40 MW BUNDLED SOLAR PROJECT IN TELANGANA, INDIA

Document Prepared by Infinite Solutions

Project Title	40 MW Bundled Solar Project in Telangana, India
Version	02
Date of Issue	18-Dec- 2019
Monitoring Period	22-Dec-2017 to 28-Sep-2019
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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The main purpose of this project activity is to generate clean form of electricity through renewable solar energy source for sale of electricity to the grid. The project is a bundle project activity with 3 individual project promoters detailed below:

Project Investors' Name	Capacity in MWAC	**Location**
Achintya Solar Power Limited-I	10 MW	Village: Mandamarri; District: Mancherial; State: Telangana
Achintya Solar Power Limited-II	10 MW	
Suvarchas Solar Power Limited	10 MW	
Grinibhrit Solar Power Limited	10 MW	

The project activity involves installation of 04 projects of 10 MWAC each, totalling to 40 MWAC (corresponding to 54.525 MWp) solar power project under National Solar Mission, Phase-II, Batch-II, Tranche – I, State Specific Bundling Scheme. All the 4 projects are installed in the common project boundary at Village: Mandamarri, District: Mancherial, State: Telangana.

The electricity generated from project activity will be sold under the Power Purchase Agreement (PPA), signed with NTPC Ltd. NTPC has been identified by the Government of India (GoI) as the Implementation Agency for setting up of Grid-connected Solar PV Power Projects under State Specific Bundling Scheme under the National Solar Mission of Government of India (GoI). And NTPC Vidyut Vyapar Nigam Limited (NVVN) on behalf of NTPC will purchase Solar Power from Solar Power Developer, and sell it to Discoms. The electricity generated from the project activity will be evacuated through 220/132 kV sub-station located at Mandamarri for consumption in the Indian Electricity Grid.

The Project comprises of total 40 MW, out of which 32 MW has been commissioned dated 22/12/2017 and the rest 8 MW has been commissioned dated 17/01/2018.

The project will replace anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately average 77,456 tCO2e per annum, thereon displacing average 82,683 MWh/year amount of electricity from the generation-mix of power plants connected to the Indian electricity grid, which is mainly dominated by thermal/fossil fuel-based power plant.

The monitoring period is from 22-Dec-2017 to 28-Sep-2019. The total GHG emission reductions or removals generated in this monitoring period are 127,119 tCO2 thereon displacing 135,697 MWh amount of electricity generation.

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" Version 7.0 EB 100 Annex 4.

Baseline Scenario:

As per the applicable methodology, a Greenfield power plant is defined as "a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity".

As the project activity falls under the definition of a Greenfield power plant, the baseline scenario as per paragraph 24 of Section 5.2.1 of applied methodology is the following:
If the project activity is the installation of a Greenfield power plant, the baseline scenario is 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.

1.2 Sectoral Scope and Project Type

The project activity falls under the following Sectoral scope and Project Type:

Sectoral Scope : 01 - Energy industries (renewable / non-renewable sources)

Project Type : I - Renewable Energy Projects

Methodology : ACM0002: Grid-connected electricity generation from renewable sources - Version 19

The project is not a grouped project activity.

1.3 Project Proponent

Organization name	Achintya Solar Power Limited- I and II
Contact person	Murali Krishnam Raju M
Title	Senior Manager - Commercial
Address	PLOT NO. #1131/A, ROAD NO. 36, JUBILEE HILLS, HYDERABAD – 500033, TELANGANA, INDIA.
Telephone	+91(40) 4030 1004
Email	muraliraju.m@greenkogroup.com

Organization name	Suvarchas Solar Power Limited
Contact person	Murali Krishnam Raju M
Title	Senior Manager - Commercial
Address	PLOT NO. #1131/A, ROAD NO. 36, JUBILEE HILLS, HYDERABAD – 500033, TELANGANA, INDIA.
Telephone	+91(40) 4030 1004
Email	muraliraju.m@greenkogroup.com

Organization name	Grinibhrit Solar Power Limited
Contact person	Murali Krishnam Raju M

Title	Senior Manager - Commercial
Address	PLOT NO. #1131/A, ROAD NO. 36, JUBILEE HILLS, HYDERABAD – 500033, TELANGANA, INDIA.
Telephone	+91(40) 4030 1004
Email	muraliraju.m@greenkogroup.com

1.4 Other Entities Involved in the Project

Organization name	Infinite Solutions
Role in the project	Project Consultant
Contact person	Mr. Jimmy Sah
Title	Head – Sustainability
Address	611, Chetak Centre Main, 12/2 RNT Marg, Indore- 452001
Telephone	+91-9644130430
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1.5 Project Start Date

Project Start Date: 22-Dec-2017

The project start date is the earliest commissioning date amongst projects which are part of this Project.

1.6 Project Crediting Period

Crediting Period Start date: 22-Dec-2017

Crediting Period End date: 21-Dec-2027

The project activity adopts renewable crediting period of 10 years period which can be renewed for 2 times.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	✓
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
Year 1	79,240
Year 2	78,844
Year 3	78,448
Year 4	78,052

Year 5	77,652
Year 6	77,256
Year 7	76,860
Year 8	76,464
Year 9	76,068
Year 10	75,672
Total estimated ERs	774,556
Total number of crediting years	10
Average annual ERs	77,456

1.8 Description of the Project Activity

The main purpose of this project activity is to generate clean form of electricity through renewable solar energy source for sale of electricity to the grid. The project activity involves installation of 04 projects of 10 MWAC each, totalling to 40 MWAC (corresponding to 54.525 MWp) solar power project under National Solar Mission, Phase-II, Batch-II, Tranche – I, State Specific Bundling Scheme. All the projects are installed in the common project boundary at Village: Mandamarri, District: Mancherial, State: Telangana.

The solar PV power plant will have solar PV modules, inverters, transformers and other protection system and supporting components as under:

Solar PV modules:

Module Supplier	Module Model	Capacity (p)	Number	Total Capacity (MWp)
Renesola	Poly-crystalline	315	72702	22.901
	Poly-crystalline	320	98826	31.624
			TOTAL CAPACITY	54.525

Mounting Structure Type	Fixed tilt
Tilt	13°
Pitch(m)	6
Number of modules per string	21
Mounting Structure	
Typical mounting unit (rows x columns)	2x21
Orientation of modules (East-West)	Portrait
Inverters	
Make	SMA
Model	Sunny Central 1000CP XT
Rated Capacity	900 kW
No. of Inverters	11
Rated Input Voltage	405

The Project activity is a new facility (Greenfield) and the electricity generated by the Project will be exported to the Indian Grid. The Project will therefore displace an equivalent amount of electricity which would have otherwise been generated by fossil fuel dominant electricity grid. The Project Proponent plans to avail the VCS benefits for the Project.

In the Pre- project scenario the equivalent amount of electricity, either fetched (under captive cases) or delivered to the grid by the project activity, would have otherwise been generated by the operation of grid connected fossil fuel-based power plants and by the addition of new generation sources.
The project shall result in replacing anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 77,458 tCO2e per year, thereon displacing 82,683 MWh/year amount of electricity from the gird.

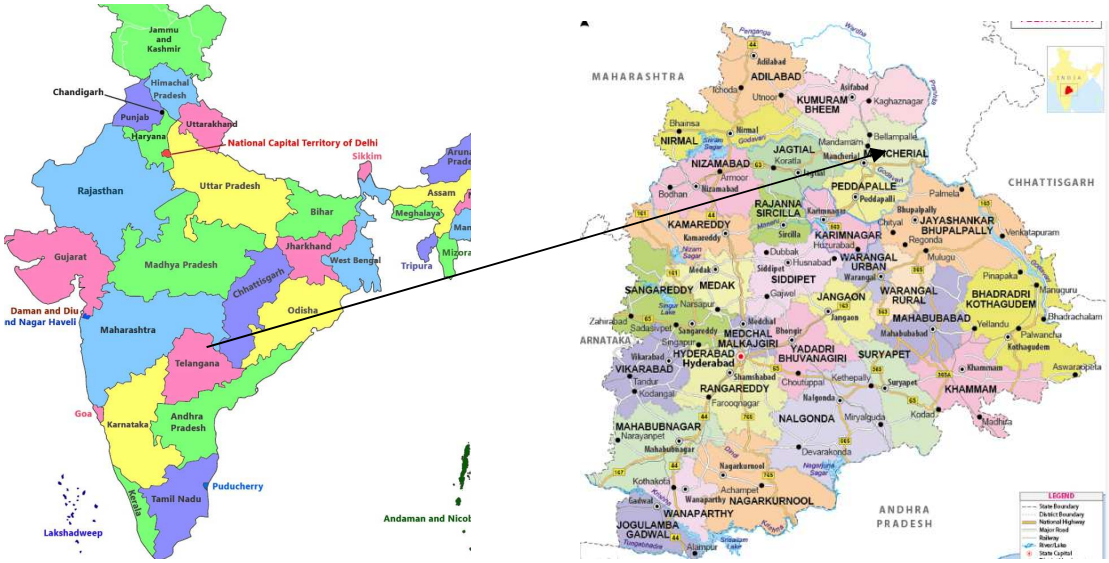
Emission Reductions from anthropogenic sources:

The solar power generated from the Project will be displacing the electricity generated from thermal power stations feeding into Indian grid and will be replacing the usage of diesel generators for meeting the power demand during shortage periods. Since, the solar power is Green House Gas (GHG) emissions free, the power generated will prevent the anthropogenic GHG emissions generated by the fossil fuel based thermal power stations comprising coal, diesel, furnace oil and gas. The estimation of GHG reductions by this project is limited to carbon dioxide (CO2) only.

1.9 Project Location

The project is located at Village: Mandamarri, District: Mancherial, State: Telangana, Country: India. The geological coordinates are:

Project Participants	Latitude	Longitude
Achintya Solar Power Limited - I	18°58'30" N	79° 25' 33.6"E
Achintya Solar Power Limited - II	18°58'30" N	79° 25' 33.6"E
Grinibhrit Solar Power Limited	18°58'30" N	79° 25' 33.6"E
Suvarchas Solar Power Limited	18°58'30" N	79° 25' 33.6"E



Project Location

1.10 Conditions Prior to Project Initiation

The project is a Greenfield solar power project and does not involve generation of GHG emissions for the purpose of their subsequent reduction, removal or destruction. Prior to the initiation of the project activity, the equivalent amount of electricity would have been drawn from grid connected or new power plants, in Indian Grid. The grid is predominantly coal based and therefore is a major source of carbon di oxide emissions in India. The main emission in the pre project scenario is the power plants connected to the Indian Grid, and main GHG involved is CO2. The baseline identified in section 2.4 is same as the pre-project scenario.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The Project has received necessary approvals for development and commissioning in the name of each individual project owners of the Solar Project from the state Nodal agencies and is in compliance to the local laws and regulations.

The relevant national laws and regulations pertaining to generation of energy in India are:

- Electricity Act 2003
- National Electricity Policy 2005
- Tariff Policy 2006

The Project activity conforms to all the applicable laws and regulations in India:

1. Power generation using Solar energy is not a legal requirement or a mandatory option.
2. There are state and sectoral policies, framed primarily to encourage Solar power projects. These policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments.
3. The Indian Electricity Act, 2003 (May 2007 Amendment) does not influence the choice of fuel used for power generation.
4. There is no legal requirement on the choice of a particular technology for power generation.

1.12 Ownership and Other Programs

1.12.1 Project Ownership

The Project is owned by Achintya Solar Power Limited-I, Achintya Solar Power Limited-II, Grinibhrit Solar Power Limited and Suvarchas Solar Power Limited hence it possesses right of use of ER credits. The Ownership is demonstrated through the following documents.

1) Commissioning certificates for 40 MW Solar PV in the name of the PPs issued by respective state nodal agencies /authorities of the state Telangana of India.

2) Power Purchase Agreement with NTPC Limited for sale of electricity by the PPs.

1.12.2 Emissions Trading Programs and Other Binding Limits

Net GHG emission reductions or removals generated by the Project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions in any Emission Trading program or other binding limits.

1.12.3 Other Forms of Environmental Credit

The Project has no intent to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under the VCS Program.

1.12.4 Participation under Other GHG Programs

The Project has not participated in any other GHG programs.

1.12.5 Projects Rejected by Other GHG Programs

The Project is not rejected by other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

This is not a grouped project activity. Thus, this section is not applicable for this project

Leakage Management

Not applicable to the project activity.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Sustainable Development

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

Social well being

The project activity will provide job opportunity to local people during erection, commissioning and maintenance of the Solar power project. Frequency of visiting to villages and nearby areas by skilled, technical and industrialist has increased due to installation /site visit/operation and maintenance work related to Solar power project at plant site. This directly and indirectly positively effects the economy of nearby populace.

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 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 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.

Further Information

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

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Methodology:

ACM0002: Grid-connected electricity generation from renewable sources --- Version 19.0, Sectoral Scope: 01, EB 100, Annex 6

https://cdm.unfccc.int/methodologies/DB/VJI9AX539D9MLOPXN2AY9UR1N4IYGD

The project activity also takes reference from following Tools from the tools prescribed by applied methodology:

1. Tool for the demonstration and assessment of additionality --- Version 07.0.0, EB 70, Annex 8

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

2. Tool to calculate the emission factor for an electricity system --- Version 07.0, EB 100, Annex 4

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

2.2 Applicability of Methodology

The following steps will show the applicability of the project under this methodology

Applicability Criterion (with Para number reference)		Project Case
1.	This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s).	The Project activity is installation of Greenfield Solar Power Project. Hence the project activity satisfies this applicability criterion of the methodology.
2.	The methodology is applicable under the following conditions: (a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar	The option (a) of applicability criteria 1 is applicable as project activity is generation of electricity through Solar Power Plant which is renewable energy power

	power plant/unit, wave power plant/unit or tidal power plant/unit; (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects) the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	plant. Hence the project activity satisfies this applicability criterion of the methodology
3.	In case of hydro power plants, one of the following conditions shall apply:[1] (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density, calculated using equation (3), is greater than 4 W/m^2; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m^2; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m^2, all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m^2; (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a. Lower than or equal to 15 MW; and	The project activity is Solar power project thus this condition is not applicable.

[1] Project participants wishing to undertake a hydroelectric project activity that result in a new reservoir or an increase in the volume of an existing reservoir, in particular where reservoirs have no significant vegetative biomass in the catchments area, may request a revision to the approved consolidated methodology.

	b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	
4.	In the case of integrated hydro power projects, project proponent shall: (a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or (b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	The project activity is Solar power project thus this condition is not applicable
5.	The methodology is not applicable to: (a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; (b) Biomass fired power plants/units.	The project activity is Solar power project thus this condition is not applicable
6.	In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The proposed project activity is a Greenfield project; thus, this criterion is not applicable.

7.	In addition, the applicability conditions included in the tools referred to below apply.[2]	The project applies the following tools and is in compliance to the same; • "Tool to calculate the emission factor for an electricity system"; • "Tool for the demonstration and assessment of additionality";

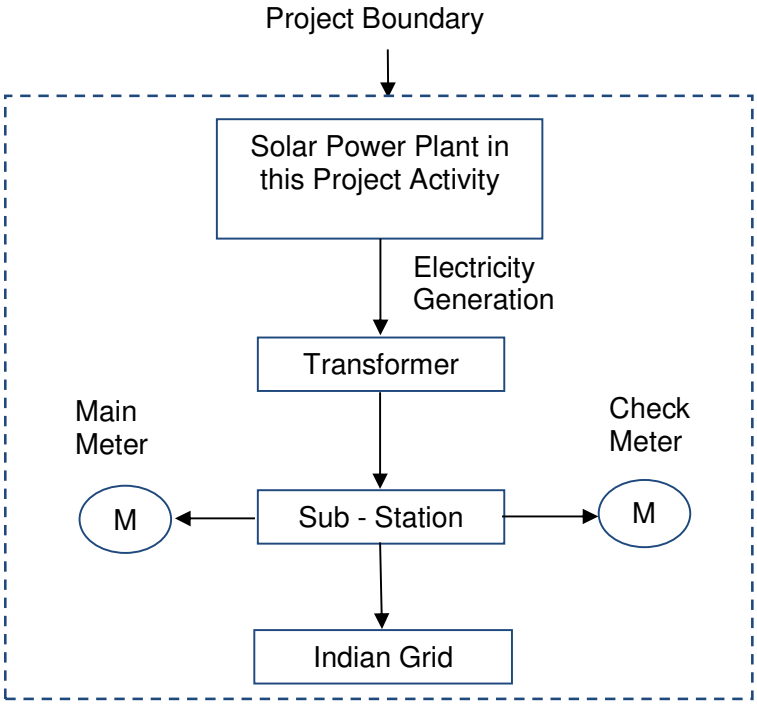
Applicability conditions of "Tool to calculate the emission factor for an electricity system"		
	Applicability Criterion (with Para number reference)	**Project Case**
1.	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	This condition is applicable. OM, BM and CM are estimated using the tool under section 3.1 for calculating baseline emissions.
2.	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 1: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Since the project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.

[2] The condition in "TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality" that all potential alternative scenarios to the proposed project activity must be available options to project participants; does not apply to this methodology, as this methodology only refers to some steps of this tool.

3.	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project activity is located in India, a non-Annex I country. Therefore, this criterion is not applicable for the project activity.
4.	Under this tool, the value applied to the CO2 emission factor of biofuels is zero.	The project activity is a grid connected Solar power plant. Therefore, this criterion is not applicable for the project activity.

2.3 Project Boundary

As per ACM0002 version 19, for solar projects, the project boundary includes the physical site of the power plant and all power plants connected physically to the electricity system that the project power plant is connected to. The project boundary consists of turbines, generators, transformers, transmission lines, metering equipment, connected grid sub-stations and Indian Grid.



Source		Gas	Included	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Major emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project	On site fossil fuel consumption due to project activity	CO_2	No	Electricity generation through Solar does not lead to emission of greenhouse gases.
		CH_4	No	Electricity generation through Solar does

Source		Gas	Included	Justification/Explanation
				not lead to emission of greenhouse gases.
		N_2O	No	Electricity generation through Solar does not lead to emission of greenhouse gases.

2.4 Baseline Scenario

Since, the project activity is a Greenfield power plant and meets all the applicability criteria for the ACM0002 Version 19,

As per para 23 of ACM0002 version 19.0; If the project activity is the installation of a Greenfield power plant

"the baseline scenario is 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".

In the absence of the project activity, the equivalent amount of power would have been drawn from the Indian grid. Hence, the baseline for the project activity is the equivalent amount of power from the Indian grid.

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) (having weightage 75%) and build margin (BM) (having weightage 25%). Calculations for this combined margin must be based on data from an official source[3] (where available) and made publically available.

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

Parameter	Value	Nomenclature	Source
$EF_{grid,CM,y}$	0.9126 tCO2/MWh	Combined margin CO2 emission factor for the project electricity system in year y	Calculated as the weighted average of the operating margin (0.50) & build margin (0.50) values, sourced from Baseline CO2 Emission Database, Version 14 published by Central Electricity Authority (CEA), Government of India
$EF_{grid,OM,y}$	0.9610 tCO2/MWh	Operating margin CO2 emission factor for the project electricity system in year y	Calculated as the last 3 year (2015-16, 2016-17 & 2017-18) generation-weighted average, sourced from Baseline CO2 Emission Database, Version 14, published by Central Electricity Authority (CEA), Government of India

[3] http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

$EF_{grid,BM,y}$	0.9368 tCO2/MWh	Build margin CO2 emission factor for the project electricity system in year y	Baseline CO2 Emission Database, Version 14, published by Central Electricity Authority (CEA), Government of India

2.5 Additionality

In line with VCS Standard version 3.7, the additionality of the Project activity is ascertained in line with the applicable guidance from the UNFCCC. The demonstration of additionality for the proposed Project activity is being carried out in accordance with the additionality tool provided by the UNFCCC i.e. "Tool for demonstration and assessment of Additionality" Version 07.0.0. The tool provides a step-wise approach to demonstrate additionality which is displayed below:

Step 0: Demonstration whether the proposed project activity is the first-of-its-kind

The proposed project activity is a solar project; hence not the first of its kind. Hence, this step is not applicable.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

As per the applied methodology ACM0002 version 19; Para 22, "*If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid connected power plant and by the addition of new generation sources*".

As the baseline scenario is prescribed by applied methodology, hence no further analysis is carried out to identify alternatives.

Step 2: Investment Analysis

Sub-step 2a: Determine appropriate analysis method

As per "Tool for the demonstration and assessment of additionality" (version 07.0.0), for financial analysis of the project, the following three options are available:

Option I: Simple Cost Analysis
Option II: Investment Comparison Analysis
Option III: Benchmark Analysis

The project will generate revenues from sale of electricity, therefore Option I is not applicable. Option II also does not apply since there is no comparable investment alternative available to the project participant in line with para 32 of the Methodological tool: "Tool for the demonstration and assessment of additionality" (version 07.0.0).

The most appropriate financial analysis method is therefore option III: the benchmark analysis, where the returns on investment in the project activity are compared to benchmark returns that are available to any investors in the country.

Sub-step 2b: Option III. Apply benchmark analysis

Project proponents have considered Post-Tax Equity IRR for investment analysis at the time of decision-making. As Project proponents is only interested in the returns project is generating on the portion of investment costs, which is financed by them in the form of equity.

As per Para 15 of EB 105 annex 06 states that Required/expected returns on equity are appropriate benchmarks for equity IRR. Therefore, the Expected return on equity is considered appropriate benchmark.

Accordingly, the post-tax Equity IRR has been considered as the relevant financial indicator for Investment Analysis.

Default Value Benchmark:

As per para 19 of EB 101, Annex 11 the cost of equity is determined by option (a) selecting the values provided in the Appendix, i.e. Default values for cost of equity (expected return on equity) and is presented below:

The Required return on equity (benchmark) was computed in the following manner:

Nominal Benchmark[4] = {(1+Real Benchmark)*(1+Inflation rate)}-1

Where:

- Default value for Real Benchmark is the default value of expected return on equity in real terms for Energy Industries (Group 1) in India as provided in the Appendix

- Inflation Rate forecast for by Reserve Bank of India (RBI) (i.e. Central Bank of India) for India.

Benchmark estimation:

The Cost of Equity has been considered using the "Methodological tool: Investment analysis" available at the time of decision making as well as the latest available value. As a conservative approach, the minimum value of benchmark has been considered as calculated using these 2 approaches.

Default Value at the time of investment decision:
Table under Appendix in EB 85 annex 12 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = **11.10%**[5]

Default Value as per latest version of Investment Analysis Tool version 10: Table under Appendix in EB 105 annex 06 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = **10.24%**[6]

[4] As per Pg. 320 of Corporate Finance, Second Edition of Aswath Damodaran

[5] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v1.pdf

[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v10.0.pdf

Thus, Minimum Default Value considered for calculation of Benchmark = 10.24%

Inflation Forecast for India as per RBI website[7] and corresponding benchmark values:

Project Promoters' Name	Inflation Forecast		Benchmark	
	5 Years	**10 Years**	**5 Years**	**10 Years**
Achintya Solar Power Limited - I	4.80%	4.70%	15.53%	**15.42%**
Achintya Solar Power Limited - II	4.80%	4.70%	15.53%	**15.42%**
Suvarchas Solar Power Limited	4.80%	4.70%	15.53%	**15.42%**
Grinibhrit Solar Power Limited	4.80%	4.70%	15.53%	**15.42%**

As a conservative approach, the minimum value of benchmark has been selected for this project activity.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III):

Key assumptions supporting the financial projections:

Input Parameters	Grinibhrit	Suvarchas	Achintya-I	Achintya-II
Capacity of Project	10.00	10.00	10.00	10.00
Expected Date of Commissioning	31-Mar-18	31-Mar-18	31-Mar-18	31-Mar-18
Life of the plant (Yrs.)	25	25	25	25
PLF (%)	24.14%	24.14%	24.14%	24.14%[8]
Total Annual generation (kWh)	21,146,198	21,146,198	21,146,198	21,146,198
Deration every year	0.5%	0.5%	0.5%	0.5%
Tariff rate at the decision making (INR/kWh)	4.67	4.67	4.67	4.67[9]
O & M Expenses (INR Mn.)	6	6	12	12¡Error! Marcador no definido.
Escalation in the operational expenses (%)	6%	6%	6%	6%
O & M free for (Yr.)	0	0	0	0
TOTAL COST (INR Mn.)	670	670	670	670¡Error! Marcador no definido.
Debt - Equity Ratio	70 : 30	70 : 30	70 : 30	70 : 30¡Error! Marcador no definido.
Interest rate (%)	11.50%	11.50%	11.50%	11.50%¡Error! Marcador no definido.
Loan Tenure (Qtr.)	76	76	76	76
Residual Value (INR Mn.)	10.00%	10.00%	10.00%	10.00%¡Error! Marcador no definido.

[7] https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=16980
[8] Third Party PLF Report
[9] DPR

IT Depreciation Rate (%)	40%	40%	40%	40%[10]
Income tax rate (%)	34.61%	34.61%	34.61%	34.61%[11]
MAT (%)	21.34%	21.34%	21.34%	21.34%
Service Tax (%)	14.50%	14.50%	14.50%	14.50%[12]

Considering the input values, Equity IRR is given below:

Project Promoters' Name	**Equity IRR without CDM**	**Benchmark (Equity IRR)**
Achintya Solar Power Limited - I	**6.97%**	**15.42%**
Achintya Solar Power Limited - II	**6.97%**	**15.42%**
Suvarchas Solar Power Limited	**6.97%**	**15.42%**
Grinibhrit Solar Power Limited	**6.97%**	**15.42%**

The project activity cannot be considered as financially attractive as the equity IRR for the project activity is less than the Benchmark.

Sub-step 2d: Sensitivity Analysis

Addressing Guidance *27 & 28 of EB 105, Annex 06*, following factors has been subjected to sensitivity analysis:

1. PLF
2. O&M Cost
3. Project Cost
4. Tariff

The rationale of sensitivity is, "*The ultimate objective of the sensitivity analysis is to determine the likelihood of the occurrence of a scenario other than the scenario presented, in order to provide a cross-check on the suitability of the assumptions used in the development of the investment analysis.*"

The results of sensitivity analysis are as follows:

Achintya Solar Power Limited – I :

Variation %	-10%	Normal	10%	Variation required to reach benchmark
PLF	4.17%	6.97%	9.71%	30.76%
O&M	7.28%	6.97%	6.65%	-316.61%

10 https://www.incometaxindia.gov.in/_layouts/15/dit/mobile/viewer.aspx?path=https://www.incometaxindia.gov.in/charts%20%20tables/depreciation%20rates.htm&k=&IsDlg=0

11 http://www.incometaxindia.gov.in/Tutorials/2%20Tax%20Rates.pdf

12 https://www.taxdose.com/comparative-service-tax-chart-with-service-tax-rate-of-14-14-5-and-15/

Project Cost	8.85%	6.97%	5.27%	-34.89%
Tariff Rate	4.17%	6.97%	9.71%	30.76%

Achintya Solar Power Limited – II :

Variation %	-10%	Normal	10%	Variation required to reach benchmark
PLF	4.17%	6.97%	9.71%	30.76%
O&M	7.28%	6.97%	6.65%	-316.61%
Project Cost	8.85%	6.97%	5.27%	-34.89%
Tariff Rate	4.17%	6.97%	9.71%	30.76%

Suvarchas Solar Power Limited:

Variation %	-10%	Normal	10%	Variation required to reach benchmark
PLF	4.17%	6.97%	9.71%	30.76%
O&M	7.28%	6.97%	6.65%	-316.61%
Project Cost	8.85%	6.97%	5.27%	-34.89%
Tariff Rate	4.17%	6.97%	9.71%	30.76%

Grinibhrit Solar Power Limited:

Variation %	-10%	Normal	10%	Variation required to reach benchmark
PLF	4.17%	6.97%	9.71%	30.76%
O&M	7.28%	6.97%	6.65%	-316.61%
Project Cost	8.85%	6.97%	5.27%	-34.89%
Tariff Rate	4.17%	6.97%	9.71%	30.76%

The results of sensitivity analysis show that even with a variation of +10% & -10% in project cost, O&M cost, PLF and Tariff Rate, Equity IRR is significantly lower than the benchmark. And it is evident from the results given above; the project remains additional even under the most favourable conditions.

Probability to breach the benchmark:
Sensitivity Parameter 1 : PLF

PLF considered in financials is as per **"Guidelines for the reporting and validation of Plant load factors" stated in EB48 Annex11**[13]. Variation in PLF of more than 10% is unlikely to happen as the PLF has been reported as per the Third-Party Report based.
Sensitivity Parameter 2 : O&M
The sensitivity analysis reveals that O&M will breach the benchmark at negative values and is hypothetical case. Since the O&M cost is subject to escalation and also subject to inflationary pressure, any reduction in the O&M costs is highly unlikely. Hence, the reduction in the O&M cost is highly unlikely.
Sensitivity Parameter 3 : Project Cost
Estimated Project Cost for financial analysis is considered from DPR. However, even if we consider the actual cost of the project even then the benchmark is not breached. Moreover, the Sensitivity is carried out for +/-10%.
Sensitivity Parameter 4 : Tariff Rate
As per the PPA with NTPC for 25 years, the tariff is fixed for the entire life of the Project. However, Sensitivity is carried out for +/-10% variation in the tariff. Even then the benchmark is not breached. Hence, there is no probability of variation for the same.

Outcome of Step 2:

This substantiates that the investment is not financially attractive (Equity IRR for the project activity is less than the Benchmark Equity IRR) for any of the investor. Thus it can be easily concluded that project activity is additional & is not business as usual scenario.

Step 3: Barrier analysis

Barrier analysis has not been used.

Step 4: Common practice analysis

Stepwise approach for common practice analysis has been carried out as per Methodological tool "Common Practice", version 03.1 EB84, Annex 7:

Step (1): *calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.*

Range	Capacity	Unit
+50%	60	MW
Capacity of the proposed project activity	40	MW
-50%	20	MW

[13] http://cdm.unfccc.int/EB/048/eb48_repan11.pdf

Step (2): *identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:*

(a) The projects are located in the applicable geographical area;
(b) The projects apply the same measure as the proposed project activity;
(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
(f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

Identification of the similar projects (CDM and non-CDM) is carried out as per sub-steps of Step (2) as follows:

a) As the projects are located in Telangana state of India, therefore, projects in the geographical area of Telangana have been chosen for analysis.

b) The project activity is a green-field solar power project and uses measure *(b) "Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies".*

Therefore, projects applying same measure (b) are candidates for similar projects.

c) The energy source used by the project activity is solar. Hence, only solar energy projects have been considered for analysis.

d) The project activity produces electricity; therefore, all power plants that produce electricity are candidates for similar projects.

e) The capacity range of the projects is within the applicable capacity range from 20 MW to 60 MW.

f) The start date of the project activity is 22-Dec-2017. Therefore projects, which have started commercial operation before 22-Dec-2017, have been considered for analysis.

Numbers of Similar projects identified (as per data published by TSSPDCL[14]), which fulfil above-mentioned conditions are

N_{solar} = 3

Step (3): *within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.*

CDM project activities, which have got registered or are under validation have been excluded in this step. The list of the power plants identified is provided to the DOE. After excluding the registered and under validation projects the total number of projects,

N_{all} = 3

Step (4): *within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}.*

From the projects identified above, those projects which employ "different technologies" have been excluded and the number of such projects has been identified as Ndiff.

Since the project activity has been allocated through Bidding process and have Power Purchase Agreement (PPA) with NTPC. The policies and tariff are regulated/governed by the respective PP investment analysis.

So, projects in Telangana that have been signed Power Purchase Agreement (PPA) with respective Discom can be assumed that such projects are governed by different investment climate. Therefore, these projects come under different investment climate and have been considered under Ndiff.

.

N_{diff} = 0

Step (5): *calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.*

Calculate **$F=1-N_{diff}/N_{all}$**

F = 1-(3/0) = 1

Outcome of Step 4:

As,

14 https://www.tssouthernpower.com/framework/skins/CPDCL_SKIN/Pdfs/RenewableEnergy/SolarPrjcts%20Synchronisedgrid30.04.2016.xls

i. **F = 1; is more than 0.2**
ii. **N_{all}-N_{diff} = 3; is equal than 3**

The project activity does not satisfy condition (ii). Hence, project activity is not a common practice

The proposed project activity is not a "common practice" within a sector in the applicable geographical area.

The above discussions show that solar power development is not a common practice and the project activity is not financially attractive; hence the project activity is additional.

2.6 Methodology Deviations

There is no methodology deviation.

3 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Baseline emissions include only CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

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

Where:

BE_y = Baseline emissions in year *y* (t CO_2/yr)

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

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

I. Calculation of $EG_{PJ,y}$

If the project activity is the installation of a Greenfield power plant, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Where:

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

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

$$EG_{PJ,y} = EG_{facility,y}$$

Net electricity generation supplied by the project plant/unit to the grid:

For solar projects, the PP need to provide schedule for electricity to be injected and based on electricity meters measured data, the actual injected electricity is monitored. Monthly Joint Meter Readings in presence of Grid officials, project proponent as well the Substation incharge is carried out and serves the official data for calculation of generation from the project.

Therefore,

$EG_{PJ,y}$ = **82,683 MWh**

II. Calculation of $EF_{grid,CM,y}$

The methodology ACM0002 (Version 19.0) requires that the combined margin for the grid be calculated in accordance with the procedure provided in the *"Tool to calculate the emission factor for an electricity system".*

As per "Tool to calculate the emission factor for an electricity system, Version 7.0.0";

The baseline emission factor ($EF_{grid,y}$) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

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_2/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 i.e.

CO_2 Baseline Database for the Indian Power Sector, Version 14, December 2018[15], 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 07.0, EB 100, Annex 4, 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, all the 5 zones have now been synchronized and called as Indian Grid.

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

[15] http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

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.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)

	2013-14	2014-15	2015-16	2016-17	2017-18
India	18.6%	16.8%	15.1%	14.6%	14.3%

Data Source: Central Electricity Authority (CEA) database Version 14, Dec'2018

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 Indian grids 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 OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (t CO2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

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 ($EF_{grid,OM,y}$) according to the selected method

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

Net Generation in Operating Margin (MWh) (incl. Imports)			
	2015-16	**2016-17**	**2017-18**
Indian Grid	871,753	916,278	960,693

Simple Operating Margin (tCO_2/MWh) (incl. Imports)			
	2015-16	**2016-17**	**2017-18**
Indian Grid	0.9655	0.9636	0.9543

Weighted Generation Operating Margin	
Indian Grid	**0.9610**

STEP 5: Calculate the build margin emission factor ($EF_{grid,BM,y}$)

In terms of vintage of data, project participants can choose between one of the following two options:

(a) ***Option 1*** *- for the first crediting period, calculate the 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. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.*

(b) ***Option 2*** *- For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.*

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.

Build Margin (tCO_2/MWh) (not adjusted for imports)	
	2017-18
Indian Grid	**0.8644**

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 reference to para 81 (b) of the Tool to calculate the emission factor for an electricity system, Version 04.0.0, EB 75, Annex 15, all projects other than wind and solar photovoltaic:

w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and

w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period,

unless otherwise specified in the approved methodology which refers to this tool.

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

Calculation of Baseline Emission Factor ($EF_{grid,y}$)

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

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

Where,

w_{OM}	75% weight of operating margin emissions factor (%)
w_{BM}	25% weight of operating margin emissions factor (%)
$EF_{grid,OM,y}$	Build margin CO_2 emission factor of a particular grid in year y; calculated as described in Steps 3&4 above (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor of a particular grid in year y; calculated as described in Steps 5 above (tCO_2/MWh)

Baseline Emission factor (Indian Grid)

$$EF_{Grid,CM,y} = 0.75*0.9610 + 0.25*0.8644$$

$$= 0.9368\ tCO_2/MW$$

Therefore, Baseline Emissions:

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

BE_y= **82,683 x 0.9368 = 77,456 tCO_2**

3.2 Project Emissions

The project emission calculation as per para 34 of ACM0002 version 19,

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (t CO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (t CO_2e/yr)

$PE_{FF,y} = 0$

As per para 37 of ACM0002 version 19,

"For all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected"

$PE_{GP,y} = 0$

Therefore, PE_y=0

3.3 Leakage

As per para 56 of ACM0002 version 19, No leakage emissions need to considered for the project activity.

3.4 Estimated Net GHG Emission Reductions and Removals

As per para 61 of ACM0002 version16; Emission Reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

PE_y = Project emissions in year *y* (t CO_2e/yr)

Therefore, Net GHG Emission Reductions and Removals are calculated as follows:

$$ER_y = BE_y - PE_y$$

ER_y **= 77,456 – 0 = 77,456 tCO_2**

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
Year 1	79,240	-	-	79,240
Year 2	78,844	-	-	78,844
Year 3	78,448	-	-	78,448
Year 4	78,052	-	-	78,052
Year 5	77,652	-	-	77,652
Year 6	77,256	-	-	77,256
Year 7	76,860	-	-	76,860
Year 8	76,464	-	-	76,464
Year 9	76,068	-	-	76,068
Year 10	75,672	-	-	75,672
Total	**774,556**	-	-	**774,556**
Average	**77,456**			**77,456**

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{grid,OM,y}$
Data unit	tCO_2/MWh
Description	Operating Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 14, December 2018[16]
Value applied:	0.9610 (Indian Grid)
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0.0" as 3-year generation weighted average using data for the years 2015-16, 2016-17 & 2017-18. The data are obtained from "CO_2 Baseline Database for Indian Power Sector" version 14.0, published by the Central Electricity Authority, Ministry of Power, Government of India.

[16] http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver10.pdf

Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO2/MWh
Description	Build Margin CO2 emission factor in year y
Source of data	Calculated from CEA database, Version 14, December 2018
Value applied:	0.8644 (Indian Grid)
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07.0.0" as 3-year generation weighted average using data for the years 2017-18. The data are obtained from "CO2 Baseline Database for Indian Power Sector" version 14.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 14, December 2018
Value applied:	0.9368 (Indian Grid)
Justification of choice of data or description of measurement methods and procedures applied	The combined margin emissions factor is calculated as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$ 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 (%) = 75% W_{BM}= Weighting of build margin emissions factor (%) = 25%
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

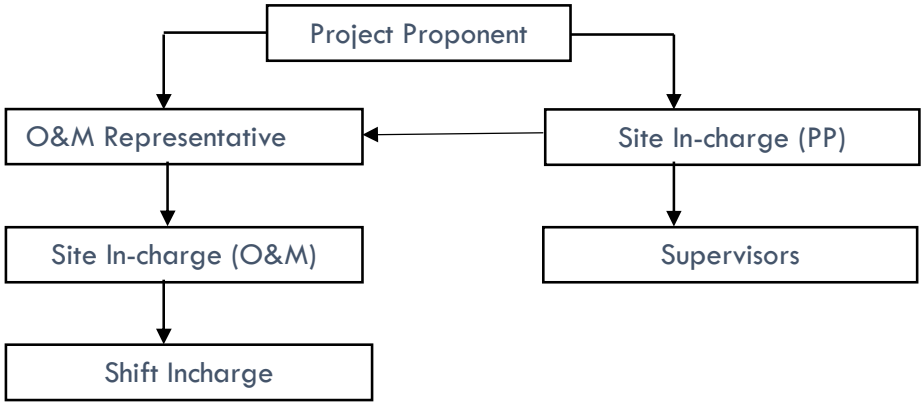
4.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity supplied to the grid by Solar Project
Source of data	Joint Meter Reading statement provided by TSSPDCL every month.
Description of measurement methods	Electricity exported and imported to the grid is in kWh. However, for the calculation purpose electricity exported and imported is

and procedures applied	converted in MWh. The Net electricity supplied to the grid by the project activity will be calculated as a difference of electricity exported to the grid and electricity imported from the grid obtained from Monthly Meter reading reports provided by TSTRANSCO / TSNPDCL as per below equation: $EG_{PJ,y} = EG_{Export} - EG_{Import}$ Cross Checking: Quantity of net electricity supplied to the grid will be cross checked from the Invoices/ Monthly Bill raised by the Project Participant to NTPC Limited.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied:	82,683 MWh
Monitoring equipment	Electricity Meters of 0.2s Class
QA/QC procedures applied	Calibration of all the meters will be undertaken at required intervals and faulty meters will be duly replaced immediately based on CEA guidelines which specifies calibration once in 5 years. The data will be cross checked with sales receipts.
Purpose of data	Calculation of Baseline emissions
Calculation method	N/A
Comments	The data will be archived electronically for two years after the end of the last crediting period or the last issuance of VERs for this project activity, whichever occurs later.

4.3 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/ unit being implemented in Telangana, India. The monitoring plan, which will be implemented by the project participant describes about the monitoring organisation, parameters to be monitored, monitoring practices, quality assurance, quality control procedures, data storage and archiving.



Responsibilities of Site Incharge (PP): Overall functioning and maintenance of the project activity, the Site incharge shall coordinate with the O&M operator as well as the site supervisors.

Responsibilities of O&M Representative: Co-ordination between Site incharge of the O&M operator as well as the project participant and further report to PP head office.

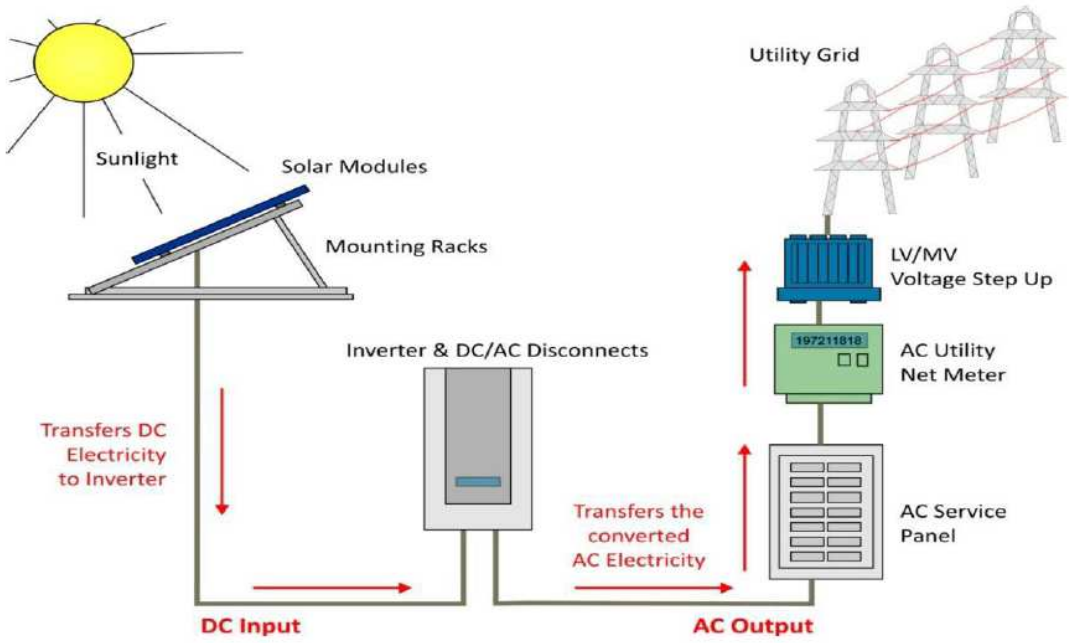
Responsibilities of Site In-charge (O&M Operator): Responsibility for maintaining the data records, ensures completeness of data, and reliability of data (calibration of equipment) as well as data recording for all the parameters.

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

QA/QC procedures: The energy meters at the feeders are maintained and owned by Telangana State Northern Power Distribution Company Limited (TSNPDCL). Neither the project proponent nor the site personnel have any control over it. The records will be cross-checked with the records of sold electricity TSNPDCL. The meters are calibrated by TSNPDCL at-least once in five years.

Data Measurement

The export and import energy will be measured continuously using above mentioned Main & Check meters. Export & Import readings of Main & Check meters installed at the substation shall be taken on monthly basis by authorized officer of TSNPDCL in the presence of PP or representative of PP. The meter reading will be taken jointly and signed by the representatives of the TSNPDCL and project investors. Based on the readings, invoices will be raised by project investors. These invoices can be used for cross checking the meter readings taken for the project activity. It is to be noted though PP or PP representative is available during meter reading, the electricity exported and imported by the Solar Project is completely under purview of TSNPDCL officer and PP do not have any control on it. Also accuracy class of meters and calibration frequency is under purview of TSNPDCL officer and PP do not have any control on it. PP get the monthly JMR report from where electricity export and import values are obtained to calculate net electricity supplied to grid and used for emission reduction calculations.



Data collection and archiving

Export & Import readings from the meters will be collected under the supervision of the authorized representatives of PP. The net electricity supplied to grid would be calculated based on export & import readings. Export and Import data would be recorded and stored in electronic &/or Paper format. The records are checked periodically by the Head (Operations) and discussed thoroughly with the O&M Team. The period of storage of the monitored data will be 2 years after the end of crediting period.

Mismatch in Monitoring Period and the Billing Period

In case the dates of a particular monitoring period do not match with the dates of the billing period, the net electricity exported to the grid would be calculated from:

D = (A/B)*C

Where,

A = Difference of number of days which are not matching of billing period and monitoring period.

B = Number of days of the billing period/ month which was not matched with the monitoring period.

C = Net Electricity supplied to the grid for that given billing period/ month.

The calculated value after apportioning would be used for calculation of emission reductions during that period.

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.

In the unlikely event of failure of all Main, Check as well as Standby meter installed at Substation, where all the faulty meters are required to be repaired or replaced simultaneously, the export & import readings from Main, Check & Standby Meters installed at the inter-connection point at the project site will be used for monitoring of net electricity exported to the grid.

Personnel training

In order to ensure a proper functioning of the project activity and a proper monitoring of emission reductions, the staff 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.

5 SAFEGUARDS

5.1 No Net Harm

There were no harm identified form the project and hence no mitigations measures are applicable.

5.2 Environmental Impact

The proposed project activity is using renewable energy generation technology (Solar energy) which is free from any kind of anthropogenic emission. Project activity is not having any negative environmental impacts.

As per the notification from MoEF dated September 14, 2006 and its amendment notification S.O.-3067(E) dated 1/12/2009, the list of project activities which require prior environmental clearance is stipulated. This does not include the proposed project activity type as it involves solar power generation. Hence the proposed project activity does not require any Environmental impact analysis. Project activity has no significant emissions.

5.3 Local Stakeholder Consultation

The Local Stakeholder Meetings were organized at the project site substation.
The local stakeholders were informed regarding the meeting on 25-April-2016. The following are the stakeholders for the project activity:

- Local community
- Local village administration
- Technology suppliers
- Local vendors

All the stakeholders have been invited through invitation letters and public notice to attend the stakeholders meeting on 28-April-2016.

In the introductory speech, the representatives of PP welcomed the gathering and given a brief about the VCS/CDM project activity. Subsequent to the introductory speech, stakeholders were explained about the electricity generation from solar power project/ unit is an environmentally friendly power generation technology contributing to reduction in GHG emissions. They were also explained about the benefits of the solar power project/ unit like, increasing energy availability and improving quality of power and its assistance to the local population by providing employment opportunities to both skilled & unskilled labours.

The Minutes of LSH meeting along with List of Attendees and other supporting's shall be submitted to the DOE.

No other major issues were identified for the project. All the minor issues were addressed and also the concerned departments are keeping a tight vigil for assessing any changes likely that may take place.

5.4 Public Comments

The project has been listed for 30 days period from 12/11/2019 to 11/12/2019. No comments were received. https://www.vcsprojectdatabase.org/#/pipeline_details/PL1990 can be checked for the same.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	$EG_{yPJ,y}$
Data unit	MWh
Description	Quantity of net electricity supplied to the grid by Solar Project as a result of the implementation of the project activity in this monitoring period.
Source of data	Measured
Description of measurement methods and procedures applied	Monthly joint meter reading reports certified by Grid personnel
Frequency of monitoring/recording	Tri-vector meter
Value applied:	135,697 MWh
Monitoring equipment	Not Applicable as it is monitored

<table>
<tr><td>QA/QC procedures applied</td><td>This data will be directly used for calculation of emission reductions. Measurement results of electricity supplied to the grid and that delivered from the grid to the project will be crosschecked with records for sold electricity.

Meter details at the Pooling Sub Substation metering point at 220Kv/132 kV Substation, Mandamarri for the total Export, total Import and Net Generation are as below:
<table>
<tr><td>Sl. No.</td><td>17074537, 17074538</td></tr>
<tr><td>Accuracy Class</td><td>0.2 S</td></tr>
<tr><td>Calibration Frequency</td><td>Once in 5 years</td></tr>
<tr><td>Date of calibration</td><td>21/09/2017</td></tr>
<tr><td>Due Date of calibration</td><td>20/09/2022</td></tr>
</table>
</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions</td></tr>
<tr><td>Calculation method</td><td>Not Applicable as it is monitored</td></tr>
<tr><td>Comments</td><td>TSTRANSCO take energy meter reading on first week of every month. The meters installed in sub-station are in control of TSTRANSCO and whenever TSTRANSCO find any error in the meter, the same will be replaced or rectified immediately.</td></tr>
</table>

6.2 Baseline Emissions

As per description earlier under this document:

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

$EF_{grid,CM,y}$: Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh) (i.e., 0.9368 tCO_2/MWh).

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

BEy : Baseline emissions in year y (tCO_2e/yr)

Here,
$EF_{grid,CM,y}$ = 0.9368
$EG_{PJ,y}$ = 135,697
BE_y = 135,697* 0.9368 = 127,119 tCO_2e

6.3 Project Emissions

The project activity involves in harnessing Solar power. So, the emissions from the project are zero

6.4 Leakage

No leakage emissions have been considered and hence the leakage emission is zero.

6.5 Net GHG Emission Reductions and Removals

As per the applied methodology, emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$

Where,

ER_y = Emission Reduction in tCO_2/year

BE_y = Baseline emission in tCO_2/year

PE_y = Project emissions in tCO_2/year

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2017	1,271			1,271
2018	67,909	-	-	67,909
2019	57,939	-	-	57,939
Total	127,119	-	-	127,119

There was no break down in the project activity during this monitoring period. Further, the comparison for estimated emission reductions as per validated VCS PD and actual observed are detailed below. The emission reductions are lower than the estimated value.

	for Project Total Capacity	**Achintya Solar Power Limited-I (kWh)**	**Achintya Solar Power Limited-II (kWh)**	**Grinibhrit Solar Power Limited (kWh)**	**Suvarchas Solar Power Limited (kWh)**
Commission Date		**22-Dec-17**	**22-Dec-17**	**17-Jan-18**	**22-Dec-17**
End date of Monitoring period		**28-Sep-19**	**28-Sep-19**	**28-Sep-19**	**28-Sep-19**
Total days in the Monitoring period		**645.00**	**645.00**	**619.00**	**645.00**
Average Estimated emission Reduction (tCO2)	77,456	19,364	19,364	19,364	19,364
Emission reduction for this monitoring period (tCO2)	135,494	34,218	34,218	32,839	34,218
Actual Emission Reduction (tCO2)	127,119	33,425	33,338	29,929	30,427
Difference in Emission reduction	-6.59%	-2.37%	-2.64%	-9.72%	-12.46%

The detail of PP wise actual vs estimated is provided below:

Project Promoters' Name	**Actual Vs estimated**
Achintya Solar Power Limited - I	-2.37%
Achintya Solar Power Limited - II	-2.64%
Suvarchas Solar Power Limited	-9.72%
Grinibhrit Solar Power Limited	-12.46%

For each PP the actual is lower than the estimated because of lower PLF observed..

APPENDIX 1: CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE

CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE	
VERSION	14
DATE	Dec'18
Tool Applied	"Tool to Calculate the Emission Factor for an Electricity System", Version 7.0

Net Generation in Operating Margin (GWH) (incl. Imports)			
	2015-16	**2016-17**	**2017-18**
Indian Grid	871,753	916,278	960,693

Simple Operating Margin (tCO2/MWh) (incl. Imports) (1) (2)			
	2015-16	**2016-17**	**2017-18**
Indian Grid	0.9655	0.9636	0.9543

Build Margin (tCO2/MWh) (not adjusted for imports)			
	2015-16	**2016-17**	**2017-18**
Indian Grid	0.9083	0.8723	0.8644

Weighted Generation Operating Margin	
Indian Grid	0.9610

Combined Margin Emission Factor	
Indian Grid	0.9368