

PARBATI HYDROELECTRIC PROJECT, STAGE-III

Document Prepared By: NHPC Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The Parbati Hydroelectric Project, Stage-III is Greenfield Hydro Power Project located on river Sainj and Jiwa nallah a tributary of Beas River near village Bihali, Kullu district of Himachal Pradesh state of India.

It is a run-of-the-river scheme whose design discharge includes the diversion of the tail race releases of Parbati Stage-II Power house as well as inflows from river Sainj and Jiwa nallah. This inflow of 177 cumec from Sainj river through 7.875 km long headrace tunnel utilized for generation of 520 MW (4x130 mw) in underground power house near village Bihali. Tailrace outlet near village Larji. The Underground powerhouse is envisaged for installation of four generating units each having a capacity of 130 MW and is proposed to be utilised to generate 1977.23 MU of electricity.

The purpose of the project activity is to generate electrical power using hydel energy, through the operation of run of the river hydro turbines. The hydel energy generated from the hydel power plant is evacuated to the State Grid System which is part of NEWNE Grid.

Generating power through hydel plant is a clean technology as no Carbon intensive fossil fuel is burnt during the process. A hydel turbine produces power by harnessing the available potential energy. Thus, there are no GHG emissions associated with the functioning of the hydro turbines. This in result replaces anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 1,931,754 tCO₂e per year, thereon displacing 1,977,230 MWh/year amount of electricity from the grid.

In the Pre- project scenario the entire 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.

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
Project Category	: I.D. - Grid connected renewable electricity generation ¹ (Version 18, EB 81, Annex 24)

PP hereby confirms that the project is an individual project and not a grouped project.

¹ <http://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK>

1.3 Project Proponent

Organization name	NHPC Limited
Contact person	Mr. R. K. Gupta
Title	Executive Director, R&D Division
Address	NHPC Limited, NHPC Office Complex, Sector 33, Faridabad - 121003, Haryana, India
Telephone	+91-129-2271405
Email	

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the project	VCS Consultant
Contact person	Mr. Manish Dabkara
Title	Director & CEO
Address	325, Block C, Prem Trade Centre, Maharani Road, Indore – 452007, Madhya Pradesh, India
Telephone	+91 731 42 89 086
Email	manish@enkingint.org

1.5 Project Start Date

Project Start Date: 24-Mar-2014;

The project start date is the earliest commissioning date amongst all the Four Hydro Turbine Units which are part of this Large Scale Hydro power project.

Project Name	Unit No.	Turbine Capacity	Location	Commissioning Date
Parbati Hydroelectric Project, Stage-III	I	130 MW	Kullu, Himachal Pradesh	24-Mar-14
	II	130 MW	Kullu, Himachal Pradesh	24-Mar-14
	III	130 MW	Kullu, Himachal Pradesh	30-Mar-14
	IV	130 MW	Kullu, Himachal Pradesh	6-Jun-14

1.6 Project Crediting Period

Crediting Period Start date: 24-Mar-2014

- Estimated life time of the project: 35 years

The project activity adopts renewable crediting period with the first crediting period of 10 years and with an option to renew twice, considering the lifetime of the project activity to be more than 35 years.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	√

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
Year 1	1,931,754
Year 2	1,931,754
Year 3	1,931,754
Year 4	1,931,754
Year 5	1,931,754
Year 6	1,931,754
Year 7	1,931,754
Year 8	1,931,754
Year 9	1,931,754
Year 10	1,931,754
Total estimated ERs	19,317,540
Total number of crediting years	10 years
Average annual ERs	1,931,754

1.8 Description of the Project Activity

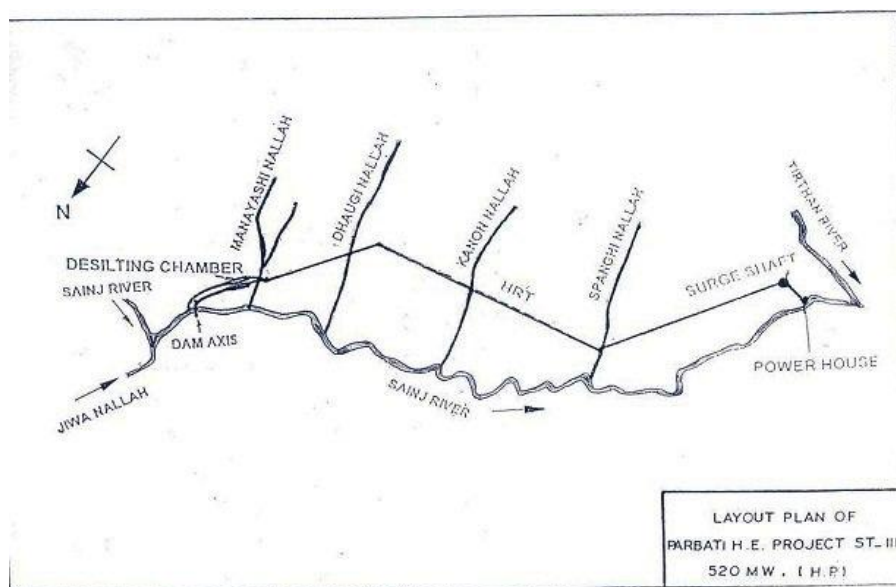
Parbati Stage-III (520 MW) is located in Kullu distt. in the state of Himachal Pradesh. It is a run-of-the-river scheme whose design discharge includes the diversion of the tail race releases of Parbati Stage-II Power house as well as inflows from river Sainj and Jiwa nallah .This inflow of 177 cumec from Sainj river through 7.875 km long headrace tunnel utilized for generation of 520 MW (4x130 mw) in underground power house near village Bihali .Tailrace outlet near village Larji. The power station is designed to generate 1963 MUs in a 90% dependable year.

Technical Features:

Barrage/DAM:	43 m high Rockfill Dam
HRT:	7.875 Km Long, 7.25m Dia Horse Shoe Shaped
Powerhouse:	Underground Powerhouse consisting of 4 units of 130 MW each

TRT:	8.1 m dia, 2.67 km long horse shoe shaped Tail Race Tunnel (TRT)
Switchyard:	400 KV GIS Swithyard
Evacuation of Power:	01 line:- 400KV Parbati-III -Banala
Total Capacity:	520 MW (4x130MW)
Estimated Annual Generation:	1963 Million Units (90% dependable year)
Estimated life time of the project:	35 years

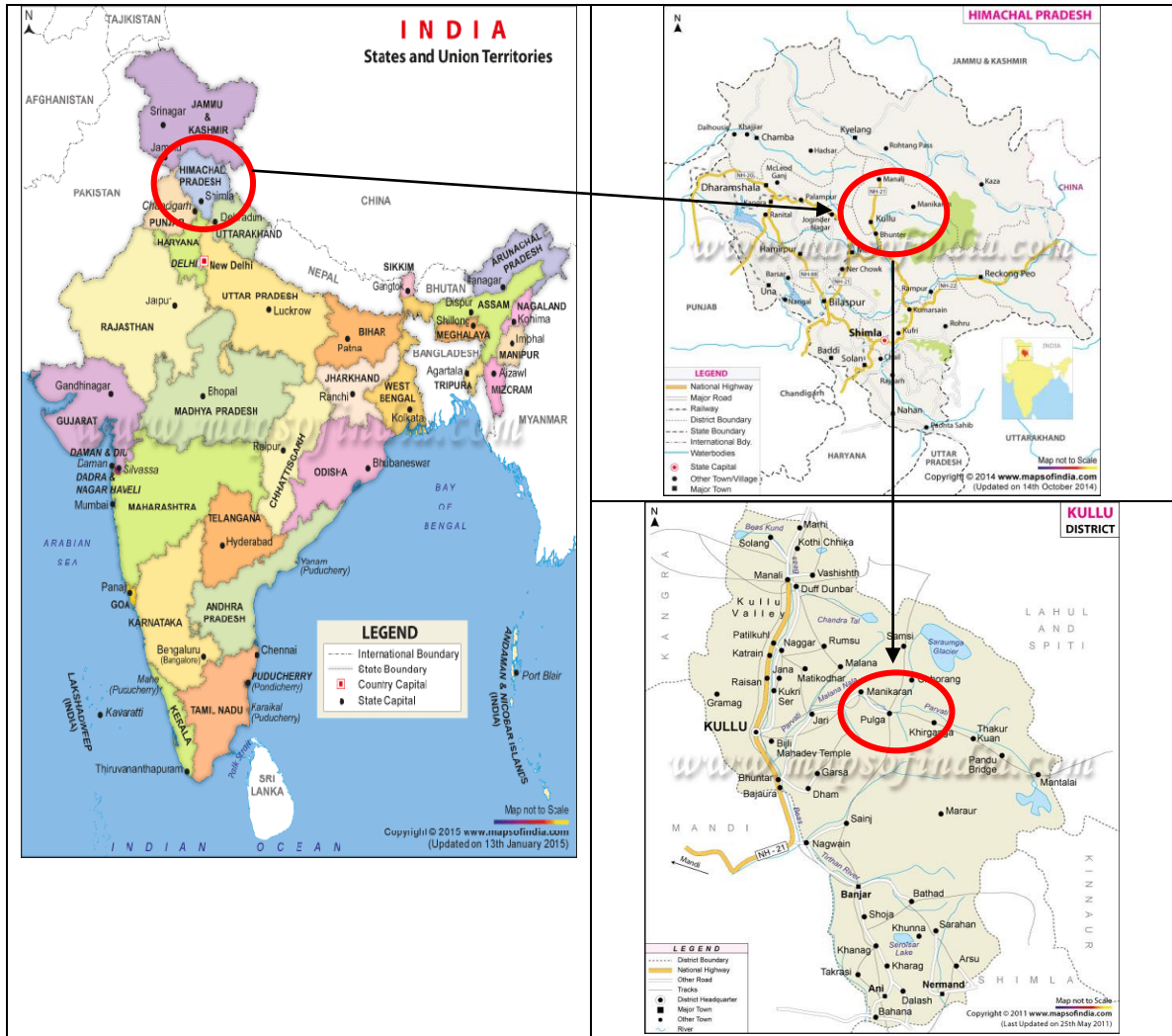
Layout Plan:



The project shall result in replacing anthropogenic emissions of greenhouse gases (GHG's) estimated to be approximately 1,931,754 tCO₂e per year, thereon displacing 1,977,230 MWh/year amount of electricity from the grid.

1.9 Project Location

The Parbati Stage-III hydroelectric project is installed across Sainj and Jiwa nallah near Bihali village in Kullu distt. in the state of Himachal Pradesh. The geographical co-ordinates of the project activity are Latitude: 31.7398, Longitude= 77.2576. The map below shows the exact location of the project activity:



1.10 Conditions Prior to Project Initiation

The pre project scenario is same as baseline scenario. Please refer section 2.4 for the description of baseline scenario.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The relevant national laws and regulation pertaining to generation of energy are:

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

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

- Power generation using hydro energy is not a legal requirement or a mandatory option. There are state and sectoral policies, framed primarily to encourage hydro power projects. These policies have also been drafted realizing the extent of risks involved in the projects and to attract private investments.
- The Indian Electricity Act, 2003 (May 2007 Amendment) does not influence the choice of fuel used for power generation.

Hence, there is no legal requirement on the choice of a particular technology for power generation.

1.12 Ownership and Other Programs

1.12.1 Right of Use

The ownership of the Project and its right to use is completely entrusted to NHPC Limited which can be verified by the following evidences:

- Power Purchase Agreement
- Environmental Clearance

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 of NHPC Limited.

1.12.3 Other Forms of Environmental Credit

The Project has no intend 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

Further Information

Legislative:

The project participants obtained all clearances from stakeholders hence no legal risks are anticipated.

Socio-economic well being:

- Project activity has generated direct and indirect employment for skilled and unskilled manpower during construction phase as well as during operational stage and thus helped in controlling migration from the region and alleviation of poverty.
- The project activity's contribution of power supply towards the NEWNE grid is helping in the upliftment of the social life of the people by ensuring a sustainable and reliable source of power for the region.
- The Project activity has improved the infrastructural facilities like water availability, road, and medical facilities etc in the region.

Environmental well being:

- The project activity generates clean and green power thus causing negligible emissions of green house gases. By building and operating the Hydro power project, much pollution is avoided. In the absence of the project activity, equivalent power would have been generated based on the fossil fuels resulting in more Green House Gas emissions into the atmosphere.
- The project activity has reduced the dependence on fossil fuels for power generation thus conserving the natural reserves. The project has lead to green house gas emission reduction and hence contributed in mitigating climate change.

Technological well being:

The project activity has increased awareness and interest among the private players to make investments in similar areas. The technology employed in the project activity is safe and sound.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Methodology:

ACM0002: Grid-connected electricity generation from renewable sources --- Version 16.0, Sectoral Scope: 01, EB 81, Annex 9

<https://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83>

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 04.0, EB 75, Annex 15

<https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.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. (e) Involve a replacement of (an) existing plant(s)/unit(s).	The Project activity is Greenfield Hydro 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	The Project activity is generation of electricity through Hydro Power Plant which is renewable energy power plant. Hence the project activity satisfies this applicability criterion of

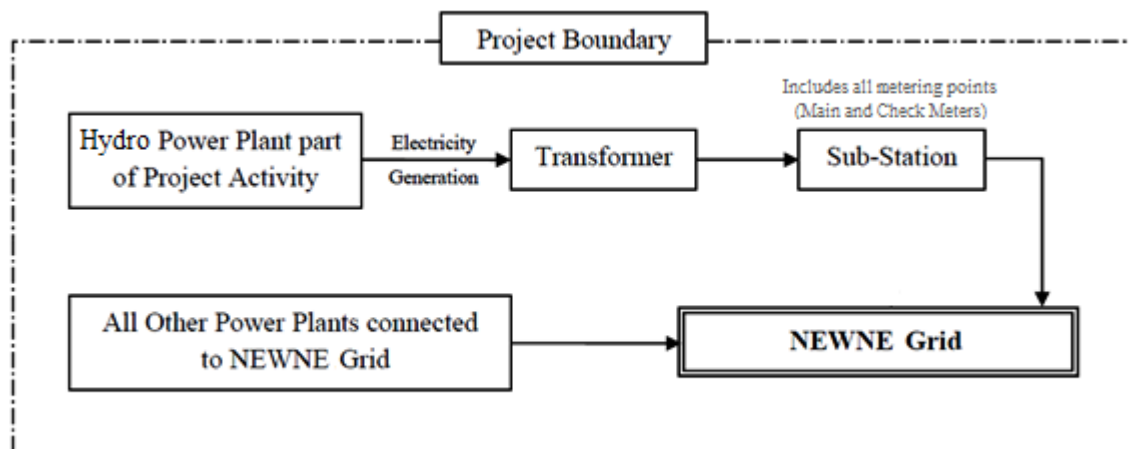
power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; b. In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started 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.	the methodology
3. In case of hydro power plants, one of the following conditions shall apply: 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/m²; 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/m²; 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/m², 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/m²; (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/m² shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	The project activity is constructed as a run-of-the-river hydropower project with limited pondage and the power density calculated using equation (3), is greater than 4 W/m² Hence, point 3. c. is applicable for the project case. i.e. The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m²
4. In the case of integrated hydro power projects, project proponent shall: • Demonstrate that water flow from upstream power	The project activity is constructed as a run-of-the-river hydropower project with limited pondage. Therefore, the

plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or • 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.	said criteria is not applicable
5. The methodology is not applicable to: • 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; • Biomass fired power plants/units.	The proposed project activity is the installation of a Hydro power plant. Therefore, the said criteria 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 criteria is not applicable.
7. In addition, the applicability conditions included in the tools referred to below apply.	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";

2.3 Project Boundary

As per ACM0002 version 16, for hydroelectric projects, the project boundary includes the physical site of the hydro 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 NEWNE 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 ₂ O	No	Minor emission source
Project	For hydro power plants, emissions of CH ₄ from the reservoir	CO ₂	No	Minor emission source
		CH ₄	No	The project activity is a run-of-river hydro power with limited pondage and hence no emissions
		N ₂ O	No	Minor emission source

2.4 Baseline Scenario

Since, the project activity is a Greenfield power plant and meets all the applicability criteria for the ACM0002 Version 16,

As per para 23 of ACM0002 version 16.0; 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”.

2.5 Additionality

In line with VCS Standard version 3.4, 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 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity:

Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed VCS project activity.

The proposed Project activity envisages the installation of 242 WEGs of type E-53 supplied by WWIL and each WEG has a capacity of 0.8 MW. The total installed generation capacity of the Project activity is 193.6 MW. As the purpose of the Project activity is to generate electrical power to be fed to the grid, the following alternatives are considered:

Alternative 1: The proposed project activity not undertaken as a VCS project activity.

The PP could proceed with the implementation of the project without Carbon credit benefits. The electricity produced from the renewable energy project would have been sold to the grid. This is in compliance with all applicable legal and regulatory requirements and can be a part of the baseline. However, the Project activity is not feasible without revenues from sale of Carbon Credits. This argument has been discussed in step 2 of the Additionality section.

Alternative 2: No proposed project activity and equivalent amount of energy would have been produced by the grid electricity system through its currently running power plants and by new capacity addition to the grid i.e. Continuation of the present situation.

The PP would have continued without investment in Project activity with usual business activities. The grid would continue with the fossil fuel based power projects and this would result in GHG emissions. Hence, the new capacity add-on from a fossil fuel based power plant is appropriate, realistic & credible baseline alternative for the project activity.

Outcome of Sub-step 1a: All the realistic alternatives for the project activity have been enlisted above.

Sub-step 1b: Consistency with mandatory laws and regulations:

The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This sub-step does not consider national and local policies that do not have legally-binding status.).

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:

- Power generation using wind energy is not a legal requirement or a mandatory option.

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

Outcome of Sub-step 1b: Hence, both the alternatives enlisted above are found to comply with the mandatory laws and regulations taking into account the enforcement of the legislations in the region or country and EB decisions on national and/or sectoral policies and regulations. However, Alternative 2 has been selected as the appropriate baseline alternative for this project activity.

Step 2: Investment analysis

Determine whether the proposed project activity is economically or financially less attractive than at least one other alternative, identified in step 1, without the revenue from the sale of emission reductions credits. To conduct the investment analysis, use the following sub-steps:

Sub-step 2a: Determine appropriate analysis method

The Project activity envisages to export the power to NEWNE grid and the revenues from the sale would be generated in accordance with the terms and tariffs established in the Power Purchase Agreement (PPA). Thus, simple cost analysis cannot be used as the analysis method as the sale of the units of generated electricity shall result in a revenue stream during the operations of the Project activity.

After eliminating Option I, the use of Benchmark analysis (Option III) is the method of analysis that has been selected as the most suitable method. This method determines the attractiveness of the project activity for the investors, as well as provides a measure of the viability of the investment to generate revenues during its operation, as compared with other avenues and investment options. Hence, the Benchmark analysis method is to be employed for analysis of the said project.

Sub-step 2b (Option III): Apply benchmark analysis

The investment analysis using Benchmark analysis approach (Option III) has been chosen. Further, this method illustrates the evaluation of the Project by the PP before the decision to undertake the project was taken and management approval granted.

IRR	Benchmark
9%	12.5%

Sub-step 2c: Sensitivity Analysis:

As per Guidance 20 and 21 of Annex 5 of EB 62 Annex 5, only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project

revenues should be subjected to reasonable variation and the results of this variation should be presented in the PDD and be reproducible in the associated spreadsheets. Guidance also states, "All parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude". The Annex also states, as a general point of departure, variations in the sensitivity analysis should at least cover a range of +10% and –10%, unless this is not deemed appropriate in the context of the specific project circumstances.

Since the project cost is already firmed up, the cost is not variable. The tariff is determined by PPA which is fixed for years mentioned as per the tariff order and hence it need not be subjected to variation. All other expenses are much less than 20% of the total cost. Hence, only PLF needs to be subjected to reasonable variation. Nevertheless, following factors have been subjected to sensitivity analysis:

- (a) PLF
- (b) O&M Cost
- (c) Project Cost
- (d) Tariff Rate

The break-even point (scenario when the Equity IRR crosses the benchmark) has also been calculated for all the above parameters. Since a significant increase/decrease (at least 25%) in the respective parameters demonstrated above is required for Equity IRR to cross the benchmark, the likelihood of occurrence of such a scenario is very low.

It can be observed from above table that in various scenarios wherein there are changes in tariff, O&M cost, net saleable units and project's capital cost, the Equity IRR does not cross the benchmark. Thus, it can be concluded that revenue from sale of CERs is important to alleviate this gap and hence the project has been considered to be additional.

Step 3: Barrier analysis

Barrier analysis has not been used.

Step 4: Common practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed Project activity:

Common practice analysis has been carried out as per "Guidelines on Common Practice, version 02.0 EB69, Annex 8". In the context of the project activity, the following parameters are defined as per **Part I. Definitions** of the Guidelines on Common Practice:

1. Applicable Geographical Area (Para 1): Himachal Pradesh State of India has been considered as the applicable geographical area for this project.
2. Measure (Para 2): The project activity reduces greenhouse gas emissions by generating electricity using renewable energy source-hydro. Therefore, the project activity falls under the following measure:

(b) *Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies*

3. Output (Para 3): The project activity produces electricity. Therefore, electricity is considered as output of the project activity.
4. Different Technologies (Para 4): The project activity uses hydro energy for producing electricity and hence as per Para 4(a), the technologies which use energy source/ fuel other than hydro will be considered as the different technologies for the project activity.

The common practice analysis is carried out step by step as per Part II. Stepwise approach for common practice as follows:

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

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%	780	MW
Capacity of the proposed project activity	520	MW
-50%	260	MW

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. Project is located Himachal Pradesh State of India. Therefore, Project is located Himachal Pradesh State have been chosen for analysis.
- b. The project activity is a green-field hydro 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, all projects applying same measure (b) as the proposed project activity are candidates for similar projects.

- c. The energy source used by the project activity is hydro. Hence, only hydro 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 260 MW to 780 MW.
- f. The start date of the project activity is 24/03/2014. As Kyoto Protocol was ratified by India on 26/08/2002², therefore projects, which had started commercial operation between 26/08/2002 to 24/03/2014, have been identified.

Numbers of Similar projects (CDM and non-CDM) indentified, which fulfil above-mentioned conditioned are:

Particulars	No. of Projects	Source
N _{Hydro}	2	Central Electricity Authority: CO ₂ Baseline Database version 10.0

Sources: CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE Version 10

Project Proponent	Capacity in MW	CDM or VCS Reference
CHAMERA II	300 MW	Not Applied
BASPA	300 MW	VCS Reference No. 92 http://www.co2blue.com/wp-content/uploads/2014/05/Project-Description-Baspa-Indian-Hydro-Project.pdf

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} .*

All the projects identified in step-2 are either registered or project activities submitted for registration, or project activities undergoing validation.

Thus $N_{all} = 1$

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 N_{diff} .

² http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php

As $N_{all} = 1$; thus $N_{diff} = 0$

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

As $N_{all} = 1$ thus, $N_{all}-N_{diff} = 1$; is less than 3

Outcome of Step 5:

As,

- i. $F = 1$;
- ii. $N_{all}-N_{diff} = 1$; is less than 3

Thus, the proposed project activity is not a “common practice” within a sector in the applicable geographical area.

2.6 Methodology Deviations

There is no methodology deviation

3 QUANTIFICATION OF 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 CO₂/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 CO₂ 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 CO₂/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)

Therefore,

$$EG_{PJ,y} = 1,123,760 \text{ MWh}$$

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

The methodology ACM0002 (Version 16.0) 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 4.0.0”;

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 CO₂/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.

CO₂ Baseline Database for the Indian Power Sector, Version 10, December 2014³, published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

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

- STEP 1: Identify the relevant electricity systems;
- STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional);
- STEP 3: Select a method to determine the operating margin (OM);
- STEP 4: Calculate the operating margin emission factor according to the selected method;
- STEP 5: Calculate the build margin (BM) emission factor;
- STEP 6: Calculate the combined margin (CM) emission factor.

STEP 1: Identify the relevant electricity power systems

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

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

Table: Grid Classification

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

³ http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver10.pdf

Uttar Pradesh				
Uttarakhand				

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

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

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

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

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

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

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

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

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

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

	2009-10	2010-11	2011-12	2012-13	2013-14
NEWNE	15.9%	17.6%	19.0%	17.2%	18.0%
South	20.6%	20.9%	21.5%	15.8%	21.0%
India	17.1%	18.4%	19.6%	16.9%	18.6%

Data Source: Central Electricity Authority (CEA) database Version 10, Dec'2014

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of three most recent years) for the NEWNE and Southern 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 operating margin" has been calculated as per the weighted average emissions (in tCO_2/MWh) of all generating sources serving the system, excluding hydro, geo-thermal, wind, low-cost biomass, nuclear and solar generation;

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

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

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

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

STEP 4: Calculate the operating margin emission factor ($EF_{grid,OM,y}$) 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)			
	2011-12	2012-13	2013-14
NEWNE	508,004,381	546,941,372	569,215,756

Simple Operating Margin (tCO ₂ /MWh) (incl. Imports)			
	2011-12	2012-13	2013-14
NEWNE	0.9699	0.9919	0.9953

Weighted Generation Operating Margin	
NEWNE	0.9862

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

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)	
	2013-14
NEWNE	0.9495

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

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

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

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

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

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 (NEWNE Grid)

$$\begin{aligned} EF_{NEWNE,CM,y} &= 0.75*0.9862 + 0.25*0.9495 \\ &= 0.9770 \text{ tCO}_2/\text{MW} \end{aligned}$$

Therefore, Baseline Emissions:

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

$$BE_y = 1,977,230 \times 0.9770 = 1,931,754 \text{ tCO}_2$$

3.2 Project Emissions

The project emission calculation as per para 35 of ACM0002 version 16,

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

Where:

$$PE_y = \text{Project emissions in year y (t CO}_2\text{e/yr)}$$

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year y (t CO₂/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 CO₂e/yr)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (t CO₂e/yr)

$$PE_{FF,y} = 0$$

As per para 37 of ACM0002 version 16,

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

$$PE_{GP,y} = 0$$

Not applicable for the hydro power projects

$$PE_{HP,y} = 0$$

Since, the project is run of river, the project activity does not involve the installation of a new reservoir; it does not result in CH₄ emission from the reservoir.

Therefore, $PE_y = 0$

3.3 Leakage

As per para 60 of ACM0002 version 16, No leakage emissions need to be considered for the project activity.

3.4 Net GHG Emission Reductions and Removals

As per para 61 of ACM0002 version 16; Emission Reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year y (t CO₂e/yr)

BE_y = Baseline emissions in year y (t CO₂/yr)

PE_y = Project emissions in year y (t CO₂e/yr)

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

$$ER_y = BE_y - PE_y$$

$$ER_y = 1,931,754 - 0 = 1,931,754 \text{ tCO}_2$$

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
Year 1	1,931,754	0	0	1,931,754
Year 2	1,931,754	0	0	1,931,754
Year 3	1,931,754	0	0	1,931,754
Year 4	1,931,754	0	0	1,931,754
Year 5	1,931,754	0	0	1,931,754
Year 6	1,931,754	0	0	1,931,754
Year 7	1,931,754	0	0	1,931,754
Year 8	1,931,754	0	0	1,931,754
Year 9	1,931,754	0	0	1,931,754
Year 10	1,931,754	0	0	1,931,754
Total	19,317,540	0	0	19,317,540

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 10, December 2014 ⁴
Value applied:	0.9862 (NEWNE 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 04.0.0” as 3-year generation weighted average using data for the years 2011-2012, 2012-2013 & 2013-2014. The data are obtained from “CO ₂ Baseline Database for Indian Power Sector” version 10.0, published by the Central Electricity Authority, Ministry of Power, Government of India.

⁴ 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	tCO ₂ /MWh
Description	Build Margin CO ₂ emission factor in year y
Source of data	Calculated from CEA database, Version 10, December 2014
Value applied:	0.9495 (NEWNE 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 04.0.0” for the year 2013-2014. The data is obtained from “CO ₂ Baseline Database for Indian Power Sector” version 10.0, 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.

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Monthly electricity share certificates/note or Credit Note or Joint Meter Reading Report
Description of measurement methods and procedures to be applied	The value of net electricity generation supplied to the grid as per Monthly electricity share certificates/note or Credit Note or Joint Meter Reading Report forms the basis for calculation of the emission reductions; which can be cross checked from the invoice raised to DISCOM. Net electricity supplied to grid will be calculated as the difference of the measured values of “export” and “import” of electricity through the dedicated SEB energy meter (electronic trivector bidirectional main meter & check meter which measures both export & import concurrently) installed at the delivery point (i.e. the connected substation).

	Net electricity generated and supplied by the project plant/unit to the grid = Electricity Export to the grid - Electricity Import from the grid Monthly meter readings are taken from the main and check meter installed at the substation and certified by the representatives of SEB Officials and the representatives of the project proponent. No other specific procedures are applied.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value applied:	1,977,230 MWh
Monitoring equipment	Monitoring: Tri vector meter will be used Data type: Measured Type of meter: Static type meter (Main & Check). Both are Bidirectional meters. Class of meter: 0.2s
QA/QC procedures to be applied	• The energy meter reading are taken on monthly basis • Energy meters will be calibrated once in a three year and faulty meters will be duly replaced immediately. • All the energy meters are under the control of state utility and calibration/testing of energy meters is also under the jurisdiction of state utility. • The Net electricity exported to the grid will be cross checked against the invoice raised by the PP towards the DISCOM
Purpose of data	Calculation of Baseline emissions
Calculation method	-
Comments	The data would be archived electronically and maintained for the entire crediting period plus two years.

4.3 Monitoring Plan

The project proponents at the power station have a procedure to ensure proper monitoring of the VCS project activity. The project activity has installed monitoring and control equipment that measure, record, report, monitor and control various key parameters.

The methodology requires monitoring of the net electricity supplied from the project activity. The energy meter is maintained by the proponent for the monitoring of the net electricity generation.

The monitoring plan includes monitoring of energy generation parameter at the substation. The metering system comprises of individual special energy meters (SEMs), these are connected via transmission lines each having its own SEM meter (main meter and check meter. The meter is installed and sealed by SEB in the presence of the representatives of the power producer. The readings of the power generated (Ex-bus) are taken every month; and this data is used for billing purposes. The check meter shall be used during the period the main metering system is not in

service. The meters will be calibrated periodically. The accuracy class of the energy meters is 0.2 s.

The monthly SEM statement is used for the calculation of net power exported from the power station. The proponent shall maintain complete and accurate records and all other data required for the purpose of proper administration and operation of the hydro power plant. The data will be kept for at least 2 years after the end of the crediting period.

1. Purpose - The purpose of monitoring the project is to assess the annual emission reductions in tonnes of CO₂ that the project activity has achieved.
2. Data to be reported - Net Electricity Exported in MWh and periodical calibrations of monitoring equipments
3. Origin of data and monitoring including estimation approach- The basis of the net electricity exported will be the Joint Meter Readings/ monthly statements which are taken in the presence of Electricity Board personnel and a representative of the proponent every month.
4. Monitoring times and periods - The data will be monitored on a continuous basis but will be recorded on a monthly basis with the energy meters installed at the site.
5. Data Accuracy - The meters recording the electricity exported will be calibrated at least once 3 years.
6. Emission Reduction Calculation Approach - The emission reductions are calculated as a product of the net electricity generated from the project activity and the combined margin emission factor calculated in section 2.4 of this document. The calculation approach is explained in detail under section 4.1 of this document.
7. Monitoring roles and responsibilities: A project team would be constituted for the monitoring of the project. This team will be responsible for data collection and archiving. The team will meet periodically to review the data collected as per section 3.3. In case of any irregularity observed by any of the team members, it will be informed to the concerned person for necessary actions to be taken. The following be will the team structure for project monitoring:
 - a. Unit Head: Overall responsibility of compliance with the monitoring plan.
 - b. Power Plant In-charge: Responsibility for completeness of data, reliability of data (calibration of meters), and monthly report generation
 - c. *Shift In-charge*: Responsibility of daily report generation from the SCADA system/ log-books
8. Managing Data Quality: The Power plant In-charge would prepare the report pertaining to the recorded values of the monitored parameters as by the shift-in- charge. The day to day records would be verified by Unit Head, compiled and documented. The company will introduce a safe storage of data. NHPC is an ISO – 9000, and ISO – 14000 certified

company having an integrated management system. It will ensure also requirements are met for the project also.

5 ENVIRONMENTAL IMPACT

The Environment and Pollution Control Division of Forest Department and the State Land Use and Environment Board was entrusted with the task by NHPC to assess the impacts of project activity through Environmental Impact Assessment and preparation of Environmental Management Plan. It was done in the planning stage of the activity.

Summary of EIA Report: NHPC has established an Environment Management Group under the Planning Division of Corporation, which looks after monitoring and implementation of environmental safeguards at project and corporate level. Also with respect to the latest guidelines issued by the MoEF, Govt. of India, an Environmental Management Cell is proposed for the planning and implementation of Environmental Management Plan. Under the rehabilitation and resettlement, affected families are provided with a compensatory package. Also there are plans for development of green belt around the project area and a compensatory afforestation plan is to started to cover a land area along with the development of Catchment Area and Treatment (CAT) plan for the overall conservation of surrounding ecosystem.

6 STAKEHOLDER COMMENTS

A detailed stakeholder consultation process has been conducted by NHPC. This task was accomplished by the Land Use and Environmental Board, Forest Department. The Member Secretary has issued notice for environmental public hearing & The pubic hearing was conducted successfully.

The stakeholders identified for the project activity are as follows:

1. Government Officials
2. Local Citizens
3. Representatives of affected people including women residing in the project area.
4. Representatives of Panchayats of villages
5. NGO representatives

The discussions mainly aimed at–

- The basic protection of the biodiversity and environment affected due to the project
- Social issues like rehabilitation, compensation and employment
- Issues of water availability and natural calamities were also discussed
- Significant impacts in the region due to the project
- Possible impacts in the long run
- To understand various stakeholder perceptions
- Stakeholder awareness of project related issues

The comments of various stakeholders are reviewed below:

- The entire project region is a relatively fragile ecosystem, which is likely to be affected by any construction activity. But, this project has taken up proper mitigation measures through a well implemented Environmental Management Plan (EMP).
- To generate employment and prevent the influx of population in form of unskilled labourers, NHPC will only employ local labourers, and only in case of non availability will it hire from outside.
- The project has caused displacement of local families, but proper compensation is provided to them and any grievances have been solved.
- The project development has lead to the anticipation of further developmental opportunities that will come up.
- For the project area proper earthquake parameters have been considered for the designing structures to prevent any calamity.
- That there are no apparent trends to indicate that the project has resulted in adversely affecting the livelihood, health, availability of water and other necessities of life in the region.

No major issue which would affect the life of the local community or raise any environment related problems in the region by the implementation of the project activity were identified during the discussion with stakeholders. 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.

APPENDIX X: CO₂ DATABASE OF CEA

From CO₂ database of CEA, Version 10 published by Government of India, Ministry of Power Central Electricity Authority, Government of India

CENTRAL ELECTRICITY AUTHORITY: CO ₂ BASELINE DATABASE	
VERSION	10
DATE	6-Dec-14
BASILINE METHODOLOGY	ACM0002 / Ver 16.0 and "Tool to Calculate the Emission Factor for an Electricity System", Version 4.0

Net Generation in Operating Margin (MWh) (incl. Imports)			
	2011-12	2012-13	2013-14
NEWNE	508,004,381	546,941,372	569,215,756

Simple Operating Margin (tCO ₂ /MWh) (incl. Imports) (1) (2)			
	2011-12	2012-13	2013-14
NEWNE	0.9699	0.9919	0.9953

Weighted Generation Operating Margin	
NEWNE	0.9862

Build Margin (tCO ₂ /MWh) (not adjusted for imports)			
	2011-12	2012-13	2013-14
NEWNE	0.9331	0.9813	0.9495

Combined Margin Emission Factor	
NEWNE	0.9770