

GRID CONNECTED 25 MW PV SOLAR POWER PROJECT AT CHARANKA IN GUJARAT



Document Prepared By GMR Gujarat Solar Power Private Limited

Project Title	Grid connected 25 MW PV solar power project at Charanka in Gujarat
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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The project activity is a 25 MWp grid connected solar PV power project in Charnaka Gujarat Solar Power Park District Patan in the State of Gujarat, India promoted by GMR Gujarat Solar Power Private Limited (GGSPPL). The power generated is supplied to the Gujarat Urja Vikas Nigam Limited (GUVNL) and will replace the equal amount of power which would have been generated by fossil fuel-intensive thermal power plants in the North Eastern Western and North Eastern (NEWNE) grid. The project activity uses thin film solar photovoltaic technology to generate clean energy. The generation of power from solar photovoltaic is a clean technology as there is no fossil fuel fired or no GHG gases are emitted during the process.

The monitoring plan and other monitoring requirements are referred from the registered CDM PDD (UNFCCC Ref no: 7128). The registered PDD can be referred from:

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

The project was commissioned on 4th March 2012. The total emission reductions for the monitoring period (04/03/2012 to 31/12/2012) account to 29,887 tCO_{2e}.

The PP GGSPPL has selected crystalline silicon PV technology and central inverters for its 25MWp solar PV plant. PV modules required for the plant has been sourced from Canadian solar make.

The two PV Modules numbers are CS6P 235P & 240P. The modules are with a rated output of 235 Wp & 240 Wp have been selected. The Canadian solar modules are qualified to IEC 61215 and are TUV certified. These module specifications are considered to be suitable for the conditions encountered at the site.

The DC electrical output from the PV modules is fed through solar PV grade cables to string combiner boxes (SCB) and further through D.C switchboard to inverters. The inverters convert the DC electrical output to AC. The cable routes from inverter leads to the MV transformers stepping up voltage to 11kV. In order to achieve system redundancy at MV level, a set of five rings of 5 MW each exists before feeding into HV substation. 11kV AC voltage is further stepped up to 66kV at the HV substation before feeding into the grid.

Crystalline Solar Modules:

1. The crystalline solar modules are manufactured using silicon cells
2. The modules comply with International Electrotechnical Commission IEC 61215 standards.
3. Maximum wind load bearing capacity is 2.4 KPa (Kilo Pascals)
4. The modules are designed to have minimum maintenance requirements and high reliability having a minimum design life of 25 years.
5. The PV modules, Canadian solar make SMA's, 500 CP inverters manufactured by SMA are considered for the project activity.

Electrical Power Requirements:

The DC electrical output from the PV modules is fed through solar PV grade cables to string combiner boxes (SCB) and further through D.C switchboard to inverters. The inverters convert the DC electrical

output to AC. The cable routes from inverter leads to the MV transformers stepping up voltage to 11kV. In order to achieve system redundancy at MV level, a set of five rings of 5 MW each exists before feeding into HV substation. 11kV AC voltage is further stepped up to 66kV at the HV substation before feeding into the grid.

The point of interconnection and metering shall remain at solar PV plant.

PV Plant components:

The main components of the PV plant that has been used for the design and energy yield predictions are solar PV modules, inverters, junction boxes, mounting structure, 11kV & 66 kV electrical substation, monitoring and data acquisition system.

PV Modules:

Two Canadian solar CS6P 235P & 240P modules with a rated output of 235 Wp & 240 Wp have been installed. The Canadian solar modules are qualified to IEC 61215 and are TUV certified. These module specifications are considered to be suitable for the conditions encountered at the site.

Table 1: Technical Specifications

S. No.	Description	Specification
PV Modules		
1.	Photovoltaic Power plant type	Fixed array ground mounted Photovoltaic Power Plant
2.	Module Technology	Polycrystalline silicon
3.	Module Make	Canadian Solar
4.	Module Name plate peak power	235 Wp / 240Wp
5.	Number of Modules	105,624
Central Inverter		
6.	Make	SMA
7.	Nominal DC power	500 kW
8.	MPP voltage range	430 V to 820 V
9.	Nominal AC voltage	270 V
10.	Operational Temperature Range	-20° C to 50° C
11.	Number of Inverters	45 No's
MV/HV Transformers		
12.	Make	Voltamp Transformers Ltd
13.	Capacity	10/12.5 MVA & 6.3 MVA
14.	Rated voltage HV side	66 kV
15.	Rated voltage MV side	11 kV
16.	Number of Transformers	2 no's of 10/12.5 MVA & 1 No. of 6.3 MVA
Tilt angle		
17.	Tilt angle to horizontal	20 °
18.	Direction	Towards south

Cables and Connectors:

The cables deployed have to be robust and resist high mechanical load and tension. High temperature resistance and weather proofing characteristics provide long life. The connectors should have high current carrying capacity and should be free from any water ingress.

Table 2: Technical specification of the HT cable:

S.No	Equipment Name	Manufacturer	Technical Details	
1	400 Sqmmx3 core 11KV XLPE Armoured cable	Ravin Cables Ltd	Nominal Area Of conductors	400
			Thickness of insulation	3.4 mm
			Thickness of outer sheath	3.55 mm
			Over All diameter	81.4 mm
			Approximate Weight	7070 kg/km
			Current Rating	
			a. In air at 40 ⁰ C	502
			b. In ground at 25 ⁰ C	441
			Conductor Resistance	
			a. Dc at 20 ⁰ C	0.0778 ohms/km
			b. 50 Hz at 90 ⁰ C	0.102 ohms/km
			Reactance at 50Hz	0.083 ohms/km
			Capacitance	0.59 µF/km
2	300 Sqmmx3 core 11KV XLPE Armoured cable	Ravin Cables Ltd	Nominal Area Of conductors	300
			Thickness of insulation	3.4 mm
			Thickness of outer sheath	3.3 mm
			Over All diameter	75.2 mm
			Approximate Weight	5910 kg/km
			Current Rating	
			a. In air at 40 ⁰ C	434
			b. In ground at 25 ⁰ C	392
			Conductor Resistance	
			a. Dc at 20 ⁰ C	0.1 ohms/km
			b.50 Hz at 90 ⁰ C	0.130 ohms/km
			Reactance at 50Hz	0.086 ohms/km
			Capacitance	0.53 µF/km
3	240 Sqmm x 3 core 11KV XLPE Armoured cable	Ravin Cables Ltd	Nominal Area Of conductors	240
			Thickness of insulation	3.4 mm
			Thickness of outer sheath	3.1 mm
			Over All diameter	70.0 mm
			Approximate Weight	5060 kg/km
			Current Rating	
			a. In air at 40 ⁰ C	383
			b. In ground at 25 ⁰ C	342
			Conductor Resistance	

		a. Dc at 20 ⁰ C	0.125 ohms/km
		b.50 Hz at 90 ⁰ C	0.161 ohms/km
		Reactance at 50Hz	0.089 ohms/km
		Capacitance	0.48 µF/km

Transformer:

Step-up transformers is used to step -up the inverter output voltage to exportable power voltage (from 280/300 V to 11 kV and from 11kV to 66 kV).

The technical details of the power transformer are as follows:

Make: VOLTAMP transformers Pvt ltd.

Table 3: Technical details of power transformer

Rating(Kw/KVA)	10000/12500
Rated Voltage (HV)	66000
Rated Voltage (LV)	11000
Rated Current (HV)	109.35
Rated Current (LV)	656.08
Frequency	50 Hz
Cooling	ONAN
Winding Material	Copper
Weight of Oil	7890Kgs
Oil Quantity	8865 Lts
Total Weight	32390Kgs
Core & Winding	13600Kgs
Vector Group	YNyn0
Insulation Level (HV)	325KVP
Insulation Level (HVN)	95KVP
Insulation Level (LV)	76KVP
Max Temp Rise (Oil/Wndg)	50/55°C
HV CT Ratio	300/1A
LV CT Ratio	800/1A
HV NCT Ratio	300/1A
LV NCT Ratio Core 1	300/1A
LV NCT Ratio Core 2	800/1A
Rating(KVA)	6300
Rated Voltage (HV)	66000
Rated Voltage (LV)	11000
Rated Current (HV)	55.11
Rated Current (LV)	330.66

Frequency	50Hz
Cooling	ONAN
Winding Material	Copper
Weight of Oil	5545Kgs
Oil Quantity	6230 Lts
Total Weight	22445Kgs
Core & Winding	9800Kgs
Vector Group	YNyn0
Insulation Level (HV)	325Kvp
Insulation Level (HVN)	95Kvp
Insulation Level (LV)	75Kvp
Max Temp Rise (Oil/Wndg)	50/55°C
HV CT Ratio	300/1
LV CT Ratio	600/1
HV NCT Ratio	300/1A
LV NCT Ratio Core 1	200/1A
LV NCT Ratio Core 2	600/1A

Technical details of Inverter duty transformer are as below:

Make: Danish Pvt Ltd:

Table 4: Technical details of power transformer

Capacity	1250KVA
Rated Voltage(HV)	11KV
Rated Current (HV)	65.61A
Rated Voltage(LV)	270V
Rated Current (LV)	1336.5A
Cooling Type	ONAN
Vector Group	Dy11y11
Winding Material	Copper
Insulation Class	A
Temp rise oil/wdg	35/45°C at Ambient
Oil Qty	1100lts

Lightning Arrestors:

Lightning arrestors of adequate capacity will be is 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 is complete with insulating base, self-contained discharge counters and suitable milli-ammmeters.

Technical specification of LA:

Make: OBLUM

Table 5: Technical Details of Lighting Arrestors

Technical Details	
Rated Voltage	60KV
Pressure Relief clam	40KA
Rated Frequency	48-60HZ
Discharge clam	3
MCOV	541KV

HT-Structures:

The structures is 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 /Grounding System:

A safety earthing system consisting of a buried GI flat conductor earthing grid is provided for the switchyard and the Solar PV array system. The earthing system is formed to limit the grid resistance to below 1 ohm.

Table 6: Technical details of Earthing:

Sr. No	Technical description	Material used
1	Earthing conductor for earth mat	40MM dia MS rod
2	Type of earth electrode	40MM dia MS rod
3	Number of earth electrode for switchyard	Total 27 Nos pit

Lighting (Plant Illumination) System:

Suitable number of lighting fixtures is provided in the plant area to illuminate the complete solar power plant area in the night time.

Table 7: Technical Specification lighting:

Sr. no	Description	Location	Total no
1	30W LED lighting	Plant peripheral area	126
2	2* 400Watt HPSV	66KV switchyard	14
3	13W lighting fixture	Plant Internal lighting	157
4	2X36W FTL Fixtures	Inverter station	45

Power Evacuation System:

The power from the inverters / transformers is collected in a collecting station (pooling substation inside the SPV plant boundary) and the high voltage power is routed through the double circuit 66 kV switchyard to the transmission line and be eventually connected to the grid (66kv/220kv GETCO sub-station, Charanka). All the statutory requirements of state grid code is complied with. The tariff metering panels and accessories is provided in 66 kV switchyard in the plant boundary of solar power plant. The technology used in the project activity employs renewable solar energy for electricity generation. It generates no end products in the form of solid waste (ash etc.) compared to alternative modes of power generation (e.g. coal based on which the NEWNE grid is primarily dependent). Hence, the solar PV technology is

environmentally safe and sound. Technology is indigenous as available within the country. Further, there is no technology transfer associated with the project activity.

The project activity is designed for operational lifetime of 25 years.

1.2 Sectoral Scope and Project Type

Sectoral Scope: 01, Energy Industries (renewable and non-renewable sources)

Type 1: Renewable energy projects

This is not a grouped project

1.3 Project Proponent

Organization name	GMR Gujarat Solar Power Private Limited (GGSPPL)
Contact person	Mr. Shivarama M. S
Title	Head Sustainability and EHS
Address	GMR Gujarat Solar Power Private Limited New Shakti Bhawan – Ground Floor Building no 301 Near Terminal 3 IGI Airport New Delhi 110 037
Telephone	+91-11-4988-3343
Email	shivarama.ms@gmrgroup.in

1.4 Other Entities Involved in the Project

Not Applicable

1.5 Project Start Date

The project start date is 08/12/2010, i.e. PPA signing date with Gujarat Urja Vikas Nigam Ltd.

1.6 Project Crediting Period

CDM crediting period: Ten years (from 01 Jan 13 - 30 Aug 19).

VCS Monitoring period: (04 March 2012 to 31 Dec 2012).

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

The project falls under project category since the emission reductions are less than 300,000 tCO₂e per annum.

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
Year 1	34,462
Year 2	34,462
Year 3	34,462
Year 4	34,462
Year 5	34,462
Year 6	34,462
Year 7	34,462
Total estimated ER	241,234
Total number of crediting years	7
Annual average ERs	34,462

1.8 Description of the Project Activity

The project activity is a solar PV power project which has employed environmentally safe and sound technology and is resulting in abatement of GHG emissions.

The project activity is 25 MW solar PV based power generation. The full power generation capacity of solar PV plant is 25.00 MW under standard conditions of 1000 W/sq.metre sunlight, 25°C temperature and 1.5 air mass. The 25 MW plant consist of fixed mounting structures on which Crystalline silicon modules are installed.

Crystalline Solar Modules:

1. The crystalline solar modules are manufactured using silicon cells
2. The modules comply with International Electrotechnical Commission IEC 61215 standards.
3. Maximum wind load bearing capacity is 2.4 KPa (Kilo Pascals)
4. The modules are designed to have minimum maintenance requirements and high reliability having a minimum design life of 25 years.
5. The PV modules, Canadian solar make SMA's, 500 CP inverters manufactured by SMA are considered for the project activity.

Electrical Power Requirements:

The DC electrical output from the PV modules is fed through solar PV grade cables to string combiner boxes (SCB) and further through D.C switchboard to inverters. The inverters convert the DC electrical output to AC. The cable routes from inverter leads to the MV transformers stepping up voltage to 11kV. In order to achieve system redundancy at MV level, a set of five rings of 5 MW each exists before feeding into HV substation. The 11kV AC voltage is further stepped up to 66kV at the HV substation before feeding into the grid.

The point of interconnection and metering is at solar PV plant.

PV Plant components:

The main components of the PV plant that has been used for the design and energy yield predictions are solar PV modules, inverters, junction boxes, mounting structure, 11kV & 66 kV electrical substation, monitoring and data acquisition system.

PV Modules:

Canadian solar CS6P 235 P & 240P modules with a rated output of 235 Wp & 240 Wp have been selected. The Canadian solar modules are qualified to IEC 61215 and are TUV certified. These module specifications are considered to be suitable for the conditions encountered at the site.

TABLE 1: Technical Specifications:

S. No.	Description	Specification
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5.	Number of Modules	105,624
Central Inverter		
6.	Make	SMA
7.	Nominal DC power	500 kW
8.	MPP voltage range	430 V to 820 V
9.	Nominal AC voltage	270 V
10.	Operational Temperature Range	-20° C to 50° C
11.	Number of Inverters	45 No's
MV/HV Transformers		
12.	Make	Voltamp Transformers Ltd
13.	Capacity	10/12.5 MVA & 6.3 MVA
14.	Rated voltage HV side	66 kV
15.	Rated voltage MV side	11 kV
16.	Number of Transformers	2 no's of 10/12.5 MVA & 1 No. of 6.3 MVA
17.	Tilt angle	
18.	Tilt angle to horizontal	20 °

Table 2: Temperature Coefficients for PV Modules

Temperature Coefficient	Pmax	-0.43 % /°C
	Voc	-0.34 % /°C
	Isc	0.065 % /°C
Normal Operating Cell Temperature		45 ± 2° C

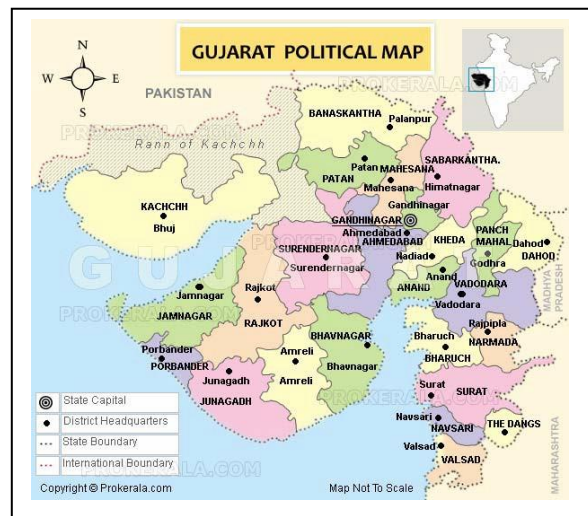
Table 3: NOCT values for PV modules

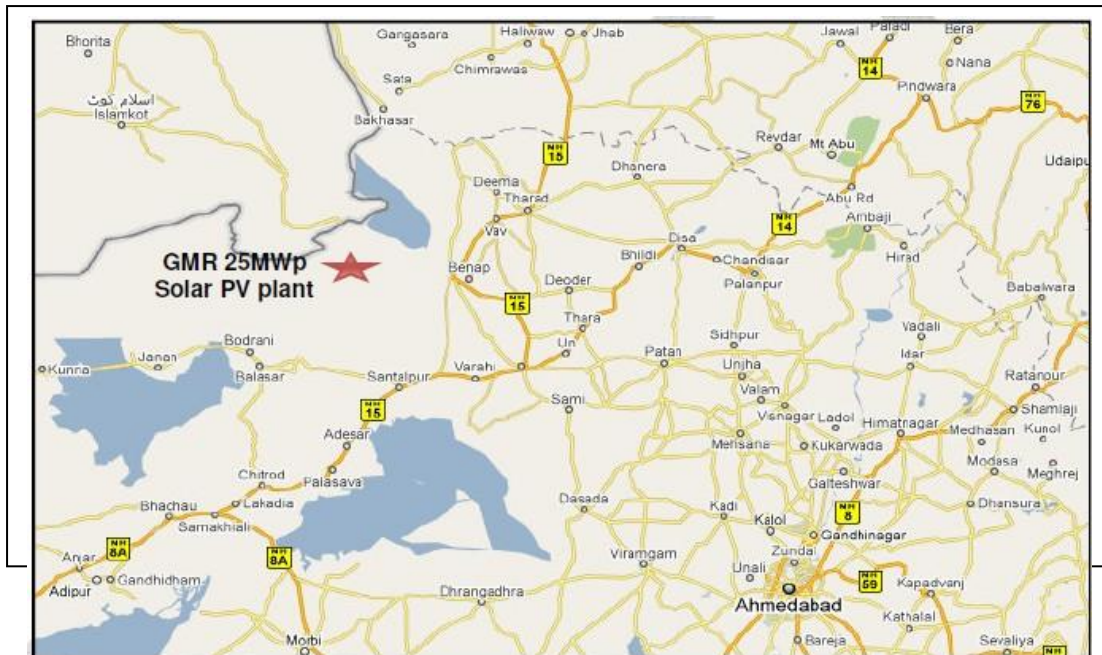
Parameters	CS6P-235P	CS6P-240P
Nominal Maximum power (Pmax)	170 W	174 W
Optimum Operating Voltage (Vop)	27.2 V	27.3V
Optimum Operating Current (Iop)	6.27 A	6.38A
Open Circuit Voltage (Voc)	33.9 V	34.0 V
Short Circuit Current (Isc)	6.86 A	6.96 A

1.9 Project Location

The project activity is located in the Charanka Village of Patan District of Gujarat State in India at an altitude of approximately 8m above mean sea level. The site is located within the GPCL developed Gujarat Solar Park coming up in this village which is approximately 58km from the Radhanpur and 174km from the city of Ahmedabad, a commercial city in the Indian state of Gujarat. The geographical coordinates of the project activity are between:

Latitude: 23°55' 03.32" N, Longitude: 71°12'53.24" E





1.10 Conditions Prior to Project Initiation

This is a Greenfield project. The project activity replaces the carbon intensive grid electricity. The proposed project activity effectively utilises renewable solar energy to generate electricity which is feed into the coal intensive NEWNE Grid. Thereby the project activity reduces the dependence on fossil fuel based generation units and as there are no associated emissions with this project it contributes to the reduction of greenhouse gases (GHG) emissions.

Please refer section B.4 of the registered PDD. The web link for the same is mentioned below:

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project has received necessary approvals for development and commissioning for each plants from the state Nodal agencies and is in compliance to the local laws and regulations. The Project has received Letter of Accreditation from RRECL (State Nodal Agency) as well as received Certificate of Registration as an eligible entity by Central Agency of National Load Dispatch Centre for development, commissioning and generation from the 25 MWp Solar PV Plant and hence is in compliance to the local laws and regulations.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

For the ownership details of the project any of the following may be referred to:

1. Power Purchase Agreement between the project promoters and State Utility;

2. Commissioning certificates;
3. Purchase order of WTGs.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project is registered under CDM and UNFCCC (Registration ID -7128)¹. The project is also approved by the DNA and a copy of the approval is also submitted to the DOE. Project Proponent has submitted undertaking that PP not claim same GHG emission reductions of the project from CDM and VCS. PP would not use net GHG emission reductions by the projects for compliance with emission trading program to meet binding limits on GHG emissions.

1.12.3 Other forms of Environmental Credit

Project has been registration with UNFCCC under Clean Development Mechanism program, Registration reference number is 7128. PP hereby confirms that and also gives undertaking that for Project neither has not intends to generate any form of GHG related environmental credit for GHG emission reductions or removals claimed under the VCS program.

1.12.4 Participation under Other GHG Programs

The project has participated in UNFCCC under Clean Development Mechanism program, Registration reference number is 7128.

1.12.5 Projects Rejected by Other GHG Programs

The project is not rejected by any other GHG Programme.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

The project does not fall under AFOLU category, hence not applicable.

Leakage Management

Project does not involve any leakage emissions as this is solar power project, Hence Leakage Management Plan and risk mitigation measures are not required.

Commercially Sensitive Information

There is no commercially sensitive information accounted for the determination of baseline, net GHG removals and for demonstration of additionality for the present project activity.

Sustainable Development

The project contributes to host country sustainable development criteria.

¹<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

Ministry of Environment and Forests, has stipulated economic, social, environment and technological well-being as the four indicators of sustainable development. The project contributes to sustainable development using the following ways.

Social well-being:

The project would help in generating employment opportunities during the construction and operation phases. The project activity has led to development in infrastructure in the region like development of roads and also may promote business with improved power generation.

Economic well-being:

The project is a clean technology investment in the region, which would not have been taken place in the absence of the VCS benefits the project activity will also help to reduce the demand supply gap in the state. The project activity is generating power using zero emissions solar based power generation which helps to reduce GHG emissions and specific pollutants like SO_x, NO_x, and SPM associated with the conventional thermal power generation facilities.

Technological well-being:

The successful operation of project activity would lead to promotion of solar based power generation and would encourage other entrepreneurs to participate in similar projects.

Environmental well-being:

Solar being a renewable source of energy, it reduces the dependence on fossil fuels and conserves natural resources which are on the verge of depletion. Due to its zero emission the Project activity also helps in avoiding significant amount of GHG emissions.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

Further Information

There are no information or incidents that will have bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission reductions or removals.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The ACM0002 ver. 12 - Consolidated baseline methodology for grid-connected electricity generation from renewable source. Kindly refer registered PDD section B.1.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

2.2 Applicability of Methodology

The methodology applied for the project activity is ACM0002, Version 12.1.0 (EB 58) and the applicability conditions specified in the methodology have been evaluated with respect to the project activity. Kindly refer registered CDM PDD section B.2 at UNFCCC weblink.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

2.3 Project Boundary

The spatial extent of the project boundary includes the proposed project activity power plant and all the other power plants connected physically to the electricity systems, to the project activity is connected to. As per the selected methodology for the project activity a set of greenhouse gases and emission sources are given as follows:

Table: Summary of emission sources included in or excluded from the project boundary				
	Source	Gas	Included?	Justification / Explanation
Baseline	CO ₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO ₂	Yes	Main emission source
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
Project Activity	For geothermal power plants fugitive emissions of CH ₄ and CO ₂ from non-condensable gases contained in geothermal steam	CO ₂	No	Not applicable, as the project activity is a Solar PV power plants
		CH ₄	No	
		N ₂ O	No	
	CO ₂ emission from combustion of fossil for electricity generation in solar thermal power plants and geothermal power plants	CO ₂	No	Not applicable, as the project activity is a Solar PV power plants
		CH ₄	No	
		N ₂ O	No	
	For hydro power plants, emissions of CH ₄ from the reservoir	CO ₂	No	Not applicable, as the project activity is a Solar PV power plants
		CH ₄	No	
		N ₂ O	No	

The project activity consists of the utilization of the solar radiation as input source of energy. This solar radiation is converted to direct current (DC) through Photo Voltaic cell modules and further converted to alternate current (AC) through inverters and fed into the regional grid. There are no sources of gas generation or involvement of gas either as fuel or as exhaust. For details refer registered CDM PDD section B.3 at UNFCCC weblink.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

2.4 Baseline Scenario

The details of Baseline Scenario is mentioned in registered CDM PDD section B.4 at UNFCCC weblink.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

2.5 Additionality

The details of Additionality is mentioned in registered CDM PDD section B.5 at UNFCCC weblink.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

2.6 Methodology Deviations

Not Applicable

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

The details of Baseline Emission is mentioned in registered CDM PDD B.6.1, B.6.2 at UNFCCC weblink.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

3.2 Project Emissions

The Project Emissions are not applicable since project activity does not use any fossil fuels. The details are mentioned in Registered CDM PDD section B.6.3.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

3.3 Leakage

Not Applicable, The details are mentioned in Registered CDM PDD section B.6.3.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

3.4 Estimated Net GHG Emission Reductions and Removals

The details are mentioned in Registered CDM PDD section B.6.3.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

Year	Estimated Baseline	Estimated Project emissions or	Estimated Leakage	Estimated net GHG emission
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	emissions or removals (tCO ₂ e)	removals (tCO ₂ e)	emissions (tCO ₂ e)	reductions or removals (tCO ₂ e)
04/03/2012 – 31/12/2012	29,887	0	0	29,887
Total	29,887	0	0	29,887

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	EFOM,y
Data unit	tCO ₂ /MWh
Description	Simple Operating Margin emission factor for NEWNE grid
Source of data	Latest CO ₂ Baseline Database for the Indian Power Sector prepared by Central Electricity Authority Version 6.0.
Value applied:	0.9941
Justification of choice of data or description of measurement methods and procedures applied	The CO ₂ database is an official publication CEA, Government of India for the purpose of CDM baselines. It is based on most recent data (2007-08, 2008-09 & 2009-10) available to the CEA and hence considered authentic.
Purpose of the data	Calculation of baseline emissions
Comments	The value is fixed ex-ante and it will remain same throughout during the crediting period

Data / Parameter	EFBM,y
Data unit	tCO ₂ /MWh
Description	Build Margin emission factor for NEWNE grid
Source of data	Latest CO ₂ Baseline Database for the Indian Power Sector prepared by Central Electricity Authority Version 6.0.
Value applied:	0.8123
Justification of choice of data or description of measurement methods and procedures applied	The CO ₂ database is an official publication CEA, Government of India for the purpose of CDM baselines. It is based on most recent data (2007-08, 2008-09 & 2009-10) available to the CEA and hence considered authentic.
Purpose of the data	Calculation of baseline emissions
Comments	The value is fixed ex-ante and it will remain same throughout during the crediting period

Data / Parameter	EFCM,y
Data unit	tCO ₂ /MWh
Description	Combined Margin emission factor for NEWNE grid
Source of data	Latest CO ₂ Baseline Database for the Indian Power Sector prepared by Central Electricity Authority Version 6.0.
Value applied:	0.9486 tCO ₂ /MWh. Fixed during the crediting period.
Justification of choice of data or description of measurement methods and procedures applied	The CO ₂ database is an official publication CEA, Government of India for the purpose of CDM baselines. It is based on most recent data (2007-08, 2008-09 & 2009-10) available to the CEA and hence considered authentic.
Purpose of the data	Calculation of baseline emissions
Comments	The value is fixed ex-ante and it will remain same throughout during the crediting period.

4.2 Data and Parameters Monitored

Data / Parameter	EGfacility,y
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Joint Meter readings by Project Proponent and GETCO at the interconnection point
Description of measurement methods and procedures to be applied	The metering system will include three main meters and three check meters (also known as Backup meters) at HT side of the transformers. (Three transformers exist). The Backup meters are used for cross checking. Total electricity generated by the project activity would be the sum of three meter readings of the main meters having facilities to record both export and import of electricity to and from the grid. The net electricity exported from project to the grid is a calculated parameter and is determined from the difference between the electricity export and import. In case of failure of the main meters, check meter readings would be used. The meter readings (coded) is taken by GETCO on monthly basis and is decoded at their end and send a statement of electricity generation to PP.
Frequency of	Continuously measured with Monthly recording

monitoring/recording													
Value monitored:	31,507												
Monitoring equipment	3 Main Meter and 3 Check at 3 Transformer Equipment: Electronic trivector meters Accuracy Class: 0.2S Serial number of main & check meter: Date of Calibration of main and check energy meter is 26-12-2011 and valid till date 25-12-2014. <table><tr><th>Serial No</th><th>Main Meter</th><th>Check Meter</th></tr><tr><td>Transformer 1</td><td>GJ1196A</td><td>GJ1197A</td></tr><tr><td>Transformer 2</td><td>GJ1440A</td><td>GJ1441A</td></tr><tr><td>Transformer 3</td><td>GJ1190A</td><td>GJ1198A</td></tr></table>	Serial No	Main Meter	Check Meter	Transformer 1	GJ1196A	GJ1197A	Transformer 2	GJ1440A	GJ1441A	Transformer 3	GJ1190A	GJ1198A
Serial No	Main Meter	Check Meter											
Transformer 1	GJ1196A	GJ1197A											
Transformer 2	GJ1440A	GJ1441A											
Transformer 3	GJ1190A	GJ1198A											
QA/QC procedures to be applied	The main meter and check meters is sealed under in the presence of representatives of Project Proponent and GETCO. The main and check meters are of ABT compliant and with an accuracy class of 0.2S. The Backup meters are used for cross checking. The main and check meters is calibrated once in a period of three years. However, in case of any of the meters found outside the acceptable limits of accuracy or otherwise not functioning properly it is repaired or adjusted or re-calibrated or replaced by Project Proponent in consultation with GETCO. The measured results by GETCO is cross checked with records for sold electricity (Invoices).												
Purpose of the data	Calculation of baseline emissions												
Calculation method	Not Applicable												
Comments	The data is archived for crediting period + 2 years.												

4.3 Monitoring Plan

Monitoring of emission reductions is carried out as per the baseline and monitoring methodology for the project activity i.e. ACM0002 version 12 which requires monitoring of the following:

Quantity of net electricity supplied to the grid from the project activity:

The project proponent selected ex-ante determination of the baseline hence the monitoring of operating margin emission factor and build margin emission factor is not required. Further, solar energy based electricity generation is not associated with any kind of leakages. Hence, the sole parameter for monitoring is the electricity generated by the project activity and supplied to the grid.

Monitoring Plan:

Metering Arrangement:

The metering arrangement is done as per Power Purchase Agreement (PPA) signed by the project proponent. For the purpose of energy accounting, the project proponent shall provide ABT complaint meters

at the interface points. Interface metering shall confirm to the Central Electricity Authority (installation and Operation Meters) Regulation 2006.

Metering Equipment:**Main meter and backup meter:****Measurement Procedure:**

The GETCO and the project proponent shall jointly read the metering system every month at the delivery point. In the event that the main metering system is not in service as a result of maintenance, repairs or testing, then the backup metering system is used during the period the main metering system is not in service and the provisions above shall apply to the backup metering system.

Meter reading taken jointly at the appointed date and time is signed by the representatives of GUVNL, GETCO and the project proponent. If project proponent's representative is not present, then the GETCO shall provide the project proponent with the signed copy of the meter reading of the main metering system or the backup metering system as the case may be. Such meter reading is treated as the accurate and final measurement, unless proved otherwise, of the energy provided to the GUVNL, by the project proponent of the preceding month for the purpose of payment.

Sealing and Maintenance of Meters:

The main metering system and the backup metering system is sealed in the presence of representatives of the project proponent and GETCO. When the main metering system and/or backup metering system and/or any component thereof is found to be outside the acceptable limits of accuracy or otherwise not functioning properly, it is repaired, re-calibrated or replaced by the project proponent and/or the GUVNL/GETCO at the project proponent's cost, as soon as possible.

Any meter seal(s) is broken only by the GETCO's representative in the presence of project proponent's representative whenever the main metering System or the Backup Metering System is to be inspected, tested, adjusted, repaired or replaced.

All the main and check meters is calibrated once in a period of three (3) years.

In case, both the main and check meters are found to be beyond permissible limit of error, both the meters is be calibrated immediately and the correction applicable to the main meter is applied to the energy registered by the main meter at the correct energy for the purpose of energy account/billing for the actual period during which inaccurate measurements were made, if such period can be determined or, if not readily determinable, is the shorter of:

1. The period since the immediately preceding test of the relevant Main Meter, or
2. One hundred and eighty (180) days immediately preceding the test at which the relevant Main meter was determined to be defective or inaccurate.

QA/QC Procedure:

1. Meters accuracy class: 0.2 s
2. Meters are calibrated once in a period of three years.
3. Net electricity generated by project activity is cross-checked with electricity invoiced.

Data Monitoring Procedures:

The metering system will include three main meters and three check meters (also known as Backup meters) at HT side of the transformers. (Three transformers exist). The Backup meters are used for cross checking.

Total electricity generated by the project activity would be the sum of three meter readings of the main meters having facilities to record both export and import of electricity to and from the grid. The net electricity exported from project to the grid is a calculated parameter and is determined from the difference between the electricity export and import. In case of failure of the main meters, check meter readings would be used. The meter readings (coded) is taken by GETCO on monthly basis and is decoded at their end and send a statement of electricity generation to PP.

The project team is delegated with the responsibility to monitor and document the electricity generated and also safe keeping of the recorded data. The project team is also responsible for calculation of emission reduction in the most transparent and relevant manner. All the monitoring data is stored/is recorded and kept under safe custody. The organizational structure for the monitoring plan for both the sites is shown below.

The monitoring plan for measurement of key parameters for emission reduction calculations and the responsible personnel is given below:

Position	Responsibility
Project in-charge (at Corporate office, Bangalore)	• Reviewing the monthly and annual generation statistics. • Evaluating the GHG performance of the project activity. • Identify opportunities for further improvement.
Site In-charge	• Implementation of appropriate corrective measures in case any discrepancies are identified in the reported parameters. • Review of monthly reports. • Monitoring and reporting the GHG performance related parameters following the guidance provided in the Project Design Document • Ensuring calibration of the monitoring equipment's as and when required
O&M In-charge (out sourced)	• Preparation of the monthly and annual generation statistics. • Reporting of any discrepancies identified in the reporting parameters
Support Staff	• Data input to O&M in-charge for report preparation

5 SAFEGUARDS

5.1 No Net Harm

Not Applicable

5.2 Environmental Impact

Not Applicable. The details are mentioned in Registered CDM PDD section D.2

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

5.3 Local Stakeholder Consultation

The details are mentioned in Registered CDM PDD section E.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

5.4 Public Comments

The details are mentioned in Registered CDM PDD section E.

<https://cdm.unfccc.int/Projects/DB/LRQA%20Ltd1346316979.16/view>

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	EGfacility,y
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Joint Meter readings by Project Proponent and GETCO at the interconnection point
Description of measurement methods and procedures to be applied	The metering system will include three main meters and three check meters (also known as Backup meters) at HT side of the transformers. (Three transformers exist). The Backup meters are used for cross checking. Total electricity generated by the project activity would be the sum of three meter readings of the main meters having facilities to record both export and import of electricity to and from the grid. The net electricity exported from project to the grid is a calculated parameter and is determined from the difference between the electricity export and import. In case of failure of the main meters, check meter readings would be used. The meter readings (coded) is taken by GETCO on monthly basis and is decoded at their end and send a statement of electricity generation to PP.
Frequency of monitoring/recording	Continuously measured with Monthly recording
Value monitored:	31,507

Monitoring equipment	3 Main Meter and 3 Check at 3 Transformer Equipment: Electronic trivector meters Accuracy Class: 0.2S Serial number of main & check meter: Date of Calibration of main and check energy meter is 26-12-2011 and valid till date 25-12-2014. <table><tr><th>Serial No</th><th>Main Meter</th><th>Check Meter</th></tr><tr><td>Transformer 1</td><td>GJ1196A</td><td>GJ1197A</td></tr><tr><td>Transformer 2</td><td>GJ1440A</td><td>GJ1441A</td></tr><tr><td>Transformer 3</td><td>GJ1190A</td><td>GJ1198A</td></tr></table>	Serial No	Main Meter	Check Meter	Transformer 1	GJ1196A	GJ1197A	Transformer 2	GJ1440A	GJ1441A	Transformer 3	GJ1190A	GJ1198A
Serial No	Main Meter	Check Meter											
Transformer 1	GJ1196A	GJ1197A											
Transformer 2	GJ1440A	GJ1441A											
Transformer 3	GJ1190A	GJ1198A											
QA/QC procedures to be applied	The main meter and check meters is sealed under in the presence of representatives of Project Proponent and GETCO. The main and check meters are of ABT compliant and with an accuracy class of 0.2S. The Backup meters are used for cross checking. The main and check meters is calibrated once in a period of three years. However, in case of any of the meters found outside the acceptable limits of accuracy or otherwise not functioning properly it is repaired or adjusted or re-calibrated or replaced by Project Proponent in consultation with GETCO. The measured results by GETCO is cross checked with records for sold electricity (Invoices).												
Purpose of the data	Calculation of baseline emissions												
Calculation method	Not Applicable												
Comments	The data is archived for crediting period + 2 years.												

6.2 Baseline Emissions

$$BE_y = EG_{PJ,y} \cdot EF_{grid, CM, y}$$

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).

$EF_{grid, CM, y}$ is the CO₂ emission factor (combined margin) of the grid. This is fixed ex-ante parameter having value as **0.9486** tCO₂/MWh.

	Meter Reading for Month*	Export kWh	Import kWh	Net Export kWh
FY 12-13	Mar'12 ²	2,317,561	13,976	2,304

²CoD 12 March 2012

	Apr'12	3,583,570	28,328	3,555
	May'12	4,066,113	36,807	4,029
	June'12	3,396,328	29,082	3,367
	July'12	2,556,696	32,126	2,525
	Aug'12	2,289,521	31,724	2,258
	Sep'12	2,901,430	31,536	2,870
	Oct'12	3,805,821	36,981	3,769
	Nov'12	3,414,811	32,290	3,383
	Dec'12	3,480,945	33,436	3,448
Total		31,812,796	306,286	31,507

Annual Generation $EG_{PJ,y}$ is calculated as follows:		
Parameters		
Annual average net electricity generation ($EG_{PJ,y}$)	31,507	MWh
Baseline emissions (BE_y) are calculated as follows:		
Baseline Emission factor (NEWNE) $EF_{grid,CM,y}$	0.9486	tCO ₂ /MWh
<i>Baseline Emissions: $BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$</i>		
Baseline Emissions (BE_y)	29,887	tCO ₂

Project activity emissions

Since the project activity does not use any fossil fuels, thus Project Emissions (PE_y) = 0

Leakage

According to ACM0002, Leakage (L_y) is 0.

Emission Reductions $ER_y = BE_y - PE_y$

$ER_y = BE_y$

Emission Reductions = 29,887 tCO₂e

6.3 Project Emissions

As per the registered PDD, project emissions are not applicable as this is a solar power generation project.

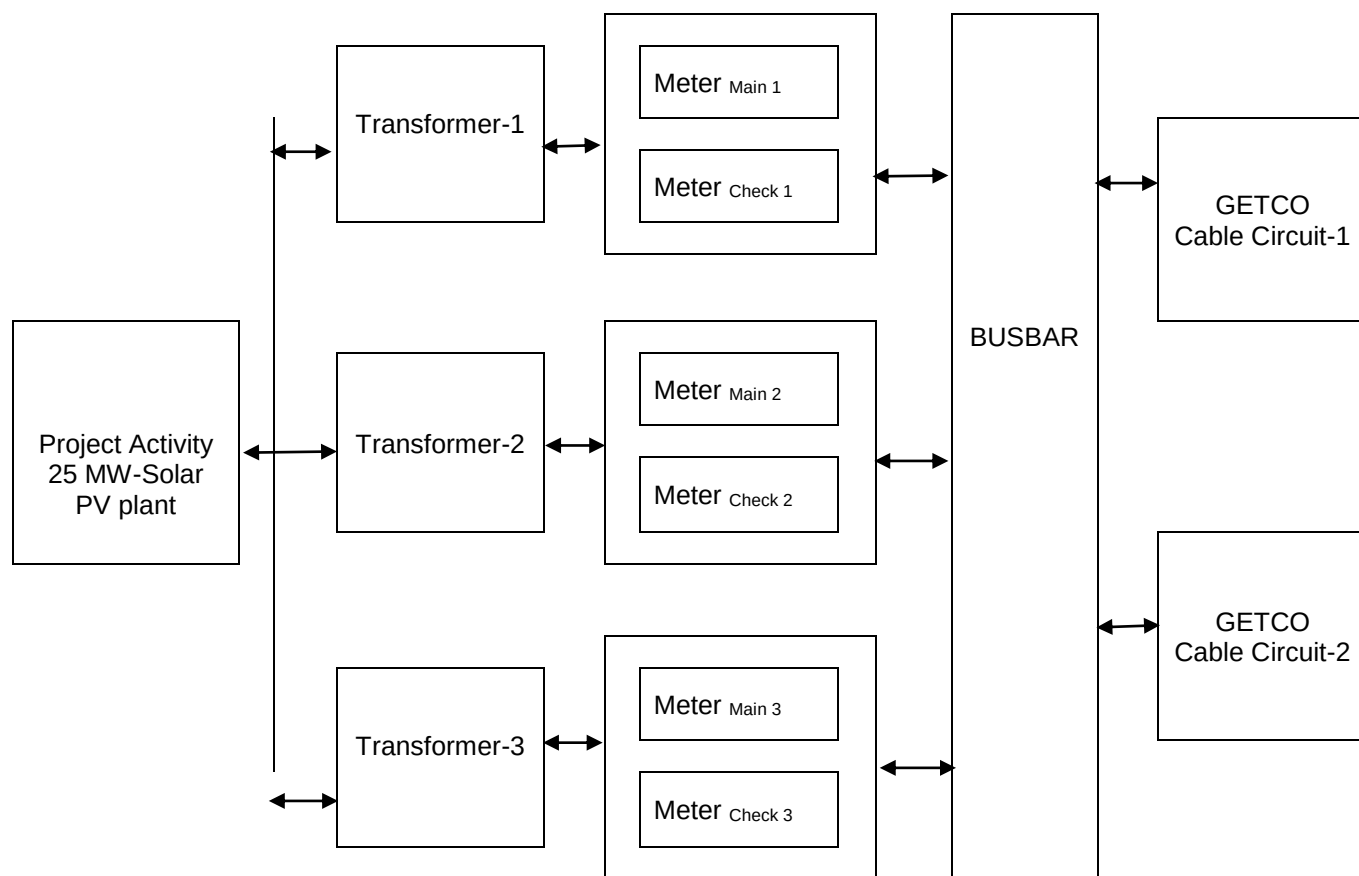
6.4 Leakage

As per the registered PDD, leakage is not applicable as this is a solar power generation project.

6.5 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
From 4 th March 2012 to 31 st Dec 2012	29,887	0	0	29,887
Total	29,887	0	0	29,887

APPENDIX X: METERING DIAGRAM



Commercial Operation Date (CoD)	4-Mar-12			
Calibration Validity as per registered PDD and PPA	3 years			
ABT Meter at the time of CoD M/s Secure Make				
	Main Meter	Check Meter	Date of Calibration	Calibration Valid till
Transformer 1	GJ1196A	GJ1197A	26-12-2011	25-12-2014
Transformer 2	GJ1440A	GJ1441A	26-12-2011	25-12-2014
Transformer 3	GJ1190A	GJ1198A	26-12-2011	25-12-2014