VISHNUPRAYAG HYDRO-ELECTRIC PROJECT (VHEP) BY JAIPRAKASH POWER VENTURES LTD.(JPVL)

India's Largest Carbon Credit Developer & Supplier

Document Prepared by EKI Energy Services Limited

Project Title	Vishnuprayag Hydro-electric Project (VHEP) by Jaiprakash Power Ventures Ltd. (JPVL)
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Vishnuprayag Hydroelectric Project (VHEP), a 4 x 100 MW Run-of-the-River Project, implemented by Jaiprakash Power Ventures Ltd. (JPVL) - a subsidiary of Jaiprakash Associates Limited (JAL a wellknown business group of India), is located across river Alaknanda near Joshimath in Chamoli district of Uttaranchal (now Uttarakhand) state of India. An agreement was entered into by the Company with State Government of Uttaranchal (now Uttarakhand), State government of Uttar Pradesh and Uttar Pradesh Power Corporation Limited (UPPCL) for implementation of VHEP.

The project activity is a run-of-the-river hydro project which supplies power to INDIAN Grid. The power generated by the project activity displaces the power that would have otherwise been generated using fossil-fuel as in the current supply pattern of the grid. INDIAN grid is operating with a mix of hydro, nuclear and fossil fuel power plants. Project activity generates electricity using renewable hydel energy and sell it to Uttar Pradesh Power Corporation Limited (UPPCL). JPVL has already been entered into Power Purchase Agreement (PPA) with UPPCL for this purpose. As the project activity involves generation of electricity by renewable sources of energy it will reduce anthropogenic Green House Gases (GHG) emissions that would have been generated to supply power to grid using fossil fuel. Here it is important to mention that at present more than 70% of power at the northern grid of India is obtained by fossil fuels.

The project was successfully commissioned as per the schedule; running successfully till date and the expected operational lifetime for the project is 30 years. The commissioning dates of each turbine are mentioned below:

S. No.	Unit	Date of commissioning
1	Unit I	17-June-2006
2	Unit II	14-July-2006
3	Unit III	31-August-2006
4	Unit IV	13-October-2006

The total emission reductions achieved in this monitoring period is 2,889,200 tCO_2e.

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 6.0[1]

The project is not a grouped project activity.

1.3 Project Proponent

Organization name	Jaiprakash Power Ventures Limited
Contact person	R.K. Narang
Title	Director
Address	Sector 128, Noida -201304, Uttar Pradesh
Telephone	+91-120- 4609000
Email	rk.narang@jalindia.co.in

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the Project	Project Representative
Contact person	Manish Dabkara
Title	MD & CEO
Address	P48, Scheme 78 part 2, Viajay Nagar-452010, Indore, India
Telephone	+91-9589899649
Email	manish@enkingint.org

1.5 Project Start Date

03-June-2006 (As per VCS registered PD section 1.6)

1.6 Project Crediting Period

Crediting Period type: Fixed 10 years

Crediting period: 03-June-2006 to 02-June-2016

1.7 Project Location

The project is located near Joshimath in Chamoli district of Uttaranchal (now Uttarakhand) (Between Lat. 30°32'-30°42'N and Long. 79°28'-79°38' E). The project site is located at

[1] https://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_BW759ID58ST5YEEV6WUCN5744MN763

Rishikesh- Badrinath highway. Nearest railhead is Rishikesh at a distance of about 250 km from the project site and 525 km from Delhi. Location is depicted in following maps

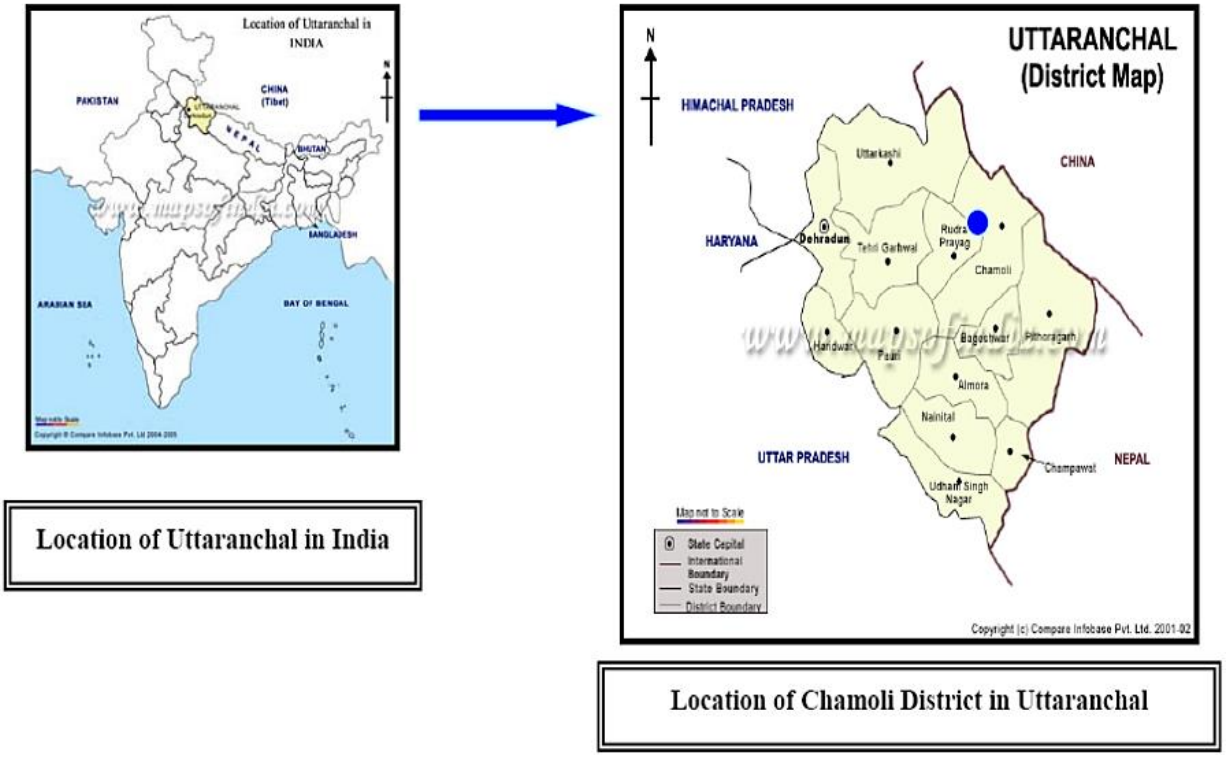


Figure 1. Location of project activity

1.8 Title and Reference of Methodology

The methodology for the project activity is approved methodology for large-scale CDM project activities. The details of the methodology are as follows:

Methodology : ACM0002
Project Type : Type-I: Renewable Energy Projects
Title: ACM0002 : Grid-connected electricity generation from renewable sources
Version No. : Version 6.0;

Reference: CDM Methodology[2].

1.9 Participation under other GHG Programs

The proposed project activity has not been registered and is not seeking registration at moment under any other GHG programs.

This project activity is not participating in any other GHG program.

[2] https://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_BW759ID58ST5YEEV6WUCN5744MN763

1.10 Other Forms of Credit

Include the following information, as applicable:

Emission Trading Programs and Other Binding Limits: The project activity under consideration is not participating in any other Emission trading programme and other binding limits.

The project activity is not participating at moment in any other emission trading programme and other binding limits. The GHG emission reductions generated during the current monitoring period have not been used for compliance of other mechanism.

Other Forms of Environmental Credit: The proposed project activity neither has nor intends to generate any other form of GHG related environmental credit for GHG emission reductions or removals claimed under the VCS Program. The initial project activity is neither has nor intends to generate any other form of GHG related environmental credit for GHG emission reductions or removals claimed under the VCS Program.

1.11 Sustainable Development

Contribution to sustainable development:

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

- **Social well-being:** The project helps in generating employment opportunities during the construction and operation phases. The project activity leads to development in infrastructure in the region like development of roads and also may promote business with improved power generation.
- **Economic well-being:** The project is a clean technology investment in the region, which had not been taken place in the absence of the VCS benefits the project activity. It also help to reduce the demand supply gap in the state. The project activity generates power using zero emissions solar based power generation which helps to reduce GHG emissions and specific pollutants like SOx, NOx, and SPM associated with the conventional thermal power generation facilities.
- **Technological well-being:** The operation of project activity leads to promotion of hydro based power generation and encourages other entrepreneurs to participate in similar projects.
- **Environmental well-being:** The project activity being a renewable source of energy, it reduces the dependence on fossil fuels and conserves natural resources which are on the verge of depletion. Due to its zero emission the project activity also helps in avoiding significant amount of GHG emissions.

2 SAFEGUARDS

2.1 No Net Harm

This operations of hydro-electric project doesn't result in direct air pollution, noise pollution and water pollution. Thus there are no any significant impacts due to implementation of project activity on air, water, soil quality and ambience are envisaged due to the project activity.

Following are the risks that may substantially affect the project's GHG emissions reductions:

Geological Risk

- The Proposed project activity is based on ROR scheme, with no storage facilities for the lean periods. Thus, power generation from the project activity throughout the year depends completely on the water availability in the streams or indirectly on amount of rainfall. As the project site is subjected to severe winter seasons, it results in decreased water availability in the streams due to freezing. This results in poor power generation during the lean periods, affecting the GHG emission reduction capability of the project.
- During monsoon season the amount of silt carried by the streams goes up significantly, resulting in poor functioning or closure of hydro projects.
- Alaknanda River on which the project activity has been proposed has been subject to disastrous flash flood situation in 1970. The Alaknanda flood of 1970, considered to be the worst disaster of its kind in northwest India of the last century, was triggered by a cloudburst followed by flash flood in the downstream. Thus, the project activity could also face similar situation while its implementation, affecting its GHG reduction potential.

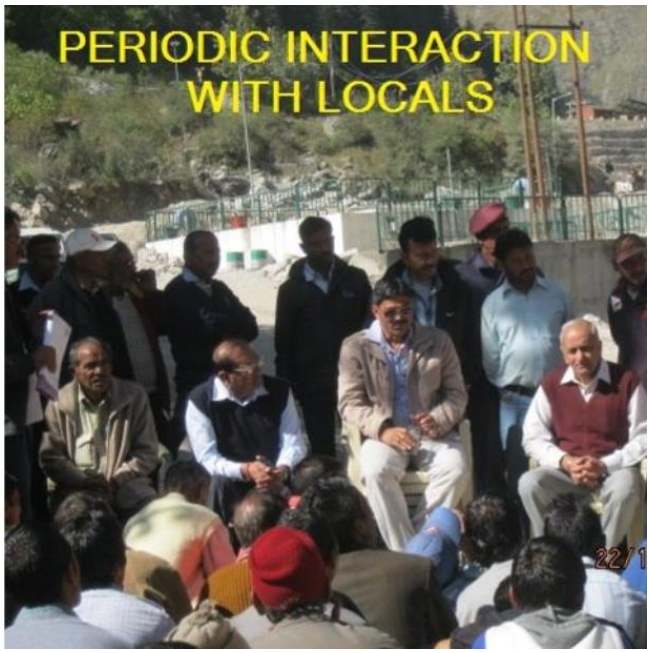
2.2 Local Stakeholder Consultation

As a part of continual improvement process, feedback from the associated stakeholders is vital, therefore a dedicated Visitor register cum grievance register has been placed at the project site which is accessible to stakeholders to provide their feedback on the project. It is appropriate publicly accessible location at which local stakeholders can provide their feedback on the project. This location is also conducive to continuous and regular checks for stakeholder comments. For the global stakeholders, the suggestion and the grievance can be submitted to Sectl.dept@jalindia.co.in

Stakeholder meetings are organized on regular intervals in order to identify the major challenges around the area, stakeholders are invited well in advance through printed invitation, calls, meeting and a notice is placed around the local common areas. Various CSR activities around site are carried out with proper stakeholder requirements meeting. The stakeholder are also request to share their experiences and grievances on continuous basis. Registers is used to records the grievances and feedback. During the current monitoring period, positive feedback are received regarding site operation. No any grievances received during the current monitoring period, therefore, no any mitigation measures are required. Incase of grievances, the nature of

probable resolution is discussed with the plant head office and implemented by the site incharge. The grievance copies have been submitted to DOE.

Some photographs of stakeholders meetings are illustrated here:



2.3 AFOLU-Specific Safeguards

This Section is not applicable here as the project activity is not an AFOLU project activity.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity supports the development of new grid-connected renewable energy power plants in India and covers the solar energy technologies. It seeks to enable investment in large scale grid connected plants that export their generated output to the regional / national electricity grid in India.

VHEP is a run of river scheme with no storage dam upstream and downstream. The project as envisaged comprises 60m long, 17m high (above river bed) diversion barrage across river Alaknanda, two intakes and two underground sedimentation chambers 11.343 km long head race tunnel, and underground power station and 1.92 km long tail race tunnel and outfall works. The water would be delivered to the power house through a steel lined pressure shaft. A surge shaft is constructed between the head race tunnel and the pressure shaft which would be used to regulate the flow. The project activity utilizes Impulse type Pelton turbines. In an impulse turbine, the power is generated due to high velocity water stream striking the turbine blades, which are designed in the shape of cups. The cups move as a result of the impact in the same direction as the flow. The turbine shaft is coupled with the shaft of generator.

Technical Details of Project

Parameter	Specifications
Hydrology	
Catchment area at barrage axis	1057.75 sq.km
Snow catchment	606.97 sq.km
Diversion Barrage	
Type	63 m long, 3 m High
Intake	2 in no., Discharge through intake : 63 Cumecs
Sedimentation Chamber	2 in no, size: 160m(L) x16m(W) x 10m(H), Particles of size 0.15 mm and above to be excluded
Head Race Tunnel (HRT)	
Length	11.343 m
Type of Section	4m dia, Modified Horse Shoe, circular
Power House	
Capacity	4 x 100 MW
Type	Underground
Size of P.H. Cavern	122m(L) x 18.5 m(W) x 38.6 m(H)
Size of Transformer Cavern	103 m(L) x 14m(W) x 22.5 m(H)
Tail Race Tunnel (TRT) and Unit TRT'S	
Length and Shape	1924 m long, 5.6 m x 5.7 m, D shape

The project was successfully commissioned as per the plan and all the four turbines are running successfully till date. The commissioning dates of each turbine are mentioned below:

S. No.	Unit	Date of commissioning
1	Unit I	17-June-2006
2	Unit II	14-June-2006
3	Unit III	31-August-2006
4	Unit IV	13-October-2006

The total AC capacity of the project activity is 400 MW and the power produced displaces an equivalent amount of power from the grid, which is fed mainly by fossil fuel fired power plants. Hence, it results in reduction of GHG emissions. GHG emission reductions from the project activity will be 1,468,106 tonnes of CO_2e and total GHG emission reductions for the chosen 10 year crediting period will be 14,681,060 tonnes of CO_2e.

The project is running smoothly since commissioning with regular schedule maintenance. There are no changes that have happened in project activity which may impact the applicability of the methodology and not any adverse events happened that may impact the GHG emission reductions or removals and monitoring.

3.2 Deviations

2.3.1 Methodology Deviations

There is no request for deviation applied during this monitoring period.

2.3.2 Project Description Deviations

Deviation 1:

It is observed that electricity imported by project activity from Diesel Generator, therefore electricity generated from the diesel generated is considered as the project emission. The parameter *Electricity imported from the Diesel generator* ($EG_{import,DG,y}$) and *Emission factor for the diesel generator systems* ($EF_{CO2,DG}$) have been included. The parameter details is added in section 4.2 *Data and Parameters Monitored*. The deviation would lead to lower the outcome of emission reduction in an appropriate way, therefore it is conservative. This deviation is applied from current monitoring period and the nature of deviation is permanent.

The deviation applied is conservative and as per the applicable methodology, therefore it having no impact on the methodology applicability, additionality or the appropriateness of the project baseline scenario. There were no any project description deviations applied in the previous monitoring reports.

3.3 Grouped Projects

This project activity is not a grouped project activity.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	EF_y
Data unit	tCO_2/MWh
Description	CO_2 baseline emission factor for the electricity displaced due to the project activity in during the year y
Source of data	CEA website
Value applied	0.75 tCO_2/MWh
Justification of choice of data or description of measurement methods and procedures applied	Justify the choice of data source, providing references where applicable. Where values are based on measurement, include a description of the measurement methods and procedures applied (e.g., what standards or protocols have been followed), indicate the responsible person/entity that undertook the measurement, the date of the measurement and the measurement results. More detailed information may be provided in an appendix.
Purpose of Data	The data is used for calculation of baseline emissions. The data is based on published data on Central Electricity Authority (CEA). CEA being a central authority, undertaking of Indian government, has all the first-hand information available for calculation of GEF
Comments	For actual calculation, the latest available data and the data for the corresponding year will be used to calculate the baseline emissions.

4.2 Data and Parameters Monitored

Data / Parameter	EG_y
Data unit	MWh
Description	Electricity supplied to the grid by the project activity during the year y
Source of data	Electricity meters maintained by state departments
Description of measurement methods and procedures to be applied	The measurements are done from electricity meters maintained by state authorities. There is a pair of meters viz. main meter and check meter provided on each transmission line. The readings of these meters are taken as basis for calculation of emission reductions.
Frequency of monitoring/recording	Monitoring frequency : Continuous

	Recording Frequency : Monthly
Value monitored	=4031944.988-178236.184 =3852752.856
Monitoring equipment	Type of Meter : Energy Meters (Line I & Line II) Accuracy Class : 0.2% **Main Meters** Serial Number : APM 20005 (Line I) & APM 20004 (Line II) Calibration Frequency : Quarterly Refer APPENDIX 1: Meter Calibration for more details **Check Meters** Serial Number: APM 20007 (Line I) & APM 20006 (Line II) Refer APPENDIX 1: Meter Calibration for more details
QA/QC procedures to be applied	Electricity meters are properly maintained with regular testing and calibration schedules developed as per the technical specification requirements and PPA to ensure accuracy. Electricity supply data to the grid could also be cross checked with the invoices for sale of electricity to the UPPCL.
Purpose of the data	Calculation of baseline emissions
Calculation method	The net electricity delivered by project activity to grid is calculated by subtracting total electricity imported by project from gird via line I and II from total electricity delivered by project to grid via line I and Line I
Comments	The Monitored Data to be kept for a minimum period of two years after the end of the crediting period.

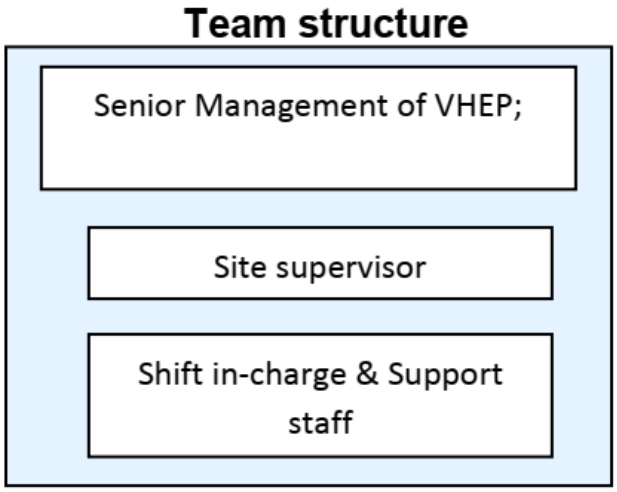
Data / Parameter	$EG_{Import,DG,y}$
Data unit	MWh
Description	Total electricity imported by project activity from Diesel Generator during the period y
Source of data	Energy meter installed at plant site
Description of measurement methods and procedures to be applied	Data is archived from energy meters installed at plant site.
Frequency of monitoring/recording	Monitoring frequency : Continuous Recording Frequency : Monthly

Value monitored	449.681
Monitoring equipment	Type of Meter: Energy Meter Accuracy Class: 0.5% Serial Number: 619139 Calibration Frequency: Yearly Refer APPENDIX 1: Meter Calibration for more details
QA/QC procedures to be applied	Energy meter is calibrated as per schedule.
Purpose of the data	Calculation of baseline emissions
Calculation method	Not Applicable
Comments	The Monitored Data to be kept for a minimum period of two years after the end of the crediting period.

Data / Parameter	$EF_{CO2,DG}$
Data unit	tCO_2/MWh
Description	Emission Factors for diesel generator systems
Source of data	CDM Methodology AMS 1-F "Renewable electricity generation for captive use and mini-grid", version.3
Description of measurement methods and procedures to be applied	Default, As per AMS 1-F, version 3, Table 2, for diesel generators of capacity more than 200 KW
Frequency of monitoring/recording	Recording Frequency : Every Verification
Value monitored	0.8
Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of the data	Calculation of baseline emissions
Calculation method	NA
Comments	The Monitored Data to be kept for a minimum period of two years after the end of the crediting period.

4.3 Monitoring Plan

A project team is constituted with participation from relevant departments. This team will be responsible for data collection and archiving. This team will meet periodically to review performance of project activity, check data etc. In case of any irregularity observed by any of the CDM team member, it shall be informed to the concerned person for necessary actions. On monthly basis, these reports are forwarded at the management level.



Senior Management of VHEP/Technical Head: Overall responsibility of compliance with the monitoring plan.

Site Supervisor: Responsibility for completeness of data, reliability of data (calibration of meters), and monthly report generation

Shift In-charge: Responsibility of daily report generation

Data Monitoring:

Completeness –

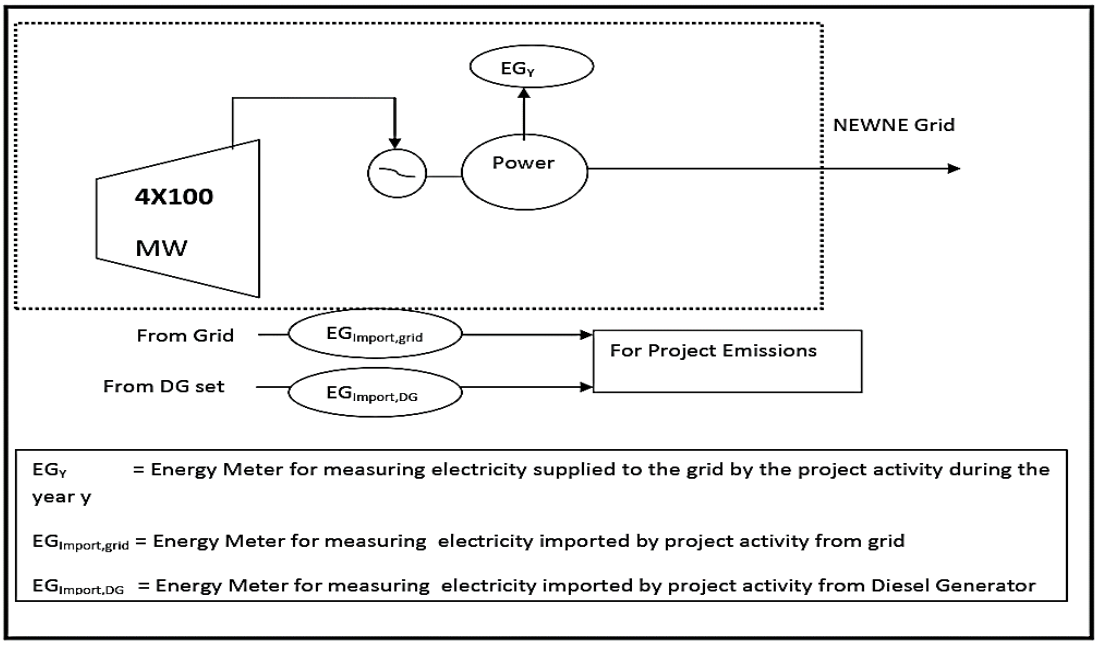
For Electricity generation data: The project activity has installed the latest state-of-art monitoring and control equipment that measure, record, report, monitor and control various key parameters. An hourly log and daily report, of data is prepared by the shift in-charge. Parameters monitored are the total power generated, power exported to the grid and auxiliary power consumed.

Reliability-

For electricity generation data: automatic control meters for power generation and exports are regularly maintained. The regular plant operation & maintenance procedure also includes process of regular meter testing, calibration & maintenance. Actual power generation data is also metered using power output meter at the substation. The billing invoices for the power sold and meter readings could be used to validate the data accuracy.

Frequency-

The measurement is recorded and monitored on a continuous basis. An hourly log is prepared by the shift in-charge. At the end of the day, hourly data is aggregated in a daily report. All relevant monitoring points for the project are depicted in the diagram below:



5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per the registered VCS PD section 3.2, *for actual calculation, the* ***latest available data*** *and the data for the corresponding year will be used to calculate the baseline emissions,*

Also, as per section 4.1 of registered PDD, step 2, *Calculation of the Build Margin emission factor* $EF_{BM,y}$ ***ex-ante*** *are based on the most recent information available on plants already built for sample group m at the time of PDD submission.*

Considering both the statement from the registered PDD, the lower combined margin value has been considered as a conservative approach.

The ex-post calculation of the combined margin is explained below:

Tool to calculate the emission factor for an electricity system[3] - Version 07.0 (EB 100, Annex 04)

Applicability Criterion	Project Case
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).	The project is a grid connected Greenfield wind power project and thus the tool is applicable.
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 2: 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.	Steps involved in calculation of Emission Factor is included in this section of the monitoring report as per the requirement of the tool.
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.	Project is located in non-Annex I country and hence the tool is applicable
Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	The project is a hydro project and there is no involvement of biofuels.

As per methodology, combined grid emission factor as per the "Tool to calculate the emission factor for an electricity system" version 07 is calculated as below.

CO_2 Baseline Database for the Indian Power Sector, Version 15, Dec 2019 published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

[3] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

As per Methodological tool: Tool to calculate the emission factor for an electricity system (Version 07.0, EB 100, Annex 4), following six 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 systems

As described in tool "For determining the electricity emission factors, identify the relevant project 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 August 2006, all regional grids except the Southern Grid had been integrated and were operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids were treated as a single grid named as NEWNE grid from FY 2007-08 onwards for the purpose of this CO_2 Baseline Database. As of 31 December 2013, the Southern grid has also been synchronised with the NEWNE grid, hence forming one unified Indian Grid. Since the project supplies electricity to the Indian grid, emissions generated due to the electricity generated by the Indian grid as per CM calculations will serve as the baseline for this project.

Table: Geographical Scope of Indian Electricity Grid

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

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

Project participants may choose 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)

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 and Dispatch data analysis OM is not possible due to lack of availability of data to project developers. The choice of other two options for calculating operating margin emission factor depends on 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)

	2014-15	2015-16	2016-17	2017-18	2018-19
India	16.8%	15.1%	14.6%	14.3%	14.5%

Data Source: Central Electricity Authority (CEA) database Version 15, Dec'2019

The above data clearly shows that the percentage of total grid generation by low-cost/ must-run plants (on the basis of average of five most recent years) for the Indian grid is less than 50 % of the total generation. Thus the Average OM 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 CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

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:

(a) **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

(b) **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 calculation of Simple OM emission factor using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD 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 ($EF_{grid,OMSimple,y}$) according to the selected method

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

Net Generation in Operating Margin (GWh) (incl. Imports)			
	2016-17	2017-18	2018-19
INDIAN Grid	916,278	960,693	995,957

Simple Operating Margin (tCO_2/MWh) (incl. Imports)			
	2016-17	2017-18	2018-19
INDIAN Grid	0.9636	0.9543	0.96853

Weighted Generation Operating Margin	
INDIAN Grid	**0.9622**

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

As per Methodological tool: "Tool to calculate the emission factor for an electricity system" (Version 07.0, EB 100, Annex 4) para 72:

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 PD 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 by PP 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 PD and is fixed for the entire crediting period.

Build Margin (tCO_2/MWh) (not adjusted for imports)

	2018-19
INDIAN Grid	0.8611

Step 6: Calculate the combined margin (CM) emission factor ($EF_{grid, CM,y}$)

As per Methodological tool: "Tool to calculate the emission factor for an electricity system" (Version 07.0, EB 100, Annex 4) para 81:

The calculation of the combined margin (CM) emission factor ($EF_{grid,y}$) is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

PP has chosen option (a) i.e. weighted average CM to calculate the combined margin emission factor for the project activity.

The combined margin emissions factor is calculated as follows:

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

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (t CO_2/MWh)
W_{OM} = Weighting of operating margin emissions factor (per cent)
W_{BM} = Weighting of build margin emissions factor (per cent)

The following default values should be used for W_{OM} and W_{BM}:

Wind and solar power generation project activities: W_{OM}= 0.50 and W_{BM}= 0.50 for the first crediting period. Since project activity is of hydro power generation, the above weightage has been considered for OM and BM.

Therefore, $EF_{grid,y}$ = 0.9622 * 0.50 + 0.8611 * 0.50
= 0.9216 t CO_2/MWh

Ex-ante value as per the registered PD is 0.75 tCO2/MWh.

Baseline emission factor (EF_y):

Considering both the approaches ex-ante and ex-post, the combined margin of ex-ante found to be lower. Therefore ex-ante values has been considered as a conservative approach.

Therefore, EF_y = 0.75 tCO2/MWh.

The baseline is the MWh produced by the renewable generating unit multiplied by an emission coefficient (measured in tCO_2eq/MWh).

Baseline emission:

$BE_y = EF_y X EG_y$

Where,

BE_y : Baseline emissions

EG_y : Electricity supplied to the grid by the project activity during the year y in MWh, and

EF_y: CO_2 baseline emission factor for the electricity displaced due to the project activity in during the year y in tons CO_2/MWh.

Energy supplied to Grid

The energy supplied to grid is measured using electricity meters at the supply points. The net electricity supplied is measured as

EG_y = Total Generation – Auxiliary Consumption

Therefore, $BE_y = EF_y \text{ X } EG_y$

BE_y = 0.75 tCO_2e/MWh X 3852752.856 MWh

BE_y = 2,889,200 tCO_2e

5.2 Project Emissions

Project activity emissions have been calculated for the amount of electricity generated from DG sets:

Month	Electricity supplied by DG sets (KWh), ($EG_{import,DG,y}$)	Emission factor for power generation in the DG set (tCO_2/MWh)*, ($EF_{CO2,DG}$)	Project emissions (tCO_2)
2013	200375	0.8	161
2014	156992	0.8	126
2015	28141	0.8	23
2016	64173	0.8	52
Total	**449681**		**362**

*As per AMS 1-F, version.3, Table 2[4], for diesel generators of capacity more than 200 KW. The capacity of DG set installed at project site is 800 KW which is greater than 200 KW, hence it is justified to use emission factor of 0.8 tCO_2/MWh for power generation in the DG set.

5.3 Leakage

There are no leakages associated with the project activity as per the registered PD.

5.4 Net GHG Emission Reductions and Removals

$ER_y = BE_y - PE_y - L_y$

BE_y = Baseline Emissions

PE_y = Project emissions

[4] https://cdm.unfccc.int/UserManagement/FileStorage/YP1U4E0H976Z3WDMV2NGSTBLQIRCK5

L_y = Leakages = 0

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)
01-January-2013 to 31-December-2013	408,171	161	0	408,010
01-January-2014 to 31-December-2014	1,222,880	126	0	1,222,754
01-January-2015 to 31-December-2015	927,129	23	0	927,106
01-January-2016 to 02-June-2016	331,382	52	0	331,330
Total	**2,889,562**	**362**	**0**	**2,889,200**

The estimated annual emission reductions as per the registered VCS PD corresponding to the current monitoring period is 2,889,200 tCO_2e. The actual emission reductions is 2,889,200 which is 42.44% lower than the estimated emission reduction.

APPENDIX 1: METER CALIBRATION

Meter Details	Meter Serial Number	Previous Calibration	Subsequent Calibrations	Accuracy Class
Line I- Main Meter	APM 20005	31-March-2012 & 30-June-2012	31-Januray-2013, 31-March-2013, 30-April-2014, 30-June-2014, 30-September-2014, 31-December-2014, 31-March-2015, 30-June-2015, 30-September-2015, 31-December-2015, 31-March-2016, 30-June-2016, 30-September-2016 and 31-December-2016	0.2
Line I- Check Meter	APM 20007	31-March-2012 & 30-June-2012		0.2
Line II- Main Meter	APM 20004	31-March-2012 & 30-June-2012		0.2
Line II- Check Meter	APM 20006	31-March-2012 & 30-June-2012		0.2
DG Incomer	619139	13-January-2012 & 25-May-2012	31-January-2013, 12-November-2013, 14-August-2014 & 06-July-2015	0.5
Grid Incomer	619137	17-December-2011 & 03-May-2012	31-January-2013, 12-November-2013, 13-August-2014, 07-July-2015 & 09-February-2016	0.5
Master Meter[5]	29993	07-Septemebr-2012	22-March-2013, 26-March-2014, 03-September-2014, 16-March-2015, 07-October-2015, 29-March-2016 & 22-September-2016	0.2

The calibration records have been checked calibration frequency, Period during April 2013 to April 2014 are not covered in the energy calibration validity, therefore error factor have been applied to the same months.

[5] Master meter is not used in the JMR generation process.

APPENDIX 2: MAJOR BREAKDOWN DETAILS

Unit/ Feeder/ System	Date/Time		Duration during month	Purpose/Reason
	From	To		
BFV	26-June-2019 06:52 Hrs	26-June-2019 11:28 Hrs	04 Hrs 36 Mts	Butterfly Vavlve closed at 0652 Hrs. on 26.06.19, subsequently all running Units 1, 2, 3 & 4 tripped on "Sudden Closure of B.F.V" at 0652 Hrs. on 26.06.19. After attending the fault & opening of BFV at 1128 Hrs, Units 1, 2, 3 & 4 are synchronized with grid at 1212Hrs, 1201 Hrs, 1207 Hrs &1236 Hrs respectively on 26.06.19.
Unit-1	26-June-2019 06:52 Hrs	26 -June-2019 12:12 Hrs	05 Hrs 20 Mts	
Unit-2	26-June-2019 06:52 Hrs	26-June-2019 12:01 Hrs	05 Hrs 09 Mts	
Unit-3	26-June-2019 06:52 Hrs	26-June-2019 12:07 Hrs	05 Hrs 15 Mts	
Unit-4	26-June-2019 06:52 Hrs	26-June-2019 12:36 Hrs	05 Hrs 44 Mts	