



**Project design document form for  
small-scale CDM project activities**

**(Version 05.0)**

*Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.*

**PROJECT DESIGN DOCUMENT (PDD)**

<b>Title of the project activity</b>	6 MW Solar Power Project by Arhyama Solar Power
<b>Version number of the PDD</b>	1.0
<b>Completion date of the PDD</b>	14/07/2014
<b>Project participant(s)</b>	Arhyama Solar Power Pvt. Ltd.
<b>Host Party</b>	India
<b>Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)</b>	Sectoral Scope: 1 - Energy industries (renewable / non renewable sources) Methodology: AMS-I.D "Grid connected renewable electricity generation" (Version 17)
<b>Estimated amount of annual average GHG emission reductions</b>	9,535 tCO <sub>2</sub> / annum

## SECTION A. Description of project activity

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

The main purpose of this project activity is to generate clean form of electricity through renewable solar energy source. Arhyama Solar Power Pvt. Ltd. is the promoter of the proposed project activity. The project activity involves installations of 6 MW solar photovoltaic technology based power plant at Nalgonda, Andhra Pradesh. The project will replace anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 9,535 tCO<sub>2</sub>e per year, thereon displaces 9,899 MWh/year amount of electricity from the generation-mix of power plants connected to the Southern grid, which is mainly dominated by thermal/fossil fuel based power plant.

The details of the project and the state of installation are mentioned in the table:

Project Promoters' Name	Capacity	Connection with Grid	State	Use of Electricity
Arhyama Solar Power Pvt. Ltd.	6 MW	Southern	Andhra Pradesh	Sale to third party

### Scenario existing prior to the implementation of project activity:

The scenario existing prior to the implementation of the project activity, is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

### Baseline Scenario:

As the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following as per applied methodology:

*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, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".*

Hence, pre-project scenario and baseline scenario are the same.

### Sustainable development indicators

The National CDM Authority (NCDMA), which is the Designated National Authority (DNA) for the Government of India (GOI) under the Ministry of Environment and Forests (MoEF), has mentioned four indicators for the sustainable development in the interim approval guidelines for Clean Development Mechanism (CDM) projects from India<sup>1</sup>. Thus the project's contribution towards sustainable development has been addressed based on the following sustainable development aspects:

### Social well being

The project activity provided / provides job opportunity to local people during erection, commissioning and maintenance of the solar project. Frequency of visiting villages and nearby areas by skilled, technical and industrialist increase due to installation /site visit/operation and

<sup>1</sup> [http://www.cdmindia.gov.in/approval\\_process.php](http://www.cdmindia.gov.in/approval_process.php)

maintenance work related to solar project. This directly and indirectly positively effects the economy of villages and nearby area.

### **Environmental well being**

Solar power is one of the cleanest renewable energy powers and does not involve any fossil fuel. There are no GHG emissions. The impact on land, water, air and soil is negligible. Thus the project activity contributes to environmental well-being without causing any negative impact on the surrounding environment.

### **Economic well being**

The CDM project activity generates permanent and temporary employment opportunity within the vicinity of the project. The electricity supply in the nearby area improves which directly and indirectly improves the economy and life style of the area.

### **Technological well being**

The project activity is step forward in harnessing the untapped solar potential and further diffusion of the solar technology in the region. The project activity leads to the promotion of solar projects and demonstrates the success of solar projects in the region which further motivate more investors to invest in solar power projects. Hence, the project activity leads to technological well-being.

The Host County Approval issued by India DNA declaring acceptability of the Sustainable Indicators by the project activity shall be submitted to DOE.

## **A.2. Location of project activity**

### **A.2.1. Host Party**

India

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

Andhra Pradesh

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

<b>Project Promoters' Name</b>	<b>Capacity</b>	<b>Village</b>	<b>District</b>	<b>State</b>
Arhyama Solar Power Pvt. Ltd.	6 MW	Kolanpaka	Nalgonda	Andhra Pradesh

### **A.2.4. Physical/Geographical location**

The project is located at Kolanpaka Village, Aleir Mandal, Nalgonda District, Andhra Pradesh. The land is located about 1000 meters from the main road. The Project is located 17° 63" North and 79° 01" East.

<b>Key Drivers</b>	<b>Distance</b>
Nearest City	Hyderabad 105 km
Nearest Rail Station	Aleir 5 km from the site
Nearest Airport	Hyderabad 140 Km



### A.3. Technologies and/or measures

The project activity aims to harness solar energy through installation of PV with total installed capacity of 6 MW. The solar PV power plant will have solar PV modules, inverters, transformers and other protection system and supporting components as under:

- Solar Photovoltaic modules
- Inverters
- Transformers
- LT & HT switch gears & panels
- Circuit breakers
- Isolator
- Switchyard
- Earthing system
- Lightning Arresters

The Plant Load Factor for the project activity is estimated to be 19.29% and the solar PV modules have a useful life of 25 years.

#### Baseline Scenario:

As the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following as per applied methodology:

*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, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.*

Hence, pre-project scenario and baseline scenario are the same.

### A.4. Parties and project participants

Party involved (host) indicates 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	Arhyama Solar Power Pvt. Ltd. (Private Entity)	No
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#### A.5. Public funding of project activity

There is no public funding from Annex 1 countries and no diversion of Official Development Assistance (ODA) involved in the project activity.

#### A.6. Debundling for project activity

As per 'Guidelines on assessment of de-bundling for SSC project activities' Annex 13 EB 54, para 2, 'A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity :

- (a) With the same project participants;
- (b) In the same project category and technology/measure;
- (c) Registered within the previous 2 years; and
- (d) Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The project participant hereby confirms that they have not registered any small scale CDM activity or applied to register another small scale CDM project activity within 1 km of the project boundary, in the same project category and technology/measure in previous 2 years.

### SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

#### B.1. Reference of methodology and standardized baseline

**Title:** Grid Connected Renewable Electricity Generation

**Reference:** AMS I.D. (Version 17)

The approved methodology also refers to latest approved versions of "Tool to calculate the emission factor for an electricity system, version 04.

#### B.2. Project activity eligibility

The project activity involves generation of grid connected electricity from renewable solar energy. Since the project activity capacity is 6 MW, which is less than the maximum qualifying capacity of 15 MW for a small scale CDM project activity under Type-I of the small scale methodologies. The installed capacity will not increase throughout the crediting period of 7 years and the project activity will remain within the limit of small scale in each year of the crediting period. Therefore, small scale methodology AMS I.D is applied.

Justification for the choice has been illustrated as per the requirements set in para 1-8 in methodology AMS I.D Version 17 as follows:

Applicability reference)	Criterion (with Para number	Project Case
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<p>1. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:</p> <p>(a) Supplying electricity to a national or a regional grid.</p> <p>(b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.</p>	<p>The project activity is a Renewable Energy Project i.e. Solar Power Project which falls under applicability criteria option 1(a) and 1 (b) i.e., “supplying electricity to a national or a regional grid” or to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling. Hence the project activity meets the given applicability criterion.</p>
<p>2. Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A) applies is included in Table 2<sup>2</sup></p>	<p>The 3<sup>rd</sup> option of Table 2 of AMS I.D. Version 17, EB 61 is applicable (please refer footnote).</p>
<p>3. 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 plant(s).</p>	<p>The project is installation of new solar based electricity generation plants (not addition to existing system). Hence, footnotes 3, 4 &amp; 5 are not applicable here.</p>
<p>4. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:</p> <ul style="list-style-type: none"> <li>• The project activity is implemented in an existing reservoir with no change in the volume of reservoir;</li> <li>• The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density</li> </ul>	<p>The bundled Project activity is power generation from solar energy source hence criteria, along with footnote 6 and 7, is not applicable to the project activity.</p>

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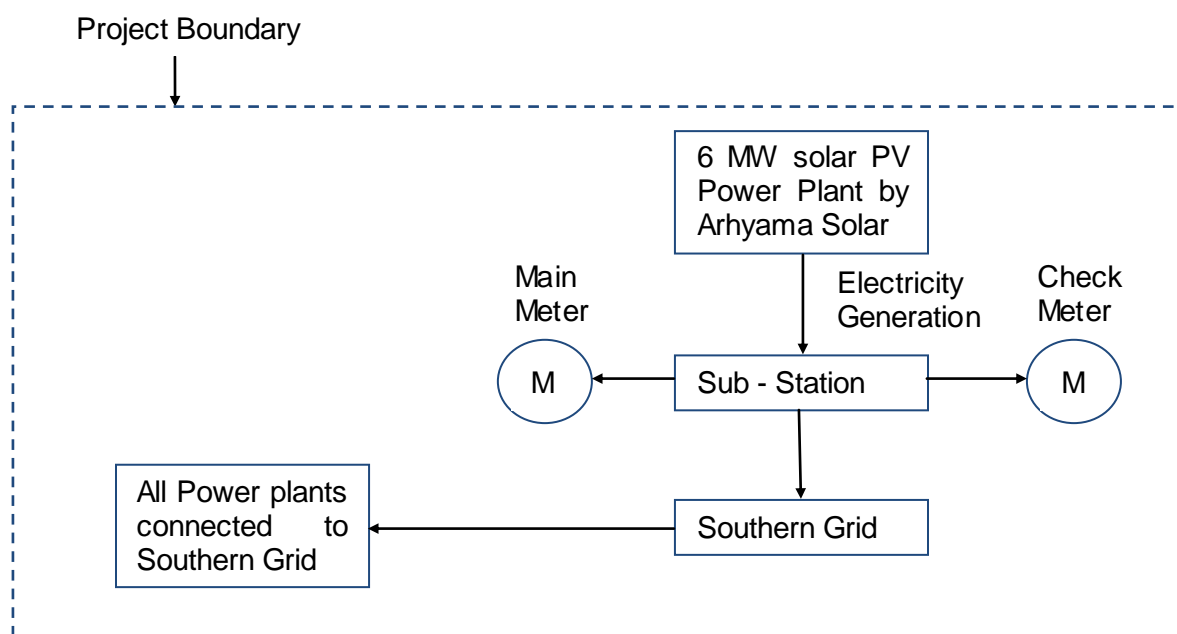
	Project type	AMS-I.A	AMS-I.D	AMS-I.F
1	Project supplies electricity to a national/regional grid		√	
2	Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)			√
3	Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)		√	
4	Project supplies electricity to a mini grid <sup>2</sup> system where in the baseline all 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	√		

<p>of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m<sup>2</sup>;</p> <ul style="list-style-type: none"> <li>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/m<sup>2</sup>.</li> </ul>	
<p>5. If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW 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 15 MW.</p>	<p>The project activity is a 6 MW solar electricity generation. Unit does not co-fire fossil fuels. Hence, footnote 8 is also not applicable here.</p>
<p>6. Combined heat and power (co-generation) systems are not eligible under this category.</p>	<p>The Project activity is not a combined heat and power system.</p>
<p>7. 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.</p>	<p>The project activity is Greenfield and there is no existing power generation facility at the site. Footnote 9 is also not applicable here.</p>
<p>8. 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.</p>	<p>Not applicable, the solar project is a Green field project activity and this project is not the enhancement or up gradation project.</p>

### B.3. Project boundary

Project boundary has been ascertained using para 9 of AMS-I.D, Version 17 - *“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”*.

Accordingly the project boundary includes solar PV power generation system and all power plants connected physically to the local grid to which the proposed project supplies renewable electricity to avoid GHG emissions. The proposed project is located in the state of Andhra Pradesh and hence falls under the Southern grid of the Indian Electricity system. The following diagram explains the project boundary for the proposed project activity.



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

As per guidelines for baseline in Para 10 of methodology, AMS I.D, Version 17, “the baseline scenario is the electricity delivered to the grid by 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.”

Thus, proposed project activity will evacuate power to the Southern Grid & completely comply with the stated guideline.

Further, as per Para 11 of AMS I.D, Version 17, “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.”

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

Where,

$BE_y$	Baseline Emissions in year y (t CO <sub>2</sub> )
$EG_{BL,y}$	Quantity of net electricity supplied to the grid from project activity in year y (MWh)
$EF_{grid,CM,y}$	CO <sub>2</sub> emission factor of the grid in year y (t CO <sub>2</sub> /MWh )

The combined margin ( $EF_{grid,CM,y}$ ) is the result of a weighted average of two emission factor pertaining to the electricity system: the operating margin (OM) and build margin (BM). Calculations for this combined margin must be based on data from an official source<sup>3</sup> (where available) and made publically available.

<sup>3</sup>[http://www.cea.nic.in/reports/planning/cdm\\_co2/user\\_guide\\_ver9.pdf](http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver9.pdf)



The combined margin of the Southern grid used for the project activity is as follows:

Parameter	Value	Nomenclature	Source
$EF_{grid,CM,y}$	0.9633 tCO <sub>2</sub> /MWh	Combined margin CO <sub>2</sub> emission factor for the project electricity system in year y	Calculated as the weighted average of the operating margin (0.75) & build margin (.25) values, sourced from Baseline CO <sub>2</sub> Emission Database, Version 9.0 published by Central Electricity Authority (CEA), Government of India
$EF_{grid,OM,y}$	0.9675 tCO <sub>2</sub> /MWh	Operating margin CO <sub>2</sub> emission factor for the project electricity system in year y	Calculated as the last 3 year (2010-11, 2011-12, 2012-13) generation-weighted average, sourced from Baseline CO <sub>2</sub> Emission Database, Version 9.0, published by Central Electricity Authority (CEA), Government of India
$EF_{grid,BM,y}$	0.9509 tCO <sub>2</sub> /MWh	Build margin CO <sub>2</sub> emission factor for the project electricity system in year y	Baseline CO <sub>2</sub> Emission Database, Version 9.0, published by Central Electricity Authority (CEA), Government of India

## B.5. Demonstration of additionality

### Existing National and/or Sectoral Policies

Annexure 3 of the EB 22 states that national and/or sectoral policies and circumstances have to be accounted for when considering the baseline scenario.

Para 7(a) of the same states that, only those national and/or sectoral policies or regulations under paragraph 6(a) i.e. type E+ policy that increase GHG emissions, that have been implemented before adoption of the Kyoto Protocol by the COP (decision 1/CP.3, 11 December 1997), shall be taken into account when developing a baseline scenario. The Electricity Act of 2003 promoted cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity (Refer Section 86(1) of Electricity Act 2003). Therefore, it could be seen that the provincial and sectoral policies are E- i.e., policies that decrease GHG emissions and are after November 2001. Hence the baseline scenario is the electricity generation by grid connected fossil fuel dominated power plants confirming to Annex 3 of EB 22.

Further, the baseline alternative mentioned above is in compliance with all the applicable regulatory policies and laws. Additionally, the project participant is under no compulsion to opt for any particular technology or even a renewable mode of power generation. There is no governmental body or EB policy which requires a particular kind of fuel to be chosen and there is no legal requirement to which the above alternative does not conform.

### Prior Consideration of CDM

CDM Project Standard Version 07.0, Section 6.3 states that “For a proposed CDM project activity with a start date on or after 2 August 2008, project participants shall inform the host Party’s designated national authority (DNA) and the secretariat of their intention to seek CDM status in accordance with the Project cycle procedure”.

In line with the above guidance, Arhyama Solar Power Pvt. Ltd. intimated the UNFCCC and host party DNA i.e. National CDM Authority (NCDMA) of its intention to seek CDM for the proposed project activity in a defined F-CDM form on 15<sup>th</sup> March 2013, which is within six months of the project activity start date (as mentioned in section C.1.1). Hence from the above it can be clearly established that CDM was seriously considered in the decision to proceed with the proposed project activity.

### Additionality Assessment

As per the 'Guidance on demonstration of Additionality of small scale Project Activity' (version 09), a positive list of grid-connected renewable electricity generation technologies are listed that are automatically defined as additional, without further documentation of barriers. The positive list comprises of the following grid-connected renewable electricity generation technologies of installed capacity up to 15 MW:

- 1) Solar technologies (photovoltaic and solar thermal electricity generation);
- 2) Off-shore wind technologies;
- 3) Marine technologies (wave, tidal).
- 4) Building-integrated wind turbines or household rooftop wind turbines of a size up to 100 kW;

Since the project activity is a solar photovoltaic electricity generation project of capacity 6 MW, it can be concluded from the above list that the project activity is automatically additional and does not require demonstration of barriers.

Thus, it is well established that the proposed project activity is additional.

## B.6. Emission reductions

### B.6.1. Explanation of methodological choices

**Applied Methodology:** AMS I.D, version 17, EB 61

As per the para 3 of the AMS – I.D, version 17, EB 61, "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 plant(s).

### Baseline emissions:

The baseline emission calculation for the project activity is attributable to the CO<sub>2</sub> Emission that could have been produced by the fossil fuel based power plants in absence of the proposed project activity. Therefore the amount electricity supplied to the Southern grid will be multiplied by the grid emission factor to calculate the baseline emissions reduced by the proposed project activity.

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

Where,

<b>BE<sub>y</sub></b>	=	Baseline Emissions in year y; tCO <sub>2</sub>
<b>EG<sub>facility,y</sub></b>	=	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)
<b>EF<sub>grid,CM,y</sub></b>	=	CO <sub>2</sub> emission factor of the grid in year y; tCO <sub>2</sub> /MWh

The methodology provides following approaches for emission factor calculations:

- (a) *Combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology "Tool to calculate the emission factor for an electricity system".*

OR

- (b) *The weighted average emissions (in t CO<sub>2</sub>/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.*

**Option (a) has been considered to calculate the grid emission factor as per the** 'Tool to calculate the emission factor for an electricity system' since data is available from an official source.

CO<sub>2</sub> Baseline Database for the Indian Power Sector, Version 9, January 2014<sup>4</sup>, published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

**As per the "Tool to calculate the emission factor for an electricity system" Version 04.0, EB 75, Annex 15, the following steps have been followed.**

STEP 1: Identify the relevant electricity systems;

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

STEP 3: Select a method to determine the operating margin (OM);

STEP 4: Calculate the operating margin emission factor according to the selected method;

STEP 5: Calculate the build margin (BM) emission factor;

STEP 6: Calculate the combined margin (CM) emission factor.

### **STEP 1: Identify the relevant electricity power systems**

The tool defines that "for determining the electricity emission factors, identify the relevant electricity system. Similarly, identify any connected electricity systems". It also states that "If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used". Keeping this into consideration, the Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into five regional grids viz. Northern, Eastern, Western, North-eastern and Southern.

However since 2007-08 as the four regional grids except the Southern grid has been synchronized, they are now being considered as one and named as NEWNE grid. Since the project supplies electricity to the Southern grid, emissions generated due to the electricity generated by the Southern grid as per CM calculations will serve as the baseline for this project.

**Table: Grid Classification**

NEWNE				Southern
Northern	Eastern	Western	North-Eastern	
Chandigarh	Bihar	Chhattisgarh	Arunachal Pradesh	Kerala

<sup>4</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/user\\_guide\\_ver9.pdf](http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver9.pdf)

Delhi	Jharkhand	Gujarat	Assam	Karnataka
Haryana	Orissa	Daman & Diu	Manipur	Tamil Nadu
Himachal Pradesh	West Bengal	Dadar & Nagar Haveli	Meghalaya	<b>Andhra Pradesh</b>
Jammu & Kashmir	Sikkim	Madhya Pradesh	Mizoram	
Punjab	Andaman & Nicobar	Maharashtra	Nagaland	
Rajasthan		Goa	Tripura	
Uttar Pradesh				
Uttarakhand				

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

Project participants have the option of choosing between the following two options to calculate the operating margin and build margin emission factor:

**Option I:** Only grid power plants are included in the calculation.

**Option II:** Both grid power plants and off-grid power plants are included in the calculation.

The Project Participant has chosen only grid power plants in the calculation.

**STEP 3: Select a method to determine the operating margin (OM) method**

The calculation of the operating margin emission factor ( $EF_{grid,OM,y}$ ) is based on one of the following methods, which are described under Step 4:

- (a) Simple OM, or
- (b) Simple adjusted OM, or
- (c) Dispatch data analysis OM, or
- (d) Average OM.

The data required to calculate simple adjusted OM or Dispatch data analysis is not possible due to lack of availability of this activity data to the project developers. The choice of other two options for calculating the operating margin emission factor depends on the generation of electricity from low cost/must run sources. In the context of the methodology low cost/must run resources typically include hydro, geothermal, wind, low cost biomass, nuclear and solar generation.

<b>Share of Must-Run (Hydro/Nuclear) (% of Net Generation)</b>					
	<b>2008-09</b>	<b>2009-10</b>	<b>2010-11</b>	<b>2011-12</b>	<b>2012-13</b>
Southern	22.8%	20.6%	21.0%	21.0%	15.2%
India	18.7%	17.1%	18.4%	19.6%	16.9%

*Data Source: Central Electricity Authority (CEA) database Version 9, Jan'2014*

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of three most recent years) for the Southern grid is less than 50 % of the total generation. Thus the average emission rate method cannot be applied, as low cost/must run resources constitute less than 50% of total grid generation.

The “Simple operating margin” has been calculated as per the weighted average emissions (in tCO<sub>2</sub>/MWh) of all generating sources serving the system, excluding hydro, geo-thermal, wind, low-cost biomass, nuclear and solar generation;

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:** If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. **Or**
- **Ex post option:** If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

**PP has chosen ex ante option for the calculation of OM with 3 years generation weighted average of the most recent years available at the time of submission of CDM-PDD to the DOE for validation.**

**OM determined at validation stage will be the same throughout the crediting period. There will be no requirement to monitor & recalculate the emission factor during the crediting period.**

#### **STEP 4: Calculate the operating margin emission factor according to the selected method**

The operating margin emission factor has been calculated using a 3 year data vintage:

<b>Net Generation in Operating Margin (MWh) (incl. Imports)</b>			
	2010-11	2011-12	2012-13
Southern	145,076,457	157,535,870	162,905,082

<b>Simple Operating Margin (tCO<sub>2</sub>/MWh) (incl. Imports)</b>			
	2010-11	2011-12	2012-13
Southern	0.9421	0.9602	0.9972

<b>Weighted Generation Operating Margin</b>	
Southern	<b>0.9675</b>

#### **STEP 5: Calculate the build margin emission factor (EF<sub>BM,y</sub>)**

Option 1 as described above is chosen to calculate the build margin emission factor for the project activity. 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.

<b>Build Margin (tCO<sub>2</sub>/MWh) (not adjusted for imports)</b>	
	2012-13
Southern	<b>0.9509</b>

(With sample group constituting most recent capacity additions to the grid comprising 20% of the system generation)

**STEP 6: Calculate the combined margin (CM) emissions factor**

**Combined Margin** – The combined margin is the weighted average of the simple operating Margin and the build margin. In particular, for intermittent and non-dispatchable generation types such as wind and solar photovoltaic, the Tool to calculate the emission factor for an electricity system, Version 04.0.0, EB 75, Annex 15, allows to weigh the operating margin and Build margin at 75% and 25%, respectively.

The baseline emission factor is calculated using the combined margin approach as described in the following steps:

**Calculation of Baseline Emission Factor  $EF_y$** 

The baseline emission factor  $EF_y$  is calculated as the weighted average of the Operating Margin emission factor ( $EF_{OM,y}$ ) and the Build Margin emission factor ( $EF_{BM,y}$ ):

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$$

Where,

$w_{OM}$	75% weight for solar energy projects
$w_{BM}$	25% weight for solar energy projects
$EF_{OM,y}$	calculated as described in Steps 3&4 above (tCO <sub>2</sub> /MWh)
$EF_{BM,y}$	calculated as described in Steps 5 above (tCO <sub>2</sub> /MWh)

$$\begin{aligned} \text{Baseline Emission factor (Southern Grid)} &= 0.75 * 0.9675 + 0.25 * 0.9509 \\ &= 0.9633 \text{ tCO}_2/\text{MW} \end{aligned}$$

**Project Emissions:** For most renewable power generation projects activities  $PE_y = 0$ . As per applied methodology only emission associated with the fossil fuel combustion, emission from operation of geo-thermal power plants due to release of non-condensable gases, emission from water reservoir of Hydro should be accounted for the project emission. Since the project activity is a solar power project,

**Hence  $PE_y = 0$**

**Leakage Emissions:** No Leakage emissions are considered. The main emission potentially giving rise to leakage in the context of electrical sector projects is emission arising due to activities arising such as power plant construction and upstream emission from fossil fuel use (e.g. extraction, processing, and transport). These emission sources are neglected.

**Hence,  $LE_y = 0$**

**Emission reduction ( $ER_y$ ):** The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plant by renewable electricity. The emission reduction  $ER_y$  by the project activity during a given year  $y$  is the difference between Baseline emission and Project emission & Leakage emission.

$$ER_y = BE_y - PE_y - LE_y$$

Where,

$ER_y$  = Emission Reduction in tCO<sub>2</sub>/year

$BE_y$  = Baseline emission in tCO<sub>2</sub>/year

$PE_y$  = Project emissions in tCO<sub>2</sub>/year  
 $LE_y$  = Leakage Emissions in tCO<sub>2</sub>/year

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

Data / Parameter	$EF_{grid,OMy}$
Unit	tCO <sub>2</sub> /MWh
Description	Operating Margin CO <sub>2</sub> emission factor in year y
Source of data	Calculated from CEA database, Version 09, January 2014 <sup>5</sup>
Value(s) applied	0.9675
Choice of data or Measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 04.0.0" as 3-year generation weighted average using data for the years 2010-2011, 2011-2012, & 2012-2013. The data are obtained from "CO <sub>2</sub> Baseline Database for Indian Power Sector" version 9.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of data	For the calculation of the Baseline Emission
Additional comment	This parameter is fixed ex-ante for the entire crediting period.

Data / Parameter	$EF_{grid,BMy}$
Unit	tCO <sub>2</sub> /MWh
Description	Build Margin CO <sub>2</sub> emission factor in year y
Source of data	Calculated from CEA database, Version 09, January 2014
Value(s) applied	0.9509
Choice of data or Measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 04.0.0" for the year 2012-2013. The data is obtained from "CO <sub>2</sub> Baseline Database for Indian Power Sector" version 9.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of data	For the calculation of the Baseline Emission
Additional comment	This parameter is fixed ex-ante for the entire crediting period.

### B.6.3. Ex ante calculation of emission reductions

Formula used to calculate the net emission reduction for the project activity is

$$ER_y = BE_y - PE_y - LE_y$$

Where,

$ER_y$  = Emission Reduction in tCO<sub>2</sub>/year  
 $BE_y$  = Baseline emission in tCO<sub>2</sub>/year  
 $PE_y$  = Project emissions in tCO<sub>2</sub>/year  
 $LE_y$  = Leakage Emissions in tCO<sub>2</sub>/year

#### **Baseline Emission ( $BE_y$ )**

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

$$BE_y = EG_{facility,y} * EF_{grid,CM,y}$$

<sup>5</sup> [http://www.cea.nic.in/reports/planning/cdm\\_co2/user\\_guide\\_ver9.pdf](http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver9.pdf)

Where,

$EG_{facility,y}$  = Total quantity of net electricity delivered to the Southern grid

Project Investors' Name	PLF (%)	Grid	Generated Power (MWh) p.a	Baseline Emission Factor (tCO <sub>2</sub> /MWh)	Baseline emissions (tCO <sub>2</sub> / year)
Arhyama Solar Power Pvt. Ltd.	19.29%	Southern	10,139	0.9633	9,766

$EF_{grid,CM,y}$  = Baseline emission factor  
= 0.9633 tCO<sub>2</sub>/MWh

$BE_y$  = 10,139 \* 0.9633  
= 9,766

As per Section B.6.1:

$PE_y = LE_y = 0$

Thus,

$ER_y = BE_y - PE_y - LE_y$

$ER_y = BE_y - 0 - 0$

$ER_y = BE_y$

Therefore,

$ER_y = BE_y = 9,766^6$

#### B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO <sub>2</sub> e)	Project emissions (t CO <sub>2</sub> e)	Leakage (t CO <sub>2</sub> e)	Emission reductions (t CO <sub>2</sub> e)
Year 1	9,766	-	-	9,766
Year 2	9,688	-	-	9,688
Year 3	9,611	-	-	9,611
Year 4	9,534	-	-	9,534
Year 5	9,457	-	-	9,457
Year 6	9,382	-	-	9,382
Year 7	9,307	-	-	9,307
Total	66,745	-	-	66,745
Total number of crediting years	7			
Annual average over the crediting period	9,535	-	-	9,535

#### B.7. Monitoring plan

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

Data / Parameter	$EG_{facility,y}$
Unit	MWh

<sup>6</sup> This is a sample calculation for the first year only.



Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year $y$ (MWh)
Source of data	Credit Report as per Monthly Generation Report
Value(s) applied	9,899 (Estimated Value)
Measurement methods and procedures	<p>Data Type: Measured  Monitoring equipment: Energy Meters are used for monitoring  Recording Frequency: Continuous monitoring and Monthly recording from Energy Meters, Summarized Annually  Archiving Policy: Paper &amp; Electronic  Calibration frequency: Annually</p> <p>Electricity exported/imported to the grid is in kWh. However for the calculation purpose electricity exported is converted in MWh.</p> <p>The Net electricity supplied to the grid by the project activity will be calculated as a difference of electricity exported to the grid, electricity imported from the grid obtained from joint meter reading certificates/credit notes issued by MSEDCL as per below equation:</p> $EG_{\text{facility},y} = EG_{\text{Export}} - EG_{\text{Import}}$ <p>The electricity exported to the grid by the project activity connected to the sub-station is measured by electronic trivector meters of accuracy class 0.2s. The electricity exported will be measured continuously using above mentioned Main &amp; Check meters at the substation. Export readings of Main &amp; Check meters shall be taken on monthly basis by authorized officer of APTRANSCO (Transmission corporation of Andhra Pradesh Limited) and APCPDCL (Central Power Distribution Company of AP Limited) in the presence of PP or representative of PP. The meter reading will be taken jointly and signed by the representatives of the APTRANSCO, APCPDCL and Arhyama Solar.</p> <p>Cross Checking:  Quantity of net electricity supplied to the grid will be cross checked from the invoices raised by the project proponent.</p>
Monitoring frequency	Monthly
QA/QC procedures	Annual calibration of all the meters will be undertaken at required intervals and faulty meters will be duly replaced immediately. The meters will be of accuracy class 0.2.
Purpose of data	The Data/Parameter is required to calculate the baseline emission
Additional comment	Data will be archived electronically for a period of 2 years beyond the end of crediting period.

### B.7.2. Sampling plan

Sampling is not required for the given project activity.

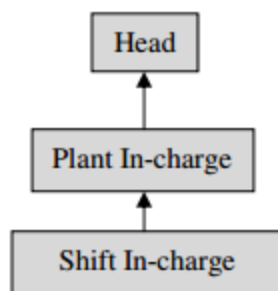
### B.7.3. Other elements of monitoring plan

The monitoring plan is developed in accordance with the modalities and procedures for CDM project activities and is proposed for grid-connected solar power project being implemented in Andhra Pradesh, India. The monitoring plan, which will be implemented by the project proponent describes about the monitoring organisation, parameters to be monitored, monitoring practices, quality assurance, quality control procedures, data storage and archiving.

The authority and responsibility for registration, monitoring, measurement, reporting and reviewing of the data rests with the project proponent. PP proposed the following structure for data

monitoring, collection, data archiving and calibration of equipments for this project activity. The team comprises of the following members:

### Organisational Structure for Monitoring



**Responsibilities of Head:** Overall functioning and maintenance of the project activity.

**Responsibilities of Plant In-charge:** Responsibility for Maintains the data records, ensures completeness of data, and reliability of data (calibration of equipments).

**Responsibilities of Shift In-charge:** Responsibility for day to day data collection and maintains day to day log book for monitored data.

### Data Measurement

The export and import energy will be measured continuously using above mentioned Main & Check meters. Export & Import readings of Main & Check meters shall be taken on monthly basis by authorized officer of APCPDCL in the presence of PP or representative of PP. The meter reading will be taken jointly and signed by the representatives of the APCPDCL and Arhyama Solar. Based on the readings, invoices will be raised by Arhyama Solar. These invoices can be used for cross checking the meter readings taken for the project activity.

### Data collection and archiving

Export & Import readings from main & check meter will be collected under the supervision of the plant in-charge. 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 on a daily basis. The records are checked periodically by the Plant Manager and discussed thoroughly with the plant supervisor. 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 plant helpers will be trained in equipment operation, data recording, reports writing, operation and maintenance and emergency procedures in compliance with the monitoring plan.

### B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

30/06/2014 is the date of completion of study on application of the selected methodology (AMS I.D - version 17.0). Further, the standardized baseline is not applicable for this project activity.

Arhyama Solar Power Pvt. Ltd. is the entity responsible for the application of the selected methodology and is also a project participant for this project activity as indicated in Appendix 1 below.

## **SECTION C. Duration and crediting period**

### **C.1. Duration of project activity**

#### **C.1.1. Start date of project activity**

Start date of the project activity is the date of purchase order as on 08/02/2013.

#### **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 of 7 years 00 Months have been opted for the project activity. This is the first crediting period of the project activity.

#### **C.2.2. Start date of crediting period**

30/10/2014 or Date of submission of complete request for registration by the DOE whichever is later.

#### **C.2.3. Length of crediting period**

07 Years 00 Months

## **SECTION D. Environmental impacts**

### **D.1. Analysis of environmental impacts**

The project activity has no significant impact on the environment. Solar PV power projects are not included in the Schedule I of the EIA notification S.O.1533 (E) dated 14th September 2006<sup>7</sup> and thus an EIA is not required. Ministry of Environment & forests vide their OM J-11013/41/2006 - IA II (I) dated 13th May 2011<sup>8</sup> has re-affirmed this and exempted the Solar PV power plants from EIA and EC requirement.

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<sup>7</sup> <http://envfor.nic.in/legis/eia/so1533.pdf>

<sup>8</sup> <http://moef.nic.in/downloads/public-information/OM-SolarPV.pdf>

**SECTION E. Local stakeholder consultation****E.1. Solicitation of comments from local stakeholders**

The promoters have invited comments/suggestions from local stakeholders in connection to the proposed project activity. For this a newspaper advertisement dated 30/11/2012 indicating the description of the project activity and date of stakeholder meeting was published in a local news paper.

A fairly decent gathering of the local stakeholders involved in the project activity were present for the meeting on 10/12/2012.

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

Meeting started with opening speech by representative of project proponent. He introduced all guests on dais. The representative of project proponent explained Technical aspects of project to stakeholders. He also explained about social, environmental & economical benefits of the project. He also elaborated about CDM & its requirement for the current project. After the presentation, the session was open for questions/feedback from stakeholders.

The villagers raised various queries as summarised below:

- Does the project provide employment opportunities or improve economic development of area?
- Will the project help in improving the electricity supply to the villagers or the neighbourhood areas?
- How will the project activity benefit the villages around the project site and their residents?

All the above queries have been suitable and satisfactorily replied / clarified by project proponent's representatives. Local stakeholders welcomed and expressed their support to the project. The meeting was concluded by vote of thanks to all the participants.

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

There were no comments raised by the stakeholders and they were totally in support for setting up of these kinds of projects in the region.

**SECTION F. Approval and authorization**

The letter of approval from the party involved in the project activity is not available at the time of submitting the PDD to the validating DOE.

## Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input checked="" type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Arhyama Solar Power Pvt. Ltd.
Street/P.O. Box	8-3-224/4/a/11 & 12, 2 <sup>nd</sup> floor, Door No. 215,
Building	Yousufguda Main Road, Beside Ratandeeep Supermarket
City	Hyderabad
State/Region	Andhra Pradesh
Postcode	500 045
Country	India
Telephone	-
Fax	-
E-mail	-
Website	<a href="http://www.arhyama.com/">http://www.arhyama.com/</a>
Contact person	Mr. Ananth Nakirikanti
Title	Director
Salutation	Mr.
Last name	Nakirikanti
Middle name	-
First name	Ananth
Department	-
Mobile	+91-91774-39452
Direct fax	-
Direct tel.	-
Personal e-mail	<a href="mailto:ananth@arhyamasolar.com">ananth@arhyamasolar.com</a>

## **Appendix 2. Affirmation regarding public funding**

No public funding for this project activity was received from annex 1 parties.

## **Appendix 3. Applicability of methodology and standardized baseline**

Please refer section B of the PDD for the same.

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

From CO2 database of CEA, Version 09 published by Government of India, Ministry of Power  
Central Electricity Authority, Government of India.

<b>CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE</b>			
VERSION	9		
DATE	January'14		
BASELINE METHODOLOGY	ACM0002 / Ver 14.0 and "Tool to Calculate the Emission Factor for an Electricity System", Version 4.0		

<b>Net Generation in Operating Margin (GWH) (incl. Imports)</b>			
	2010-11	2011-12	2012-13
Southern	145,076	157,536	162,905

<b>Simple Operating Margin (tCO2/MWh) (incl. Imports) (1) (2)</b>			
	2010-11	2011-12	2012-13
Southern	0.9421	0.9602	0.9972

<b>Weighted Generation Operating Margin</b>	
Southern	<b>0.9675</b>

<b>Build Margin (tCO2/MWh) (not adjusted for imports)</b>			
	2010-11	2011-12	2012-13
Southern	0.7828	0.8544	<b>0.9509</b>

<b>Combined Margin Emission Factor</b>	
Southern	<b>0.9633</b>

## **Appendix 5. Further background information on monitoring plan**

Please refer section B.7.1 and B.7.2 for information on monitoring.

## **Appendix 6. Summary of post registration changes**

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## Document information

Version	Date	Description
05.0	25 June 2014	<p>Revisions to:</p> <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and <b>Error! Reference source not found.</b>;</li> <li>• Change the reference number from <i>F-CDM-SSC-PDD</i> to <i>CDM-PDD-SSC-FORM</i>;</li> <li>• Editorial improvement.</li> </ul>
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	<p>EB 66, Annex 9</p> <p>Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities"</p>
03.0	15 December 2006	<p>EB 28, Annex 34</p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>
02.0	08 July 2005	<p>EB 20, Annex 14</p> <ul style="list-style-type: none"> <li>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.</li> <li>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <a href="http://cdm.unfccc.int/Reference/Documents">http://cdm.unfccc.int/Reference/Documents</a>.</li> </ul>
01.0	21 January 2003	<p>EB 07, Annex 05</p> <p>Initial adoption.</p>
<p>Decision Class: Regulatory</p> <p>Document Type: Form</p> <p>Business Function: Registration</p> <p>Keywords: project design document, SSC project activities</p>		