**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

# PROJECT DESIGN DOCUMENT (PDD)

| | |
|---|---|
| **Title of the project activity** | 5 MW Solar PV Power Plant CDM Project by OPG Energy Private Ltd., - Baap, Jodhpur, Rajasthan, India |
| **Version number of the PDD** | 01 |
| **Completion date of the PDD** | 30/07/2013 |
| **Project participant(s)** | OPG Energy Private Ltd |
| **Host Party(ies)** | India |
| **Sectoral scope(s) and selected methodology(ies)** | **Sectoral scope:** 1<br>**Selected Methodology**: AMS-I.D. Grid Connected Renewable Electricity Generation (Version 17.0) |
| **Estimated amount of annual average GHG emission reductions** | 8,680 tCO2 |

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

>>

*Purpose of the project activity:*

OPG Energy Private Ltd has developed a 5 MWp solar photovoltaic power plant at Baap village (also called as "Bap" village) of Jodhpur district, in the State of Rajasthan. The project participant will supply power to the grid and hence replaces the equal amount of power which would have otherwise been generated by grid connected carbon intensive power plants.

The proposed 5 MWp solar project is a Greenfield project activity. The project activity uses solar photovoltaic modules for producing the power. The process of generating power through solar energy is a clean technology, as there is no fossil fuel fired or no green house gases are emitted during the process. The generated power from this project activity is supplied to the NEWNE grid. The project participant has signed Power Purchase Agreement (PPA) for 25 years period, with NTPC Vidyut Vyapar Nigam Limited (NVVN), New Delhi, India. The project activity helps in reducing 8,680 $tCO_2e$ per year, by displacing 9,071 MWh equivalent amount of electricity which would have been generated through the operation power from fossil fuel based electricity generation in the NEWNE grid. The project has been commissioned on 13th October 2011.

*Contribution to Sustainable Development:*

The implementation of this project activity would contribute to the sustainable development of the region in the following ways as stipulated by the Ministry of Environment and Forests (MoEF) in the interim approval guidelines for CDM projects. Ministry of Environment and Forests, Govt. of India has stipulated the social well being, economic well being, environmental well being and technological well being as the four indicators for sustainable development in the interim approval guidelines host country approval eligibility criteria for Clean Development Mechanism (CDM) projects[1].

**Social well-being:**

The project activity will provide employment opportunities to the local people thereby improving the employment level of the local people.

**Economic well-being:**

The project activity will create business opportunities for local stakeholders such as bankers, consultants, equipment suppliers, manufacturers and contractors during the implementation phase. The contribution of the project activity towards the infrastructural development of the region will result in an economic well-being for the local populace throughout the project lifetime.

**Environmental well-being:**

This project activity would be using the available solar potential for power generation process, which has no associated GHG emissions. This will certainly have a positive impact on the environment both at local and global level.

**Technological well-being:**

The project leads to utilization of environmentally safe and sound technologies in small scale solar projects. Setting up of this project will also increase the private sector participation in this project category thereby contributing to more green power to the grid system.

[1] http://www.cdmindia.in/approval_process.php

## A.2. Location of project activity

### A.2.1. Host Party(ies)

>>

India

### A.2.2. Region/State/Province etc.

>>

State: Rajasthan

### A.2.3. City/Town/Community etc.

>>

District: Jodhpur
Tehsil: Phalodi
Village: Baap

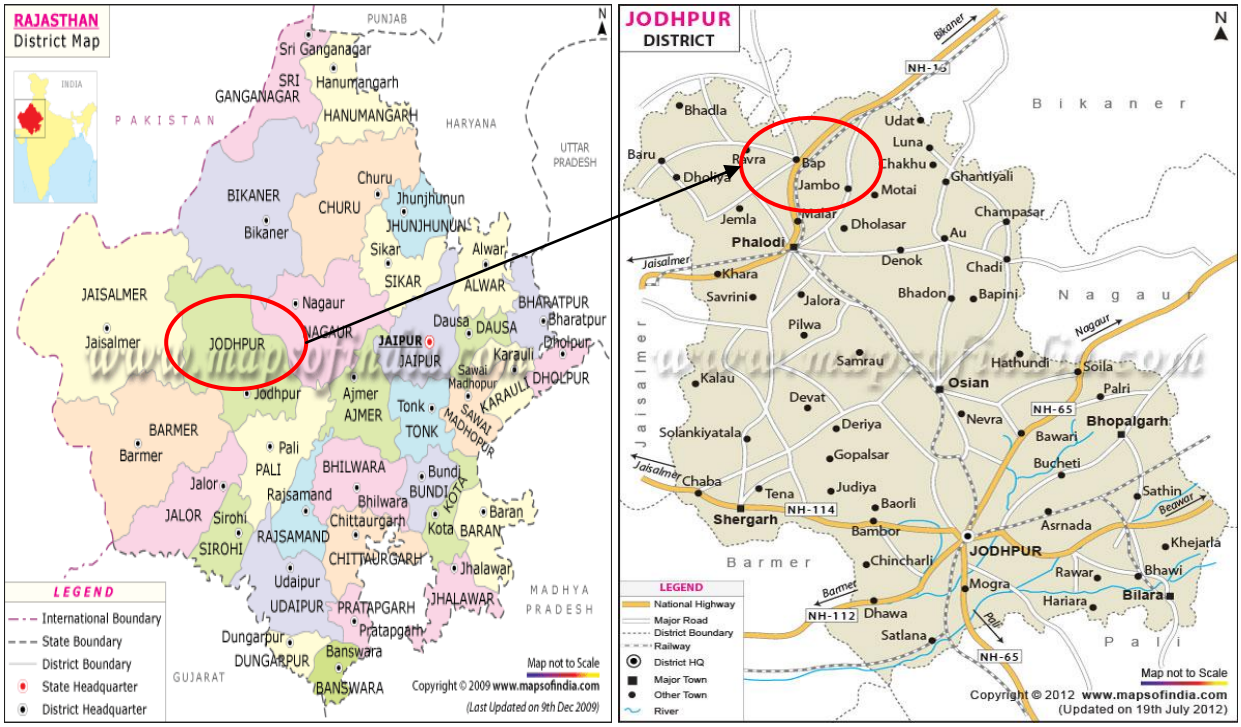
### A.2.4. Physical/ Geographical location

>>

The Proposed project site is in Baap village located in Phalodi Tehsil of Jodhpur district.The coordinates of the site are

Latitude : $27^0$ 21'20.61" N
Longitude : $72^0$ 21' 04.71'' E

The location map is as given below[2,3]




## A.3. Technologies and/or measures

>>

[2] http://www.mapsofindia.com/maps/rajasthan/rajasthan.htm
[3] http://www.mapsofindia.com/maps/rajasthan/districts/jodhpur.htm

The project activity uses thin film solar photovoltaic technology. The solar photovoltaic cells, also known as the solar cells, are used to convert solar energy into electrical energy[4]. The solar cells are the basic elements of a solar module. Essentially, when light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This energy knocks electrons loose, allowing them to flow freely. PV cells have one or more electric fields that act to force electrons freed by light absorption to flow in a certain direction. This flow of electrons constitutes an electric current, which can be drawn from the cell. This current, together with the cell's voltage defines the power that the solar cell can produce.
Solar modules with varying module wattage of 40 Wp, 62.5 Wp and 72.5 Wp are connected together to produce the total project capacity of 5 MWp power. The solar modules are further connected to the inverters. Inverters shall convert the DC energy produced by array to AC voltage using its MPPT (Maximum Power Point Control) control to extract maximum energy from solar array and synchronize with the grid through LT/HT panels.

Technical specifications of the solar modules:

| **Topray Solar (40 W)** | |
|---|---|
| Maximum Power Pmax (W) | 40 |
| Open circuit voltage-Voc (V) | 61 |
| Short Circuit Current Isc | 1 |
| Maximum Power Voltage-Vpm | 46 |
| Maximum Power Current-Ipm (A) | 0.87 |
| Power Tolerance | +/-3% |
| Cell Type | Amorphous Silicon Solar Cell |
| | |
| **Abound Solar (62.5 W)** | |
| Model number | AB1-62 |
| Nominal Power $P_{MPP}$ (w) | 62.5 |
| Voltage at nominal power $V_{MPP}$ (V) | 34.3 |
| Current at nominal power $I_{MPP}$ (A) | 1.83 |
| Short circuit current $I_{sc}$ (A) | 2.24 |
| Open circuit voltage $V_{oc}$ (V) | 45.7 |
| Cell Type | Calcium Telluride (CdTe) |
| | |
| **Abound Solar (72.5 W)** | |
| Model number | AB1-72 |
| Nominal Power $P_{MPP}$ (w) | 72.5 |
| Voltage at nominal power $V_{MPP}$ (V) | 34.3 |
| Current at nominal power $I_{MPP}$ (A) | 2.10 |
| Short circuit current $I_{sc}$ (A) | 2.48 |
| Open circuit voltage $V_{oc}$ (V) | 46.40 |
| Cell Type | Calcium Telluride (CdTe) |

Technical specifications of the transformers:

| | |
|---|---|
| Rated capacity, kVA (Continuous) | 1250 |
| Type of Cooling | ONAN |
| Short circuit level (HV) and duration | 31.5 kArms 1 secs |

[4] http://protekan.com/SolarPVTechnology.aspx

| | |
|---|---|
| Rated voltage / highest voltage for the equipment between phases, kV | |
| *HV* | 36 |
| LV | 0.270+10%<br>(insulated for 3.6 kV rms) |
| Rated frequency, Hz | 50 Hz ± 5% |

**A.4. Parties and project participants**

| **Party involved (host) indicates a host Party** | **Private and/or public entity(ies) project participants (as applicable)** | **Indicate if the Party involved wishes to be considered as project participant (Yes/No)** |
|---|---|---|
| India<br>(host) | OPG Energy Private Ltd<br>(Private entity) | No |

**A.5. Public funding of project activity**

>>

There is no public funding involved in this Project Activity from Annex I countries.

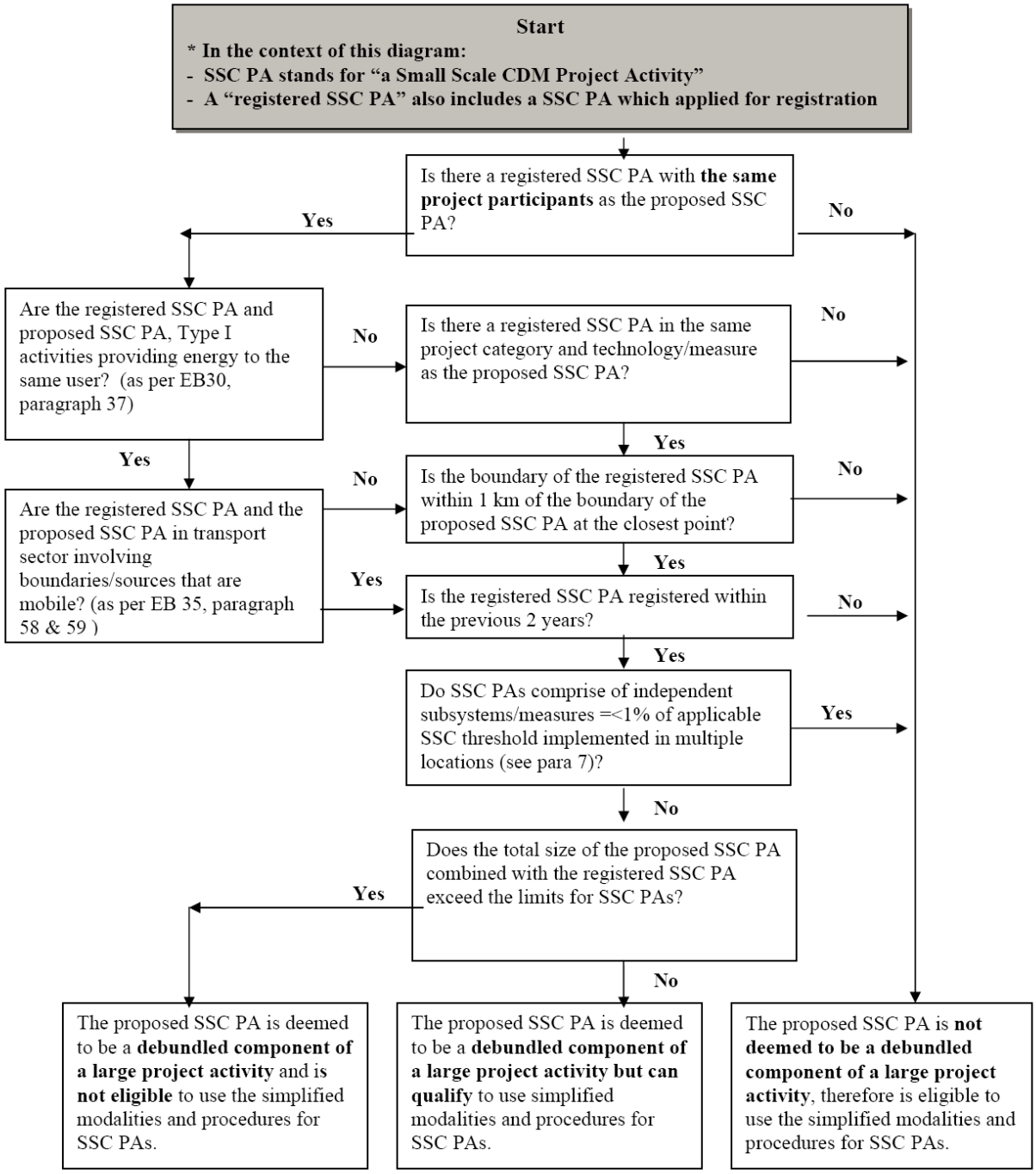
**A.6. Debundling for project activity**

>>

According to paragraph 2 of Appendix C to the Simplified Modalities and Procedures for Small-Scale CDM project activities (FCCC/CP/2002/7/Add.3), a small-scale project is considered as a debundled component of a large project activity if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same project participants
- In the same project category and technology
- Registered within the previous two years; and
- Whose project boundary is within 1km of the project boundary of the proposed small scale activity

As per "Guidelines on assessment of debundling for SSC project activities" version 03, EB 54 the procedure for determining occurrence of bundling is as given below:




The project activity is not a de-bundled component of a large project activity as –

There is no small scale CDM project activity or an application registered by the project proponent, in the same project category in the last two years within 1 km of the project boundary of the proposed small-scale project activity.

**SECTION B. Application of selected approved baseline and monitoring methodology**

**B.1. Reference of methodology**

>>

The project activity is a small scale project activity and conforms to Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

Type : I - Renewable Energy Industries
Category : AMS-I.D. Grid Connected Renewable Electricity Generation[5].
Version : 17, EB 61
Date : 03/06/2011
Tools Used : Tool to calculate the emission factor for an electricity system[6]
Version 03.0.0 / EB – 70 Annex 22

**B.2. Project activity eligibility**

>>

<table>
<tr><th>AMS-I.D. ver 17 applicability conditions</th><th>Project Applicability</th></tr>
<tr><td>This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and renewable biomass supplying electricity to a national or a regional grid. Projects supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.</td><td>This project generates energy from solar photovoltaic and supply electricity to the regional grid. Hence the condition is applicable.</td></tr>
<tr><td>Illustration of respective situations under which each of the methodology (i.e. AMS-I.A, AMS-I.D and AMS-I.F) applies is included in below table.<br><br>Applicability of AMS-I.D, AMS-I.F and AMS-I.A based on project types
<table>
<tr><th></th><th>Project type</th><th>AMS-I.A</th><th>AMS-I.D</th><th>AMS-I.F</th></tr>
<tr><td>1</td><td>Project supplies electricity to a national/regional grid</td><td></td><td>√</td><td></td></tr>
<tr><td>2</td><td>Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity ma be supplied to a grid)</td><td></td><td></td><td>√</td></tr>
<tr><td>3</td><td>Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td><td></td><td>√</td><td></td></tr>
<tr><td>4</td><td>Project supplies electricity to a mini grid[7] system where in the baseline all</td><td></td><td></td><td>√</td></tr>
</table></td><td>The project supplies electricity to the regional grid. Hence, this criteria for AMS-I.D. is applicable.</td></tr>
</table>

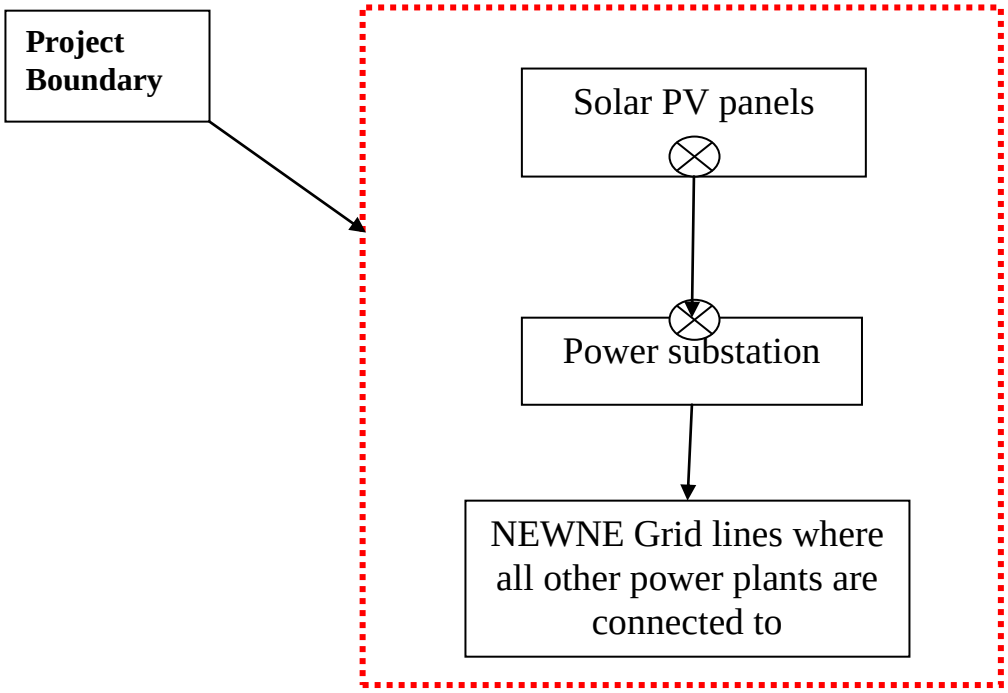
[5] http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X
[6] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v3.0.0.pdf
[7] The sum of installed capacities of all generators connected to the mini-grid is equal to or less than 15 MW.

| | | | | | |
|---|---|---|---|---|---|
| | generators use exclusively fuel oil and/or diesel fuel | | | | |
| 5 | Project supplies electricity to household users (included in the project boundary) located in off grid areas | √ | | | |
| This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of an existing plants | | | | | This project activity is a newly grid connected solar PV based renewable electricity generation project. Hence, the criterion is applicable for the project activity. |
| Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:<br>✓ The project activity is implemented in an existing reservoir with no change in the volume of reservoir;<br>✓ The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2;<br>✓ The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2. | | | | | The project is a solar PV based renewable electricity generation project. So, the condition is not applicable. |
| If the new unit has both renewable and non-renewable components (e.g... a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW. | | | | | The project activity is a solar PV based renewable electricity generation project. Hence, there is no fossil fuel co fired in this project activity. The total installed capacity of this project activity is 5 MW, which is below than the limit of 15 MW. |
| Combined heat and power (co-generation) systems are not eligible under this category. | | | | | This project activity is not a combined heat and power (cogeneration) systems and hence, the criterion is not applicable. |
| In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units. | | | | | This project activity is a solar PV based renewable electricity generation project and does not involve addition of capacity in any existing renewable energy generation unit. The total capacity of this project activity is 5 MW which is less than the limit of 15 MW. |
| In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW. | | | | | Since there is no retrofit or replacement of unit in the project activity, this criterion is not applicable. |

**B.3. Project boundary**

>>

As per the approved methodology, "*The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to"* is termed as boundary. The project boundary is therefore the physical boundary, which includes the Solar PV panels and the metering/substation system connected to NEWNE Grid. The proposed project and all other power plants are connected physically to the NEWNE grid.




⊗ Denotes the location of meters at the project site and at the substation.

There is a main meter and check meter located within the premises of the power plant. At the substation end, there is a main meter, check meter and a standby meter to measure the net amount of electricity exported to the grid. The readings from the meter at the substation end will be used for the calculation of emission reductions.

**B.4. Establishment and description of baseline scenario**

>>

The project activity installs and operates a new grid connected renewable solar power plant.

The baseline scenario according to AMS-I.D., Version 17 para 10 is-'T*he baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.'*

Hence the baseline scenario for the project activity would be the grid connected electricity being produced from fossil fuel based power plants that would have emitted large quantity of greenhouse gases.

As per AMS-I.D., Version 17, para 11, '*The baseline emissions are the product of electrical energy baseline* $EG_{BL,y}$ *expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.*'

$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$

| | |
|---|---|
| $BE_y$ | Baseline emissions in year y ($tCO_2$) |
| $EG_{BL, y}$ | Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh) |
| $EF_{CO2, grid,y}$ | $CO_2$ emission factor of the grid in year y ($tCO_2$/MWh) |

The emission factor can be calculated as per the procedures described in paragraph 12 (a) and (b) of the methodology.

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'

(OR)

(b) The weighted average emissions (in kg $CO_2$equ/kWh) of current generation mix. The data of the year in which project generation occurs must be used. Calculations must be based on data from an official source (where available) and made publicly available.

Based on the above options project proponent has considered option (a) and the baseline emission factor has been calculated Ex-ante based on baseline methodology AMS-I.D. (Version 17). 'Tool to calculate the emission factor for an electricity system' is used for emission factor calculation

The combined margin of the NEWNE grid[8] used for the project activity is as follows:

| **Parameter** | **Value ($tCO_2$/ MWh)** |
|---|---|
| OM, Operating Margin | 0.972 |
| BM, Build Margin | 0.916 |
| **CM, Combined Margin** | **0.958** |

**B.5. Demonstration of additionality**

>>

As per "Clean development mechanism project standard", version 03.0 (EB 65, Annex 5) and **"**Guidelines on Demonstration and Assessment of prior consideration of CDM" issued in EB 62, Annex 13, the project participant is required to indicate that continuing and real actions were taken to secure CDM status for the project in parallel with implementation.

As per para 2 of guidance on the demonstration and assessment of prior consideration of CDM:
*"for project activities with a starting date on or after 02 August 2008, the project participant must inform a Host Party DNA and/or the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date and shall contain the precise geographical location and a brief description of the proposed project activity".*

Following the guidelines in para 2 and 4, the project proponent sent intimations[9] to both the host party DNA and the UNFCCC on 13/04/2011 about the project activity and intentions of the project proponent

[8] Based on Baseline Carbon Dioxide Emission Database Version 8.0; dated January 2013 (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm). The detailed calculation on the combined margin of NEWNE grid is provided in section B.6.1.

to apply for registration under the Clean Development Mechanism of UNFCCC. The start date of the project activity is 28/12/2010, the date on which the EPC contract was signed for the project. OPG Energy Private Ltd has sent the notification of the project activity to UNFCCC and host country DNA within 6 months of the project activity start date. As per the "CDM Project Cycle Procedure" version 03.2, para 9, the project participants of the projects whose PDD has not been published for global stakeholder consultation, shall inform the secretariat of the progress of the project activity every subsequent two (2) years after the initial notification, using the "Prior consideration of the CDM form" (F-CDM-PC)." Since the PDD for the project activity has not been published within 2 years of initial intimation, project proponent has reintimated UNFCCC and host country DNA on 06/04/2013.

As per para 3 of the guidance, the project has been listed in the publicly available list maintained by UNFCCC Secretariat.

The exact chronology of the events is explained below; as can be seen the project proponent has made continuous efforts to secure CDM status in parallel with the project's implementation. The chronology of events in the tabulated form is given below:

| Chronology of events | Date |
|---|---|
| Power purchase agreement signed for the project activity | 15/10/2010 |
| EPC contract signed | 28/12/2010 |
| First CDM consideration form e-mailed to UNFCCC and host country DNA (MoEF) | 13/04/2011 |
| Commissioning of the project activity | 13/10/2011 |
| Second CDM consideration form e-mailed to UNFCCC and host country DNA (MoEF) | 06/04/2013 |

According to decision 17/CP.7 paragraph 43, a project will be defined additional if the anthropogenic GHG emissions from the source are reduced below that would have occurred in the absence of the registered project activity.
As per para 2 of the provisions of Attachment A to Appendix B, version 08, of the *simplified modalities and procedures for small-scale CDM project activities, "the positive list of grid-connected renewable electricity generation technologies that are automatically defined as additional, without further documentation of barriers, consists of the following grid-connected renewable electricity generation technologies of installed capacity up to 15 MW:*
*(a) Solar technologies (photovoltaic and solar thermal electricity generation);*
*(b) Off-shore wind technologies;*
*(c) Marine technologies (wave, tidal)".*

The following conditions apply to the proposed project activity:

- The project activity is a grid connected renewable electricity generation unit[10]
- The project activity uses a solar technology using photovoltaic cells[11]
- The project activity has an installed capacity of 5MW[12] (ie, less than 15MW)

[9] The mail communications done by PP to host country DNA and UNFCCC secretariat will be provided to the validator.
[10] As per the Power Purchase Agreement with NTPC Vidyut Vyapar Nigam Limited
[11] As per the commissioning certificate dated 08/11/2011
[12] As per the commissioning certificate dated 08/11/2011

**Hence, in line with para 2 of the Attachment A to Appendix B, the proposed project activity is automatically additional.**

**B.6. Emission reductions**

**B.6.1. Explanation of methodological choices**

>>

The project activity is generation of electricity using solar and exporting the same to the local grid system, which is mainly fed by fossil fuel based power plants. Emission reductions due to the project activity are considered to be equivalent to the emissions avoided in the baseline scenario by displacing the electricity generated to the Grid.

According to the approved methodology AMS-I. D. (version 17) Emission Reductions are calculated as

$$\mathbf{ER_y = BE_y – PE_y – LE_y}$$

Where:

| | |
|---|---|
| $BE_y$ | Baseline Emissions in year *y* (t $CO_2$/y) |
| $PE_y$ | Project Emissions in year *y* (t $CO_2$/y) |
| $LE_y$ | Leakage Emissions in year *y* (t $CO_2$/y) |

As this project installs a new grid connected renewable power plant, the baseline emissions according to AMS-I.D., Version 17 para 11 is-

The baseline emissions are the product of electrical energy baseline $EG_{BL,\ y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$\mathbf{BE_y = EG_{BL,\ y} * EF_{CO2,\ grid,y}}$$

Where:

| | |
|---|---|
| $BE_y$ | = Baseline Emissions in year y (t $CO_2$) |
| $EG_{BL,\ y}$ | = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh) |
| $EF_{CO2,grid,y}$ | = $CO_2$ emission factor of the grid in year y (t $CO_2$/MWh) |

The emission factor can be calculated as per the procedures described in paragraph 12 (a) and (b) of the methodology.

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'
(OR)

(b) The weighted average emissions (in kg$CO_2$equ/kWh) of current generation mix. The data of the year in which project generation occurs must be used. Calculations must be based on data from an official source (where available) and made publicly available.

Based on the above options project has considered option (a) and the baseline emission factor has been calculated Ex-ante based on baseline methodology AMS-I.D. (Version 17). 'Tool to calculate the emission factor for an electricity system' is used for emission factor calculation. The following steps to be used to calculate the baseline emission factor.

**Estimation of Baseline Emissions**

Baseline emissions ($BE_y$ in $tCO_2$) due to displacement of grid-electricity are calculated as the product of the Baseline Emissions Factor ($EF_y$ in $tCO_2$/MWh) calculated as described below and the electricity supplied by the project activity to the grid, over the crediting period.

$$\mathbf{BE_y = EG_{BL,\,y} * EF_{CO2,\,grid,y}}$$

Where:

| | |
|---|---|
| $BE_y$ | Baseline emissions in year y ($tCO_2$) |
| $EG_{BL,\,y}$ | Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh) |
| $EF_{CO2,\,grid,y}$ | Baseline emission coefficient determined in accordance with option (a) specified below |

**Step 1**: **Identify the relevant electric power system**

For the purposes of the CDM, the delineation of the electricity grid is a key step in the calculation of a grid emission factor.
The tool[13] defines the electric power system as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. Keeping this into consideration, the Central Electricity Authority (CEA)[14], Government of India has divided the Indian Power Sector into two regional grids (see table below).

| NEWNE | | | | Southern |
|---|---|---|---|---|
| **Northern** | **Eastern** | **Western** | **North-Eastern** | |
| Chandigarh | Bihar | Chhattisgarh | Arunachal Pradesh | Andhra Pradesh |
| Delhi | Jharkhand | Gujarat | Assam | Karnataka |
| Haryana | Orissa | Daman & Diu | Manipur | Kerala |
| Himachal Pradesh | West Bengal | Dadar & Nagar Haveli | Meghalaya | Tamil Nadu |
| Jammu and Kashmir | Sikkim | Madhya Pradesh | Mizoram | Pondicherry |
| Punjab | Andaman- Nicobar | Maharashtra | Nagaland | Lakshadweep |
| **Rajasthan** | | Goa | Tripura | |
| Uttar Pradesh | | | | |
| Uttarakhand | | | | |

The project activity is located in the state of Rajasthan which comes under NEWNE grid and the electricity generated by this project displaces the electricity from the NEWNE grid. Due to the displacement of electricity, the project activity would have impact on the NEWNE grid. Thus all the power generation facilities connected to this grid form the boundary for the purpose of baseline estimation. Since the project supplies electricity to the NEWNE grid, emissions generated due to the electricity generated by the NEWNE grid as per CM calculations will serve as the baseline for this project.

**STEP 2 Choose whether to include off-grid power plants in the project electricity system (optional)**

Only grid power plants are included in the calculation of OM & BM.

[13] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf/history_view
[14] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

**STEP 3. Select an operating margin (OM) method.**

According to the tool the calculation of the operating margin emission factor is based on one of the following methods:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

The Share of Low Cost / Must-Run (% of Net Generation) in the generation profile of the different grids in India in the last five years is as follows:

| Years | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 |
|---|---|---|---|---|---|
| NEWNE Grid[15] | 19% | 17.4% | 15.9% | 17.6% | 19.2% |

The above table clearly shows that the percentage of total grid generation by low-cost/must-run plants (on the basis of average of five most recent years) for the NEWNE grid is only 17.8% which is much lesser than 50% of the total generation. Thus, Simple OM method can be used for calculating the emission factor.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

• Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or

• Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

**The project proponent has chosen an ex-ante approach for the calculation of grid emission factor and the value will be considered throughout the crediting period.**

**Step 4- Calculating Operating Margin (OM) as per the method available for determining Simple OM.**
The generation weighted average $CO_2$ emissions per unit net electricity generation ($tCO_2/MWh$) of all generating power plants serving the system, not including low-cost/must-run power plants/units.
The Simple OM must be calculated as:

**Option A:** Based on the net electricity generation and a $CO_2$ emission factor of each power unit; or

[15] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

**Option B:** Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

The project proponent is using values for calculating OM that are published in the CEA database for calculating $CO_2$ emissions Version 8, dated January 2013. These calculations are based on "Tool to Calculate the Emission Factor for an Electricity System", Version 03.0.0, EB 70 Annex 22. These correspond with **option A** of the current version of the Tool.

(a) Simple OM
The full generation weighted average for the most recent years has been considered from the Central Electricity Authority data[16].

**Operating Margin**

**Table B.3: Operating Margin**

| Year | $tCO_2/MWh$ | Net generation in Operating Margin (Gwh) |
|---|---|---|
| 2009-10 | 0.978 | 462,327 |
| 2010-11 | 0.971 | 476,987 |
| 2011-12 | 0.969 | 502,300 |
| Weighted Simple OM ( **$tCO_2/MWh$** ) = 0.972 | | |

In this PDD *ex-ante* vintage has been fixed and will not be changed during the crediting period.

**Step5: Calculate the build margin emission factor ($EF_{grid, BM,y}$)**

In terms of vintage of data, PP has chosen option a) build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation.
Calculations were done by the CEA (database version 8) to determine Emission Factor. CEA adopted build margin calculation based on an approach similar to Option b and c) "for sample group of power units m used to calculate the build margin" of the current Tool to calculate emission factor in the electrical system'- Version03.0.0, EB 70, Annex 22.

Build margin is calculated by the formula:

$$EF_{grid, BM,y} = \sum(EG_{m,y} \times EF_{EL,m,y}) / \sum EG_{m,y}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year *y* (tCO2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

BM is calculated ex-ante based on the most recent information available at the time of submission of PDD and is fixed for the entire crediting period.

[16] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

**Table B.4: Build Margin**

| Build Margin[17] | 2011-12 |
|---|---|
| Build Margin (tCO2/MWh) | 0.916 |

**Step 6. Calculate the combined margin emission factor**

PP has chosen option a) Weighted Average CM, in calculation of combine Margin emission factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:

$EF_{grid,BM,y}$ = Build margin $CO_2$ emission factor in year $y$ ($tCO_2/MWh$)
$EF_{grid,OM,y}$ = Operating margin $CO_2$ emission factor in year $y$ ($tCO_2/MWh$)
$w_{OM}$ = Weighting of operating margin emissions factor (%)
$w_{BM}$ = Weighting of build margin emissions factor (%)

Where:

The default weights for OM and BM for solar power are as follows: $W_{OM}$ = 75% and $W_{BM}$ = 25%. $EF_{grid\ OM,\ y}$ and $EF_{grid\ BM,\ y}$ is calculated as described in Steps 1 and 2 above and are expressed in tCO2/MWh.

The weighted average applied by the project participants are fixed for the entire crediting period.

**Combined Margin/ Grid Emission Factor**

**Table B.5: Combined Margin**

| Year | $tCO_2/MWh$ |
|---|---|
| 2009-10 OM | 0.978 |
| 2010-11 OM | 0.971 |
| 2011-12 OM | 0.969 |
| Average OM | 0.972 |
| Build Margin, BM 2011-12 | 0.916 |
| **Combined Margin, CM** | **0.958** |

OM and BM directly sourced from CEA database

Thus the grid emission factor for the project activity is **0.958 $tCO_2$/ MWh** and is fixed for the entire crediting period.

*Project emissions:*

[17] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

Since the project activity is a PV based solar power project, a zero emission source, there are no associated project emissions.
Hence, project emissions, $PE_y = 0$

*Leakage:*

The project activity is a Greenfield project and there is no transfer of energy generating equipment from another activity. So, there is no leakage within the project boundary as per para 22 of AMS-I.D. ver 17.
Hence, leakage, $LE_y = 0$

*Emission reductions:*

$ER_y = BE_y - PE_y - LE_y$
$= BE_y - 0 - 0$
$= BE_y$

**B.6.2. Data and parameters fixed ex ante**

| **Data / Parameter** | **$EF_{OM}$** |
|---|---|
| **Unit** | $tCO_2/MWh$ |
| **Description** | Operational Margin of the NEWNE Grid |
| **Source of data** | Central Electricity Authority(CEA) of India Database version 8.0 http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm |
| **Value(s) applied** | 0.972 |
| **Choice of data or Measurement methods and procedures** | Operating Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with "Tool to calculate the emission factor for an electricity system" version 2.2.1. |
| **Purpose of data** | Calculation of Baseline emissions |
| **Additional comment** | Fixed ex-ante for entire crediting period |

| Years | Operating margin emission factor of NEWNE Electricity Grid (t CO2 e/MWh) |
|---|---|
| FY 2009-10 | 0.978 |
| FY 2010-11 | 0.971 |
| FY 2011-12 | 0.969 |

| **Data / Parameter** | **$EF_{BM,y}$** |
|---|---|
| **Unit** | t CO2 e/MWh |
| **Description** | Build Margin Emission Factor of the NEWNE Electricity Grid |
| **Source of data** | The $CO_2$ Baseline Database for the Indian Power Sector - Ministry of Power: Central Electricity Authority (CEA) Version 8. |
| **Value(s) applied** | 0.916 |
| **Choice of data or Measurement methods and procedures** | Build Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with "Tool to calculate the emission factor for an electricity system" version 2.2.1. |
| **Purpose of data** | Calculation of Baseline emissions |
| **Additional comment** | Fixed ex-ante for entire crediting period |

| Data / Parameter | $EF_y$ |
|---|---|
| Unit | t CO2 e/MWh |
| Description | $CO_2$ emission Factor of the NEWNE Electricity Grid |
| Source of data | As per the Tool to calculate the emission factor for an electricity system, $EF_y$ is calculated as the weighted average of OM emission factor (weight given is 0.75) and BM emission factor (weight given is 0.25) |
| Value(s) applied | 0.958 |
| Choice of data or Measurement methods and procedures | The calculation has been done as per the Tool to calculate the emission factor for an electricity system, version 03.0.0. The fixed ex-ante combined margin emission factor from CEA database is used in the calculation of emission factor. This has been calculated as per the Tool to calculate the emission factor for an electricity system, version 03.0.0, with 3 years vintage data and option of ex-ante based on 75% of OM and 25% of BM values approach. |
| Purpose of data | Calculation of Baseline emissions |
| Additional comment | Fixed ex-ante for entire crediting period |

**B.6.3. Ex-ante calculation of emission reductions**
>>

**Baseline emissions**

Baseline for the project activity is power generated from renewable energy source multiplied by the grid emission factor of NEWNE grid calculated in transparent and conservative manner.

$BE_y = EG_{BL,y} \text{ X } EF_{CO2,grid,y}$

$EG_{BL,y}$ = 9,061 MWh
$EF_{CO2,grid,y}$ = 0.958 tCO2e/MWh

$BE_y$ =9,061*0.958
= 8,680 tCO2/ annum

**Project emissions**
As per AMS I. D.,project emissions for solar power project activities is zero.
$PE_y = 0$

**Leakage emissions**
The project activity is a Greenfield project and there is no transfer of energy generating equipment from another activity. Hence there is no leakage within the project boundary as per para 22 of AMS I.D ver 17.
$LE_y = 0$

**Emission reductions**
As per the methodology, emission reductions are calculated based on the following formula

$ER_y = BE_y – PE_y - LE_y$

or

$ER_y = BE_y$ as $PE_y = 0$ and $LE_y = 0$

$ER_y$ = 8,615 tCO2/ annum

**B.6.4. Summary of ex-ante estimates of emission reductions**

| Year | Baseline emissions (t CO2e) | Project emissions (t CO2e) | Leakage (t CO2e) | Emission reductions (t CO2e) |
|---|---|---|---|---|
| **Year 1** | 8,811 | **0** | **0** | 8,811 |
| **Year 2** | 8,767 | **0** | **0** | 8,767 |
| **Year 3** | 8,723 | **0** | **0** | 8,723 |
| **Year 4** | 8,680 | **0** | **0** | 8,680 |
| **Year 5** | 8,636 | **0** | **0** | 8,636 |
| **Year 6** | 8,593 | **0** | **0** | 8,593 |
| **Year 7** | 8,550 | **0** | **0** | 8,550 |
| **Total** | **60,760** | **0** | **0** | **60,760** |
| **Total number of crediting years** | 10 | | | |
| **Annual average over the crediting period** | **8,680** | **0** | **0** | **8,680** |

**B.7. Monitoring plan**

**B.7.1. Data and parameters to be monitored**

| **Data / Parameter** | **$EG_{BL,y}$** |
|---|---|
| **Unit** | MWh |
| **Description** | Net quantity of electricity export to the grid during the year y. |
| **Source of data** | Monthly generation report |
| **Value(s) applied** | 9,061 |
| **Measurement methods and procedures** | The electricity is exported to the grid by the project activity by a feeder line to the sub-station. The net electricity is measured by a two-way electronic meters of accuracy class 0.2s. There is a main meter and check meter on the feeder line. Net electricity supplied to the grid would be calculated based on export & import data (Net electricity supplied to grid = Export electricity – Import electricity).<br>The export and import energy will be measured continuously using above mentioned Main & Check meters at the switchyard. Export & Import readings of Main meter shall be taken on monthly basis at appointed day and hour (time) by authorized officer of Jodhpur Discom in the presence of PP or representative of PP.The meter reading will be taken jointly and signed by the representatives of the Jodhpur Discom OPG Energy Private Limited. Based on the readings, invoices for net electricity exported will be raised by OPG Energy Private Limited to Jodhpur Discom. |
| **Monitoring frequency** | Continuous monitoring with hourly measurement and monthly recording |
| **QA/QC procedures** | The main meter and check meter will be calibrated atleast once in 3 years. The net energy exported to the grid could be cross checked by the invoices raised by the PP. In case of any failure in the main meter, the invoice will be raised to NVVN based on the check meter readings. Also, the main meter will be replaced immediately with the calibrated back up meter. |
| **Purpose of data** | Calculation of baseline emissions |
| **Additional comment** | The data will be kept for two years after the crediting period or from last issuance. |

**B.7.2. Sampling plan**

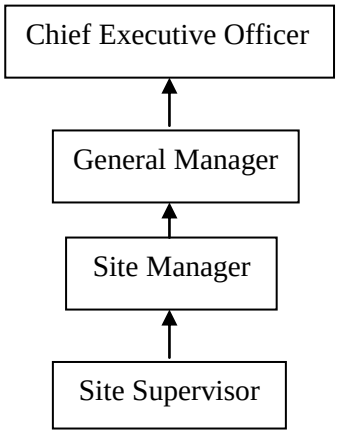
>>

Monitored parameter in section B.7.1 above is not determined by any sampling approach. Hence, there is no specific sampling plan involved in the project activity.

**B.7.3. Other elements of monitoring plan**

>>

The project proponent has proposed the following operational & management structure in order to monitor the emission reduction. The organisation structure for the proposed power plant envisages a General Manager as the in-charge for the entire power plant operations and maintenance. He will be positioned at site and will directly report to the Chief executive officer. He will be assisted by Site Manager and Site supervisor. The day-to-day operation like planning the routine maintenance, safety and environmental control will be placed under the care of the Site manager. The organizational structure and responsibilities on project operation, monitoring, data recording and ER calculation has been mentioned below:




**Organizational structure**

**Responsibilities**:
The Chief Executive officer (CEO) holds complete control over monitoring aspects pertaining to the project. The monitoring report will be reviewed and will keep a check on the proper training of staff, etc. Also, emission reduction calculation will be maintained by the CEO for verification.
The general manager controls the operation and maintenance of the entire power plant. A periodic checking of recorded and stored data and the emission reduction calculation sheet and monitoring report will be prepared. The site manager and site supervisor records the day to day operation data and stores it in hard copy as well as soft copy.

***Data Measurement***:
The Export and Import data will be measured continuously. Export & Import readings of Main & Check meters, of accuracy class 0.2S, shall be taken on monthly basis at appointed day & hour (time) by authorized officer of Jodhpu Discom and a representative of OPG Energy Private Ltd. Check meter reading will be considered when Main meter is found to be defective or stopped. The main meter and check meters will be calibrated once in three years as per provisions of the CEA Metering Regulations.

***Data collection and archiving:*** Export & Import readings from main & check meter will be collected under the supervision of the Site Manager. The net electricity supplied to grid would be calculated based on export & import readings. Export and Import data would be recorded and stored in logs as well as in electronic form. The records are checked periodically by the General Manager and discussed thoroughly with the Site Manager. The period of storage of the monitored data will be 2 years after the end of crediting period or till the last issuance of CERs for the project activity whichever occurs later.

***Emergency preparedness:*** The project activity will not result in any unidentified activity that can result in substantial emissions from the project activity. No need for emergency preparedness in data monitoring is visualized.

***Personnel training:*** In order to ensure a proper functioning of the project activity and a properly monitoring of emission reductions, the staff (CDM team) will be trained. The operator personnel will be trained in equipment operation, data recording, reports writing, operation and maintenance and emergency procedures in compliance with the monitoring plan. CEO is responsible for the training of the staff.

**SECTION C. Duration and crediting period**
**C.1. Duration of project activity**
**C.1.1. Start date of project activity**
>>
28/12/2010 (The date of signing of EPC contract is the project start date)

**C.1.2. Expected operational lifetime of project activity**
>>
25 years 00 months

**C.2. Crediting period of project activity**
**C.2.1. Type of crediting period**
>>
Renewable crediting period has been used and this is the first renewable crediting period.

**C.2.2. Start date of crediting period**
>>
01/10/2013 or date of registration of the project activity with the CDM EB of UNFCCC whichever occurs later

**C.2.3. Length of crediting period**
>>
07 years 00 months

**SECTION D. Environmental impacts**
**D.1. Analysis of environmental impacts**
>>
As per the notification from MoEF dated September 14, 2006[18] and its amendment notification S.O.-3067(E) dated 1/12/2009[19], the list of project activities which require prior environmental clearance is stipulated. This does not include the proposed small scale project activity type as it involves solar power generation. Hence the proposed project activity does not require any Environmental impact analysis.

**SECTION E. Local stakeholder consultation**
**E.1. Solicitation of comments from local stakeholders**
>>
OPG Energy Private Ltd has invited the villagers and other stakeholders for suggestions, views, comments and objections in the environment aspects of the project activity. The invitations were circulated among the local villagers in Baap village A public hearing was conducted by OPG Energy Private Ltd on 24/07/2013 at the project site in Rajasthan. In the meeting, the project proponent representatives explained the local stakeholders of the project activity and its benefits. The stakeholders were details about the benefits of producing clean energy as compared to producing energy from fossil fuel based power plants. This was followed by a discussion round where comments/views from local stakeholders were invited. The project proponents responded to the comments of the stakeholders.

**E.2. Summary of comments received**
>>

[18] http://envfor.nic.in/legis/eia/so1533.pdf
[19] http://moef.nic.in/downloads/rules-and-regulations/3067.pdf

The stakeholders appreciated the efforts of the project proponent to promote clean energy. The stakeholders expressed satisfaction on the project activity and were happy about the fact that local people were provided employment at the project site.

### E.3. Report on consideration of comments received

>>

No negative comments were received during the stakeholder consultation process.

## SECTION F. Approval and authorization

>>

The approval letter from the host country is not available at the time of submission of PDD to the validating DOE.

- - - - -

## Appendix 1: Contact information of project participants

| | |
|---|---|
| **Organization** | OPG Energy Private Ltd |
| **Street/P.O. Box** | St. Ebba's Avenue, Mylapore |
| **Building** | 117, Sir P.S. Sivaswami Salai |
| **City** | Chennai |
| **State/Region** | Tamil Nadu |
| **Postcode** | 600004 |
| **Country** | India |
| **Telephone** | |
| **Fax** | |
| **E-mail** | sunil.singh@opgpower.com |
| **Website** | |
| **Contact person** | |
| **Title** | |
| **Salutation** | |
| **Last name** | Singh |
| **Middle name** | |
| **First name** | Sunil |
| **Department** | |
| **Mobile** | 9560858999 |
| **Direct fax** | |
| **Direct tel.** | |
| **Personal e-mail** | sunil.singh@opgpower.com |

## Appendix 2: Affirmation regarding public funding

There is no public funding involved in this project activity.

## Appendix 3: Applicability of selected methodology

Detailed applicability condition for the selected methodology is provided in section B.2.

## Appendix 4: Further background information on ex ante calculation of emission reductions

Ex-ante calculation of emission reduction is provided in section B.6.3.

## Appendix 5: Further background information on monitoring plan

Detailed monitoring plan for the project activity is provided in section B.7.3.

## Appendix 6: Summary of post registration changes

The CDM project activity is not yet registered.

- - - - -

**History of the document**

| Version | Date | Nature of revision |
|---|---|---|
| 04.1 | 11 April 2012 | Editorial revision to change history box by adding EB meeting and annex numbers in the Date column. |
| 04.0 | EB 66<br>13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9). |
| 03 | EB 28, Annex 34<br>15 December 2006 | • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |
| 02 | EB 20, Annex 14<br>08 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |
| 01 | EB 07, Annex 05<br>21 January 2003 | Initial adoption. |
| **Decision Class:** Regulatory<br>**Document Type:** Form<br>**Business Function:** Registration | | |