative and secondary data collected.

As with any assessment exercise, there is a certain degree of dependence upon verbal information provided by the point of contact for assessment, limited number of documents available for review and information available in the public domain, which is not readily verifiable through visual observations or supported by any available written documentation. During the course of the site assessment, AECOM has attempted to independently assess the potential presence of such conditions within the limits of the established scope of work as described in the report. However, verification of potentially important facts is not always possible. AECOM shall not be held

responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed by site representative at the time this assessment was performed.

This report has been prepared by AECOM for the benefit of its client, Hero Future Energies. AECOM's client may release the information to third parties, who may use and rely upon the information at their discretion. However, any use of or reliance upon the information by any party shall be solely at the risk of such party and without legal recourse against AECOM, its parent, its subsidiaries and affiliates; or their respective employees, officers, or directors; regardless of whether the action in which recovery of damages is sought is based upon contract, tort (including the sole, concurrent, or other negligence and strict liability of AECOM), statute, or otherwise. This information shall not be used or relied upon by a party that does not agree to be bound by the above statement.

1.5 Layout of Report

The report structure is outlined in the following manner:

- Chapter 2 – outlines Project Description
- Chapter 3 – outlines Environmental and Social Regulatory Framework
- Chapter 4 – outlines Environmental and Socio-Economic Baseline
- Chapter 5 – outlines Alternatives that may be considered for the project
- Chapter 6 – describes Impacts associated with the project
- Chapter 7 – presents the Environmental and Social Management Plan
- Chapter 8 – describes the Project Categorisation and Concluding Remarks

2. Project Description

This section of the report provides a description of the site settings and project components along with other associated facilities. This section also elaborates on project phases along with its implementation mechanism and schedule.

2.1 Site Location

The Project Site is located in Cheekode and Dubbak villages of Dubbak Mandal of Medak district and Maddikunta village in Mustabad Mandal of Karimnagar district. The nearest highway is the State Highway –11 which passes through the Karimnagar, Siricilla and Kamareddy Districts and is located at a distance of approximately 29 km from site in north direction. As per the discussions with the Client representatives, the site does not have any encroachments in the present day or reported to have any during the past. The nearest habitation around the site is Maddikunta village, located at a distance of 1.73 km approximately in North-east direction. The nearest Airport to the Site is the Rajiv Gandhi International Airport at a distance of approximately 132 km from the site towards South. ***1*** below presents the site location of the solar power project.

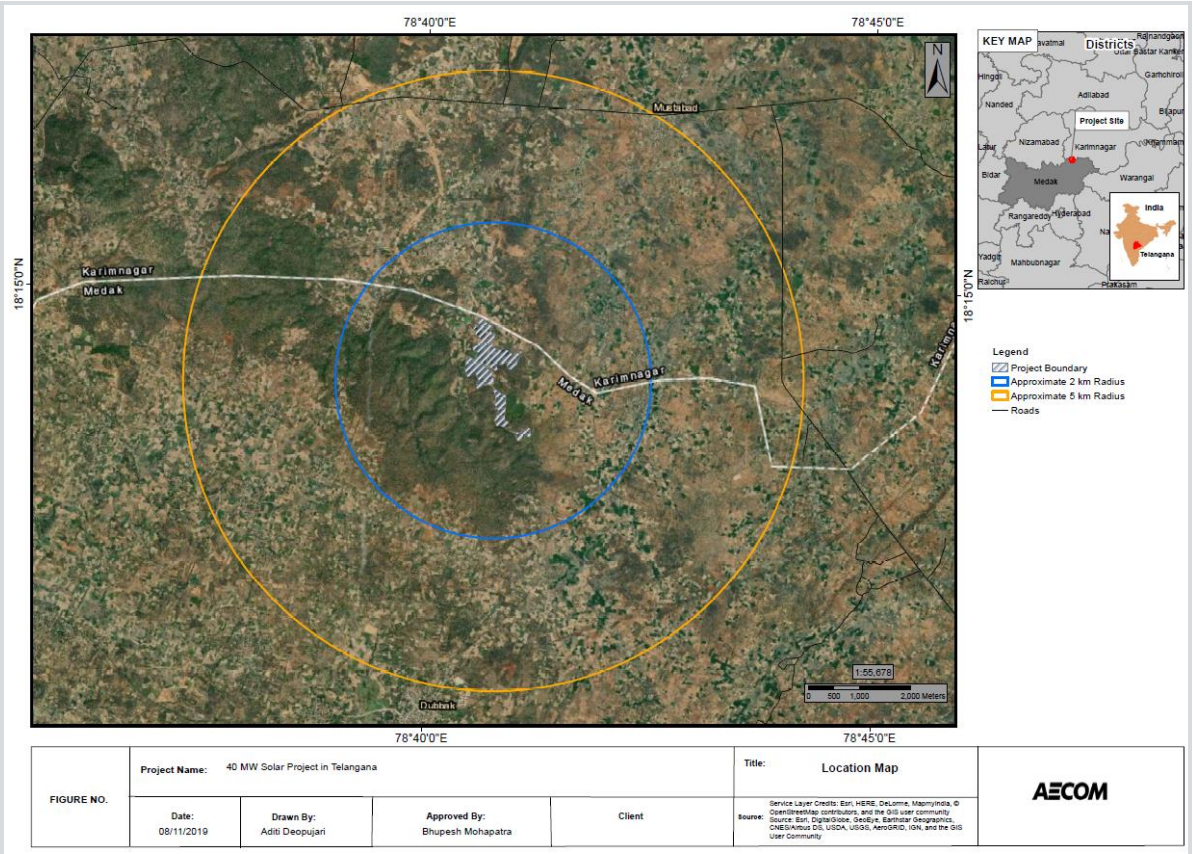


Figure 1: Indicative Location of 40 MW Solar Project in Medak & Karimnagar District in Telangana

2.2 Site Setting

The Site has an undulating topography with slightly rocky terrain. The Site is mostly covered with shrubs and trees. The land procured was used for agricultural purposes or was mostly barren. As per the Google imagery, the Site elevation is about 1613 feet above mean sea level. Connectivity to the two (02) Main gates of Site is provided through the Rekulakuntta Temple Road. Shiva Temple is located at an aerial distance of 367 m from the Site. No water body is located within a 5 km radius of the Site.

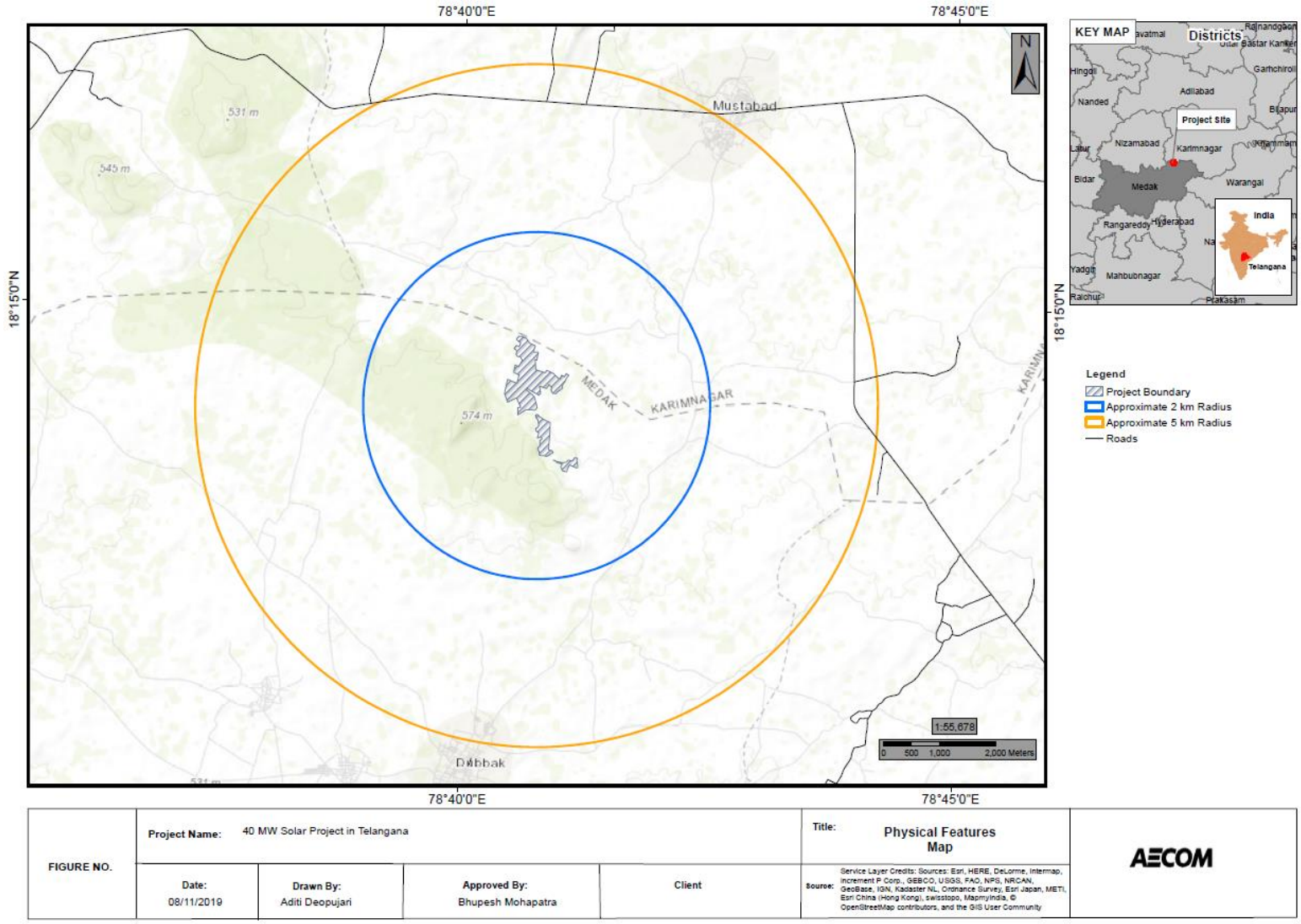


Figure 2: Physical Features of Project Area

2.3 Project Schedule

Based on the type of activities, the Project can be divided into four phases, as follows:

a) planning;

b) construction;

c) operations and maintenance and

d) decommissioning.

Key project activities during these phases of the Project have been summarized below:

2.3.1 Planning Phase

The planning phase includes the following components:

- Identification of land area and site;
- Site surveys as topographic, geo-technical investigations, solar radiation and yield study, electrical grid studies, etc.;
- Obtaining all necessary approvals/clearances; and
- Design and finalization of contractors;

The identification and purchase of land is a key component of the planning and pre-construction phase. The process of purchasing land can be divided into two phases (a) land title verification and (b) purchase of land.

The planning phase had already been completed at the time of site visit by AECOM professionals. As per the information provided by the Site representatives, the Construction phase was planned to be starting in 10 days after the Site visit. Waaree Energies Ltd. Is the EPC contractor for development of 38 MW of the power project.

2.3.2 Construction Phase

Construction phase of project activities will include the following:

- Contractor mobilization;
- Site Preparation including fencing, clearing of bushes, pit filling, levelling and grading;
- Construction of site office and internal roads;
- Construction of temporary storage facilities;
- Foundation laying for ground mounted structures;
- Storage of PV modules delivery and their installation;
- Laying of internal electrical connections;
- Construction of sub-station and office buildings;
- Installation of inverter and transformers;
- Excavation foundation and erection of transmission line towers; and
- Stringing of transmission lines.

2.3.3 Operation and Maintenance

The list of activities to be carried out in the operation and maintenance phase would be:

- Monthly cleaning of PV modules;
- Control of vegetation viz. weeds, bushes etc. within the site and those immediately surrounding it;

- Routine inspection of all PV modules and associated structures viz. cables, transformers, inverters, mounting structures etc.;
- Operation and maintenance of ancillary facilities such as power substation;
- Inspection and maintenance of transmission lines; and
- Inspection and maintenance of internal site pathways/access roads.

2.3.4 Decommissioning

The average life span of the solar modules is 25 years. At the end of this life cycle, the solar modules will either be revamped or replaced and continue with its operation. If decommissioned, all components including foundations and internal roads of the project will be removed and the site will be restored to its pre-construction state. The concrete pedestals of the ground mounted structure foundations will be demolished and removed from the sub-surface. The associated infrastructures will be returned to the government for use.

2.4 Implementation Schedule

The proposed implementation schedule of the completion of project starting from inception stage, as provided by the Client is presented in Table below:

Table 2-1: Implementation Schedule of Project

Sl. No	Activity	Proposed Schedule		Feb-17	Mar-17					Apr-17				May-17				Jun-17				Jul-17				Aug-17			
		Start	End		Wk-05	Wk-06	Wk-07	Wk-08	Wk-09	Wk-10	Wk-11	Wk-12	Wk-13	Wk-14	Wk-15	Wk-16	Wk-17	Wk-18	Wk-19	Wk-20	Wk-21	Wk-22	Wk-23	Wk-24	Wk-25	Wk-26	Wk-27	Wk-28	Wk-29
1	COD	28-Jul-17																											
2	Land hand Over	20-Feb-17																											
3	Survey	21-Feb-17	25-Feb-17																										
4	Soil Testing	20-Feb-17	28-Feb-17																										
5	Fencing Contract		15-Mar-17																										
6	Fencing	15-Mar-17	23-Jun-17																										
7	TL & Bay Contract		8-May-17																										
8	TL	8-May-17	26-Jun-17																										
9	Bay	15-May-17	26-Jun-17																										
10	Procurements and Delivery	10-Mar-17	20-Jun-17																										
11	EPC -Finalization	16-Feb-17																											
12	Site Mobilization		11-Mar-17																										
13	Engineering Contract		25-Dec-16																										
14	Engineering	25-Dec-16	28-Feb-17																										
15	Executions	15-Mar-17	23-Aug-17																										
16	Testing	23-Jul-17	26-Aug-17																										
17	Process for Commissioning	26-Jul-17	28-Aug-17																										

2.5 Current Status of Project

At the time of visit to the site in January 2017, the project Construction had not started and the land hand over and survey was in process. The civil works were about to be initiated at site. The evacuation approvals had been obtained for the proposed project. The Site area was an undulating surface, mostly covered with shrubs and grasses. As per the information provided during the Sit visit, the construction works were planned to be starting in mid-January to late January. Additionally, Geo-tech investigation had been carried out on the Site.

2.6 Power Purchase Agreement

M/s Clean Solar Power (Chitradurga) Pvt Ltd (CSPCPL) signed a Power Purchase Agreement with Southern Power Distribution Company of Telangana Limited, dated 22 February 2019, for a period of 25 years, with effect from the date of Commercial Operation. The 40 MW project located near 220/132 KV Siddipet will be connected to the 220/132 KV Siddipet Grid substation. Out of the 40 MW, 0.04 MW will be for auxiliary consumption and the rest 39.96 will be for export to grid for sale to the DISCOM.

2.7 Project Components

As per the Detailed project report provided by the Client, the solar PV Power will be generated at 380 V AC, stepped upto 132 kV level and connected to the grid of nearest 220/132 kV Siddipet Substation in Medak District of Telangana. The plant is expected to generate about 82.56 million units (kWh) for sale in the first year of operation. The proposed technology for the plant will be Multi-crystalline. The plant shall consist of a solar PV arrays to generate 40 MW power; the system will generate DC power. This DC power will be converted to AC power through a number of inverters (Power Conditioning Units) at 3 Ph, 380 V, 50 Hz. The output of the Power Conditioning Units (PCUs) shall be stepped upto 132 kV, 3 Ph, AC supply by transformers connected through proper isolation and circuit breaking arrangements. This power shall be evacuated to feeder bay in Substation. Necessary metering and protection to the men and equipment is proposed to be provided. The components shall include but not be limited to the following:

Inverter:

The proposed Inverter for the 40 MW SPV power plants will be a grid connect which will be a combined unit comprising of inverter and necessary protections.

Transformer:

It is proposed to use transformers of required capacity to step-up the generated exportable power at 380 V into 132 kV.

Lightning Arrestors:

Lightning arrestors of adequate capacity shall be provided for transformer/ switchyard equipment protection and on terminating ends of the transmission lines. The lightning arrestor will be heavy duty station class type, discharge class III, conforming to IEC specification. Arrestors will be complete with Insulating base, contained discharge counters and suitable milli-ammeters.

Structures:

The structures will be made up of hot-dip galvanized steel and designed to withstand forces during normal conditions (viz. wind loads & dead load of switchyard components) and abnormal conditions (viz. short circuit, earthquake, etc.).

Safety Earthing System:

A safety earthing system consisting of a buried GI flat conductor earthing grid will be provided for the switchyard and the Solar PV array system. The earthing system will be formed to limit the grid resistance to below 1 ohm. In the switchyard area, the touch potential and step potential will be limited to the safe values.

Lightning Protection System:

Switchyard equipment will be shielded against direct lightning strikes by providing spikes/shield wires. The spikes/wires shall be formed to shield all substation equipment with an angle of shield of 30 Deg.

2.8 Technical Details of the PV Modules

The technical specifications for the modules are provided in the Table below.

Table 2-2: Technical Specifications of Modules

Sl. No.	Item Description	Quantity	UoM	Make
1.	Solar PV Modules – 315 Wp	139680	Nos.	JA Solar/Trina/Yingli/equivalent
2.	Module Mounting Structure suitable for accommodating 40 MW capacity SPV Modules including foundation	1X42 matrix	MT	HFE Design
3.	Grid interactive Inverter: 1000 kW as per system capacity of 10 MW	40	Nos.	ABB/Schneider/Hitachi/equivalent
4.	String combiner boxes	320	Nos.	Statcon/Trinity Touch/equivalent
5.	Cables as per Design DC	Set	Meters	Lapp/KEI/Polycab/equivalent
6.	Cables as per Design AC	Set	Meters	Polycab/KEI/equivalent
7.	Substation: Transformers, CTs, PTs, Isolators, Circuit Breakers, Surge Arrestors	Set	Nos.	PCI/ABB/Areva/equivalent
8.	Metering – TVM 0.5s, 415V LT CT based	Set	Nos.	L&T/Secure/equivalent
9.	Lighting Arrestor	Set	Nos.	Jef/Sabo/ equivalent
10.	Earthing Kit	Set	Nos.	Jef/Sabo/ equivalent

Source: Detailed Project Report provided by the Client

2.9 Resource Requirement

The resource requirement for the different phases of the project have been stipulated below:

2.9.1 Construction Activities

Site Preparation Works

The proposed project site at the time of site visit was noted to be used partly for agricultural activities and partly was unutilized or barren. Site preparation will involve excavation works, clearing of vegetation, levelling of land and transportation of construction materials.

Equipment

Various kinds of machineries will be utilized during construction phase like Crane to unload materials, forklift to lift and transport materials, hammer driving piles to provide support for buildings and other structures. Three (03) Diesel Generators will be utilized for provision of electricity during construction phase, however, it is proposed that no DG sets would be used during the construction phase.

Labour requirement and Accommodation

During construction stage, the average labour demand for the proposed project is estimated to be about 200 workers. The peak labour requirement for the project is estimated by client to be 300-350 workers.

The employment of labour for various works is the responsibility of the respective contractor. Erection, procurement and construction of the proposed project were supervised by CSPCPL, who have also engaged a number of Engineers for construction phase.

Water and Waste water

It is estimated that approximately 300 kiloliters of water will be required for the cleaning of solar panels every month. Except these the entire construction phase requires water for curing works, batching plant and domestic requirement of workers.

It will be the responsibility of respective contractors for making arrangements to meet water requirements for construction works and domestic purposes. Water tankers from authorized vendors will be sourced from nearby villages. Waste water generation from the construction activities is proposed to be limited to washing and cleaning activities.

Waste Generation

Solid waste generation during the construction phase consists primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and human waste. During the construction there will be generation of garbage, for which designated practices of solid waste disposal shall be followed. During construction phase, hazardous waste such as used oil from DG sets, oil-soaked cotton, oil lined containers, paints etc. will be generated at the site.

Power Requirement

The power requirement during construction phase will be sourced from, Diesel Generators, as informed by the CSPCPL. The proposed capacity of the DG sets will range from 15 to 30 kVA. Installation of DG sets will be the responsibility of the respective sub-contractor.

2.9.2 Operations and Maintenance

The solar photovoltaic system requires least maintenance among all power generation facilities due to the absence of fuel, intense heat, rotating machinery, waste disposal, etc. However, keeping the photovoltaic panels in good condition, monitoring and correcting faults in the connected equipment and cabling are still required in order to get maximum energy from the plant. The maintenance functions of a typical solar PV power plant can be categorized as given.

1) Scheduled or preventative maintenance – Planned in advance and aimed at preventing faults from occurring, as well as keeping the plant operating at its optimum level.

2) Breakdown maintenance –carried out in response to failures.

Maintenance Requirement

The main objective of the plant maintenance is to keep the plant running reliably and efficiently as long as possible. Efficient operation implies close control not only over the cost of production but also over the cost of maintenance. There are two components in maintenance cost: one is the direct cost of maintenance, (i.e. the material and labour), and the other is the cost of production loss.

Routine Maintenance

Several maintenance activities need to be completed at regular intervals during the lifetime of the system. The energy yield of the plant will be monitored using the remote data acquisition system connected to each inverter. Significant reduction in energy yield will trigger specific maintenance requirements, such as inverter servicing or module replacement. Typical activities required are described below:

1) General maintenance: Vegetation will need to be cut back if it starts to cause a fire risk or introduce shading;

2) Modules: Visual inspection and replacement of damaged modules will be required. Cleaning of the module glass surface during long dry periods may be considered. Module cleaning needs to be carried out periodically to remove dust, bird dropping etc.;

3) Wiring and junction box: Visual inspection for corrosion, damage such as chafing and damage by rodents and birds and for overheating of cables and connections;

4) Inverter Servicing –Inverter faults are the most common cause of system downtime in PV power plants and therefore, the scheduled maintenance of inverters should be treated as a centrally important part of the O&M strategy. The preventive maintenance of inverters includes visual inspection, cleaning/replacing cooling fan filters, removal of dust from electronic components, tightening of any loose connections etc.

Breakdown Maintenance

Breakdowns can occur due to lack of routine or preventive maintenance, bad climatic conditions, disturbance in utility grid etc. As breakdowns affect energy generation and hence revenue generation, these kind of faults needs

to be immediately corrected. Breakdown can occur at any part of the system between solar PV modules to substation end.

Operation and Maintenance Staff

The manpower requirement for the operation phase of the Project has been estimated to be approximately 10-15 skilled staff (engineers and technicians) and 7-8 semi-skilled labour for cleaning of solar panels. About 6-10 security guards will also be deployed during operation phase. Site-In-Charge will be responsible for all site related issues and will coordinate with security guards, operation contractor, and equipment service provider.

Water and Waste Water

The water requirements for the plant will be predominantly for washing of solar PV modules periodically to remove bird droppings, dust and other dirt. Assuming a minimum of 1 liter of water per module, the water requirement for cleaning the whole plant (i.e.1,39,680 modules) will be approximately 140-150 kiloliters, at one time. With a cleaning schedule of twice a month, it is estimated that approximately 300 kiloliters of water will be required for cleaning purpose on monthly basis and the requirements will be met through water tankers.

Waste Generation

During operation phase, the waste generated is limited to paper, plastic waste and food waste from the site office. The waste is proposed to be collected in designated bins at site and disposed at a regular interval through municipal vehicle.

Training

It will be necessary to have the operation and maintenance personnel to have requisite qualifications, experience and skill. The Plant Manager will be selected as an experienced person, preferably drawn from similar industry. Adequate training will be provided to operation and maintenance personnel at the Photovoltaic power plant. The training requirements shall cover:

1. The nature, purpose and limitations of all plant and equipments;

2. The detailed operation instructions on each section and equipment of the plant;

3. Normal Start up and shut down program for the plant;

4. The emergency procedures and all related HSE issues according to the standards;

5. The basis for the training shall be the plant's O&M Manual.

2.10 Associated Facilities

2.10.1 Power Evacuation

Power from the solar PV plant is proposed to be evacuated to the 220/132 KV Siddipet grid substation which is located at a distance of about 21.3 km, out of which 1.3 km will be underground. The associated land details of transmission line was not submitted for review.

2.10.2 Access Roads

As per the google imagery, the Rekulakuntta Temple Road provides access to the Site. The access road to the Site has been existing.

3. Environment and Social Regulatory Framework

3.1 Introduction

This section highlights the environmental and social regulations applicable to the solar power project. The section broadly focuses on the institutional framework, applicable environment, health & safety and social legislative requirements, World Bank Operational Policies and IFC Performance Standards relevant to the Operational Project.

3.1.1 National and Regional Enforcement Authorities

In India, Ministry of New and Renewable Energy (MNRE) is the nodal agency to manage the upcoming solar power projects and the environmental aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB) Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC).

All the permissions and the approvals have to be taken from the concerned ministries, line departments and the local civic bodies for any upcoming project in India. The environmental and social governance approach in the country consists of –

1. Regulatory and implementing entities;
2. Legal framework including policies, acts and laws; and
3. Permitting system

Table 3-1: Enforcement Agencies and their Functions

Sl. No	Agencies	Description	Functions
1.	Ministry of Environment, Forest and Climate Change (MoEF&CC)	Nodal Agency for planning, promotion, co-ordination and overseeing the implementation of environmental and forestry policies and programmes	• Environmental policy planning; • Effective implementation of legislation; • Monitoring and control of pollution; • Environmental Clearances for industrial and development projects covered under EIA notification; • Promotion of environmental education, training and awareness; and • Forest conservation, development, and wildlife protection.
2.	Central Pollution Control Board (CPCB)	For the implementation of the Water (Prevention and Control of Pollution) Act, 1974	• Prevent pollution of streams and wells; • Advise the Central Government on matters concerning prevention, control and abatement of water and air pollution; • Co-ordinate the activities of State Pollution Control Board's (SPCB's) and provide them with technical and research assistance; • Establish and keep under review quality standards for surface and groundwater and for air quality; • Planning and execution of national programme for the prevention, control and abatement of pollution through the Water and Air Acts; and • The CPCB is also responsible for the overall implementation and monitoring of air and water pollution control under the Water Act, 1974, and the Air Act, 1981
3.	Telangana State Pollution Control Board (TSPCB)	To implements various environmental legislations in the State of Telangana, Such as Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981.	• To plan comprehensive program for the prevention, control or abatement of pollution and secure executions thereof; • To collect and disseminate information relating to pollution and the prevention, control or abatement thereof; • To inspect sewage or trade effluent treatment and disposal facilities, and air pollution control systems and to review plans, specification or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted; • Supporting and encouraging the developments in the fields of pollution control, wastes recycle reuse and eco-friendly practices;
4.	Environment, Forests, Science and Technology, Telangana	Headed by the Principal Secretary, this department deals with aspects relating to forest, mining and others.	Responsible for the enforcement of various natural resource such as forest related Acts, Rules, Notifications etc., • Proposals relating to forest lands, mining leases, encroachments on forest lands, forest Conservation Act 1980, use of forest land for non-forest purposes, soil conservation Issues relating to Podu cultivation, forest settlement, forest survey and mapping Protection of forests and related notifications. • Issues relating to destruction of forests. • Budget planning and Non-Plan schemes. • Research and development/monitoring and evaluation. • Social forestry programmes. • Development of waste land

5. Ministry of Renewable Energy	Nodal ministry of Government of India for all matters related to new and renewable energy	To develop and deploy new and renewable energy for supplementing the energy requirements of the country as stated on its website.
6. Telangana State Renewable Energy Development Corporation Ltd., (TSREDCO)	Telangana State Renewable Energy Development Corporation Ltd., (TSREDCO) has been created vide G.O. Ms no.25 dated 03.09.2015 of Energy (CC) Department to act as Nodal Agency for implementing all New and Renewable Energy Programmes and also nominated as State Designated Agency (SDA), for implementing all Energy Conservation activities in the state respectively for Energy Security of the State.	• Planning and preparation of Policies for promoting Renewable Energy and Energy Conservation activities • Encourage and Promote Renewable Energy activities and Energy Conservation activities • Monitoring& Verification of initiated Renewable Energy Technologies • Import, upgrade and adapt upcoming technologies in areas of Renewable Energy and Energy Conservation • Promote R&D in the field of Renewable Energy and Energy Conservation • Renewable Energy activities in the state consist of Biomass, Bagasse, Solar, Wind, Mini Hydel, Waste based power projects (Grid and Off-Grid) Energy Conservation activities in the state consists of Promotion of Energy Conservation in SMEs, Large Industries, Commercial Establishments and transport sector, Demand Side Management Activities includes AgDSM, MuDSM, promotion of Energy Efficient Equipment's and conducting awareness workshops and training programmes for promoting Energy Conservation.
7. Central Electricity Authority (CEA)	Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, hereinafter replaced by the Electricity Act, 2003, where similar provisions exists, the office of the CEA is an "Attached Office" of the Ministry of Power.	Responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
8. Central Regulatory Electricity Commission	To promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers	• Improve the operations and management of the regional transmission systems through Indian Electricity Grid Code (IEGC), Availability Based Tariff (ABT), etc.; • Formulate an efficient tariff setting mechanism, which ensures speedy and time bound disposal of tariff petitions, promotes competition, economy and efficiency in the pricing of bulk power and transmission services and ensures least cost investments; facilitate open access in inter-state transmission; • Facilitate inter-state trading; • Promote development of power market; and • Improve access to information for all stakeholders.
9. Central Ground Water Authority	Constituted under Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 for the purposes of regulation and control of ground water development and management	• To resort the penal provisions contained in section 15 to 21 of the said act; • To regulate and control, management and development of ground water in the country and to issue necessary regulatory directions for the purpose; and • Exercise of powers under Section 4 of Environment (Protection) Act, 1986 for the appointment of Officers.
10.Gram Sabha or the Panchayats	Local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992	• Preparation of plans for economic development and social justice and the implementation of such schemes for economic development and social justice, as may be assigned to them.

11.	Southern Power Distribution Company, Telangana	The Southern Power Distribution Company of Telangana or TSSPDCL is the Electricity Distribution company under the government of Telangana.	TSSPDCL focuses on innovative, efficient and tailored way of electrifying villages and urban areas. products and services. TSSPDCL has a vast infrastructure facility in its operating area with 1,605 Nos. of 33/11 KV substations 3,102 Nos. of power transformers, 1,220 Nos. of 33 KV feeders 7,263 Nos. of 11 KV feeders and around 4,22,003 Nos. of distribution transformers of various capacities. • Construction of Stations and Transmission Lines and maintenance of Sub-Stations.

3.1.2 Applicable Environment and Social Regulations and Policies

The relevant Acts, Rules and Policies pertaining to the project have been summarised in the following ***Table 3-2***.

Table 3-2: Applicable Environment and Social Laws and Regulations and Policies

Sl. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
	Environmental Protection	Scattering of debris and waste material can contaminate the soil, water and surroundings.	**The *Environment (Protection) Act 1986*, as amended in April 2003;** ***EPA Rules 1986*, as amended in 2002.**	TSPCB MoEF&CC CPCB	Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act.
	Prevention and Control of Water Pollution	Waste water generation from construction and operation of the Plant	**The *Water (Prevention and Control of Pollution) Act, 1974*, amended in 1988**	TSPCB	Intimation to TSPCB for the solar power plant and ensure compliance under the *Water Act, 1974.*
	License under Factories Act, 1948	Factory license is required as the project is generating, transforming and transmitting power.	**Chapter I of The Factories Act, 1948**	Factories Inspectorate, Telangana	CSPGPL shall obtain Factory License from the State Government or Chief Inspectorate of Factories, Telangana before starting operations of the project.
	Hazardous Wastes Management	The project will generate broken photo-voltaic cells, waste oil from transformer from switchyard. Solvents and chemicals used or cleaning etc.	***Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016* as amended in 2019**	TSPCB	As per the recent amendment dated 1st March 2019, an occupier shall not be required to obtain authorization for collection, reception, storage, transportation and disposal of hazardous wastes if Consent to Operate is not required from SPCB for the project activity. Liability of the occupier, transporter and operator of a facility: The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste listed in schedules to the Rules; The occupier and operator of a facility shall also be liable to reinstate or restore damaged or destroyed elements of the environment; The occupier and operator of a facility shall be liable to pay a fine as levied by the State Pollution Control Board with the approval of the Central Pollution Control

Sl. No.	Issues	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					Board for any violation of the provisions under these rules. *All the hazardous waste generated due to the project shall be stored and disposed as per the requirements of the Hazardous Waste Rules i.e., on a paved surface in a designated area with adequate secondary containment, with adequate labelling and before it is disposed to an* ***approved vendor.***
	Electricity Distribution License	Private sector projects to obtain distribution Licenses from the State Electricity Regulation Committee and to have open access to the transmission lines	***The Electricity Act 2003***	State Electricity Regulation Committee	CSPGPL should ensure to obtain license under the electricity act and ensure that the Health and Safety requirements specified under the rules are compiled to.
	Surface Transportation	Movement of vehicles during operational phase	**The *Motor Vehicles Act 1988*, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000** **The *Central Motor Vehicles Rules 1989*, as amended through 20th October 2004 by the Central Motor Vehicles (Fourth Amendment) Rules 2004.**	State Transport Authority	CSPGPL should ensure compliance of stipulated standards under rule 115 safety compliance under the rules.
7.	Labour	Labour	Engagement of Labour at site	***Workmen's Compensation Act, 1923 & Rules 1924***	**It shall be ensured that compensation is provided** to **workmen** and their dependants in case of injury and accident (including certain occupational disease) arising out of and in the course of employment and resulting in disablement or death
8.	Labour	Labour	Engagement of bonded Labour at site	***Bonded Labour (Abolition) Act 1976***	Ensure that no bonded labour has been employed at the site. The Contractor or sub-contractor should also ensure the same.
9.	Labour	Labour	Working conditions of contracted Labour working at the site	***The Contract Labour (Regulation and Abolition) Rules, 1971***	**The Project to ensure that a license for the Contract labour is obtained by the Contractor.**
10.	Labour	Labour	Engagement of Child Labour at site	***The Child Labour (Prohibition and Regulation) Act, 1986***	Ensure that no child labour has been employed at the site. The Contractor or sub-contractor should also ensure the same.
11.	Labour	Labour	Provision of wages to labour engaged at the site	***Minimum Wages Act, 1948***	It shall be ensured that all the employees are compensated equal to or above the minimum wages, as stipulated by the State or Central government, based on the categories of work.
12.	Labour	Labour	Equal wages to male and female workers at site	***Equal Remuneration Act 1976***	The project management to ensure that equal remuneration is provide to both men and women carrying out similar nature of jobs.

3.1.3 Policies Framework in India

Various policies released by the Government of India from time to time needs to be addressed while undertaking the projects. Some of the policies (including sector specific) have been discussed briefly in the table below.

Table 3-3: National and State Level Policies Applicable to the Project

Name of the Policy	Agency	Description
National Environmental Policy, 2006	Telangana state pollution control board	Government of India released the National Environment Policy in 2006. The present national policies for environmental management are contained in the National Forest Policy, 1988, the National Conservation Strategy and Policy Statement on Environment and Development, 1992; and the Policy Statement on Abatement of Pollution, 1992. Some sector policies such as the National Agriculture Policy, 2000; National Population Policy, 2000; and National Water Policy, 2002; have also contributed towards environmental management. All of these policies have recognized the need for sustainable development in their specific contexts and formulated necessary strategies to give effect to such recognition. The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.
National Electricity Policy 2005	Ministry of Power, Government of India	The National Electricity Policy 2005 states that environmental concerns would be suitably addressed through appropriate advance action by way of comprehensive Environmental Impact Assessment and implementation of Environment Action Plan (EAP). As per the Policy, adequate safeguards for environmental protection with suitable mechanism for monitoring of implementation of Environmental Action Plan and R&R Schemes should be put in place. Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell to different distribution licensees across the country. This should lead to availability of cheaper power.
National Solar Mission	Government of Telangana	The objective of the Jawaharlal Nehru National Solar Mission (JNNSM) under the brand 'Solar India' is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The Mission has set a target of 20,000 MW and stipulates implementation and achievement of the target in three phases (first phase up to 2012-13, second phase from 2013 to 2017 and the third phase from 2017 to 2022) for various components, including grid connected solar power. The successful implementation of the JNNSM requires the identification of resources to overcome the financial, investment, technology, institutional and other related barriers which confront solar power development in India. The penetration of solar power, therefore, requires substantial support. The policy framework of the Mission will facilitate the process of achieving grid parity by 2022.
Telangana Solar Power Policy 2015	Telangana State Renewable Energy Development Corporation Ltd., (TSREDCO)	To harness the potential of the solar resource in the state, Government of Telangana had issued a Solar Policy in 2015. The Solar Policy has been formulated by KREDL with the following objectives: • Realize and harness the vast solar power potential of the State.

Name of the Policy	Agency	Description
		• Contribute to long-term energy security of the state and promote a • sustainable fuel mix in generation through higher contribution of solar energy. • To promote solar parks • To promote public as well as private investment in solar power generation • To promote decentralized and distributed generation • To promote grid connected and off-grid solar applications and effective energy conservation measures. • To promote all technologies of harnessing solar energy. CSPCPL holds the responsibility for development of power evacuation facilities along with interconnection scheme and bay equipment along with protection equipment from the project till the grid sub-station of GESCOM.

3.1.4 IFC Performance Standards

The IFC Performance Standards stipulates that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution:

- **Performance Standard 1:** Assessment and Management of Environmental and Social Risks and Impacts;
- **Performance Standard 2:** Labour and Working Conditions;
- **Performance Standard 3:** Resource Efficiency and Pollution Prevention;
- **Performance Standard 4:** Community Health, Safety, and Security;
- **Performance Standard 5:** Land Acquisition and Involuntary Resettlement;
- **Performance Standard 6:** Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- **Performance Standard 7:** Indigenous Peoples; and
- **Performance Standard 8:** Cultural Heritage.

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. The applicability of the Performance Standards is discussed in the ***Table 3-4*** below:

Table 3-4: Applicability of the IFC Performance Standards for the Project

S. No.	Performance Standard	Description and Applicability
1.	PS1 – Assessment and Management of Environmental and Social Risks and Impacts	***APPLICABLE*** PS 1 establishes the importance of: • Integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; • Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and • The project proponent's management of environmental and social performance throughout the life of the project. The PS 1 is applicable to projects with environment and/or social risks and/or impacts. Hence, PS 1 is applicable to the project necessitating an Environmental and Social Impact Assessment (ESIA) study to be conducted prior to commencement of the project. The project is a solar power project and will have environmental and social impacts such as stress on existing water resources, waste generation etc.

S. No.	Performance Standard	Description and Applicability
		Hero Future Energies has developed and implemented an Environmental and Social Management System to manage the risks associated with its operations. The ESMS will be implemented by CSPCPL at the project level.
2.	PS2 – Labour and Working Conditions	***APPLICABLE*** PS-2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The applicability of PS 2 will be for the operation phase even though there would be fewer numbers of workers. It will not only cover the main plant employees, but all employees/workers, even those working through contractors. CSPCPL shall provide adequate provisions such as access to clean water, sanitary facilities and other necessary facilities at the site in the operational phase. CSPCPL is to take measures to prevent child labour, forced labour and discrimination at site. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be as per the national labour and employment laws. CSPCPL will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. In providing a grievance mechanism through which workers may raise workplace concerns, CSPCPL should ensure that matters are brought to management's attention and addressed expeditiously. CSPCPL needs to document all grievances and follow up on any corrective actions. CSPCPL to extend a safe and healthy work environment to contracted workers and to any other workers who provide project-related work and services. CSPCPL to ensure that training is provided to all workers on relevant aspects of OHS associated with their daily work, including emergency arrangements and OHS briefing for visitors and other third parties accessing the premises. All occupational injuries, illnesses and fatalities are to be documented.
3.	PS3 - Resource Efficiency and Pollution Prevention	***APPLICABLE*** PS3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The objectives of PS 3 are: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project-related GHG emissions. The solar project is a clean energy project and will not have major pollution sources associated with it. The construction works for the development of project entailed generation of wastes like wastewater, used oil from DG sets and construction debris. The operation phase will result in generation of minor quantities of waste such as used transformer oil, broken and defunct solar panels and waste water from cleaning of solar panels. CSPCPL to monitor emissions and manage waste to ensure that the requirements of PS 3 are being met.
4.	PS4 – Community Health, Safety and Security	***APPLICABLE*** PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. The applicability of this PS is to be established during the ESIA process, resulting in preparation of an Action Plan to be disclosed to the community. The Applicability during the operation phase will be limited to Noise levels and glare impacts at adjoining villages which need to be kept within the acceptable norms. Labour and security staff to be engaged from local community.

S. No.	Performance Standard	Description and Applicability
		The Action Plan and any other relevant project-related information is to enable the influenced communities and relevant government agencies to understand these risks and impacts and will engage the influenced communities and agencies on an on - going basis consistent with the requirements of PS 1.
5.	PS5 – Land Acquisition and Involuntary Resettlement	***NOT APPLICABLE*** PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected. For the project, a total of 170 acres of private land has been purchased by CSPGPL through a land aggregator based in Hyderabad from titleholders for settling up of the solar power plant and its associated facilities such as internal roads, office buildings, switch yard etc. As informed, during discussions held with the sample representatives of landowners, the land was used in undertaking limited agricultural activities. It was reported by the Client that the land owners willingly sold their land.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	***APPLICABLE*** PS 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. This standard is aimed to promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities. The objectives of PS 6 are: • To protect and conserve biodiversity. • To maintain the benefits from ecosystem services. • To promote the sustainable management of living natural resources through the • adoption of practices that integrate conservation needs and development priorities. The project involved various activities such as removal of vegetation cover, levelling of land for site preparation, laying of new access roads (in case needed), movement of vehicles and physical presence of solar panels which are likely to cause habitat loss.
7.	PS7 – Indigenous People	***NOT APPLICABLE*** Telangana state falls under the category of Schedule 5. However, any land seller could not be identified as a tribal, based on the documents and discussions provided by the Client. Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development.
8.	PS8 – Cultural Heritage	***NOT APPLICABLE*** For the purposes of this Performance Standard, cultural heritage refers to tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values. There are no culturally important sites in or around the project site. The requirements of PS 8 are therefore not applicable to the project.

3.1.5 IFC Categorisation of Project

As part of its review of a project's expected social and environmental impacts, IFC uses a system of social and environmental categorization. This categorization is used to reflect the size of impacts understood as a result of the client's social and environmental assessment and to specify IFC's institutional requirements. The following categories are used by the IFC:

- Category A Projects: Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented;
- Category B Projects: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;
- Category C Projects: Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks;
- Category FI Projects: All FI projects excluding those that are Category C projects.

IFC therefore, categorizes projects primarily according to the significance and nature of impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; associated facilities that are not funded as part of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project; areas potentially impacted by cumulative impacts from further planned development of the project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

3.1.6 World Bank EHS Guidelines

The Equator Principle 3 requires follow up of the environmental, health and safety requirements as per the following guidelines released by IFC on 30th April 2007:

- Environmental, Health, and Safety General Guidelines
- Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution issued on 30th April 2007.

3.2 Applicable Environmental Standards

3.2.1 Ambient Air Quality

As per the IFC EHS guidelines (April 2007), "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". National Ambient Air Quality Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given ***Table 3-5***:

Table 3-5: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30
	24 Hours**	80	80
	Annual*	60	60

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O_3), µg/m^3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m^3	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO), mg/m^3	8 Hours**	2	2
	1 Hour**	4	4
Ammonia (NH_3), µg/m^3	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6), µg/m^3	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual*	1	1
Arsenic (As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

**Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval*

***24 hourly or 8 hourly or 1 hourly value as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days. Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.*

3.2.2 Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for day time (6.00 a.m. to 10.00 p.m.) is **55 dB (A)** while the Leq hourly for night time (10.00 p.m. to 6.00 a.m.) is prescribed as **45 dB (A).** Noise standards notified by the MoEF&CC vide gazette notification dated 14th February 2000 based on the *A- weighted equivalent noise level (Leq)* are as presented in ***Table 3-6***.

Table 3-6: Ambient Noise Standards

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone*	50	40

**Silence zone is defined as area up to 100 m around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.*

3.2.3 Noise Standards for Occupational Exposure

Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) which in turn are being enforced by Government of India through model rules framed under the Factories Act.

Table 3-7: Standards for Occupational Noise Exposure

Total Time of Exposure per Day in Hours (Continuous or Short-term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
¾	107
½	110
¼	115
Never	>115

No exposure in excess of 115 dB (A) is to be permitted.

For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

3.2.4 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in ***Table 3-8***.

Table 3-8: Primary Water Quality Criteria for Designated Best Use Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

As per the IFC EHS guidelines, the treated sewage discharge is required to meet the following guidelines.

Table 3-9: Treated sewage discharge guidelines as per IFC

S. No.	Parameter	Guideline Value
1.	pH	6-9

S. No.	Parameter	Guideline Value
2.	BOD	30mg/l
3.	COD	125 mg/l
4.	Total Nitrogen	125 mg/l
5.	Oil and Grease	10 mg/l
6.	Total Suspended Solids	50 mg/l
7.	Total coliform bacteria	400 MPN/100 ml

3.2.5 Applicable International Conventions

Environmental problems which migrate beyond the jurisdiction (Trans-boundary) require power to control such issues through international co-operation by either becoming a Contracting Party (CP) i.e. ratifying treaties or as a Signatory by officially signing the treaties and agreeing to carry out provisions of various treaties on environment and social safeguards. The relevant international conventions are as provided in the ***Table 3-10.***

Table 3-10: Relevant International Conventions applicable to the project

S. No	International Conventions	Salient Features
1	Montreal Protocol on Substances That Deplete the Ozone Layer (and subsequent Amendments)	India signed the Montreal Protocol along with its London Amendment on 17th September 1992 and also ratified the Copenhagen, Montreal and Beijing Amendments on 3rd March 2003.
2	UN (Rio) Convention on Biological Diversity	India is a party since: 1994-02-18 by: Ratification; Protocol - Party since: 11th November 2003.
3	Conventions on the Conservation of Migratory species of wild animals and migratory species	India is contracting party to the convention on conservation of migratory species of wild animals and migratory species.
4	Kyoto Protocol	The Kyoto protocol was signed by India in August 2002 and ratified in February 2005. The convention pertains to the United Nations framework on Climate Change. The 3rd Conference of the Parties to the Framework Convention on Climate Change (FCCC) in Kyoto in December 1997 introduced the Clean Development Mechanism (CDM) as a new concept for voluntary greenhouse-gas emission reduction agreements between industrialized and developing countries on the project level.
5	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure	The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals & Pesticides in international Trade was adopted by India at the Conference of Plenipotentiaries at Rotterdam in 1998
6	International Labour Organization conventions	India has also ratified many of the International Labour Organization conventions that are relevant to the Project including: • C1 Hours of Work (Industry) Convention, 1919 (14:07:1921, ratified); • C5 Minimum Age (Industry) Convention, 1919 (09:09:1955, ratified): • C11 Right of Association (Agriculture) Convention, 1921 (11:05:1923, ratified): • C14 Weekly Rest (Industry) Convention, 1921 (11:05:1923, ratified); • C29 Forced Labour Convention, 1930 (30:11:1954, ratified) & C105 Abolition of Forced Labour Convention, 1957 (18:05:2000, ratified); • C100 Equal Remuneration Convention, 1951 (25:09:1958, ratified); • C107 Indigenous and Tribal Populations Convention, 1957 • C111 discrimination (Employment and Occupation) Convention, 1958 (03:06:1960, ratified)

4. Environmental and Socio-Economic Baseline

4.1 Environmental Baseline

This section of the Environment and Social Impact Assessment (ESIA) presents information on the baseline condition of the physical, chemical, biological and social environment within the project area.

The Environmental and Social baseline study helps determine existing environmental conditions. Local knowledge and scientific field work provided most of the site-specific information used in this report. Existing information from the scientific literature (both published and unpublished), test work results, technical reports, and engineering studies were used wherever available. These studies were used to validate the baseline information.

This section covers the following topics:

- Physiography
- Geology
- Drainage
- Land Use
- Soil Classification
- Hydrogeology
- Climate and Meteorology
- Natural Hazards
- Noise Monitoring
- Ambient Air Quality
- Water Quality

4.1.1 Study Area

The solar power plant is located in Cheekode and Dubbak villages of Dubbak Mandal of Medak district and Maddikunta village in Mustabad Mandal of Karimnagar district. The nearest highway is the State Highway –11 which passes through the Karimnagar, Siricilla and Kamareddy Districts and is located at a distance of 17.9 km from site in north direction. The site does not have any encroachments in the present day or reported to have any during the past. The nearest habitation around the site is Maddikunta village, located at a distance of 1.73 km approximately in North-east direction.

For the purpose of environment baseline assessment, area falling within 5 km radius from the project boundary has been considered as “Study Area”. Details pertaining to both the project talukas and district, from authentic government sources, have been presented where project area / project site specific information was not available in public domain.

As agriculture is the primary land use category of the region and absence of any major industrial centres in nearby area, the air pollution concentration level is expected to be very low in the project area. No significant concentration of gaseous pollution is expected.

4.1.2 Topography

The Project Site area is an open area, mostly plain with mild undulations. The topography of the Medak District can be characterised by plains as well as upland, plateau, significant areas of stony waste and boulder rocks characterise the district with open scrubs and dry channels, ponds are quite frequent all over the district[2].

[2] DISTRICT CENSUS HANDBOOK: MEDAK (http://censusindia.gov.in/2011census/dchb/2804_PART_A_DCHB_MEDAK.pdf)

4.1.3 Drainage

The state of Telangana is drained by two major rivers namely, Godavari and Krishna and their tributaries before entering into the state of Andhra Pradesh and finally to Bay of Bengal. There are 2 major basins and 13 sub basins in the state. The major river basins are Godavari basin with 8 sub-basins namely, lower Godavari, Maneru, Manjira, middle Godavari, Penganga, Pranhita, Sabari and Wardha and Krishna basin with 5 sub basins namely, lower Bhima, lower Krishna, Munneru, Musi and Paleru (Fig.3). As per the map shown in the figure, Karimnagar is drained by Maneru and Middle Goadavari basins, while Manjira forms the major draining in the Medak district.

As per the District Census Handbook, 2011, Manjira, a tributary of River Godavari is an important drainage flowing in the Medak district. The important Nizam Sagar dam is constructed on this river. The other important streams are Haldi and Kudalair flow in the Eastern half of the district.

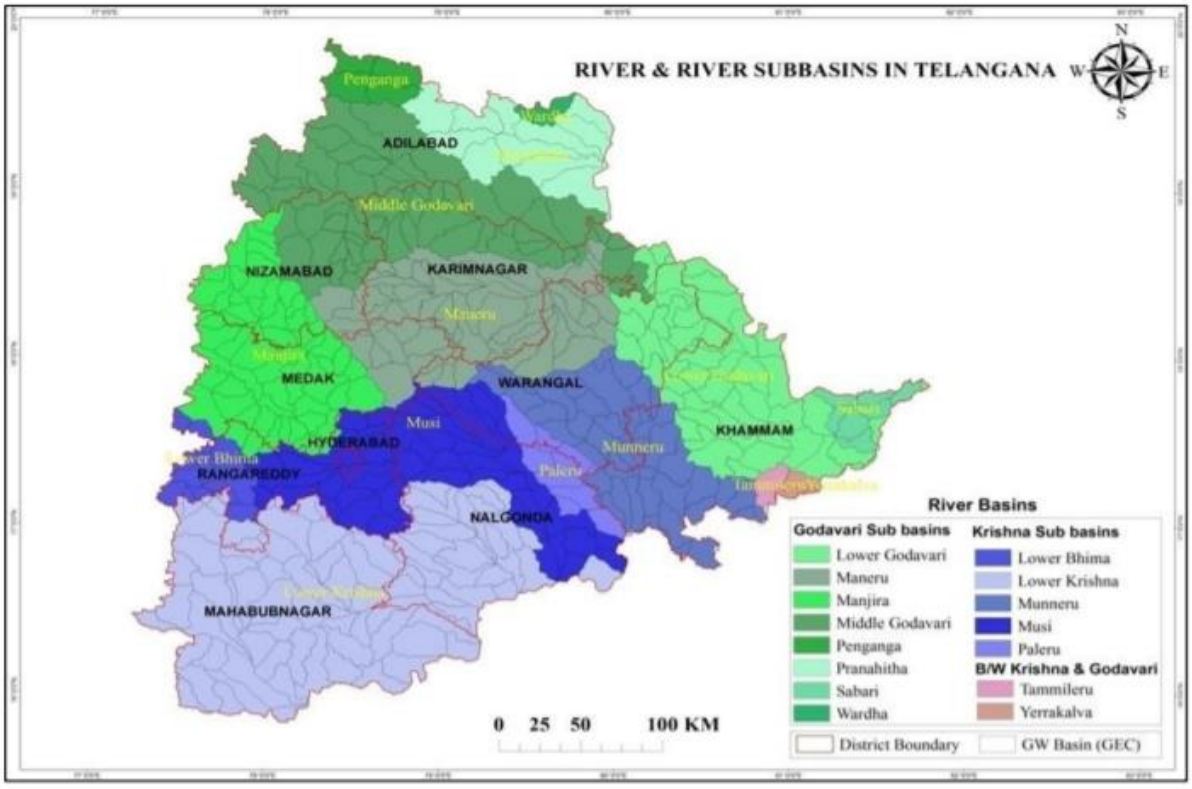


Figure 3 Drainage and River sub-basin map of Telangana state

4.1.4 Soil Types

The soil has been classified based on colour, texture, formation, physical, chemical and morphological properties of the formation. The state has a wide variety of soils viz., red soil, lateritic soils and black cotton soils. ~ 60 % of the state is occupied by red soils with loamy sub-soils covering entire Nalgonda district, a major part of Mahabubnagar, Waranagal, Karimnagar and Nizamabad districts. Black cotton soil commonly occurs in Adilabad and Nizamabad districts. Laterite soil occurs in western part of Ranga Reddy and Medak districts.

4.1.5 Geology

Geologically, the Medak district region has been developed on Archaean gneisses. As per the Soil & Land Resources Mapping of Medak[3], the district falls in five (05) major landscape/geology classes, these are Alluvium, Basalt, Dolorite, Granite, and Laterite. Most of the area in Medak district comes under Granite landscape

[3] Soil and Land Use Survey of India Soil Resource Mapping Inventory (2013-2014): http://slusi.dacnet.nic.in/srm/srmabstracts/SRM_96_Medak.pdf

accounting 68.1 percent followed by basalt (15.6%), laterite (5.6%) and alluvium accounting 2.8 percent. The distribution of area under different geology/ landscape of the district is depicted in the given table below.

While the Karimnagar district is mainly agrarian and agriculture activities are main stay of the population. The district forms part of the Godavari river basin. The major rock types occurring in the Karimnagar district are granites, gneisses, sandstone, limestone, shale, quartzite's etc. Karimnagar district falls in six major physiographic sub divisions namely, alluvial plains, lower pediplains, upper pediplains, pediments, dykes and Undifferentiated hills side slopes. Majority of the district area falls under upper pediplain physiography followed by lower pediplains.

Table 4-1: Geology of Study Area

Sl No.	Geology/Landscape	Area (Ha)	Area (%)
1.	Alluvium	27654	2.8
2.	Basalt	151659	15.6
3.	Dolorite	1209	0.1
4.	Granite	661569	68.1
5.	Laterite	54092	5.6
6.	Reservoir	54092	5.6
7.	River	9229	0.9
8.	Tank	33566	3.5
9.	ROC	1474	0.2
10.	Hab.	18142	1.9
11.	Total	972030	100.0

4.1.6 Hydrogeology

Ground water occurs in all the geological formations in the Karimnagar district. The occurrence and movement of the ground water is a consequence of a finite combination of topographical, climatological, hydrological, geological, and structural and pedagogical factors, which together form integrated dynamic system.

The depth to water levels during pre-monsoon range from 1.63 to 24.67 m bgl. The depth to water level during post-monsoon 2012 ranges from 1.22 to 13.82 m bgl. The area under < 2 m bgl occurs in central, eastern and western part as isolated patches.

The entire Medak district is covered by hard rock except for 0.2% of the alluvium area. Ground water occurs under unconfined to confined conditions in hard rock (Archaean and Deccan traps ages) and recent alluvial formations. The common ground water abstraction structures are dug wells, dug-cum-bore wells and bore wells and their yields mainly depending on the recharge conditions in the area. Yield potential of the aquifers in the consolidated rocks varies widely from 3 to 7 lps. Due to indiscriminate drilling of bore wells, the yields have fallen drastically, lack of recharge to fracture confined aquifer and existing borewells becoming to defunct and even leading to failure.

As per the ground water yearbook of Telangana (2016-2017), an analysis of depth to water level data of 589 wells showed water levels vary between -0.60 m.bgl (Karimnagar district) and 69.5 m.bgl (Medak district).

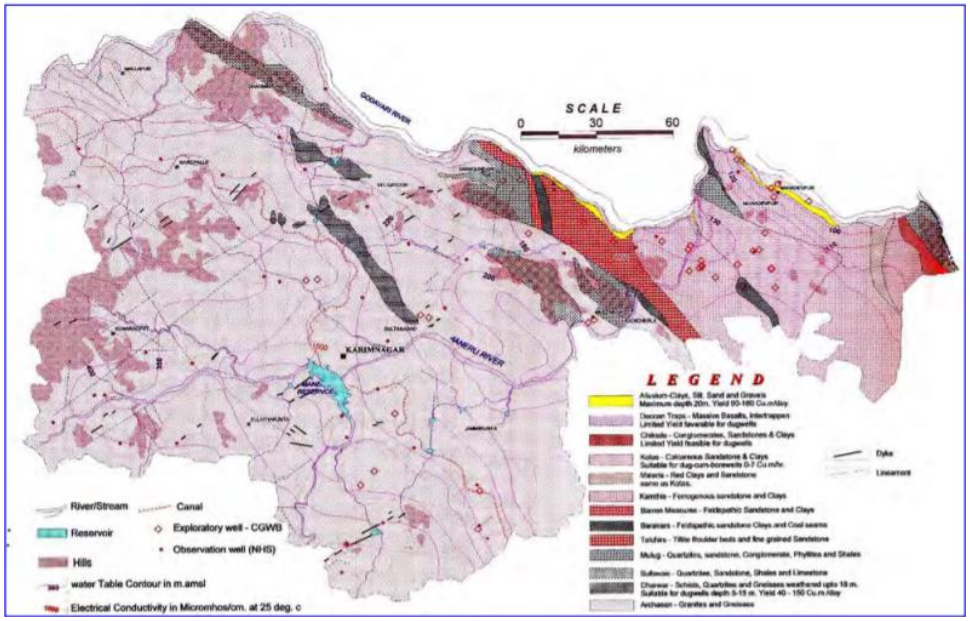


Figure 4 Hydrogeology map of Telangana State

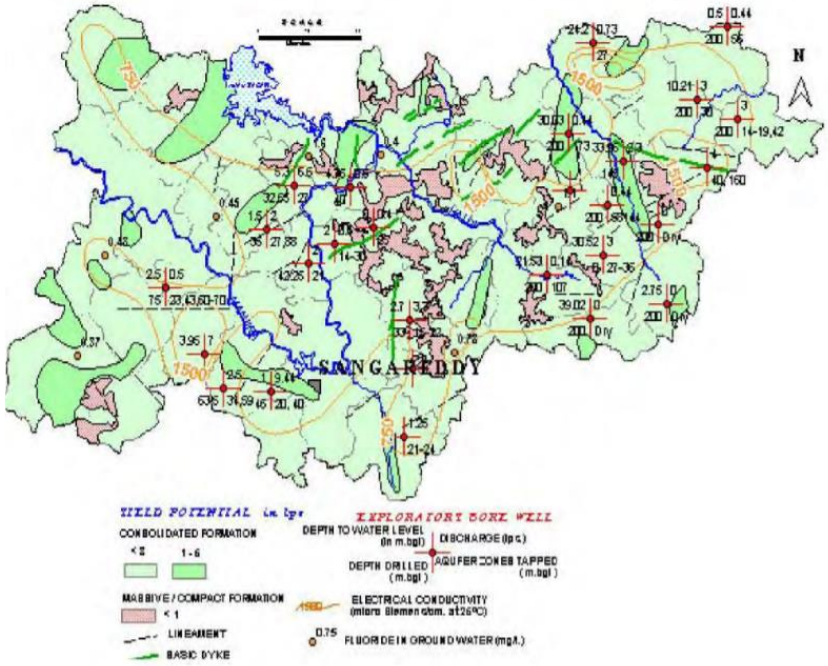


Figure 5 Hydrogeology map of Medak District

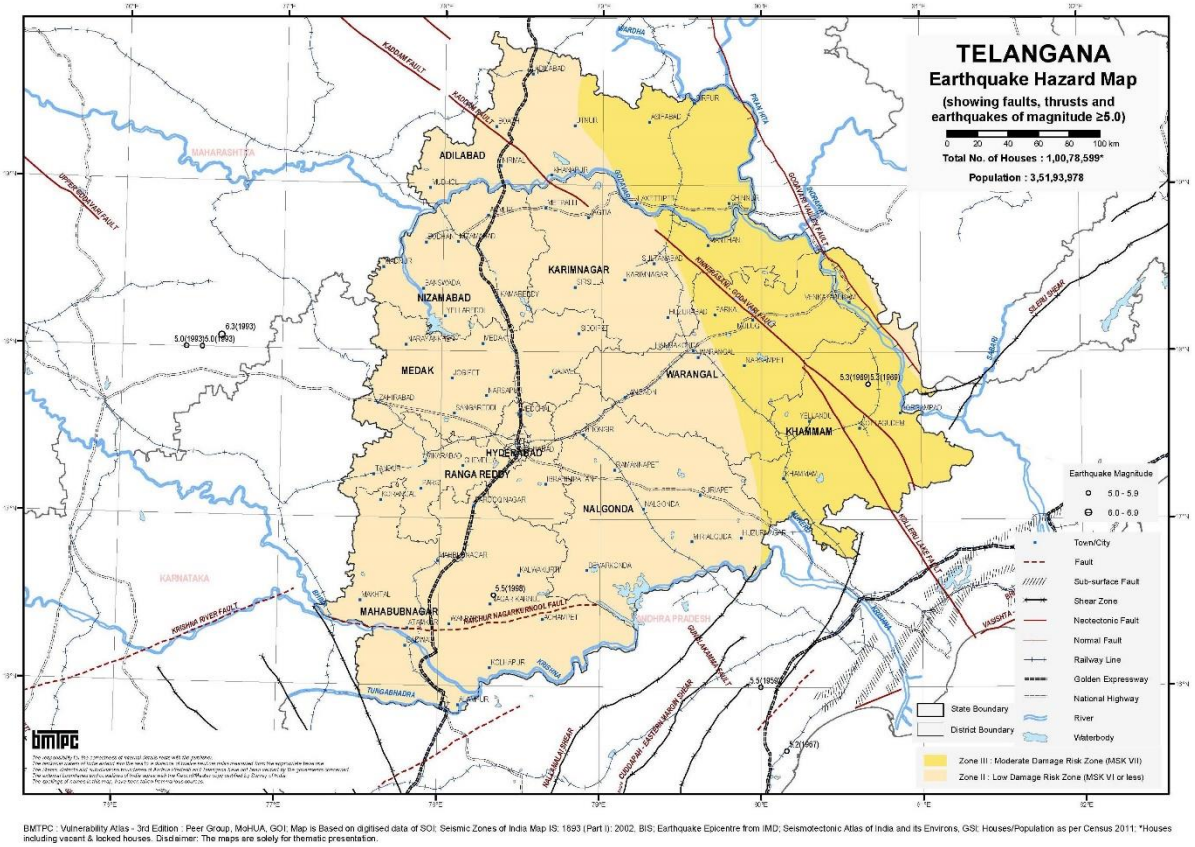
4.1.7 Climate

The climate in Medak district can be classified as tropical to sub-tropical. Max temperature during summer is around 42^0C and min. temperature in winter touches 9^0 – 10^0 C. The district receives maximum rainfall through the South West monsoon, which sets in during mid-June. The normal rainfall received in the district is 868 mm rainfall received during 2009-10 was 613 mm. The maximum temperature in Karimnagar District touches 49^0 C in summer. Normal rainfall is approximately 967 mm. The district is located between 18^0 – 19^0 Northern latitude and 78^0 30^0 - 80^0 31 Eastern longitude.

4.1.8 Natural Hazards

As per Building Materials and Technology Promotion Council (BMTPC) vulnerability Atlas, the proposed project is situated in Zone II Low damage risk zone (MSK VI or less) of getting affected due to earth quakes. As such, the materials used for construction of mounting structures for solar panels should have earthquake resistant properties to withstand and resist damage due to earthquakes which may lead to financial losses due to damage to the plant.

The Project Site does not fall under the flood risk area as per the BMTPC vulnerability Atlas.



BMTPC : Vulnerability Atlas - 3rd Edition : Peer Group, MoHUA, GOI; Map is Based on digitised data of SOI; Seismic Zones of India Map IS: 1893 (Part I): 2002, BIS; Earthquake Epicentre from IMD; Seismotectonic Atlas of India and its Environs, GSI; Houses/Population as per Census 2011; *Houses including vacant & locked houses. Disclaimer: The maps are solely for thematic presentation.

Figure 6 Earthquake Hazard Map for the State of Telangana

4.1.9 Land Use/Land Cover

Dubbak has 25 inhabited villages, with a total area of 24,326 hectares to with 64.89% of cultivable area and 10.49% of irrigated area to total cultivable area[4].

Agriculture is dominant land use in the Medak district occupying 5,82,523 ha (59.9%) followed by open scrub area of 216898 ha (22.3%), forest 8.5 percent and plantation a mere 1.5 percent. Out of the total area, about 60 per cent area is suitable for cultivation and is classified as moderately good to good land with moderate limitations. As per the Land capability classification, LCC class II dominated accounting to 31.79 per cent followed by III- IV (23.50%) and III (16.04%). As per the Soil irrigation potential, 32.45 per cent area has moderate soil limitations for sustained use under irrigation; whereas 29.18 per cent lands that have severe soil limitations and 0.4 per cent lands under very severe soil limitation for sustained use under irrigation. The percentage with area is depicted in the table below.

Agriculture is also dominant in the Karimnagar district[5] and occupies 581502 ha (48.14%) followed by forest 235550 ha (19.50%) and open scrub accounting 136565 ha (11.31 %). Most of the area of the district comes under nearly level to very gently sloping slope class (50.73 percent) followed by very gently sloping to gently sloping class (13.64 percent). As per the Soil irrigation potential, 27.48 per cent area has moderate to severe soil limitations for sustained

[4] District Census Handbook, Medak District
[5] http://slusi.dacnet.nic.in/srm/srmabstracts/SRM_108_Karimnagar.pdf

use under irrigation whereas 11.61 per cent lands have severe soil limitations,19.26 per cent lands have severe to very severe soil limitations and 3.43 percent under very severe soil limitation for sustained use under irrigation.

Table 4-2: Distribution of area under different Land use classes for Karimnagar District

Sl. No.	Land use Classes	Area (ha)	Area (%)
1.	Agriculture	581502	48.14
2.	Forest	235550	19.50
3.	Open scrub	136565	11.31
4.	Plantation	28081	2.32
5.	Misc. (Canal, River, Reservoir, Hab., ROC, Quarry etc.)	226174	18.73
	Total	**1207871**	**100.00**

Source: Soil & Land Resources Mapping of Karimnagar District, SULC

Table 4-3: Area under different land use classes for Medak District

Sl. No.	Land Use Classes	Area(Ha)	Area(%)
6.	Agriculture	582523	59.9
7.	Plantation	14597	1.5
8.	Forest	82165	8.5
9.	Open scrub	216898	22.3
10.	Reservoir	13436	1.4
11.	River	9229	0.9
12.	Tank	33566	3.5
13.	ROC	1474	0.2
14.	Hab.	18142	1.9
	Total	**972030**	**100**

Source: Soil & Land Resources Mapping of Medak District, SULC

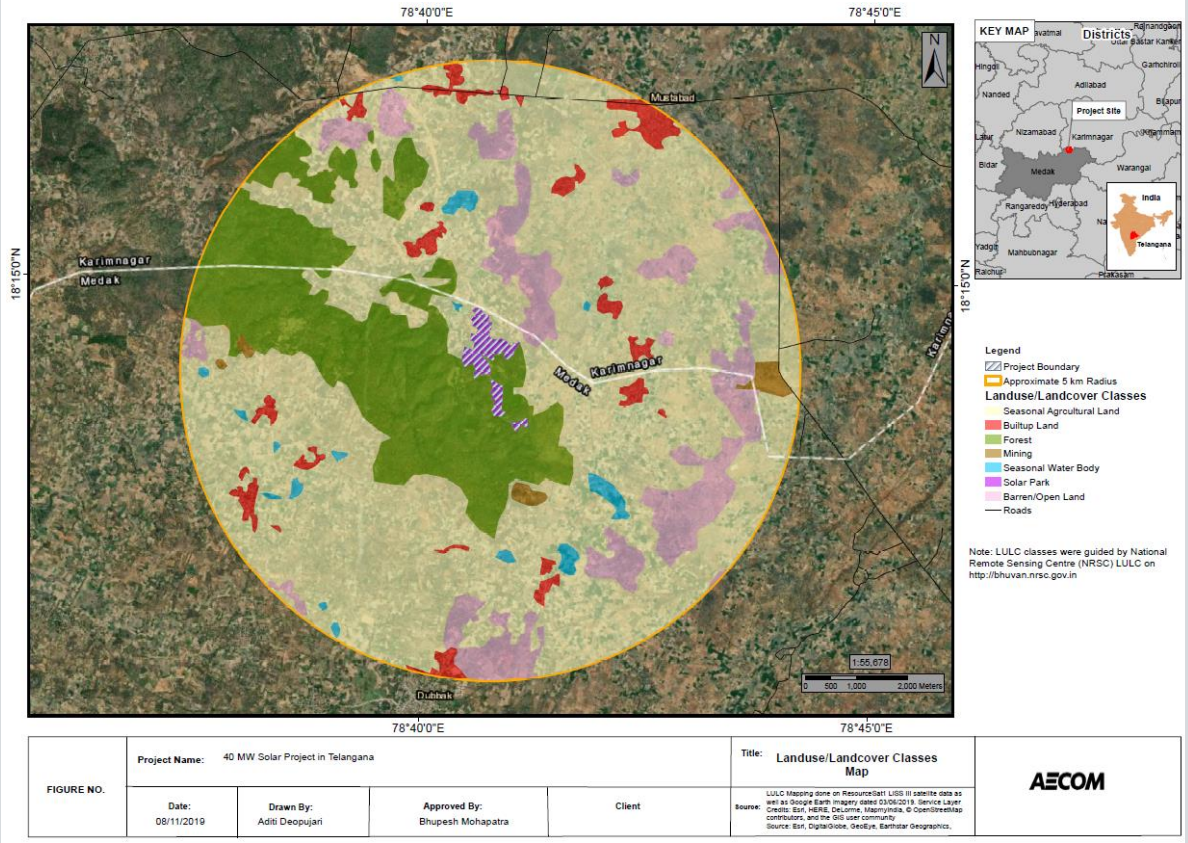


Figure 7. Land use land change cover for Project Influence Area

4.1.10 Ambient Air Quality

4.1.11 Water Quality

4.2 Ecological profile

4.2.1 Introduction

A detailed primary ecological assessment was undertaken at the project site to assess the existing status of ecological resources (flora and fauna) in the study area. The primary survey was conducted in the month of December, 2016. The assessment focused on identification of floral and faunal species, sensitive habitats, endangered species and forestland and estimating the bio-diversity indices. Secondary information was also collected from offices of Divisional Forest and Botanical and Zoological Surveys of India for ascertaining bio-diversity aspects.

4.2.2 Description of Study Area

The project area falls under an extended section of the Deccan Plateau. The project area and the surrounding are primarily plain with occasional undulation. Rocky patches are found to be scattered all over this area. The area has few low-lying land which is often submerged because of rainfall. The soil is considered to be less fertile, however paddy is cultivated in the patches with irrigation. The vegetation type ranges from dry deciduous to mixed deciduous. Dry deciduous scrub species are also common in this area.

Figure 8 Project Area Overview

4.2.3 Species Profile of the Study Area

Floristic Species

Common species of dry deciduous to mixed deciduous are found here. Deciduous dry scrubs are scattered on the rocky and arid patches. The general feature of the study area shows a sparse vegetation cover and is largely dominated by toddy palm, Tamarind, Gum acacia and Flame of the Forest. Occasionally a fine carpet of grasses, and wild flowers comes up with first shower of rains and dries quickly after the rain. Some of the common species observed during the site visit are listed below:

Table 4-4: Common Floristic Species

Sl. No	Scientific name	Common Name
1.	*Borassus flabellifer*	palmyra palm or toddy palm
2.	*Cassia fistula*	golden shower or Indian laburnum
3.	*Tamarindus indica*	Tamarind
4.	*Lantana camara*	wild-sage
5.	*Calotropis gigantea*	Crown Flower
6.	*Acacia senegal*	Gum acacia
7.	*bidens pilosa*	Black Jack
8.	*Cyanthillium cinereum*	Little ironweed
9.	*Butea Monosperma*	Flame of the Forest
10.	*Senna alexandrina*	East Indian senna

Source: Primary Survey

Borassus flabellifer

Cassia fistula

Tamarindus indica

Butea Monosperma

Senna alexandrina

Lantana camara

Acacia senegal

Calotropis gigantea

Bidens pilosa

Cyanthillium cinereum

Common Faunal Species

The study on terrestrial fauna in the study area is based on the field investigation and Zoological Survey of India. Due to scanty vegetation growth in this region, not much of varied animal life is found in this State. Despite this, still a large variety of avifaunal species are found in this area. The different variety of faunal life that was spotted during the field visit can be categorized as (i) Primates, (ii) Avifauna, and (iii) Lepidoptera.

Table 4-5: Faunal Species

Sl No	Scientific name	Common Name
Primates		
1.	*macaca mulatta*	rhesus macaques
Avifauna		
2.	*Anastomus oscitans*	Asian openbill stork
3.	*Passer domesticus*	House sparrow
4.	*Amaurornis phoenicurus*	white-breasted waterhen
5.	*Turdoides striatus*	Jungle babbler
6.	*Upupa epops*	common hoopoe
7.	*Halcyon pileata*	Black-capped kingfisher
8.	*Spilopelia chinensis*	spotted dove

Sl No	Scientific name	Common Name
9.	*Leptocoma zeylonica*	Purple-rumped sunbird

Source: Primary Survey

Macaca mulatta

Anastomus oscitans

Passer domesticus

Amaurornis phoenicurus

Turdoides striatus

Upupa epops

Halcyon pileata

Spilopelia chinensis

Leptocoma zeylonica

Figure 9. Fauna Species

4.3 Socio-economic Profile

This section of the report primarily summarises the socio-economic characteristics of the project area and the area of influence from the macro district level to the micro village level. The data collected through desk-based review have been studied and analysed to present a comprehensive analysis of the socio-economic characteristics of the project area and its influenced area. Information gathered through consultations undertaken with landowners and representative of the village falling within the project area have also been analysed and presented below:

4.3.1 Approach and Methodology

The scope of work as detailed earlier in the proposal has been the guiding criteria for the undertaking the Social Impact Assessment (SIA) Study. The location of the project covers sections of three villages of Telangana.

Table 4-6: Administrative Details of Villages

Name of the Village	Mandal	District
Dubbak	Dubbak	Medak
Cheekode	Dubbak	Medak
Maddikunta	Mustabad	Karimnagar

Source: Census of India (2011) and Locations provided by Hero Future Energies

In order to undertake the representative sample comprising the primary survey and identification and consultation of the stakeholders, the location of the project was considered for the study.

A structured questionnaire was prepared to undertake the interviews and evaluate the socio-economic status of the representative sample of the project affected families comprising the landowners. In addition, discussions were also held with representatives of the villages falling within the project area to provide an understanding of the socio-economic status of the people residing in the area.

Secondary Data Review:

A detailed review and assessment of the secondary data available on the project location was done wherein the project and its associated facilities operate. Detailed reviews of available documents on the socio- economic characteristics of the project-influenced areas were undertaken. The documents referred to for the desk-based research are,

- Primary Census Abstract (PCA), 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs
- Village Directory Data (VDA), 2011; Office of the Registrar General & Census Commissioner, India; Ministry of Home Affairs
- Telangana at a Glance (2017), Directorate of Economics and Statistics, Telangana
- Annual Survey of Industries (2013-14), Directorate of Economics and Statistics, Telangana
- Statistical Year Book, Telangana, 2017
- District Census Handbook, for the Districts of Medak and Karimnagar, Telangana, India

Primary Data:

Primary data was collected on the socio- economic status of the villages wherein the project is located through identification of stakeholders and thereafter consultations undertaken with them. The data collected have been collated and analysed to understand the impact of the project on the area.

4.3.2 Administrative Profile

The project encompasses two districts of Telangana State. Medak district is located in the northern part of Telangana state covering an area of 2757.37 sq. km. The district shares boundaries with Sangareddy, Kamareddy, Siddipet and Medchal districts. According to the 2011 Census of India, the district has a population of 7,67,428. Medak district has 20 Revenue Mandals. There are 381 Revenue Villages and 4 Municipality.

The Karimnagar lies in the northern part of the Telangana state. The total area is 2128 sq. km with 16 Revenue Mandals. There are 210 Revenue Villages and 3 Municipalities. Karimnagar district is bounded by Warangal and Medak districts in the South, Nizamabad district in the West, Madhya Pradesh state in the east and Adilabad district in the northern direction.

4.3.3 Project Area

The project area is spread across three villages, namely Dubbak and Cheekode villages in Medak district while Maddikunta village is in Karimnagar district. . The section below provides information regarding details of the socio-economic profile of the project area.

Study Area

To assess the impacts of the project in the surrounding area, an area of 2 km radius has been considered as the project area of influence from the project area. Villages such as Morraipally, Mohinikunta, Rajakkapet, Yellapur, Chellapur, Mallaipalle, Sijua, Parsuramnagar are near to the project area and have been cumulatively termed as ‘study area’.

4.3.4 Demographic Profile of the Study Area

The demographic profile section below intends to present an understanding of the prevalent demography in the study area. The population of the study area has been analysed below with a focus on the size and its composition.

4.3.5 Population

District Level

The District level population has been represented in the table below:

Table 4-7: District Level Population in the Study Area

District	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (female as per 1000 males)
Medak	3033288	1523030	1510258	992
		(50.21%)	(49.79%)	
Karimnagar	3776269	1880800	1895469	1,008
		(49.81%)	(50.19%)	

Source: Primary Census Abstract 2011

The population size of Medak and Karimnagar Districts is 3033288 and 3776269 respectively. The number of females outnumbers male population in Karimnagar District with sex ratio 1008 female per 1000 male. In Medak District the ratio is 992 female per 1000 male.

Mandal Level

The Mandal level population has been represented in the table below:

Table 4-8: Mandal level Population in the Study Area

Mandal	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (females as per 1000 males)
Dubbak	71847	35,324	36,523	1034
		(49.16%)	(50.83%)	
Mustabad	44,217	22,046	22,171	1006
		(49.85%)	(50.15%)	

Source: Primary Census Abstract 2011

The table above represents that both in Dubbak and Mustabad mandal sex ratio indicates that female population outnumbers the male population. In Dubbak Mandal the sex ratio is 1034 females per 1000 males and in Mustabad it is 1006 females per 1000 males respectively. The male and female population in both the mandals is proportionate to each other.

Table 4-9: Distribution of Rural and Urban Population

Mandal	Total Population (2011)	Rural Population (2011)	Urban Population (2011)
Dubbak	71847	71847	–
Mustabad	44,217	44,217	–

Source: Primary Census Abstract 2011

These two Mandals are entirely rural areas with 100% of rural population.

Village Level

The village level population in the study area has been represented in the table below:

Table 4-10: Village Level Population in the Study Area

Mandal	Village	Total Population (2011)	Male Population (2011)	Female Population (2011)	Sex Ratio (females per 1000 males)
Medak	Dubbak	12,349	6,071	6,278	993
			(49.16%)	(50.84%)	
	Cheekode	5,426	2,716	2,710	998
			(50.06%)	(49.94%)	
Mustabad	Maddikunta	1,531	755	776	1028
			(49.31%)	(50.69%)	

Source: DCHB, 2011

The table above represents that the village with highest population amongst the study area villages, is Dubbak with 12349 persons where Cheekode and Maddikunta villages are considerably small with population of 5426 and 1531 respectively. Sex ratio amongst the villages is highest in Maddikunta village with1028 females per 1000 males.

Status of Literacy Level

Literacy indicates the ability of a person to read and write. For the purpose of identifying literate persons for the Census in India, the benchmark taken is that of an individual above the age of seven (07) years who can both read and write in any Indian language. Analysis of literate population in the country is essential as education is considered a vehicle for development and progress and the increase of female educated persons is an indicator of inclusive growth and social progress.

District Level

The District level literate population has been represented in the table below,

Table 4-11: District Literacy Level in the Study Area

District	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Medak	3033288	1637137	953406	683731
		(53.97%)	(31.43%)	(22.54%)
Karimnagar	3776269	22,06,829	1257238	949591
		(58.43%)	(33.29%)	(25.14%)

Source: Primary Census Abstract 2011

It can be noted from the above table that at the district level the literacy level comprises of 53.97% (1637137) in Medak district and 58.43% (22,06,829) in Karimnagar district. In Medak District, 683731 females were literate representing 22.54% of the total population of 3033288. In Karimnagar District it was 949591 females, constituting 24.14% of total population of 3776269.

Mandal Level

The Mandal level literate population has been represented in the table below:

Table 4-12: Mandal Literacy Level in the Study Area

District	Mandal	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Medak	Dubbak	71847	39457	23284	16173
			(60.86%)	(73.51%)	(48.77%)
Karimnagar	Mustabad	44,217	23374	13872	9502
			(57.64%)	(68.87%)	(46.55%)

District	Mandal	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)

Source: District Census Handbook – Karimnagar, Medak, 2011

It can be noted in the table above that 60.86% (39457) of the population of Dubbak Mandal is literate while 57.64% (23374) of Mustabad's population is literate. Dubbak Mandal has 73.51% (23284) of literate male population which is more than Mustabad Mandal 68.87% (13872). Female literacy is 48.77% (16173) and 46.55% (9502) in Dubbak and Mustabad Mandals respectively.

Village Level

The Village level literate population has been represented in the table below:

Table 4-13: Village Literacy Level in the Study Area

District	Village	Total Population (2011)	Total Literate Population (2011)	Male Literate Population (2011)	Female Literate Population (2011)
Medak	Dubbak	5426	2846 (52.45%)	1690 (59.38%)	1156 (40.62%)
	Cheekode	12349	7805 (63.20%)	4521 (57.92%)	3284 (42.08%)
Karimnagar	Maddikunta	1531	832 (54.34%)	497 (59.74%)	335 (40.26%)

Source: DCHB, 2011

It can be noted in the table above that Cheekode village has the highest literacy level at 63.20% (7805) followed by Maddikunta village at 54.34% (832) and lastly Dubbak village at 52.45% (2846). Female literacy levels in all study area villages is between 43% to 40%.

4.3.6 Presence of Vulnerable Communities and Groups

Vulnerable groups are those groups of people who may find it difficult to lead a comfortable life, and lack developmental opportunities due to their disadvantageous positions. Further, due to adverse socio-economical, cultural, and other practices present in each society, they find it difficult many a times to exercise their human rights fully[6].

The accessibility to development opportunities or its absence thereof can be attributed to the level of integration and responsiveness to mediums which enhance and improve livelihoods. Marginalization from the resources can be a result of social exclusion thereafter hindering all round development and improvement of livelihood of these groups. Categories such as scheduled tribes, scheduled castes primitive tribal group, legally released bonded labour and manual scavengers and other backward classes are recognised as socially excluded categories by the constitution of India. Recognising the relative backwardness of these weaker/socio-economically disadvantaged sections of the society, the Constitution of India guarantees equality before the law (Article 14) and enjoins the State to make special provisions for the advancement of any socially and educationally backward classes or for SCs (Article 15(4)).

The section below aims to define the status of these socially excluded categories/ groups within the study area.

4.3.6.1 Schedules Caste and Scheduled Tribe Population

The tables below depict the representation of Scheduled Castes (SC) and Scheduled Tribes (ST) in the District, Taluka and Village levels:

District Level

The table below represents the SC and ST population at the District Level,

[6] Human Rights of Vulnerable & Disadvantaged Groups; Dr. T. S. N. Sastry; University of Pune; 2012

Table 4-14: District Level SC and ST Population in the Study Area

District	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Medak	3033288	5,37,947	2,66,413	2,71,534	1,68,985	86,574	82,411
		(17.73%)	(17.49%)	(17.98%)	(5.57 %)	(5.68%)	(5.46%)
Karimnagar	3776269	7,09,757	3,52,481	3,57,276	1,06,745	53,495	53,250
		(18.80%)	(18.74%)	(18.85%)	(2.83%)	(2.84%)	(2.81%)

Source: DCHB, 2011

It can be noted from the table above that the Scheduled Tribe population in Medak district is 9.5% (72900) and the Scheduled Caste population is 16.68% (127970) of the total population. the Scheduled Tribe population in Karimnagar district is 18.80% (7,09,757) and the Scheduled Caste population is 2.83% (1,06,745) of the total population.

Village Level

The table below represents the SC and ST population at village level:

Table 4-15: Village Level SC and ST Population in the Study Area

Mandal	Villages	Total Population (2011)	SC Population (2011)	SC Male Population (2011)	SC Female Population (2011)	ST Population (2011)	ST Male Population (2011)	ST Female Population (2011)
Medak	Dubbak	12,349	1,949	972	977	110	57	53
			(15.78%)	(49.87%)	(50.13%)	(5.64%)	(51.82%)	(48.18%)
	Cheekode	5,426	1,025	511	514	89	41	48
			(18.89%)	(49.85%)	(50.15%)	(8.68%)	(46.07%)	(53.93%)
Mustabad	Maddikunta	1,531	450	224	226	-	-	-
			(29.39%)	(49.78%)	(50.22%)	-	-	-

Source: DCHB, 2011

The table above represents that the highest Scheduled Tribe population amongst the study area villages is in Cheekode village with 8.68% (89) to its total population. Dubbak has 5.64% (110) Scheduled Tribe population of its total population.

4.3.7 Workforce Population

The working population of the area means the population of the area who is engaged in productive activity and contribute towards economic and social growth of the area.

The section below will elaborate on the number and type of workforce population in the study area:

District Level

The table below represents the district level workforce population:

Table 4-16: District Level Workforce in the Study Area

District	Total Population (2011)	Total Population (2011)	Workforce	Male Population (2011)	Workforce	Female Population (2011)	Workforce
Medak	3033288	14,42,203		8,37,874		6,04,329	
		(47.55%)		(55.01%)		(40.01%)	

District	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Karimnagar	3776269	18,76,768	10,49,463	8,27,305
		(49.70%)	(55.80%)	(43.65%)

Source: DCHB, 2011

The table above shows that Karimnagar district has a larger number of workforce population with 49.70% (18,76,768) of the total population while Medak District has 47.55% (14,42,203). In Karimnagar and Medak districts the male workforce population comprise of 55.80% and 50.01% respectively. Female workforce population comprises of 40.01% and 43.65% of the total working population in Karimnagar and Medak districts.

Village Level

The table below represents the village level workforce population:

Table 4-17: Village level Workforce Population in the Study Area

District	Villages	Total Population (2011)	Total Workforce Population (2011)	Male Workforce Population (2011)	Female Workforce Population (2011)
Medak	Dubbak	12,349	5,791	3,162	2,629
			(46.89%)	(54.60%)	(45.40%)
	Cheekode	5,426	2,795	1,474	1,321
			(51.51%)	(52.74%)	(47.26%)
Karimnagar	Maddikunta	1,531	805	432	373
			(52.58%)	(53.66%)	(46.34%)

Source: DCHB, 2011

It can be noted in the table above that Maddikunta village has the highest workforce population with 52.58% of its total population. It is followed by Cheekode village at 51.51% and lastly by Dubbak village at 46.89%).

4.3.7.1 Main and Marginal Workforce Population

The workforce population can be further segregated into Main and Marginal Workers. Main workers are those who have been engaged in economically productive activities for more than one hundred eighty-three (183) days and Marginal workers are those workers who have been engaged in any economically productive activity for less than one hundred eighty -three days (183) days. This section of the report represents the Main and Marginal Workforce population in the study area.

District Level

The table below represents the district level Main and Marginal Workforce population,

Table 4-18: Type of Workforce Population in the District Level

District	Total Workforce Population (2011)	Main Workforce Population (2011)	Main Male Workforce Population (2011)	Main Female Workforce Population (2011)	Marginal Workforce Population (2011)	Marginal Male Workforce Population (2011)	Marginal Female Workforce Population (2011)
Medak	14,42,203	11,95,494	7,28,047	4,67,447	2,46,709	1,09,827	1,36,882
		(82.89%)	(47.80%)	(30.95%)	(17.11%)	(7.21%)	(9.06%)
Karimnagar	18,76,768	1,59,03,04	9,35,666	6,54,638	286464	113797	172667
		(84.73%)	(49.75%)	(34.54%)	(15.27%)	(6.05%)	(9.11%)

Source: DCHB, 2011

The table above represents that main workforce population consists of 82.89% (11,94,494) of the total workforce population (14,42,203) of Medak district and 84.73% (1,59,03,04) of the total workforce population (18,76,768) of Karimnagar District. It can be noted that the main female workforce population comprises of only 30.95% (4,67,447) of the total working population for Medak District and 34.54% (6,54,638) for Karimnagar District. However, in the marginal workforce population it can be noted that the women's participation in the workforce is higher than that of males working population for both the districts.

Mandal Level

Main and Marginal workforce population in the Taluka level has been represented in the figure below,

Table 4-19: Type of Workforce Population in the Mandal Level

Mandal	Total Workforce Population (2011)	Main Workforce Population (2011)	Male Main Workforce Population (2011)	Female Main Workforce Population (2011)	Marginal Workforce Population (2011)	Male Marginal Workforce Population (2011)	Female Marginal Workforce Population (2011)
Dubbak	36692	33097	17156	15941	3595	1759	1836
		(90.20%)	(51.83%)	(48.16%)	(9.97%)	(48.92%)	(51.07%)
Mustabad	24,079	18894	10498	8396	5185	2132	3053
		(78.46%)	(55.56%)	(44.43%)	(21.54%)	(41.11%)	(58.88%)

Source: DCHB, 2011

The Table shows distribution of main and marginal workforce population in Dubbak and Mustabad Districts. Out of the total workforce population of 36692 persons in Dubbak Mandal, main workforce population consists of 90.20% (33097) which can be further classified into 51.83% (17156) male main workforce population and 48.16% (15941) as female population. In Mustabad Mandal, the main workforce population is 78.46% (18894) of which 55.56% (10498) is main male workforce population and 44.43% (8396) is main female workforce population. Compared to main workforce population, marginal workforce population consists of only 9.97% (3595) and 21.54% (5185) in Dubbak and Mustabad Districts respectively. However, female marginal workforce population outnumbers male marginal workforce population in both the mandals.

Village Level

The table below represents Main and Marginal Workforce Population at the Village level.

Table 4-20: Main and Marginal Workforce Population in the Study Area

Taluka	Villages	Total Workforce Population (2011)	Main Workforce Population (2011)	Main Male Workforce Population (2011)	Main Female Workforce Population (2011)	Marginal Workforce Population (2011)	Marginal Male Workforce Population (2011)	Marginal Female Workforce Population (2011)
Medak	Cheekode	2795	1956	1009	947	839	465	374
			(69.98%)	(51.58%)	(48.42%)	(30.02%)	(55.42%)	(44.58%)
	Dubbak	5791	5451	2694	2487	340	198	142
			(94.12%)	(54.37%)	(45.62%)	(5.17%)	(58.23%)	(41.76%)
Karimnagar	Maddikunta	805	598	329	269	207	103	104
			(74.28%)	(55.01%)	(44.98%)	(25.71%)	(49.75%)	(50.24%)

Source: DCHB, 2011

The table above represents that the main workforce population is the highest in Dubbak village with 94.12% (5451) followed by Maddikunta village with 74.28% (598) and Cheekode with 69.98% (1956) of the total workforce population in respective villages. Marginal workforce population comprises of 30.02% (839), 5.17% (340) and 25.71% (207) in Cheekode, Dubak and Maddikunta villages respectively.

4.3.7.2 Occupational Pattern

Occupational pattern distribution of a population in an area indicates the development and diversification of an economy. The trend suggests that developed countries have higher distribution of population in the services and secondary sectors and the developing or underdeveloped countries have higher concentration of population in the primary (i.e. the agricultural) sector. For the Census Survey, the occupations are classified into Cultivators, Agricultural Labourers, Household (HH) Industries and Others[7].

As main workforce population comprises majority of the workforce population in the state, district and village levels. The Occupational Pattern of the Main Workforce population in the study area has been represented in the section below.

District Level

The District level occupational pattern has been presented in the table below:

Table 4-21: District Level Occupational Pattern of Study Area

District	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Medak	1195494	353221	223325	128896	571129	254143	316986	67642	21360	46282	450211	339046	111165
		(29.55%)	(63.23%)	(36.49%)	(47.77%)	(44.50%)	(55.50%)	(5.66%)	(31.58%)	(68.42%)	(37.66%)	(75.31%)	(24.69%)
Karimnagar	1590304	360390	225913	134477	756859	342311	414458	168340	44454	123886	591179	436785	154394
		(22.66%)	(62.69%)	(37.31%)	(47.59%)	(45.23%)	(54.76%)	(10.59%)	(26.41%)	(73.59%)	(37.17%)	(73.88%)	(26.12%)

Source: DCHB, 2011

The table above represents that the agricultural activities related occupations. For Medak District main cultivator population consists of 29.55% (353221) of the main workforce population. For Karimnagar District, the main cultivator population consists of 22.66% (360390) of the main workforce population. Main agricultural labourers consists of 47.77% (571129) and 47.59% (756859) of the main workforce population of Medak and Karimnagar districts respectively. Participation of females in household industries is more than the male populations with 68.42% (46282) and 73.59% (123886) in Medak and Karimnagar respectively.

Mandal Level

The Mandal level occupational pattern has been presented in the table below,

Table 4-22: Taluka Level Occupational Pattern of Study Area

Taluka	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Dubbak	33097	8348	5719	2629	10638	5856	4782	5030	693	4337	12676	6647	6029
		(25.22%)	(68.51%)	(31.49%)	(32.14%)	(55.05%)	(44.95%)	(15.20%)	(13.78%)	(86.22%)	(38.30%)	(52.44%)	(47.56%)

[7] the type of workers that come under this category of 'Other Workers' include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport banking, mining, construction, political or social work, priests, entertainment artists, etc.

Taluka	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Mustabad	18894	5227	3545	1682	8141	4202	3939	4509	785	3724	6202	4098	2104
		(27.66 %)	(67.82 %)	(32.18 %)	(43.09 %)	(51.62 %)	(48.38 %)	(23.86 %)	(17.41 %)	(82.59 %)	(32.83 %)	(66.08 %)	(33.92 %)

Source: DCHB, 2011

The table above represents the distribution of occupations where in Dubbak Mandal the percentage of workforce population engaged in other occupation is 38.30% (12676) which is more that workforce population engaged in main cultivator 25.22% (8348) and main household industries 15.20% (5030). Similarly, in Mustabad mandal 43.09% (8141) of main workforce is engaged as main agricultural labourers and 32.83%(6202) is engaged in other occupation. In Mustabad mandal 27.66% (5227) is main cultivators and only 23.86% (4506) is engaged in household industries.

Village Level

The village level occupational pattern has been presented in the table below,

Table 4-23: Village Level Occupational Pattern of Study Area

Village	Main Workforce Population (2011)	Main Cultivator Population (2011)	Male Cultivator Population (2011)	Female Cultivator Population (2011)	Main Agri. Labourers Population (2011)	Male Agri. Labourers Population (2011)	Female Agri. Labourers Population (2011)	Main HH Industries (2011)	Male HH Industries (2011)	Female HH Industries (2011)	Others Occupation (2011)	Male Others Occupation (2011)	Female Others Occupation (2011)
Cheekode	2795	732	485	247	544	308	236	334	34	300	346	182	164
		(26.19 %)	(66.26 %)	(33.74 %)	(19.46 %)	(56.62 %)	(43.38 %)	(11.95 %)	(10.18 %)	(89.82 %)	(12.38 %)	(52.60 %)	47.40%)
Dubbak	5791	374	268	106	1024	617	407	643	135	508	3410	1944	1466
		(6.46%)	(71.66 %)	(28.34 %)	(17.68 %)	(60.25 %)	(39.75 %)	(11.10 %)	(21.00 %)	(79.00 %)	(58.88 %)	(57.01 %)	(42.99 %)
Maddikunta	805	99	70	29	194	131	63	169	17	152	136	111	25
		(12.30 %)	(70.71 %)	v29.29 %)	(24.10 %)	(67.53 %)	(32.47 %)	(20.99 %)	(10.06 %)	(89.94 %)	(16.89 %)	(81.62 %)	(18.38 %)

Source: DCHB, 2011

It can be noted from the table above that in Cheekode village, main cultivator population is 26.19% (732) of main workforce population while in Dubbak village only 6.46% (374) of the main workforce population is main cultivator population. In Dubbak village main workforce population engaged in other population is 58.88% (3410).

4.3.8 Public Amenities

District Census Handbook 2011, a publication of the Directorate of Census Operations has been taken as the primary source of information for the data on existing infrastructure facilities at the village level of the study area.

4.3.8.1 Educational Facilities

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, there is one (01) government pre-primary school present in the villages of Dubbak. One (01) primary school in the villages of Cheekode and Maddikunta each, while eight (08) are present in Dubbak village. There are six (06) middle schools in Dubbak and one (01) in Cheekode. Dubbak village has six (06) secondary schools, two (02) senior secondary schools and three (03) degree colleges of Arts, Commerce and Sciences.

However, no institutions of higher studies and secondary studies are present in the villages of Cheekode and Maddikunta. Dubbak village also has a vocational training School.

4.3.8.2 Healthcare Infrastructure Facilities

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, Dubbak village has one (01) Community health centre, one (01) Primary health centre and one (01) Primary health sub centre. Additionally, it also has a dispensary, Veterinary hospital, Mobile health clinic and a Family welfare centre. However, no such medical facilities were present in the other two (02) villages of Cheekode and Maddikunta. Maddikunta only has (04) Medical practitioners with no degree, while Cheekode has three (03) Traditional practitioner and faith healer.

4.3.8.3 Road Infrastructure

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, the road infrastructure in all three (03) villages is a combination of pucca roads, and kutcha roads and all the villages are connected to other district roads (roads serving rural areas of production and providing them with access to markets, bock development headquarters and other main roads).

4.3.8.4 Transportation and Communication Facilities

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, both government and private bus services ply in all the study area villages. This is further supplemented by the private vehicles such as buses, Taxis and vans in the villages of Cheekode and Dubbak. Private Vehicle service was not available in Maddikunta. Amongst the study villages, only Dubbak village had Private Courier facility.

4.3.8.5 Banking Facilities

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, there are no commercial banks, cooperative societies and agricultural credit societies in the villages of Maddikunta and Cheekode. Dubbak village has an agricultural credit society and Commercial & Co-operative Banks.

4.3.8.6 Other Infrastructural Facilities

Water Supply

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, all three (03) study area villages have Taps and wells as water as sources of water. Additionally, Handpumps are present in the villages of Maddikunta and Cheekode.

Sanitation Facilities

According to amenities and land use data (2009) extracted from District Census Handbooks (2011) for the respective Districts, none of the study area villages have Community toilets, Rural sanitary marts, sanitary hardware outlets or sanitation facilities present in the village.

Electricity Supply Facilities

All the study area villages have access to electricity.

4.4 Stakeholder Engagement and Consultation

Stakeholder analysis is a key feature that helps assess stakeholder information acquired directly through discussion with the community. Secondary data research were carried out in order to understand and assess overall social and economic status of the area demarcated as the ‘project’s zone of influence’ .

For the purpose of socio-economic study, the ‘project zone of influence’ (hereinafter referred as ‘PZI’ or “study area”), a geographically delineated area, has been recognized to identify key affected stakeholders (both direct and indirect). An extent, covering area under 2 km radius from the project site was identified for stakeholder analysis. The PZI for social assessment has been established by including associated facilities, transport routes, and unplanned but predictable developments in addition to the primary project site. Identified stakeholder groups have been overlaid on the impact zone.

4.4.1 Stakeholder Consultation Objective and Scope

The stakeholders for the project were prioritized by identifying the influence and interest level with the project. The key stakeholders that were consulted as part of the study included the following,

- community members from these three villages
- Local panchayat members
- Representatives of Hero Future Energies

4.4.2 Noise Quality

4.4.3 Views expressed by Village Community Members

Community members from these three villages which also included landowners were consulted during the site visit to understand the impact of the project, community's expectation from the project and the process of purchase. It was confirmed by client that Payments have been disbursed to all sellers and received by them, respectively. As per the discussions with the clients, the landowners were informed about the project that was to be set up in the area. It was further mentioned that the land was sold primarily because agriculture has been limited and they received a satisfactory price for their land. Few Sample sale deeds were provided by the client for review.

In addition to the details provided by the community members regarding land, information pertaining to the socio-cultural and occupational context of the villages was also obtained during the discussions. It was mentioned that agriculture is limited in this region with the main crops being rice and cotton. In Dubbak, there is less agriculture with some poultry farms. On the other hand, the two types of occupation prevalent in Cheekode are bidi workers and cultivators. There is no such prevalent dominant presence of poultry farms or dairy. It was informed that the land is mostly barren and uneven because of which agriculture is limited to fertile patches. Among the social infrastructure, there are primary schools, PHCs and Anganwadis. The communities of these three villages have access to two PHCs, one in Dubbak and another in Cheekode. It was also informed that people from Maddikunta village visit the hospitals in Mustabad when required. There are two Primary schools and three anaganwadis in Cheekode. There is one primary school in Maddikunta and two anganwadis in Maddikunta. The sources of water for domestic use is mostly borewell. The supply of electricity varies from 24 hours to 9 hours. No issues or concerns were highlighted or informed by the local population. Employment opportunities in the form of security guards, cleaners and local suppliers would prove to be good employment opportunity for the local population.

Gender Profile of the Villages

To comprehend the existing living pattern of the local population residing across the project area, a look at the socio-economic status of women and the role that women have been playing both at the domestic and economic level needs to be taken into consideration. As the patriarchal values are entrenched in Indian society, women often play a more subordinated and dependent role. Even though they constitute almost half the population, various indicators pertaining to literacy level, labour force participation, mortality rate etc. reveal the dismal status of women to that of men.

According to the UN Gender Development Index, 2017 India ranks 130 out of 189 countries worldwide with an index value of 0.841. As per the 2011 Census data, Telangana has a total female population of 17489900 females with sex ratio of 988 females to every 1000 males. A total of 57.99% of the female population are literates in the State.

While interacting with the community members, information relating to the gender profile in the area was also gathered. The main activities undertaken by women were mostly in the form of engagement of agriculture activities and household chores. There are local Self-Help Groups (SHGs) which are prominent in the area..

4.4.4 Views expressed by CSPGCL and HFE Representatives

During discussions held with representatives of Hero Future Energies, it was noted that all 170 acres of land for the project activities were private land some of which was barren The price for the land purchase was determined based on the prevailing market value. All land parcels procured for the project were directly negotiated individually

by the land aggregator EPower who with the help of the local land aggregators interacted with the land owners. The site manager from Hero Future Energies is the responsible person for the E&S, social issues.

The community around the vicinity of the project site are aware of the project development and are aware of the Site Supervisor identity. In case of any issues/concerns, it was stated that they directly contact the Supervisor.

A formal grievance redressal mechanism has been set up for the project based on a Procedure developed by the Corporate Office. In terms of community development activities, formal decision on this aspect is yet to be finalised and implemented by the Corporate Social Responsibility (CSR) Cell of the company. It was stated that the Company will plan activities based on the community needs and this will be initiated once all construction activities onsite will be completed.

4.4.5 Cultural Heritage

A small temple is present at a distance of 356 m from the site boundary. Local population from these villages use the temple for worship purposes.

5. Analysis of Alternatives

This section of the report presents the analysis of the alternatives considered for the 40 MW solar power project. The following scenarios have been considered:

- No Project Scenario;
- Alternate Location for the project;
- Alternate Source of power generation;
- Alternate routes for transmission lines.

5.1 No Project Scenario

The State of Telangana, formed on June 2, 2014 is the youngest state in the country. Government of Telangana State (GoTS) recognizes the critical role which power sector plays in the socio-economic development of the state. Within a year of its formation, the State of Telangana has taken rapid strides in the power sector and GoTS has chalked out an action plan to make the State self-sufficient in power over the next few years. Due to the progressive policies implemented by GoTS, the state is expected to witness a high socio-economic growth trajectory. This would translate to higher requirement of power over the next few years. The state is fully geared up to meet the additional demand and has plans of adding over 6,000 MW of power from conventional sources over the next few years. Telangana discoms have been successfully harnessing the solar potential in the state and this will enable the state to have a more sustainable fuel mix in the years to come.

Energy requirement of Telangana is expected to nearly double from 50,916 MU in FY 2014-15 to 105,974 MU by FY 2018-19. The peak demand is also expected to increase Three-fold from 8,331 MW in FY 2014-15 to 19,053 MW in FY 2018-19628.

As per the Load Generation Report 2016-2017, Ministry of Power, Government of India, actual power requirement for the state of Telangana for year 2015-2016, was 50,254 MU against the availability of 49,948 MU and hence experienced power deficit of 0.6%. The anticipated peak power requirement for the state of Telangana for the year 2016-2017 is 55,001 MU against the availability of 53,198 MU. Hence, indicating a power deficit of -3.3% during 2016-2017.

In order to bridge this gap between the current capacity and targets, renewable/non-conventional sources of power are required to supplement the conventional sources. The proposed project being a non-conventional source of power generation intends to contribute towards bridging the demand supply deficit as projected. India is located in the equatorial sun belt of the earth, thereby receiving abundant radiant energy from the sun.

The Meteorological Department of India maintains a nationwide network of radiation stations, which measure solar radiation, and also the daily duration of sunshine. In most parts of India, clear sunny weather is experienced 250 to 300 days a year. The annual global radiation varies from 1600 to 2400 kWh/m2, which is comparable with radiation received in the tropical and sub-tropical regions. The equivalent energy potential is about 6,000 million GWh of energy per year. Figure 7 below shows the map of India with solar radiation levels in different parts of the country. It can be observed that highest annual global radiation is received in Rajasthan, northern Gujarat, parts of Andhra Pradesh, Madhya Pradesh, Maharashtra, Rajasthan and Ladakh region which also receive fairly large amounts of radiation as compared to many parts of the world especially Japan, Europe and the United States, where development and deployment of solar technologies is maximum. Theoretically, a square piece of land, 55 kilometres each side, in the empty desert, is enough to meet India's current energy demand. With more than 300 sunny days each year, large parts of Rajasthan, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu and Madhya Pradesh can produce 4.0 - 6.4 kilowatts per square metre. Sparsely populated, these areas are ideal for solar energy.

[8] Power for All, Telangana State, pp. 128.

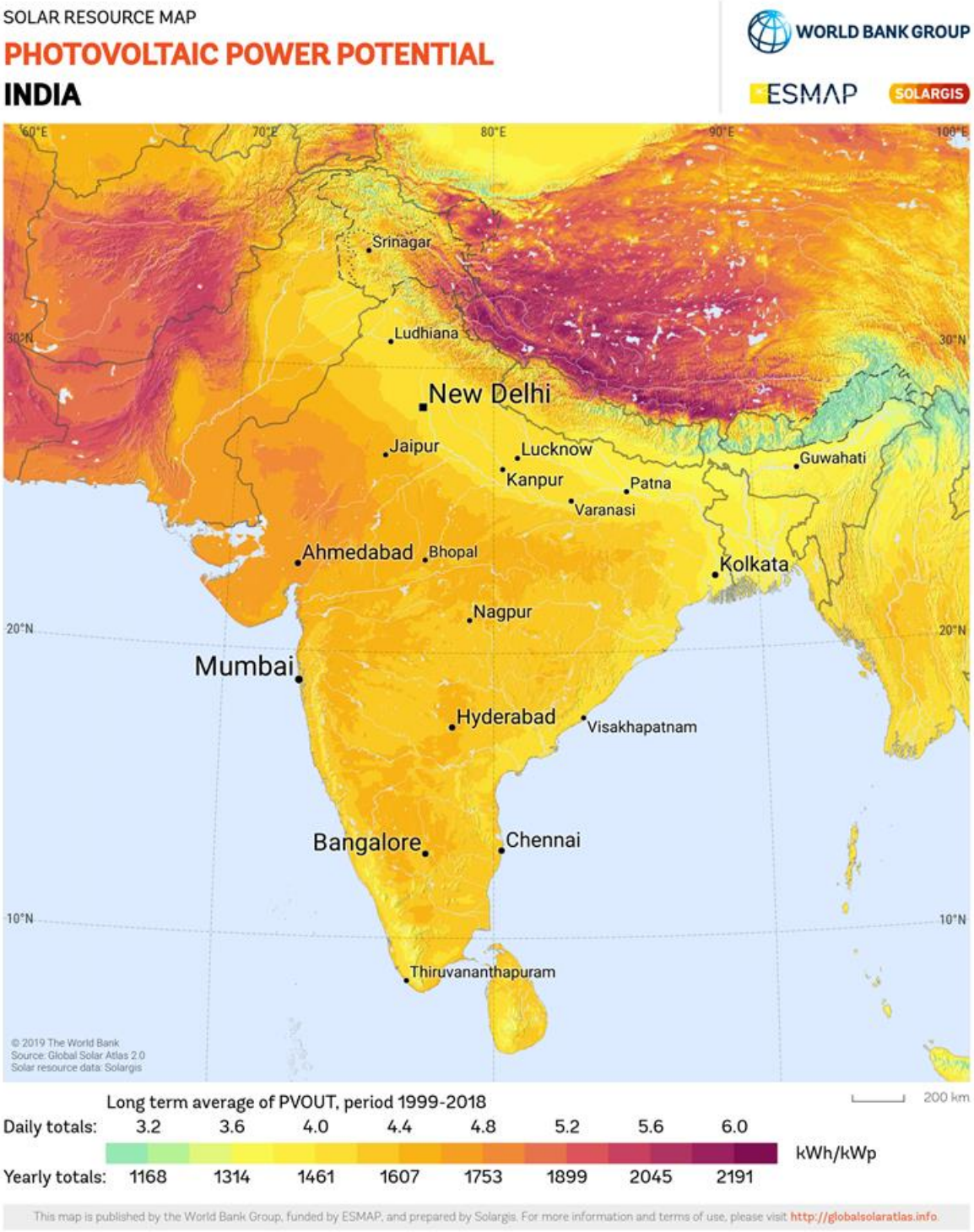


Figure 10. Photovoltaic Power Potential of India

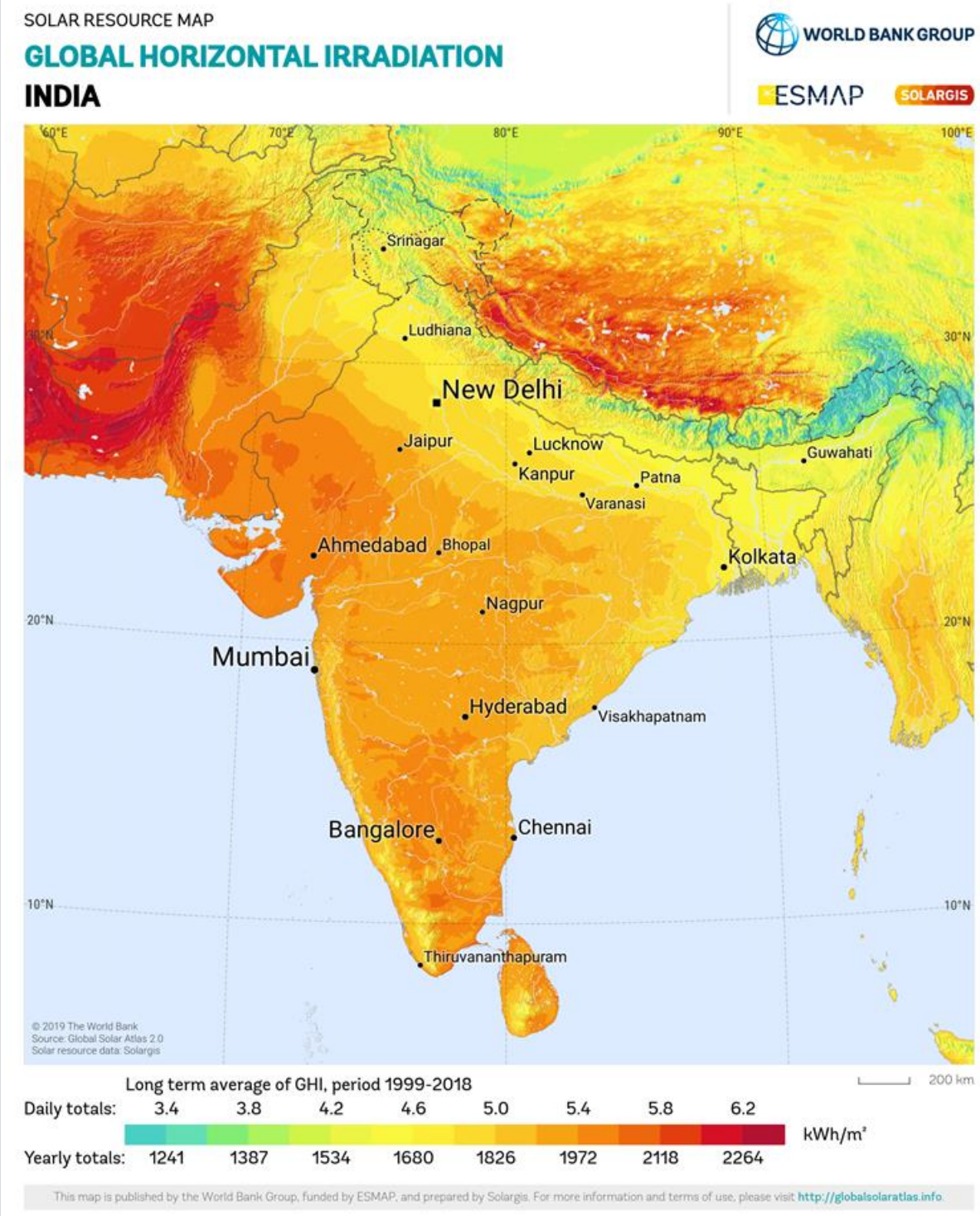


Figure 11. Global Horizontal Irradiation map of India

From the above distribution, the average global Horizontal Irradiation for Siddipet region comes out to be in the range of 1900 kWh/m^2 to 2050 kWh/m^2. The monthly average irradiation on ground for the site is as follows:

Table 5-1: Monthly Average Irradiation on Ground on Site

Month	Average GHI (kWh/m^2/mth)
January	146
February	158.9

Month	Average GHI (kWh/m^2/mth)
March	188.6
April	198.7
May	205.9
June	161.3
July	135.7
August	139.7
September	157.3
October	162.9
November	141.7
December	142.8

Source: Detailed Project Report

The proposed project is an opportunity to utilize the solar potential of the state for power generation. A "No Project Scenario" will not address the issue of power shortage in the country and economic development. An alternative without the project is undesirable, as it would worsen the power supply-demand scenario, which would be a constraint on economic growth.

5.2 Project Location

Solar power projects are non-polluting energy generation projects and are dependent on the availability of sufficient solar irradiation. As shown in Figure 6, Telangana has a good photovoltaic power potential. As per the Global Solar Atlas, the photovoltaic output at the site is 1617 kWh/kWp and the Horizontal irradiation at the site is 1962 kWh/m^2.

- **Accessibility**: Easy access to site or connectivity with main road or highways help in transportation of materials, man and machinery required during construction. The site is connected through the Rekulakuntta Temple Road and is at a distance of approximately 29 km from the State Highway 11.
- ***Electrical infrastructure***: Grid sub-station is present at a distance of about 21.3 km from the proposed site, will allow minimum transmission losses and also saves transmission cost of project.
- **Land Availability**: Reportedly, the land was available on willing seller willing buyer basis. The land was mostly barren in nature.
- **Site Location**: The site is located away from major settlements. No environmentally sensitive features such as water bodies, forests, archaeological sites are located in the immediate site surroundings.
- **Solar radiation at the site**: Solar radiation map of India indicates that Telangana receives a global horizontal irradiation (GHI) in the range of 1900 kWh/m^2 to 2050 kWh/m^2. As per the global solar atlas, the horizontal irradiation at the Site is approximately 1963 kWh/m^2.
- **Topography**: The project site is spread across an open area with very mild slope in multiple directions. Erection of solar panels is being undertaken through varying the height of the poles required for mounting solar panels. Hence, the installation is easy and reduces the cost of technical modifications required to adjust for undulations at the ground.
- **Substation proximity**: The proposed solar power plant will be connected to 220 kV Siddipet Substation. The approximate length of the proposed transmission line is 22.30 km from the Site. The transmission line does not cover any major settlements.
- **Geological and soil conditions**: To ascertain soil parameters of the proposed site for construction of foundations for module mounting structures, control room, HT lines & array yard, drainage etc., the sub soil investigation through certified soil consultant has been carried out. Geological and soil investigations report confirm soil strength to support pile foundation structures.

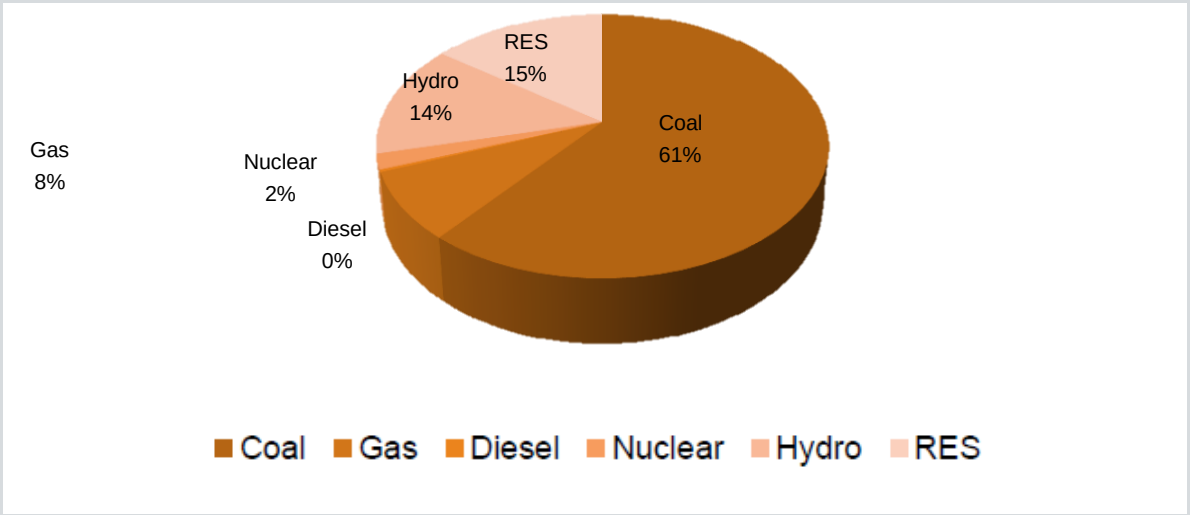
Considering all the above details of the location and site settings, the identified site was chosen as a suitable option for the project

5.3 Alternate Source of Power Generation

India has an installed capacity of 308.83 GW as of 30th November 2016. In terms of fuel, coal fired plants account for 60.8% of India's installed electricity capacity followed by renewable energy and hydropower which accounts for 14.9% and 14.0% respectively. Gas fired thermal power plants and nuclear plants account for 8.2% and 1.9% respectively. The source wise installed capacity in India is presented in Figure 6 3. The various power generation options as discussed in the earlier section can be evaluated on the levelised cost of power generation which includes the capital and O&M costs, reliability of power generation in terms of plant load factor and the greenhouse gas (GHG) emission. The comparative analysis of various power generation options based on these factors has been presented in Table 6 8.

The power generation options using conventional sources offer advantages such as lower levelised costs of power generation and higher plant load factors. The operation and maintenance of solar power projects does not typically involve air emissions or effluent discharges.

Figure 12 Source wise installed capacity



Source: Ministry of Power, 2012

Note: Breakup of RES (Renewable Energy Source) is as on 30th September 2016

There are no fuel requirements or large quantities of water required for the operation of the solar plant. GHG emissions and other environmental pollution (stack emissions, ash management etc.) issues are also insignificant. Also, there are no significant social issues associated with solar power projects.

Compared to conventional and other renewable energy sources, solar power is more attractive because it can be easily scaled up and also can be generated nearer to consumers and even on site, which greatly reduces or eliminates transmission costs and losses. Furthermore, the increasing adoption of variable- pricing or net metering schemes also favour solar electricity. Under these schemes, electricity rates are higher when peak demand is highest, and this generally correlates to when more solar energy is available and electric output is highest. Solar costs are reduced significantly through higher volume production, improved manufacturing techniques, and alternative solar technologies that reduce the amount of semiconductor material. Total installed system costs are further being reduced through cheaper “balance- of-system” components such as inverters through improved design and installation techniques. Fundamentally, the solar industry as a whole has advanced and grown to the point where solar solutions are not only an environmentally friendly option but also a cost effective[9].

Table 5-2: Comparative analysis of Various Power Generation Options

Alternative Cost (₹/kWh) *	Plant Load Factor **	Average Lifecycle	GHG Emission (tonnes CO2e/GWh) ***
Coal	2.5	65 – 85%	888
Natural Gas	3.9	70 – 85%	500
Hydro Power	3.8	30 – 50%	26

[9] Source: Detailed Project Report

Nuclear Power	2.5 – 5.7	65 – 85%	28
Wind Energy	4.2	25 – 40%	26
Solar	15.3 – 17.1	10 -15%	85

*Source: * - LBNL, CERC, CSTEP & NPCIL*

***- Renewable UK*

**** - World Nuclear Association Report*

India being a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) has formulated a National Action Plan on Climate Change (released in June 2008) to promote the development of renewable energy in the country. The Ministry of New and Renewable Energy (MNRE), GOI has been promoting new and renewable energy sources in a big way in India. The government of India envisages 30,000 MW of grid interactive renewable energy in the 12th five-year plan (2012-2017) from renewable power generation. While about 10,000 MW is expected to be generated from solar, the balance is to be realized by wind and other renewable energy systems. The Electricity Act 2003 clearly mandates state electricity boards to adopt a minimum percentage for the procurement of electricity from renewable energy sources.

Various policy measures such as Jawaharlal Nehru National Solar Mission (JNNSM) Feed-in-Tariff, Accelerated Depreciation (AD), Generation Based Incentives (GBI), Renewable Purchase Obligations (RPO) and Renewable Energy Certificates (RECs) have helped in the rapid growth of Renewable Energy deployment in the country.

Along with above demand and supply side measures to promote Renewable Energy growth in India, various states have come up with their state Solar Policies to provide an enabling framework for growth of Renewable Energy in India.

Major benefits of grid connected solar power plants include[10]:

- Power from the sun is clean, silent, limitless and free
- Photovoltaic process releases no CO_2, SO_2 or NO_2 gases which are normally associated with burning finite fossil fuel reserves and do not contribute to global warming
- Photovoltaic is now a proven technology which is inherently safe as opposed to other fossil-fuel based electricity generating technologies
- Reduces or avoids the necessity to build new transmission/ distribution lines or upgrade existing ones
- Solar power shall augment peak power needs
- Increase the grid reliability (i.e. voltage and frequency)
- Reduce the transmission line losses
- Solar Powered Grid Connect Plants can act as tail-end energizers, which in turn reduces the transmission and distribution losses
- Nil pollution compared to other clean energy generations

[10] Source: Detailed Project Report

6. Evaluation of Impacts

This chapter describes various environmental and social impacts identified by accessing information gathered through primary and secondary sources. Impacts have been identified based on review of available project information; discussions conducted with the local community; representatives of the project and other sector specific professionals. Impacts during the operation and decommissioning phases have been included and are classified as per impact type.

Additionally, this section presents the identified impacts within a severity range to assess overall significance of impacts on environment, ecology, socio-economic resources, demographics, and livelihoods. Subsequently, mitigation measures have been suggested for impacts outlined in this section.

6.1 Impact Assessment Criteria

Identified impacts have been appraised through social and environmental components and have been presented in ***Table 6-1*** below. The appraisal criteria are classified according to spread, duration, intensity and nature of the impact. Severity levels have been sub classified under each criterion with specifics outlining the limits of each severity level.

Table 6-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Insignificant/ local spread	impact is restricted within the foot prints of the Project boundary	except for ecology (which is defined as limited loss of vegetation only at site)
	Medium Spread	impact is spread up to 5 km around the project area	except for ecology (which is defined as loss of vegetation at site including large trees with limited disturbance to adjoining flora & fauna)
	High spread	impact is spread beyond 5 km from footprint boundary of the Project	except for ecology (which is defined as loss of vegetation at site and/ or damage to adjoining flora and fauna
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Insignificant / Short Duration	when impact is likely to be restricted for a duration less than 2 years	the anticipated recovery of the impacted environmental aspect is within 2 years
	Medium Duration	when impact extends up to five years	the anticipated recovery of the impacted environmental aspect is within 5 years
	Long Duration	when impact extends beyond five years	the anticipated recovery of the impacted environmental aspect is more than 5 years
Intensity: Defines the magnitude of impact	Insignificant intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 10%	However, it shall be reconsidered where the baseline values are already high
	Low intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 20%	for ecology it refers to minimal changes in the existing ecology in terms of their reproductive capacity, survival or habitat change
	Moderate intensity	when changes in the prevailing (baseline) environmental conditions does not exceed 30%	for ecology, it refers to changes that are potentially recoverable
	High intensity	when changes in the prevailing (baseline) environmental conditions exceeds 30%	While for ecology, high intensity refers to changes that result in serious destruction to species, productivity or critical habitat.

Criteria	Sub-Classification	Defining Limit	Remarks
Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

A "significance assessment matrix" has been adopted in order to assess impacts appraised as per criteria mentioned in Table 6-1. The below ***Table 6-2*** provides the impact significance criteria adopted for assessment.

Table 6-2: Impact Significance Criteria

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Local	Short	Low	Insignificant	Insignificant
Local	Short	Moderate	Minor	Minor
	Medium	Low		
	Medium	Moderate		
Medium	Short	Low		
Local	Long	Low		
Local	Short	High	Moderate	Moderate
Local	Medium	High		
Local	Long	Moderate		
Medium	Short	Moderate		
Medium	Medium	Low		
Medium	Medium	Moderate		
Medium	Long	Low		
Medium	Long	Moderate		
High	Short	Low		
High	Short	Moderate		
High	Medium	Low		
High	Medium	Moderate		
High	Long	Low		
Local	Long	High	Major	Major
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Moderate		
High	Low	Low		
High	Low	High		

Impact Evaluation Matrix

Table 6-3 below presents the impact identification matrix for operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 6-3: Impact Identification Matrix – Operation and Decommissioning Phase

Environment, Health & Safety impact assessment variables	Operation and Maintenance Phase	Decommissioning Phase
Land Use and Visual Aesthetics		
Site Preparation and Grading		
Site/ Vegetation Clearance		•
Laying of Transmission Lines		

Ecology		
Site Preparation and vegetation Clearance		
Hazardous and Non- Hazardous Material and Waste Management	•	•
Power Transmission	•	
Water Resources and Water Quality		
Material Handling and Storage	•	•
Hazardous and Non- Hazardous Material and Waste Management	•	•
Washing of Solar Panels	•	
Water Requirement for workers	•	•
Ambient Air Quality/ Atmospheric Emissions		
Material Handling and Storage		•
Operation of construction equipment		
De-mobilization of construction equipment		•
Ambient Noise Quality		
Material Handling and Storage		
Repair and Maintenance Works of solar panels	•	•
Demobilization of construction equipment		
Traffic & Transport		
Material Handling and Storage		
Demobilization of construction equipment		
Soil Resources		
Site Preparation and vegetation clearance		
Demobilization of construction equipment		
Hazardous and Non- Hazardous Material and Waste Management	•	•
Material Handling and Storage	•	•
Occupational Health and Safety		
Employment of Workers	•	
Material Handling and Storage	•	•
Construction works		
Laying of transmission lines		
Electrical hazard during solar power generation	•	
Repair and Maintenance Works of solar panels	•	
Land Procurement		
Adequate Compensation		
Loss of Agricultural land		
Changing occupational opportunities		
Influx of migrant Workers		
Presence of an outside agency	•	
Conflicts Between Local Residents and Newcomers	•	
Income generating opportunities	•	
Increase in local employment	•	
Introduction of new Social classes		
Change in the commercial/industrial focus of the community	•	
Stress on local Infrastructure		
Loss of jobs		•
Community Infrastructure and property		

Change in community infrastructure	•
Land acquisition or disposal	
Initiation of community development activities	•
Effects on known cultural, historical and archaeological resources	

6.2 Environmental Impacts

Soil Environment

Pre-construction and Construction Phases:

The project site comprises of flat land with gentle slope towards south east. During construction works, levelling activities will be undertaken. The transport of materials, equipment, manpower will add to the movement of vehicles; construction machinery which may lead to some degree of compaction within the site premises.

Considerable disturbance to soil due to activities such as excavations for foundations, construction of access roads and drainage, etc. is likely during the construction phase. Other potential impacts to the soil could be due to removal of existing vegetation for construction, causing potential decrease in the rigidity of soil making it loose and open to erosion. Construction debris, excavated soils or solid waste generated when workers are on site, if dumped in nearby fields will affect the quality of soil;

In order to minimize such impacts, appropriate soil erosion control measures would have to be undertaken by the Site to reduce the chances of soil erosion.

The project may also involve use of paints for solar panels and switch yard structures during construction, which if not handled and used properly, will lead to contamination of soil. Improper disposal of hydraulic fluids or disposal of lubricating oils and other used oils can also result in contamination of soil. Improper storage of construction material can also result in unwanted dispersal of contaminants into adjoining areas.

Mitigation:

In order to reduce the effects of soil damage and minimise soil erosion, certain mitigative measures shall be adopted.

Movement of trucks and other vehicles will be maintained along dedicated paths to avoid disturbance to land and soil. Completion of excavation and foundation work in limited time schedule would also reduce / minimize the chances of soil erosion. The other measures include:

- The removal of vegetation and soil cover will be restricted to only those areas necessary for the development;
- Soil conservation measures will be implemented such as stockpiling topsoil or gravel for the remediation of disturbed areas.
- Stockpiles will be vegetated or appropriately covered to reduce soil loss as a result of wind or water erosion.
- Work areas will be clearly defined and where necessary, demarcated to avoid unnecessary disturbance of areas outside the development footprint.
- Fuel, lubricating oil and used oil storage areas will be contained in bunds of 110 percent capacity of the stored material.
- Spill containment and clean up kits will be available onsite and clean-up from any spill will be appropriately contained and disposed of.
- Construction vehicles and equipment will be serviced regularly and off site.
- Construction vehicles will remain on specifically designed and designated compacted gravel roads.
- All the hazardous waste likely to be generated on the Site, will be disposed in accordance with the Hazardous and Other Wastes (management and transboundary movement) Rules 2016.

During operation:

Operation of solar photovoltaic panels for power generation will not have any direct impact on soil. However, the water as may use for washing activities may contaminate the soil if chemical is used for washing. The hazardous waste like used oil, hydraulic oils, etc. may contaminate the soil if not handled properly. Following mitigation measures are adopted for the project.

- The water for cleaning purpose of solar PV modules to remove dust from it, is likely to get evaporate or absorbed by the vegetation and soil underneath the solar panels.
- Electro-mechanical system is being used in tracking devices; therefore, no hydraulic oil shall be required for the purpose.
- All hazardous waste should be stored in a separate designated paved space.

Water Environment:

There is no water stream within a 5 km radius from the site. The water for the labour camp construction water requirement will be sourced from private suppliers through tankers . Drinking water will be provided through the CSPCPL. Land levelling or filling operations may affect the natural drainage pattern of the site.

Removal of the vegetation cover as well as increased run-off from the construction activities will reduce the rate of infiltration and groundwater recharge. Improper disposal of sewage and wastewater from labour camp and construction debris can contaminate the ground water resources in the area

Further, the operation stage may involve high water demand for solar panel washing and domestic use by the staff. As per the Central Ground Water authority's handbook "Dynamic Ground Water Resources of India", Dubbak and Mustabad Mandals fall under the over-exploited category. Therefore, the groundwater resources may not available to meet the water consumption demands during the operation stage.

Improper disposal or spillage of fuel, lubricant and hazardous waste may lead to contamination of groundwater resource. The status of Septic tank and soak pit tank status is not known. There is potential for contamination of low-lying areas due to sediment runoff from construction activities.

Mitigation:

During Construction and Pre-construction phases:

- The natural slope of the site should be maintained to the extent possible in order to avoid any change in the drainage pattern.
- Adequate arrangement for storm water management during construction period should be made to avoid sediment runoff from the site.
- Storm water flow should be directed to the existing channels with silt traps to avoid sedimentation of the channels or the receiving water body

During operation:

- Dry wiping method using microfiber cloth can be adopted to minimize water consumption for solar panel cleaning.
- Ensure optimal usage of water viz., storage and reuse of wash water after module washing and plantation of low water requirement species
- Construct rain water harvesting pit to recharge the ground water table
- Septic tank with soak pit should be provided so that no contamination due to discharge of sewage may take place

Noise Environment

Noise and vibration will be caused by the operation of earth moving and excavation equipment, concrete mixers, Cranes, operation of DG sets and the transportation of equipment, materials and people. The noise level will be substantially lower near the plant boundary due to attenuation caused over the distance.

The project site is surrounded by a mix of agricultural land, barren land and highly vegetated land with no continuous noise generating sources in the vicinity of the project site. The nearest noise receptor is cheekode Village which is located at a distance of about 1.9 km in North-west direction. Therefore, the impact of noise due to site operation and construction activities can be considered to be low on the external communities.

The Gambhirao-Siddipet road, which also provides connectivity to the site, passes through the Cheekode village and the vehicular traffic due to transportation of equipment, construction material and people may cause disturbance to the people living in the village.

Mitigation measures:

- Use DG set with acoustic enclosure
- Provide personal protective equipment to workers wherever noise is generated due to machinery operation.
- Regular maintenance of project vehicles should be done.
- Contractor to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum.
- Restrict major noise generating construction activities during night-time. The hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas should be limited.
- It is also to be ensured that roads passing through the nearby villages are not utilized for movement of equipment reducing project traffic through community areas.
- All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50m away from the site boundary.
- Rubber padding/noise isolators will be used for construction equipment/machinery. Temporary noise barriers shall be provided surrounding the high noise generating construction equipment.
- Construction vehicles and machinery will be well maintained and not kept idling when not in use

Occupational Health and Safety

Construction activities include site preparation, infrastructure utilities installation, building structures.

Therefore, there will be potential impacts on workers' health and safety due to exposure to risks through construction activities that lead to accidents causing injuries and death. The most frequent risks of accidental death and injury are:

Safety Risks

- Risk of Electrocution and Firing due to short-circuit.
- Possible injuries associated with working with transmission line laying
- Risk of accidental fire at site.
- Accidents during cutting, chipping and piling
- Physical injuries during loading/unloading activities and working at height.
- Tripping due to uneven surfaces, obstacles, trailing cables;
- Falling during working at height due to fall from fragile surfaces, roof edges and ladders;
- Fire due to hot works, smoking, failure in electrical installations;
- Mobile plant and vehicles;
- Electrical shocks

Health Risks

- Manual handling and musculoskeletal disorders: typical construction activities that can cause injury such as lifting, lowering, pushing, pulling and carrying

- Hand-arm vibration: people work with hand-held or hand-guided power-tools and machines, such as: concrete breakers, pokers and compactors, sanders, grinders and disc cutters, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns.
- Temporary or permanent hearing loss which usually comes from noise generated from machinery used for excavation or piling work and from compressors and concrete mixers etc.
- Heat stress and working during high temperatures.
- Potential diseases in case unhygienic conditions prevail at the site due to improper waste disposal or inadequate sanitation facilities.

Mitigation Measures:

- Ensure that proper training is given to workers before the initiation of any project activity as well as ensure that workers wear appropriate Personal Protective Equipment (PPE) as per the nature of work involved.
- Ensure good housekeeping at the construction site to avoid slips and falls
- Conduct regular medical check-up of the staff and ensure that the contractor conducts regular medical check-ups of the hired labourer.
- Ensure that all material is arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor.
- Loading and unloading operation of equipment should be done under the supervision of a trained professional.
- All work at height to be undertaken during daytime with sufficient sunlight.
- Proper PPEs should be provided to workers handling welding, electricity and related components.
- Workers handling electricity and related components shall be provided with shock resistant gloves, shoes and other protective gears.
- Undertake periodical training to educate the workers for proper use of PPE’s.
- Establish proper monitoring systems to ensure that each and every individual labourers are using the PPEs properly.
- Fire extinguishing equipment should be provided in adequate number on site to handle any possible fire outbreaks.
- An accident reporting and monitoring record should be maintained
- Display phone numbers of the city/local fire services, etc. at site.
- The labour engaged for working at height should be trained for temporary fall protection devices.
- It should be ensured that proper and adequate number of toilets are constructed for the labourers so that hygienic conditions prevail in the site area.
- There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site.
- Provide enclosed and exclusive sanitation facilities for women to protect the privacy and dignity of the women involved in the work force.
- Contractors should inform the labour about the Grievance Redressal Mechanism (GRM) by which they can inform about any grievances.
- Contractor should ensure that labour receive training on health and safety issues involved in the proposed project.
- Contractor should inform the labour about Emergency Preparedness Plan (EMP) and
- Prepare emergency communication system and emergency preparedness plan

Impact due to waste handling:

Pre-Construction and Construction Phase

Waste is generated in all phases of the project:

- Construction waste including concrete, steel cuttings, etc.
- Municipal solid waste generated at the labour camps
- Hazardous materials and waste including used oil, oily rags, oil, etc.
- waste water generated during site operations.
- Solid waste generated by site staff during operation phase.

Construction Phase:

The construction activities such as site clearance, excavation works, setting up of labour camps, installation of modules will generate different types of solid and hazardous wastes.

The construction demobilization which will entail removal of machinery, workers, campsite and other temporary structures will also result in generation of waste.

The following types of wastes will be generated due to construction of the project:

Solid waste during the construction phase consists primarily of Waste oil from generator and other construction machinery, scrapped building materials, excess concrete and cement, excavated material, rejected components and materials, construction debris, dust emission due to construction debris, packing materials (pallets, crates, plastics etc.) and domestic waste from labour colonies.

The construction debris generated due to the construction activities will have the potential of spreading to areas outside the project boundary during construction. The dust particles from debris generated during construction activities can be carried along with the wind into nearby areas, thereby increasing the particulate matter in the area. However, this will happen only for a temporary period as the construction activities will be for small duration only.

Disposal of waste from Labour Camps

Improper disposal of solid waste from the labour camps at site and lack of proper sanitation facility for labour can lead to unhygienic conditions due to open defecation and spread of diseases in the area. It can lead to discontent of local community and result in conflicts with the labour engaged at site.

Disposal of waste from site

Improper disposal of packaging materials, boxes, plastics, ropes etc. can lead to littering in the construction site and surrounding areas. Hazardous wastes such as waste oil, lubricants, hydraulic oil etc. can cause contamination of soil and water bodies if adequate precautions for management and handling are not undertaken. Use of chemicals such as paints, curing chemicals can lead to contamination of soil.

Mitigation Measures

- Reuse excavated material generated, for site filling and levelling operation to the maximum extent possible.
- Ensure broken solar panels are properly packed and sent back to manufacturer.
- Ensure food waste and recyclables viz. paper, plastic, glass, scrap metal waste etc. are properly segregated and stored in designated waste bins/ containers and periodically sold to local recyclers while food waste to be disposed through waste handling agency.
- Waste oil to be collected and stored in paved and enclosed area and subsequently sold to authorized recyclers.
- The construction contractor shall ensure that the campsites provided at site have adequate waste disposal facilities.
- Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made.
- Provision of separate toilets for male and female workers (if any) in appropriate ratio of toilet to workers shall be made;

- Washing and bathing areas to be provided with proper drainage system so that wastewater is not accumulated in the campsites;
- Low lying areas prone to accumulation of water should be sprayed with mosquito repellents on regular basis to prevent health hazards to workers and community;
- Disposal of sewage to be made through a septic tank –soak pit arrangement.
- Empty paint containers to be stored at a secured area designated for scrap and sold to authorized vendors
- All packaging material to be collected at the storage area and sold to scrap dealers.
- Construction debris and excavated material to be stored in a confined area to prevent spread by wind or water.
- The construction debris to be used for backfilling of excavated areas and for foundation works at site and excess soil to be given to the local villagers for filling up of low-lying areas in the vicinity.
- The scrap metal waste generated from erection of structures and related construction activities to be collected and stored separately in a stack yard and sold to local recyclers.

Operation phase:

There will not be any substantial generation of solid waste, other than domestic waste, and broken solar panels.

Mitigation measures

- Ensure that the broken or replaced modules are properly packed and sent back to the manufacturer.
- Food waste and recyclables viz. paper, plastic, glass, scrap metal waste etc. to be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers.
- Waste/used oil generated from generators and construction machinery and equipment will be stored on paved surface in a secure location at the project site. Appropriate secondary containment capable of containing the 110 percent of the largest tank to be provided;
- The waste oil, which is characterized as hazardous according to Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, will be sold to approved vendors at frequent intervals;
- Empty paint containers will also be stored at a secured area designated for scrap and sold to authorized vendors.

6.2.1 Ecological Impact

Glare/ reflection from solar modules may distract the avian fauna flying over the solar panel area. The impact to flora from the operation is not expected since no clearance of vegetation is required. No other impacts are seen on local ecological system due to the operation of proposed project. Clearing of vegetation were limited to removal of undergrowth or shrubs at the plant site. It has no significant impact on the flora and fauna of the area.

6.2.2 Socio-Economic Impact

The decommissioning phase would involve the dismantling of the solar modules and all associated electrical infrastructure and site buildings. The impacts associated with the decommissioning phase are:

- Improper disposal of demolition waste and obsolete machinery may lead to contamination of soil which may cause discontentment amongst community members.
- Reduction of Workforce
- Demolition activity would lead to generation of dust which would be carried downward to the habitations.

Mitigation Measures

- Designated waste disposal sites should be marked for disposal of redundant and old solar panels;

- All waste generated from decommissioning shall be collected and disposed of at the nearest municipal disposal site. Structures that can be reused will be carried back by the contractors or sold to vendors;
- Reduction of workers shall be done phase wise and corresponding to completion of each activity;
- The local community members shall be intimated prior to the decommissioning phases and communicated about the anticipated dust generation; and
- The contractor shall inform workers and local community about the duration of work.

Significance of Impact

The socio-economic impact value for probable impacts during decommissioning phase has been presented below:

Table 6-4: Socio-Economic Impact during Decommissioning Phase

Aspect	Scenario	Spread	Duration	Intensity	Overall Significance
Waste Disposal	Without Mitigation	Local	Long	Moderate	**Moderate**
	With Mitigation	Local	Short	Low	**Insignificant**
Reduction of Workforce	Without Mitigation	Local	Medium	Moderate	**Minor**
	With Mitigation	Local	Short	Low	**Insignificant**

7. Environment and Social Management Plan

7.1 Introduction

This chapter addresses the requirement of IFC Performance Standard-1 which highlights the importance of managing the social and environmental performance throughout the life of the project. The purpose of an Environmental and Social Management Plan (hereinafter referred as “ESMP”) is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the construction, operation and closure of the operational solar power project. The ESMP specifies the mitigation and management measures to which the Proponent is committed and shows how the Project will mobilize organizational capacity and resources to implement these measures. The ESMP also shows how mitigation and management measures will be scheduled. The key objectives of the ESMP are to:

- Formalize and disclose the program for environmental and social management;
- Provide a framework for the implementation of environmental and social management initiatives.

The Environmental and Social Management Plan (ESMP) is specified in order to describe the mitigation measures for all the impacts associated with the project during its construction, operation and maintenance phase and decommissioning phase. The ESMP intends to delineate the monitoring and management measures to minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures during the operational phase.

Clean Solar Power (Chitradurga) Private Limited is committed to ensure compliance to all the commitments towards Environment, Social, Health and Safety Standards while executing all the project related activities to 40 MW Solar Power Project. This ESMP is applicable to all the employees of CSPCPL, Waarees Energies Limited and the sub-contractors if any, engaged during the project lifetime.

HFE has formulated an Occupational Health and Safety and Environment policy which has been endorsed by the company CEO.

7.2 Organizational Structure (Environment, Social, Health and Safety)

The enforcement and implementation of the project specific ESMP requires a robust manpower network working towards the common goal of ensuring compliance to the commitments towards ESHS standards for the project. The overall management and coordination of the project will be managed through the Managing Director of HFE. He is supported by Chief Operating Officer (CEO) who in turn is supported by the Head of Projects and Chief Engineer, O&M.

Head of Projects and Chief Engineer, O&M will overview monitor and control the activities of the HSE Engineer (based out of Bangalore for projects in the South India) and HSE – Coordinator (based out of Delhi, Corporate Office). The overall control of the site-in charge and contractor representative will be with the HSE Engineer.

The project does not foresee any significant adverse social and environment impacts or risks as indicated in the previous sections. The project footprint area is limited to its immediate vicinity and a particular range of stakeholders. However, it is suggested that CSPCPL provide professional HSE training to the site-in charge so that along with the technical project aspects he will be capable of supervising the environment, health and safety issues at the site. The HSE supervisor/site in-charge will work in coordination with the HSE staff of contractor.

CSPCPL has appointed Waaree Energies Ltd. (hereinafter referred to as "Waaree") as EPC contractor for the project and Mahindra TEQ is the O&M Contractor. The organizational structure for project at the corporate level along with the proposed organizational structure at the asset level has been presented in ***Figure 7-1*** below:

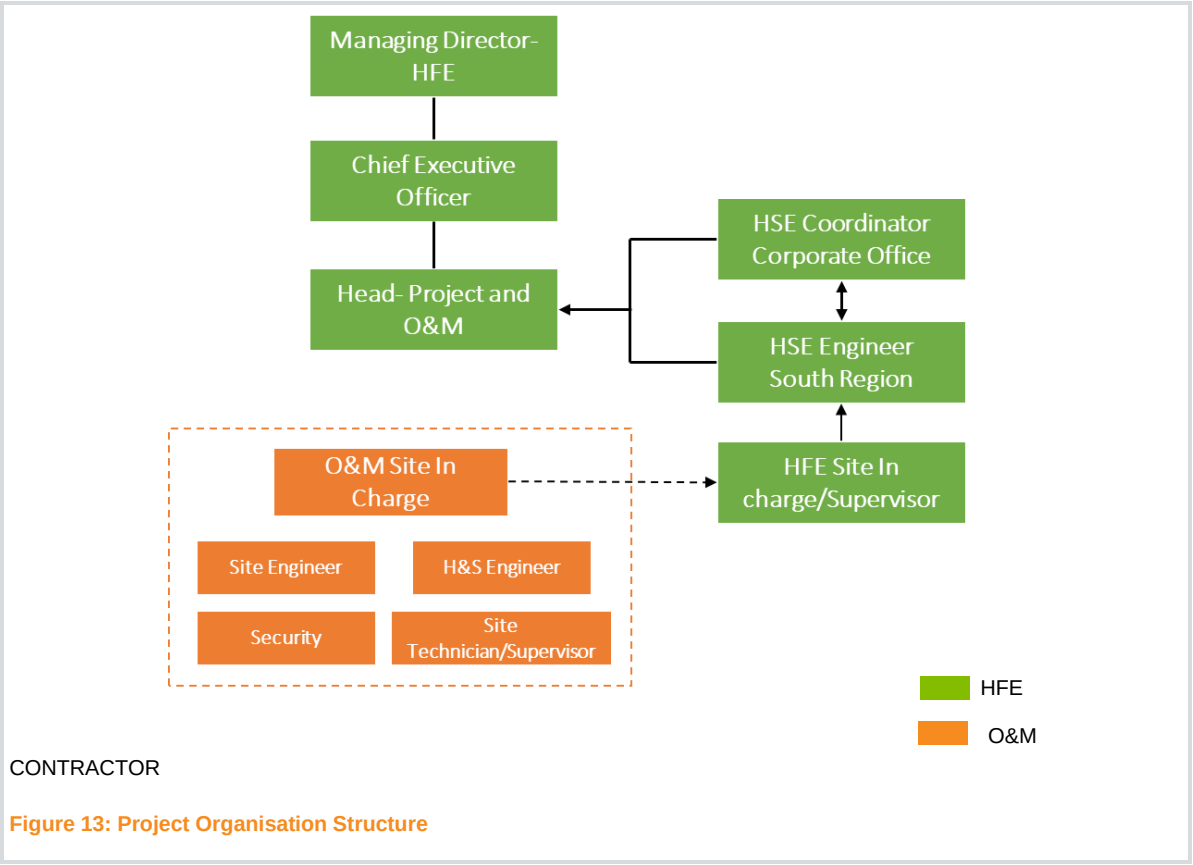


Figure 13: Project Organisation Structure

7.2.1 Roles and Responsibilities

This section describes the roles and responsibilities of the key persons responsible for management of onsite activities of the project.

CSPCPL will majorly play a role of supervisor to oversee the project performance pertaining to environment, health, safety and social issues. The O&M Contractor, i.e. Mahindra TEQO and other O&M contractors to be engaged, are proposed to have a dedicated HSE department for the Project. The HSE department will take the overall responsibility for coordination of the actions required for environment and social management, mitigation and for monitoring the progress of the proposed ESMP for the project. However, ultimate responsibility for implementing the provisions of the ESMP will lie with CSPCPL.

In general, the HSE department shall perform the following activities:

- Preparation of required documents on environmental and social management;
- Ensuring availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Implementation of the health and safety measures;
- Collection of the statistics of health of workers;
- Providing support during routine medical check-ups of workers;
- Awareness and implementing safety programs;
- Providing job specific induction training;
- Compliance of regulatory requirements;
- Carrying out internal audits;
- Identify unsafe acts and conditions and suggest remedies;
- Develop safety culture and comply with company's HSE policy and standards requirements;
- Encourage and enforce the use of PPE's;

- Educate all employees for the use of PPE's and safe practices;
- Direct, coordinate and orient the safety activities;
- Promulgate the spread of policy, objectives, rules and/or regulations;
- Perform a thorough investigation of all accidents and review the recommendations to avoid any repetition;
- Monitoring the progress of implementation of ESMP; and
- Reviewing and updating the ESMP as and when required for its effective implementation.

The roles and responsibilities of the key persons responsible for management of onsite activities of the project are described below:

Site In-charge (CSPCPL)

The Site In-charge of CSPCPL is responsible for overall management of the project and ESMP implementation on site during operation phase of the project. The following tasks will fall within his responsibilities:

- Monitor site activities on weekly basis for compliance;
- Conduct internal audits of the site against the ESMP; and
- Keeping a check on operation and maintenance services of solar panels required during operation phase;

HSE Engineer (CSPCPL)

The HSE Engineer will have the following responsibilities and will report to Site In-charge Head O&M of HFE Corporate:

- Ensure availability of resources and appropriate institutional arrangements for implementation of ESMP;
- Compliance of legislative and IFC PS requirements;
- Carry out audits, and inspection of all the project activities with Project Manager;
- Conduct training programs and awareness activities on health and safety for site staff and community;
- Preparation of necessary documents and record keeping system; and
- Review and updating of ESMP for its effective implementation.
- He will have the authority to issue the work permit system for undertaking electrical works during O&M phase of the project;
- Arrangement of first aid and firefighting equipment at the site office;
- Maintenance of the records of near miss and incidents that can happen at site, if any;
- Maintenance of records of hazardous waste generated on site on monthly basis and ensuring its proper disposal to authorized vendors of Telangana SPCB only.

7.2.2 Monitoring and Audit

The ESMP will have to be monitored on a regular basis in order to ensure effective implementation. The EHS team of HFE/CSPCPL, along with Waaree and other contractors, if any involved, will undertake inspection and monitoring of the environmental and social impacts of operation phase activities in order to ensure the effectiveness of suggested mitigation measures.

- CSPCPL will ensure that the Contractors comply with the requirements of conditions for all applicable permits and guidelines;
- The ESMP will be monitored on a regular basis (quarterly or half yearly) and all outcomes would need to be audited in accordance with EHS commitments of HFE/CSPCPL.
- The monitoring process will cover all stakeholders including the local community impacted by the project activities and associated facilities.

- The inspections and audits will be undertaken by a trained team of external agencies/experts or from HFE/CSPCPL.
- The inspection and audit findings will be implemented by Waaree in the areas of concern.
- The entire process of inspections and audits will be documented.

Sub-Contractors will be required to fully comply with the reporting requirements in terms of timely report submission with acceptable level of details. Reporting will be done in the form of environmental, health, safety and social check list, incident record register, environmental, health, safety and social performance reports (weekly, monthly, quarterly, half yearly, yearly etc.).

7.2.3 Documentation and Record Keeping

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and document control is ensured. The following records shall be maintained at site:

- Master Environment Management System document;
- Legal Register;
- Operation control procedures;
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Training records;
- Monitoring reports;
- Auditing reports; and
- Complaints register, and issues attended/closed.

7.2.4 Training

The training and competence of personnel working remotely and the readiness of all necessary safety equipment in the location is needed to be assessed. Hence, HFE/CSPCPL shall ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMS and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Waaree and other sub-contractors that may be involved in future are responsible for ensuring that their workers are provided HSE training as stipulated. A training register should be kept on site for all trainings conducted onsite.

An environmental and social management training programme shall be conducted to ensure effective implementation of the management and control measures during operation of the project. The training programme shall ensure that all concerned members of the team understand the environmental aspects of the project.

A basic occupational training program and specialty courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards. Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin.

Following are the basic trainings that shall be imparted to the employees, contract workers and community:

Table 7-1: Training Requirements for the project

Topic	Training Content	Targeted Audience
General Project Awareness	• Benefits of the Project • Type of land required for the project • Possible employment Opportunities	Local Communities
Environmental and Social Management training	• Purpose of action plan for the project activities; • Requirements of the specific management plans • Understanding of the sensitive environmental and social features within and surrounding the project areas; and • Understanding of the potential risks from the project activities;	Site Level Officers of EPC Contractor and HFE/RGSEPL and Contract Workers
Occupational Health & Safety Training	The importance of conforming with all HSE policies; • The HSE impacts of the proposed activities; • HSE benefits of improved personal performance; • Worker roles and responsibilities in achieving conformance with • HFE's HSE policy, procedures and this ESMP including associated procedures and emergency preparedness and response requirements; • Mitigation measures required to be implemented when carrying out their work activities. • Use of PPE; • Job Safety analysis • First aid trainings and awareness regarding medicines; • Fire drills and usage of fire extinguishers at the time of emergency; • Maintaining accident and incident investigation reports	Site Level Officers of EPC Contractor and HFE/RGSEPL and Contract Workers First Aiders and Fire Fighters

7.2.5 Environment and Social Management Plan and Procedures

HFE, the parent company is committed to ensuring compliance to the national and state level regulatory requirements and mitigating potential adverse environmental impacts resulting from the project activities. It has formally developed a corporate level Environment and Social Management System (ESMS) to ensure smooth functioning of its proposed projects. The ESMS is applicable for all the holding companies of HFE including this project SPV (CSPCPL).

Corporate ESMS of HFE comprises of the following policies and plans:

- Environment and Social Policy
- Occupational Health and Safety Policy
- Labour Management Plan
- Occupational Health and safety Plan
- Stakeholder Engagement Plan
- Construction Waste Management Plan
- Grievance Redressal Mechanism
- Resettlement Action Plan
- Livelihood Restoration Plan

As mentioned above, CSPCPL will adopt all of these while implementing the project specific plans at this project site along with the mitigation measures suggested for each of the potential impacts.

7.2.6 Environment and Social Management Plan

An Environment and Social Management Plan has been developed following the delineation of impacts and mitigation measures. These measures shall be adopted by CSPCPL and imposed as conditions of contract of the sub-contractor(s) employed for respective phases of the solar power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule. The ESMP includes the following:

- Mitigations suggested for adverse environmental and social impacts and associated risks;
- Institutional arrangement - management tools and techniques for the implementation of environmental impacts and risk mitigations;
- Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations;
- Monitoring arrangements for effective implementation of suggested mitigations for the project; and
- Reporting requirement to the regulatory agencies and funding institutes.

Table 7-2: Environment and Social Management Plan

Sl. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
A. Operation Phase				
1	Visual Aesthetics	• The solar panels will be installed at a low height and will be kept closer to the ground so that it does not prop out of the general landscape of the area. • The panels will be arranged in a systematic manner which will give an aesthetic sense to it. • The proposed project would include a boundary wall around the perimeter of the project to further obscure the peripheral view of the project and any indirect reflection.	Records of grievances received pertaining to visual conflicts.	CSPCPL
2	Water resource and quality	• The plant site will be provided with adequate drainage facility to drain off wash wastewater and prevent any water-logging at site or in the surroundings. • Wastage of water during cleaning of panels shall be avoided. Various factors such as tilt angle, orientation and tracking are required to be monitored for efficient cleaning of modules. • Ground water shall be extracted only after getting proper approvals from competent authority. • It is to be ensured that any water tankers required during operation phase are sourced from authorised vendor. • Rainwater harvesting system by making recharge pits shall be utilised to recharge the ground water. The water harvested will be directed to a recharge pit. • CSPCPL should ensure that rain water collected from the project site will be utilized to recharge the ground water through onsite rain water harvesting tank/pits. • Water use and harvesting/recharging in the project will be a key performance indicator that will be monitored through operation phase of the project.	Ground water sample testing at the project site location. Details of rain water harvesting	CSPCPL
3	Ecology	• Any cleared areas which do not have vegetation cover to protect the soil will be revegetated with locally occurring species and monitored to ensure recovery is taking place • Restrict the movement of vehicles to the pre-designated routes to prevent the disturbance to the ecosystems. • Vehicular emission and spillage of fuel to be monitored regularly. • Creation of green-belt through plantations within and around the project site	Awareness and training to all project personnel and contractors to use pre-designated routes and avoid rerouting or laying new temporary routes and regulate the vehicular emission. Plantations to be done in areas along the boundary of the project	CSPGCL

Sl. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
			site and other suitable areas within project site. Project manager to supervise the plantation and other related activities such as watering, pruning, etc.	
4	Soil Quality	• Ensure proper restoration of soil wherever excavation is undertaken. • Explore the option of buyback agreements for defunct panels and for replacement and disposal of transformer oil by the supplier, otherwise will make arrangements for disposal of defunct panels and waste oil by Telangana State pollution Control Board authorised recyclers. • Broken or damaged solar panels will immediately be shifted to a designated area in scrap yard to avoid land contamination. • These broken cells once collected to a certain number will be sent back to the manufacturer with the photographs taken for proper and safe disposal.	Awareness and training about the procedure for proper storage and disposal of waste oil and how to act in case of accidental oil spillage; Buy Back agreements for defunct solar panels	CSPCPL
5	Health and Safety	• Regular electrical safety training to workers; • Implement Lock out/ Tag Out (LOTO) system; • Use work equipment or other methods to prevent a fall from occurring. • Personal Protective Equipment (PPEs). should be provided to workers handling electricity and related components; • The transformer yard should be provided with fire extinguishers and sand buckets • Employees involved in electrical works shall be trained in and familiar with the safety-related work practices, safety procedures and other safety requirements that pertain to their respective job assignments; and • An accident reporting, and monitoring record shall be maintained.	Workers to be trained for use of Personal Protection Equipment and its importance. All safety related incidents will be recorded and monitored. Training to be provided to the workers regarding health and safety procedures.	CSPCPL
6	Impacts on economy Upgradation of local Infrastructure	• Details of community development activities to be shared with the Gram Panchayats of the respective villages • Engage the local workforce population for unskilled jobs whenever possible. • Encourage engagement with local contractors and vendors.	Undertaking community development activities as per the need assessment undertaken for the project Stakeholder Engagement and Grievance Mechanism activities and documentation.	CSPCPL
B. Decommissioning Phase				
1	Impact on Air, Soil, Noise, Ecology and Socio-Economic Aspects	• The proponent shall inform the workers and local community about the duration of work;	Information to workers/staffs of close down;	CSPCPL

Sl. No	Potential Impact/ Activity	Proposed Mitigation Measures	Monitoring Requirement	Responsibility
		• The workers shall be clearly informed about the expected schedule and completion of each activity; • A transparent mechanism shall be prepared wherever choice is to be made between individuals of similar capability; • All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; • All necessary Personal Protection Equipment (PPE) shall be used by the workers during demolition work; • CSPCPL will be committed to ensure all health and safety measures are in place to prevent accidents and\or reduce the consequences of non-conformance events; • Institution of suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of solar panel damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.	Training on safe handling of bulk hazardous wastes generated at site	

7.2.7 Environment Monitoring Plan

Regular monitoring of environmental aspects is important to assess the status of environment during the operation phase of the project. The monitored data can serve as an indicator for any change in environmental quality due to the project with respect to baseline environmental conditions; so that suitable mitigation could be taken in time to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented in ***Table 7-2.***

Table 7-3: Environmental Performance Monitoring

Sl. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period and Frequency
Environment Performance Monitoring			
1.	Dust generated from site clearance/ levelling	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase
2.	Noise emissions from vehicles and machineries	• Noise pressure level in dB(A) • Compliance with CPCB noise limits specified for DG sets • Check for valid certificates of Type Approval and also valid certificates of Conformity of Production for equipment particularly DG sets	Quarterly during site Preparation; Daily during construction phase
3.	Domestic Waste generation, storage, handling and disposal	• Quantity of waste generated and recycled	Monthly during operational phase
		• Visual observation of waste segregation and storage conditions viz.	
		• Usage of labelled and covered bins, insect repellents	
		• Awareness level of operational workforce	
		• Visual observation of leaks, Overflows etc.	
		• Odour	
4.	Community health and safety	• Complaints registered by the local communities • Number of Accidents	Monthly during operational phase
5.	Occupational health and safety	Health surveillance of staffs and other workers	Monthly during operational phase
		Sanitation status of onsite office building and canteen	
		Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine	
		Usage of proper PPEs	Daily during operational phase
		Safety performance indicators viz. Near misses, fatalities etc.	
6.	Surface run-off Discharge	Visual observation of water logging due to drainage disruption • CPCB Inland Water Discharge Parameters	Weekly during construction phase
7.	Hazardous chemicals and waste storage, handling and disposal	• Visual observation of chemical storage conditions viz. presence of spill kits, drip trays, fire extinguisher and display of MSDS etc. • Quantity of waste oil and other hazardous waste generated and recycled to registered recyclers • Awareness level of onsite workers	Weekly during construction phase
8.	Ground Water	Depth of ground water table should be monitored	Quarterly during Operational phase
		Amount of water consumed	Daily during operational phase
B	**Operation Phase**		
1.	Fugitive emissions	• Visual observation of dust generated • Water sprinkling details viz. frequency and quantity	Daily during operational phase

Sl. No	Environment Performance Indicator (EPI)	Monitoring Parameter	Period and Frequency
2.	Water resources	• Volume of water sourced and consumed	Daily during operation phase
3.	Community health and safety	• Complaints registered by the local communities • No. of. Accidents	Monthly during operational phase
4.	Occupational health and safety	• Health surveillance of staffs and other workers • Sanitation status of onsite office building and canteen • Potable nature of drinking water viz. coliform, pH, TSS, residual chlorine • Usage of proper PPEs • Safety performance indicators viz. Near misses, fatalities etc.	Monthly during operational phase; Daily during operational phase

7.3 Occupational Health and Safety Plan for Operational Phase

The Occupational Health and Safety (OHS) of the employees and contractual laborers will be maintained at the work sites during the operation phase. The OHS Management measures shall comply with the Indian Regulatory requirements under OHSAS and the Factories Act.

Although no significant occupational health and safety risks are foreseen during operations, the following mitigation measures need to be adopted:

- Operators to be provided with adequate PPEs depending upon nature of the operation and occupation health and safety risks associated with it viz. electrical maintenance activities;
- Special emphasis on electrical safety will be laid and all employees will be trained in electrical safety and First Aid;
- Standard Operation Procedures (SOPs) will be developed for operational activities likely to have potential occupational health and safety risks;
- Periodic medical examination will be undertaken for workers including contractor and subcontractor of the plant.
- Periodic inspections will be carried out to ensure all the above are implemented and any non-conformances will be recorded along with grievance related to OHS issues.

An EHS coordinator will effectively implement and monitor the OHS Management System and ESMP.

7.4 Waste Management Plan

The Waste Management Plan (WMP) will identify the wastes arising during operation and construction of the solar power plant of CSPCPL and document waste management practices to be employed for their collection, storage, treatment and/or disposal.
Specifically, the waste covered by this WMP includes the following sources:

- Construction and commissioning of plant and the associated facilities
- Operation of plant and the associated facilities throughout the project life-cycle.
- Temporary accommodation during construction phase for the workers.
- Other operations like equipment maintenance, road construction, site preparation etc.
- Operation and maintenance of infrastructures both during construction and operation phase.

WMP is intended to serve as a guideline for CSPCPL and the contractor(s) to manage wastes effectively during the project life cycle. The WMP describes how wastes will be managed during the project life cycle and how the project will:

- Minimize the potential to cause harm to human health and the environment.

- Comply with Indian Environmental Regulation and IFC Performance Standards.
- Reduce operational costs and reduce any potential liabilities which may arise from waste handling operations.

This plan also ensures that every waste stream and solid waste materials from the main plant site and bracketed facilities will be managed effectively.

7.5 Waste Characterisation

Operations and maintenance of the PV power facility is not expected to generate any significant amount of waste. PV panels, array enclosures and inverter/transformer enclosures will not produce waste during operation except the following:

- Defunct solar panels;
- Broken solar panels generated during cleaning and other maintenance activities;
- Fuel requirements like greasing, transformer oil etc.
- Used oil; and
- Oily rags

7.6 Waste Handling, Management and Disposal

7.6.1 Construction Phase

The waste will be generated from construction activities like site clearing, levelling etc. Other categories of waste will be produced daily and comprise of the following:

- Scrap metal;
- Soil waste;
- Food waste from kitchen premises of labour camps;
- Construction debris; and
- Sewage from temporary toilets;

The construction and decommissioning phases will require the use of hazardous materials such as diesel or petrol to cater the fuel equipment and vehicles and maintain equipment. The following hazardous wastes will also be produced from construction activities.

- Oily rags;
- Used oil and oil filters - from generators or vehicle maintenance; and
- Scrap and packaging material.

7.6.2 Operational Phase

Operations and maintenance of the PV power facility is not expected to generate any significant amount of waste. PV panels, array enclosures and inverter/transformer enclosures will not produce waste during operation except the following:

- Defunct solar panels;
- Broken solar panels generated during cleaning and other maintenance activities;
- Fuel requirements like greasing, transformer oil etc.
- Used oil; and
- Oily rags

Damaged panels would need to be characterized and managed as hazardous waste. Following measures to be taken for management of waste:

- Module Developers need to have buy back agreements for defunct solar panels;

- A designated area needs to be demarcated within the module premises for storage of defunct and broken solar panels with restricted access and on impervious surface;
- All fuel storage should be equipped with secondary containment and spillage trays;
- All used oil is required to be sent off to TSPCB approved vendors and recyclers; and
- Transportation of defunct solar panels is required to be undertaken as per the procedures specified by the Manufacture of Solar Panels.

Handling of Broken Solar Modules generated due to cleaning and other maintenance activities

- Broken or damaged solar panels are required to be shifted to a designated area in scrap yard to avoid any type of land contamination;
- The designated area should be isolated and established on an impervious surface;
- Proper PPEs to be provided to the workers handling the broken solar panels;
- The workers at site to be appraised about the potential health risks associated with handling of solar panels on regular basis.

Detailed waste management plan should be prepared for decommissioning phase. However, among other measures, ensure that the recyclable and non-recyclable non-hazardous solid waste generated onsite should be collected and stored in a temporary waste storage facility from where all wastes will be sent for recycling and disposal to appropriate facilities;

7.7 Stakeholder Engagement Plan

Stakeholder Engagement is the process of engaging the stakeholders. Stakeholders are persons or groups who are directly or indirectly affected by a project as well as those who may have interests in a project and/or ability to influence its outcome either positively or negatively. Stakeholders may include locally affected communities or individuals and their formal and informal representatives, national or local government authorities, politicians, religious leaders, civil society organizations and groups with special interest, the academic community and other businesses.

Stakeholder Engagement Process can be described as a process which engages stakeholders with an aim to achieve certain outcomes. The process enables communication between the community members and the project proponent. Increased communication between them would lead to a favourable condition and would thereby increase the viability of a project.

To ensure the systematic implementation and execution of the stakeholder engagement process certain resources and framework are required to be in place. Certain defined roles and responsibilities of designated personnel can assist in smooth implementation of the stakeholder engagement process. The following personnel shall be involved:

- ***Community Liaison Officer/CSR Officer/Grievance Officer at the Site level***: The Community Project Liaison Officer shall be responsible for the implementation of the stakeholder engagement and consultation activities. The Community Liaison Officer in consultation with the HSE Supervisor at the site level shall develop resources and plan for the consultation activities to be conducted. Documentation of all processes such as identification and engagement activities with stakeholders is imperative and shall be done by the Community Project Liaison Officer/CSR Officer.
- ***HSE Supervisor at the Site Level***: The HSE Supervisor shall assist the Community Liaison Officer/CSR Officer/Grievance Officer to develop stakeholder engagement activity plan for the financial year. The responsibility for assistance with the execution and implementation of the activity would also be the incumbent's responsibility.
- ***CSR Head/Human Resource (HR) Head at the corporate level:*** The CSR Head/HR Head shall be responsible for the overall budgeting and monitoring of the stakeholder engagement activities undertaken at the site level. Impact Assessment reports should be reviewed by the CSR Head/HR Head and shall determine the feasibility of the implementation of the activity.

To engage the stakeholders, certain process can be followed. The process includes the following procedures:

- Stakeholder Identification and Analysis.
- Stakeholders Engagement.

- Information Disclosure.
- Monitoring and Reporting.

7.7.1 Stakeholder Identification and Analysis

The first step involves the identification of all affected communities. They should be identified and classified according to the degree of their vulnerability to the impacts of the project. They can be classified into Direct and Indirect Stakeholders according to their degree of influence of the project and vice versa. The Community Liaison officer/CSR officer/Grievance officer shall be responsible in developing a list of stakeholders according to the degree of impact and will utilize the format provided in the ESMS of HFE to identify and classify the stakeholders.

7.7.2 Methods of Stakeholder Engagement

On identification and classification of Stakeholders, Community Liaison Officer/CSR/Grievance Officer will develop stakeholder engagement activities. These activities would be developed ensuring an effective engagement process with detailed objectives and platforms wherein the views, interests, concerns of different stakeholders are allowed to be communicated. The stakeholder engagement documentation can be done utilizing the format provided in HFE's ESMS. Communicated views and concerns should be taken into account while making project decisions and formulation of development benefits for affected communities. In order to increase and improve communication with the stakeholders certain communicative methods have been outlined below:

Communicative Methods

Communicative Methods are to be developed and adopted to ensure proper information dissemination and communication to the affected communities. These methods may vary according to the target audience and it can comprise of the following detailed out in the following table:

Table 7-4: Communicative Methods

Communicative Methods	Objective	Relevance
Community Meetings	To inform and consult with the local community members regarding the project and its anticipated risks and impacts.	When mass information dissemination is required To get feedback and collaborate with the community stakeholders for input of local knowledge and options.
Focus Group Discussions	To inform and consult a target group and take into account their views and make the project more inclusive in nature.	Relevant when the majority of the affected communities' population comprises of minorities or marginalized groups. When the relevant sub groups are not interactive and hesitant to participate in larger community meetings and there is a need to understand the needs, perception and concerns of the sub-group.
Participatory Workshops	To utilise local knowledge and use it as input to generate options related to the project activities. To increase the involvement of the stakeholders in the project.	Relevant when the stakeholders knowledge are keen in participating in the development of the project When there is a need to engage local people to analyse, share and enhance their knowledge to plan, manage and evaluate developmental projects.
Participatory Rural Appraisal (PRA)	To enable local people to make their own appraisal, analysis and plan. Decentralization and Empowerment of the local people.	Relevant when there is a need for identification of the community problems.

7.7.3 Information Disclosure

Information disclosure involves delivery of project related information to the community members and ensuring access to such information by other stakeholders. It is a means to communicate with the direct and indirect stakeholders of the project. The disclosure information should be done in the appropriate language (native), accessible and understandable. Disclosure of information can be done through various means such as display/information boards at local authorities' office, through audio-visual methods such as radio, pamphlets and relevant videos.

General Information of the Project: Information related to the entire project cycle should be made available to the project community members. The company website should be updated with the details of the project which should include the purpose, nature and scale of the project. It can also include the list of risks and impacts that are anticipated during the project. The information related to the project can be displayed at information boards of the local authority's office as well as and the company website.

Detailed Information of the Project: Documents like the ESIA report, Environment and Social Management Plan, Stakeholder Engagement Plan etc. shall be made available for the stakeholders if asked for. The hard copies of the same should be placed at the project site office.

7.7.4 Monitoring and Reporting

Internal audits of the stakeholder engagement program should be done. The frequency of the internal audits should be decided upon at the corporate level. Review of the applicability, execution and feedback/response to the programme should to be done. At the site level, the Community Liaison Officer and the HSE Supervisor shall be responsible for the monitoring of the stakeholder engagement activities that have been done and CSR Head/HR Head at the corporate level shall be updated on the stakeholder engagement activities at the site and shall review the stakeholder engagement activities and provide feedback on its implementation.

Record-Keeping of the following should be done:

- Stakeholders Identified.
- Minutes of Meetings.
- Communicative methods used for stakeholders, participation during these engagement activities and feedback/responses received.

7.8 Grievance Redressal Mechanism

Grievance Redressal Mechanisms assist in reducing and mitigating the anticipated risks that may arise with the project development. An effective grievance mechanism would be one which is transparent and approachable process and would address the concerns promptly in a culturally appropriate manner. The grievance mechanism should be able to inform and complement the existing stakeholder engagement process.

8. Conclusions and Recommendations

The Environmental and Social Assessment study for the Operational 40 MW solar power project has been undertaken in accordance with IFC's Performance Standards and World Bank's Environment Health and Safety (EHS) Guidelines.

The ESIA study aimed to identify and evaluate potential environmental impacts associated with all aspects of the project. The conclusion and recommendations of this study are result of on-site inspections, the evaluation of impacts identified by specialists, and the process of stakeholder consultation.

The impacts due to the project is minimal, site specific and has reversible impacts on the micro environment of the project site owing to the waste water generation from the solar panels.

The project is assessed to generate some environmental and social impacts due to operation of the project. Mitigation measures for potential impacts on air environment, water quality, land, soil, noise, ecology, and socio-economic have been specified through proper -

- Follow up of best practice of compensation, stakeholder engagement, and grievance management;
- Planning and designing of Solar Power plant, access route, drainage, traffic movement etc.;
- Application of standards for Health and Safety; and
- Clearances and permits required for each sub activity

The proposed Environmental and Social Management Plan describes the implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance. The implementation of the mitigation measures including monitoring schedule will provide a basis for ensuring that the potential positive and negative impacts associated with the operation of the Power Plant are taken care off. This ESIA study together with mitigation measures and follow up of recommendations on management actions will help CSPCPL and the O&M contractor in complying with the environmental standards and meet the IFC performance standards.

The Project is a renewable energy project which uses solar energy for power generation. Renewable energy projects are considered to be cleaner compared to fossil fuel-based energy projects. In accordance to the screening criteria of IFC, AECOM has categorized Project as ***Category B***, which specifies that the project can cause potential and limited adverse social or environmental impacts which are generally site-specific, largely reversible and can be readily addressed through mitigation measures. The rationale for categorisation being:

- Land procurement was based on 'willing buyer-willing seller' with compensation more than prevailing market rates;
- The site is not located in an ecologically sensitive area;
- There are no issues of resettlement and rehabilitation;
- The operation of solar panels has limited environment and social impacts;
- There are no indigenous communities in the project area; and
- Any adverse environmental and social impacts may be readily addressed through mitigation measures as outlined in the Environmental and Social Management Plan (ESMP).

Appendix A List of Document Review

Following documents were provided and reviewed.

Numbered copies

Number:	Document Copy	Remarks
1.	Detailed Project Report of 40 MW Solar PV Project prepared by CSPCPL	August 2016
2.	Transmission line approval letter from Telengana State Transmission Corporation	April 2017
3.	Registry Details Clean Solar Power (Chitradurga) Pvt. Ltd (Siddipet & Sircilla District) 40 MW District Telangana	Nov 2016 to May 2017
4.	Various documents shared by CSPCPL and discussion held with CSPCPL from time to time	-