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

Document Prepared by EKI Energy Services Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

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 replaces 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 (now is a part of Unified Indian 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?cp=1

The project was commissioned on 4-March- 2012. The total emission reductions for the monitoring period account to be 151,131 tCO2e.

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 SMAare 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:

5	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 40º C	502
			b. In ground at 25º C	441
			Conductor Resistance	
			a. Dc at 20º C	0.0778 ohms/km
			b. 50 Hz at 90º 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 40º C	434
			b. In ground at 25º C	392
			Conductor Resistance	
			a. Dc at 20º C	0.1 ohms/km
			b.50 Hz at 90º C	0.130 ohms/km
			Reactance at 50Hz	0.086 ohms/km
			Capacitance	0.53 µF/km
3	240 Sqmm x 3	Ravin Cables	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

	core 11KV XLPE Armoured cable	Ltd	Current Rating	
			a. In air at 40º C	383
			b. In ground at 25º C	342
			Conductor Resistance	
			a. Dc at 20º C	0.125 ohms/km
			b.50 Hz at 90º 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 is provided for transformer/ switchyard equipment protection and on terminating ends of the transmission lines. The lightning arrestor is 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-ammeters.

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. Gaurav Kumar
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	Gaurav.Kumar2@gmrgroup.in

1.4 Other Entities Involved in the Project

Organization name	**EKI Energy Services Limited**
Role in the Project	Project Consultant
Contact person	Bibhushita Ghose
Title	Assistant Manager(Operations)
Address	EnKing Embassy, Office No 201, Plot 48, Scheme 78, Part 2, Vijay Nagar, Indore- 452010, Madhya Pradesh, India.
Telephone	+91-7003202624
Email	bibhushita@enkingint.org

1.5 Project Start Date

As per CDM definition of start date, the project start date is 08-December-2010, i.e. PPA signing date with Gujarat Urja Vikas Nigam Ltd.

As per VCS standard, start date is earliest date on which GHG emission reduction occurs i.e commissioning date. Hence as per VCS, the project start date is 04-March-2012.

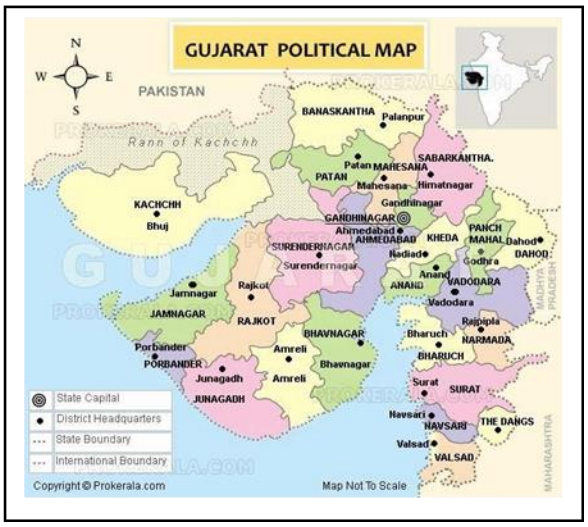
1.6 Project Crediting Period

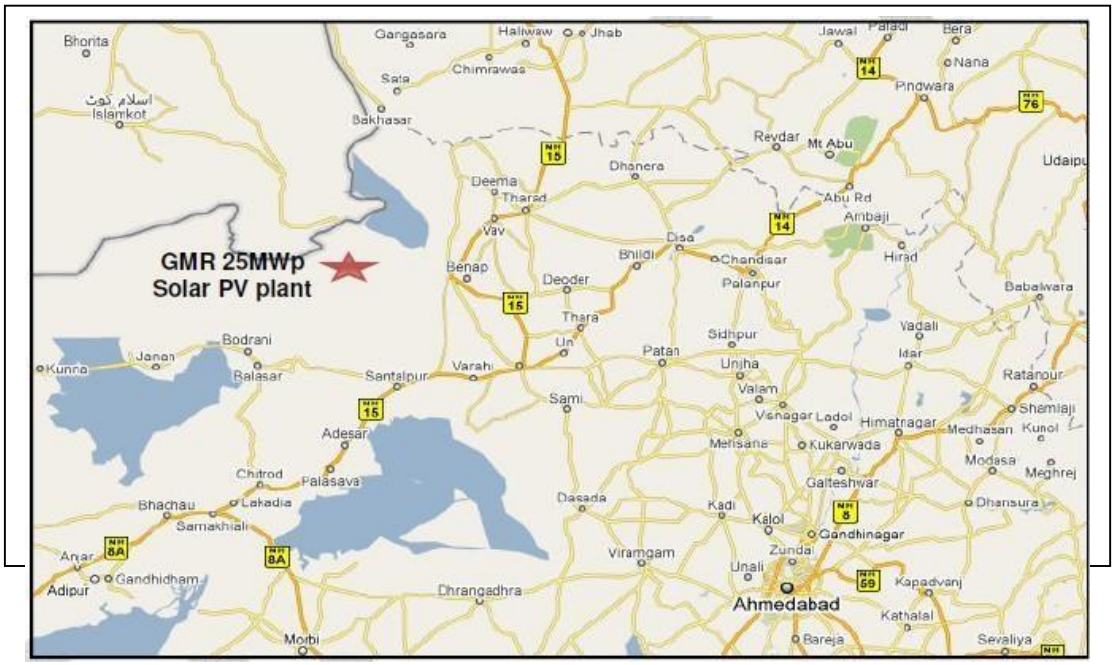
VCS Crediting Period is 04-March-2012 to 03-March-2022. (10 years and Renewable twice)

1.7 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





1.8 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.

Reference:
https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG

1.9 Participation under other GHG Programs

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

The project had completed VCS verification for period 04-March-2012 to 31-December-2012, CDM verification for period 01-January-2013 to 31-August-2016.

The Current VCS verification is for period 01-September-2016 to 31-October-2020. PP will claim credits only one mechanism (either CDM or VCS) for particular period and there will not be any double accounting.

1.10 Other Forms of Credit

The project is registered under CDM and UNFCCC (Registration ID -7128). The project is also approved by the DNA. 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.

1.11 Sustainable Development

The project contributes to host country sustainable development criteria.

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 also helps 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 SOx, NOx, 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.

2 SAFEGUARDS

2.1 No Net Harm

Not applicable

2.2 Local Stakeholder Consultation

Though the project does not have any negative impacts, it is imperative to know the perception of local Inhabitants, GGSPPL had planned for conducting the Local stakeholder's consultation meeting on 29/03/2011. Thus, the project proponent had issued invitation letters (dated 15/03/2011) to the stakeholders available locally. The invitation was prepared both in English and Gujarati language for better communication. However, the Local stakeholders' meeting was postponed due to unforeseen situations. The amendment in date of meeting was intimated through invitations again (dated 04/06/2011)in public address system The meeting was conducted on 11/06/2011 (Saturday) at Site office, wherein stakeholders from various sections such as Governmental, Non-governmental organization, Farmers, Education Centre etc., were participated. The PP has used the Power Point media & also hand-outs for appraising about the project. Among the stakeholders few dignitaries were selected to conduct the meeting and to summarize the proceedings. These were:.

1) Mr. Kanji Bhai Parmar (President – Shardha Sewa Trust (NGO), Radhanpur)

2) Mr. Bharat Bhai Goshwami (Gujarat Power Corporation Ltd. – Solar park In charge officer)
3) Mr. Murtuza Bhai (Gujarat Power Corporation Ltd.- Site Engineer)

4) Mr. I.P.Rahavar (Principal - Charanka School)

Mr. Kanji Bhai Parmar (President – Shardha Sewa Trust (NGO), Radhanpur) had been selected as the Chairman of the meeting and brief introduction about the dignitaries on the dais was given to the gathering. With the consent from the Chairman of the meeting, Mr. Amitabh Roy (Representative-GMR) gave a presentation on project, Greenhouse Effect, Kyoto Protocol, Importance of Local Stakeholders Meeting & Socio-economic Benefits Mr. Amitabh Roy explained the stakeholders regarding the project activity - being renewable technology will contribute towards sustainability of our environment – as there will not be burning of any fossil fuels to generate electricity as in the case of Thermal Power Plants.

This results in reduction of Carbon Dioxide Emission into the atmosphere and thus reduces thrust of Global Warming. Later, the presentation was concluded by Mr. Amitabh Roy inviting Queries, suggestions and concerns from the Local Stakeholders. The comments were addressed by the Project Proponent and recorded in minutes of meeting.

The process of Local Stakeholder Consultation is continuous. During the current monitoring period, the project proponent kept grievance register at project site office and sought suggestions/feedback from local stakeholders including local community and local public administrative personnel; however, no any comments/feedbacks received from the stakeholders.

2.3 AFOLU-Specific Safeguards

Not applicable to this as this is not an AFOLU project activity.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project has been completed and the monitoring equipments were installed to monitor the parameters as described in the registered Project Description (PD). All the solar modules involved in the project activity are already commissioned and operational. The modules are under operation since the date of commissioning and no event has been identified which may impact GHG emission reduction. Deviations. The plant was commissioned on 04-March-2012.

Not applicable.

2.3.1 Methodology Deviations

2.3.2 Project Description Deviations

The below deviations are requested for project activity to rectify the typo error in Joint PD & MR

1. There is a typo error in joint PD & MR, the start date (i.e PPA signing date) mentioned joint PD & MR is as per CDM definition of start date. As per VCS standard, earliest commissioning date is start date, hence VCS MR has mentioned 04/03/2012 as start date of project activity and also start date of crediting period. Deviation is requested in VCS MR for same.

2. Joint PDD & MR dated 16/10/2018, has mentioned CDM crediting period as 01 Jan 13 - 30 Aug 19 which is 7 years renewal twice. This is typo error in Joint PDD & MR dated

16/10/2018, regarding mention of CDM crediting period and not mention of VCS crediting period.

However as per VCS standard available at the time of project's VCS registration, VCS project crediting period can start from commissioning date and crediting period can be of 10 years with maximum renewal of 2 times. Hence VCS project crediting period is from 04/03/2012 to 03/03/2022 (10 years period) and same can renew twice. Deviation is requested in VCS MR for same.

The above requested deviations does not have any impacts on applicability of the methodology, additionality or the appropriateness of the baseline scenario.

3.2 Grouped Projects

The project is not a grouped project thus this is not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{OM,y}$
Data unit	tCO_2/MWh
Description	Simple Operating Margin emission factor for NEWNE grid(now part of Unified Indian Grid)
Source of data	Latest CO2 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 CO2 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 Data	Calculation of baseline emissions
Comments	The value is fixed ex-ante and it remains same throughout during the crediting period

Data / Parameter	$EF_{BM,y}$
Data unit	tCO_2/MWh

Description	Build Margin emission factor for NEWNE grid(now part of Unified Indian Grid)
Source of data	Latest CO2 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 CO2 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 Data	Calculation of baseline emissions
Comments	The value is fixed ex-ante and it remains same throughout during the crediting period

Data / Parameter	$EF_{CM,y}$
Data unit	tCO_2/MWh
Description	Combined Margin emission factor for NEWNE grid(now part of Unified Indian 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 tCO2/MWh. Fixed during the crediting period.
Justification of choice of data or description of measurement methods and procedures applied	The CO2 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 Data	Calculation of baseline emissions
Comments	The value is fixed ex-ante and it remains same throughout during the crediting period.

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
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

<table>
<tr><td></td><td>interconnection point</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>The metering system includes 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.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuously measured with Monthly recording</td></tr>
<tr><td>Value monitored</td><td>
<table>
<tr><td>Year</td><td>MWh</td></tr>
<tr><td>2016</td><td>14,061.662</td></tr>
<tr><td>2017</td><td>38,826.054</td></tr>
<tr><td>2018</td><td>38,392.342</td></tr>
<tr><td>2019</td><td>37,226.067</td></tr>
<tr><td>2020</td><td>30,817.595</td></tr>
<tr><td>Total</td><td>159,323.72</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>3 Main Meter and 3 Check Meter at 3 Transformer
Equipment: Electronic trivector meters Accuracy Class: 0.2S
Meters at the time of Commissioning are detailed below:
<table>
<tr><td></td><td>Main Meter</td><td>Check Meter</td></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>
The meters were replaced by new meters on 16/04/2013. Calibration details of new meters are detailed below:
<table>
<tr><td></td><td>Main Meter</td><td>Date of Calibration</td><td>Date of Calibration</td></tr>
<tr><td>Transformer 1</td><td>GJ1819A</td><td>07/07/2016</td><td>26/09/2019</td></tr>
<tr><td>Transformer 2</td><td>GJ1820A</td><td>07/07/2016</td><td>25/09/2019</td></tr>
</table>
</td></tr>
</table>

	Transformer 3 | GJ1818A | 04/08/2016 | 25/09/2019 | | Check Meter | Date of Calibration | Date of Calibration | | Transformer 1 | HT01131053 | 30/06/2016 | 26/09/2019 | | Transformer 2 | HT01131051 | 30/06/2016 | 26/09/2019 | | Transformer 3 | HT01131052 | 22/06/2016 | 25/09/2019 |
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). In the current monitoring period as calibration is delayed by three months, error factor has been applied for emission reduction calculation for July-2019, August-2019 and September-2019.
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.

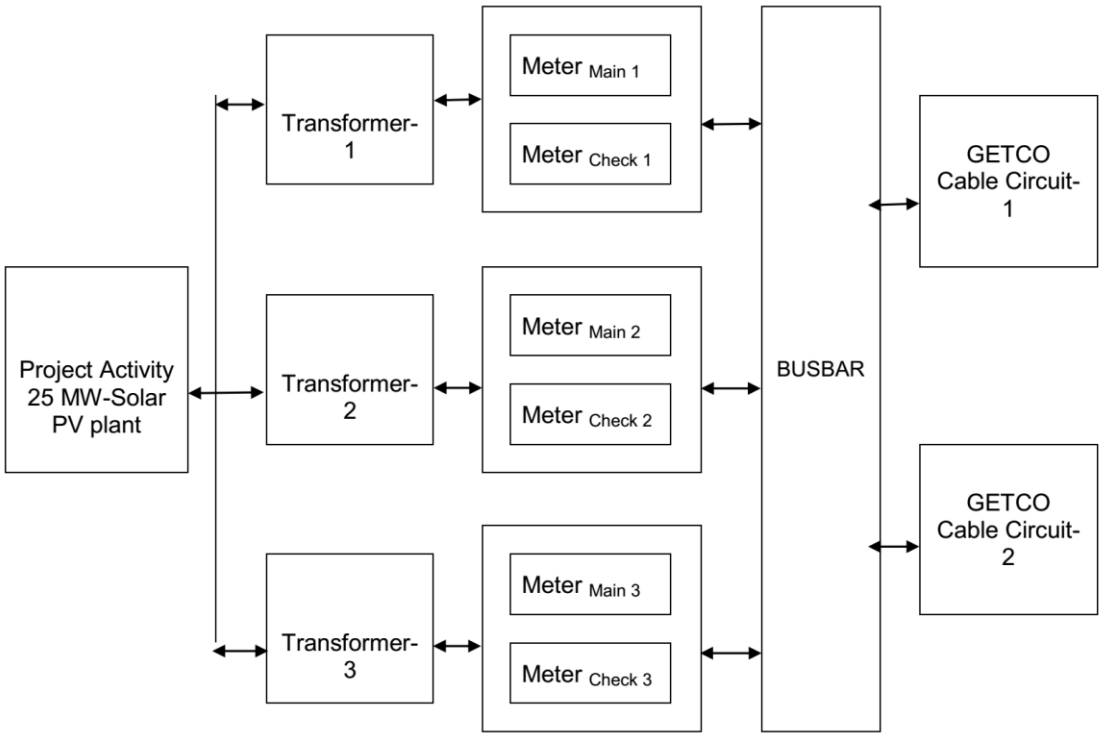
QA/QC Procedure:

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 includes 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.

The Line diagram of the Metering arrangements at the project activity (The BUSBAR is the connection point of Indian grid (NEWNE) at the project site) is shown below:



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 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

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

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.

Year wise net electricity generation details are shown in table below

Year	MWh	Vintage wise VCUs (Rounded Down)
2016	14061.662	13,338
2017	38826.054	36,830
2018	38392.342	36,418
2019	37226.067	35,312
2020	30817.595	29,233
Total	159323.72	151,131

Net electricity generation in monitoring period = 159323.72 MWh.

So Baseline emission = 151,131 tCO_2 (Rounded Down for each vintage)

5.2 Project Emissions

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

5.3 Leakage

According to ACM0002, Leakage (Ly) is 0.

Emission Reductions ERy = BEy

Emission Reductions = 151,131 tCO2e.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2016	13,338	0	0	13,338

2017	36,830	0	0	36,830
2018	36,418	0	0	36,418
2019	35,312	0	0	35,312
2020	29,233	0	0	29,233
Total	151,131	0	0	151,131

The actual VER is about 5.17% higher than the estimated VER. This variation is majorly due to the variations in weather pattern, grid availability and other parameters which are not in the control of PP. The increase of emission reductions is within threshold limit of sensitivity and do not have any impact on additionality.