

KISHANGANGA HYDROELECTRIC PROJECT



Document Prepared By Infinite Solutions

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1 PROJECT DETAILS

1.1 Summary Description of the Project and its Implementation Status

The purpose of the project activity is to generate electrical power using renewable 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 Indian Grid. NHPC Limited is the promoter of the proposed project activity.

Kishanganga Hydroelectric Project (3x110MW) is Greenfield Hydro Power Project is located in the Bandipora District of Jammu & Kashmir state of India, is a Run of the River with pondage scheme (ROR with pondage) envisaging diversion of water of Kishanganga (a tributary of river Jhelum) into an underground power house and discharging the tail race water into Wular Lake.

It is a run of the river scheme with Concrete Faced Rockfill Dam 37 m high (above deepest river bed level) The underground power house (113m x 21.3m x 46.5m) with installed capacity of 330 MW houses 3 nos. Pelton turbines and 3 generating units of 110 MW each designed to operate under the net rated head of 646 m and is proposed to be utilised to generate 1712.96 MU in a 90% dependable year with 95% machine availability.

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 1,563,247 tCO₂e per year, thereon displacing 1,712,960 MWh/year amount of electricity from the grid.

Project Name	Unit No.	Turbine Capacity	Location	Commissioning Date	Beneficiary States
Kishanganga Hydroelectric Project	I	110 MW	Bandipora; Jammu & Kashmir	13-Mar-18	Jammu & Kashmir, Uttar Pradesh & Chhattisgarh
	II	110 MW	Bandipora; Jammu & Kashmir	21-Mar-18	
	III	110 MW	Bandipora; Jammu & Kashmir	30-Mar-18	

The monitoring period is from 13-Mar-2018 to 31-May-2019. The total GHG emission reductions or removals generated in this monitoring period are 685,478 tCO₂.

Scenario existing prior to the implementation of project activity:

The scenario existing prior to the implementation of the project activity, is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" Version 7.0 EB 100 Annex 4.

Baseline Scenario:

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

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

If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

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

1.2 Sectoral Scope and Project Type

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

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

Project Type : I - Renewable Energy Projects

Methodology : ACM0002: Grid-connected electricity generation from renewable sources - Version 19¹

The project is not a grouped project activity.

1.3 Project Proponent

Organization name	NHPC Limited
Contact person	Dr. Sujit Kumar Bajpayee
Title	DGM (Environment)
Address	NHPC Limited, NHPC Office Complex, Sector 33, Faridabad - 121003, Haryana, India
Telephone	+91-129-2271297
Email	envdivmgn-co@nhpc.nic.in

1.4 Other Entities Involved in the Project

Organization name	Infinite Solutions
Role in the project	Project Consultant
Contact person	Mr. Jimmy Sah

¹ <https://cdm.unfccc.int/UserManagement/FileStorage/58IAGB7SZUDEO2VN6LYM30K41HFPRQ>

Title	Head – Sustainability
Address	611, Chetak Centre Main, 12/2 RNT Marg, Indore- 452001
Telephone	+91-9644130430
Email	jimmy@infisolutions.org

1.5 Project Start Date

Project Start Date: 13-Mar-2018;

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

Project Name	Unit No.	Turbine Capacity	Location	Commissioning Date
Kishanganga Hydroelectric Project	I	110 MW	Bandipora; Jammu & Kashmir	13-Mar-18
	II	110 MW	Bandipora; Jammu & Kashmir	21-Mar-18
	III	110 MW	Bandipora; Jammu & Kashmir	30-Mar-18

1.6 Project Crediting Period

Crediting Period Start date: 13-Mar-2018

Crediting Period End date: 12-Mar-2028

- 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	1,563,247
Year 2	1,563,247

Year 3	1,563,247
Year 4	1,563,247
Year 5	1,563,247
Year 6	1,563,247
Year 7	1,563,247
Year 8	1,563,247
Year 9	1,563,247
Year 10	1,563,247
Total estimated ERs	15,632,470
Total number of crediting years	10
Average annual ERs	1,563,247

1.8 Description of the Project Activity

Kishanganga Power station (3x110MW) is located on Kishanganga River, a tributary of river Jhelum in Bandipora District of Jammu & Kashmir. It comprises Concrete Faced Rockfill Dam 37 m high (above deepest river bed level), 23.2 Km long & 6.24 m/5.20 m dia horse shoe/circular shaped Head Race Tunnel, 2 Nos. Intakes, 109.7 m high surge shaft of 17.75 m dia restricted orifice type, 1055 m long circular inclined steel lined Pressure Shaft of 4.0 m diameter, trifurcating into three 2.3 m diameter Horizontal Branches at Bottom. The underground power house (113m x 21.3m x 46.5m) with installed capacity of 330 MW houses 3 nos. Pelton turbines and 3 generating units of 110 MW each designed to operate under the net rated head of 646 m and generating 1712.96 MU in a 90% dependable year with 95% machine availability. Tailrace system comprising of 5.0 m dia 869 m long, Horse shoe tunnel and 36 m long, 8 m wide open channel. It also comprises 220 kV open switchyard (190m x 115m). All the three units i.e Unit-I, Unit-II & Unit-III of the Power Station had been commissioned in the month of March 2018. The beneficiary states of this power station are Chhattisgarh, Uttar Pradesh & J&K. With the construction of this project the nearby project area is also benefitted by development of infrastructure, education, medical facilities, CSR activities and employment avenues.

Salient Features:

KISHANGANGA H. E. PROJECT (3 x 110 MW), J&K**SALIENT FEATURES**

1	LOCATION	
	State	Jammu & Kashmir
	District	Bandipora
	River	Kishanganga
	Dam site	Gurez valley
	Latitude	34°39'00"
	Longitude	74°45'08"
	Power House site	Near village Kralpora, Bandipora
	Latitude	34°28'17"
	Longitude	74°38'28"
2	HYDROLOGY	
	Catchment area	1815 km ²
	Max. Observed flood	990 cumec
	Probable Max. flood	2000 cumec
	Avg. Annual run-off	3103 Mcum
	Annual rainfall	676 mm
	Annual snowfall	1206 mm
3	RESERVOIR	
	Full Reservoir level	2390.0m
	Max. Reservoir level	2390.0m
	MDDL	2384.5m
	Gross storage upto FRL	18.35Mcum
	Dead storage capacity	10.80Mcum
	Live storage capacity	7.55 Mcum
4	DAM	

	Type	CFRD
	Max. height above deepest river bed	37m
	EL. of Top of dam	2395.0m
5	SPILLWAY	
	Design flood	2000 cumec
	Type	Chute Spillway
	Crest elevation of gated spillway	2370.00m
	No. of gates	3
	Energy dissipation	Flip bucket
6	DIVERSION TUNNEL	
	Number	1
	Size	9.5m dia
	Shape	Horse shoe
	Length	569m
	Diversion capacity	1000 cumecs
7	INTAKE	
	Invert level	El 2378.80
8	HEAD RACE TUNNEL	
	Number	1
	Size and Shape	6.24m Horse Shoe Shape (DBM) /5.2 m dia., Circular (TBM)
	Length	23.2 km (14.75km TBM & 8.45km DBM) Approx.
	Design discharge	58.40 cumec
9	HRT ADITS	
	No. & Length	Three – 224m, 659m & 262m
10	SURGE SHAFT	
	Dia.	17.75 m

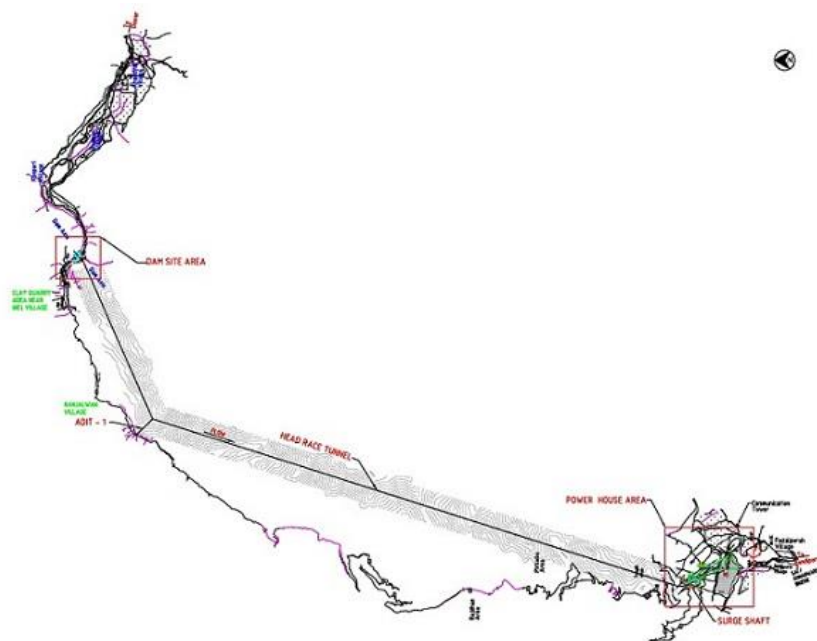
	Height	109.66m
	Type	Restricted orifice
11	PRESSURE SHAFT	
	No. & type	One circular, Inclined, steel lined
	Diameter	4.0m, trifurcating into three 2.30m dia., horizontal branches at bottom
	Length	1020m
12	POWER HOUSE COMPLEX	
	Type	Underground, two caverns
	Installed capacity	330 MW
	No. of units	3
	Power house cavity	113m x 21.3m x 46.5m
	Transformer hall cavity	75m x 15m x 15.2m
	Type of turbine	Pelton wheel
	Design Max. Gross head	670.82m
	Rated net head	646m
	Tail water level	
	For 1 unit operation	1711.18m
	For 2 unit operation	-
	For 3 unit operation	1714.15m
13	TAIL RACE SYSTEM	
	Tunnel Portion	
	Tunnel Portion type	Horse shoe
	Length	903m Approx.
	Diameter	5.0m

	Open channel	Length 36m Approx.
14	SWITCHYARD	
	Size & Location	191m x 115m Near Kralpora village
15	POWER GENERATION	
	Installed capacity	330 MW
	Annual design energy generation	1712.96Gwh

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 1,563,247 tCO₂e per year, thereon displacing 1,712,960 MWh/year amount of electricity from the grid.

1.9 Project Location

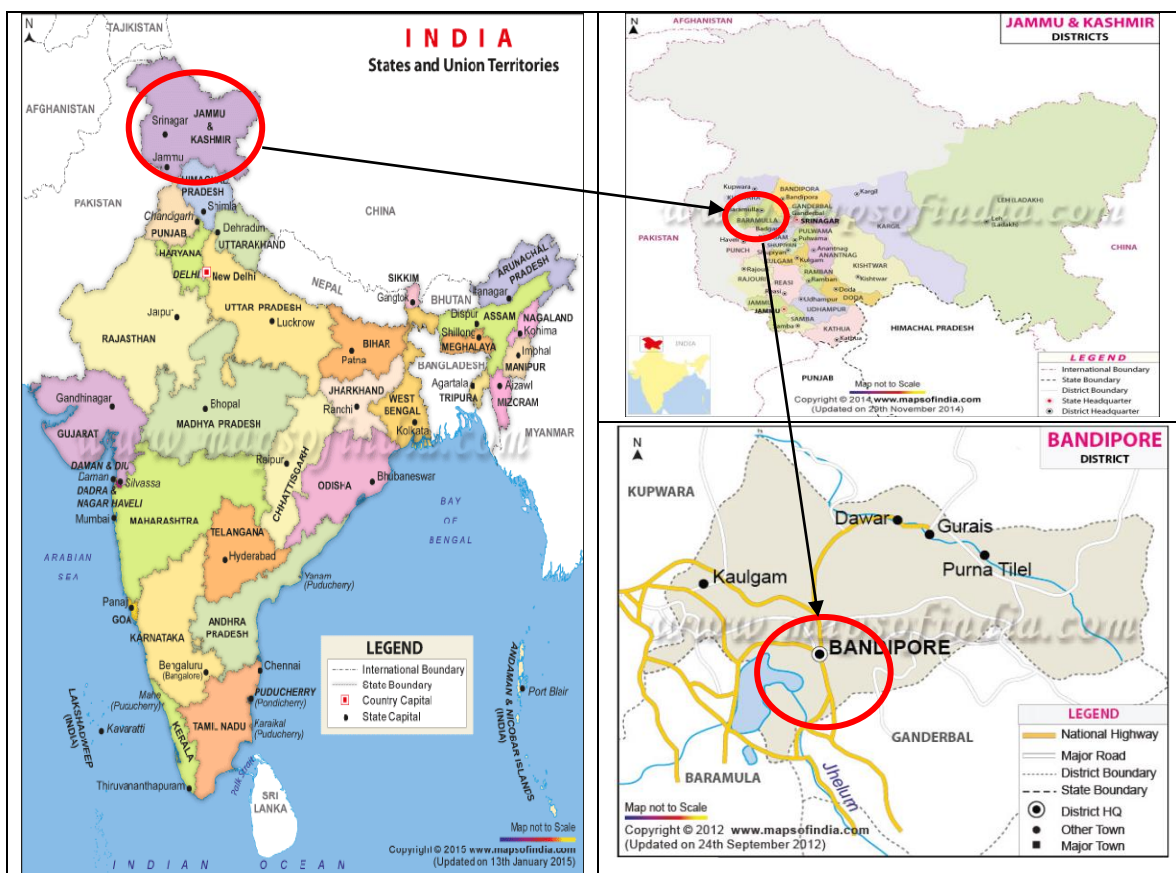
The Kishanganga Power station (3x110MW) is located on Kishanganga River, a tributary of river Jhelum in Bandipora District of Jammu & Kashmir state of India. The geographical co-ordinates of the project activity are

Latitude

34°39'00''N (dam site)

Longitude	74°45'08''E (dam site)
Latitude	34°28'17" N (power house site)
Longitude	74°38'28" E (power house site)

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

Project complies with all relevant local, regional and national laws, statutes and regulatory frameworks; same is evident from various required clearances and/or approvals received for development of the project as given below:

Approval Name	Approval date	Law under which applicable
CCEA Clearance	14-Jan-2009	Electricity (Supply) Act, 1948

Environmental Clearance	09-Mar-2006	Environmental Impact Assessment Notification, 1994
Forest Clearance (in case Forest Land used)	27-May-2008	J&K Forest (Conservation) Act, 1997
Pollution Control Board	18-Feb-2016	Water (Prevention & Control of Pollution) Act, 1974 & Air (Prevention & Control of Pollution) Act, 1981

1.12 Ownership and Other Programs

1.12.1 Project Ownership

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 in any Emission Trading program or other binding limits.

1.12.3 Other Forms of Environmental Credit

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

1.12.4 Participation under Other GHG Programs

The Project has not participated in any other GHG programs.

1.12.5 Projects Rejected by Other GHG Programs

The Project is not rejected by other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

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

Leakage Management

Project does not involve any leakage emissions other than methodology requirement for hydro power project. Hence there are no any extra Leakage Management Plan and risk mitigation measures are required.

Commercially Sensitive Information

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

Sustainable Development

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 Indian 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 greenhouse 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 led to greenhouse 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 project activity envisages installation of high efficiency turbines and generators and the power will be transmitted at high voltage to ensure low losses. Moreover, the technology being used is well established, most updated and environmentally safe.

Further Information

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

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

Methodology:

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

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

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

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

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

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

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

2.2 Applicability of Methodology

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

Applicability Criterion (with Para number reference)		Project Case
1.	This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s).	The Project activity is installation of Greenfield 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 power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal	The option (a) of applicability criteria 2 is applicable as project activity is generation of electricity through Hydro Power Plant which is renewable energy power plant. Hence the project activity satisfies this applicability

	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.	criterion of the methodology
3.	In case of hydro power plants, one of the following conditions shall apply:² (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;	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 Area of Reservoir = 2840500 m² Installed Capacity of Hydro Power Project = 330000000 W Power Density = 116.18 W/m²

² Project participants wishing to undertake a hydroelectric project activity that result in a new reservoir or an increase in the volume of an existing reservoir, in particular where reservoirs have no significant vegetative biomass in the catchments area, may request a revision to the approved consolidated methodology.

	(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.	
4.	In the case of integrated hydro power projects, project proponent shall: (a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or (b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	The project activity is constructed as a run-of-the-river hydropower project with limited pondage. Therefore, the said criteria is not applicable
5.	The methodology is not applicable to: (a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; (b) Biomass fired power plants/units.	The 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	The proposed project activity is a Greenfield project; thus, this

	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”.	criterion is not applicable.
7.	In addition, the applicability conditions included in the tools referred to below apply. ³	The project applies the following tools and is in compliance to the same; • "Tool to calculate the emission factor for an electricity system"; • "Tool for the demonstration and assessment of additionality";

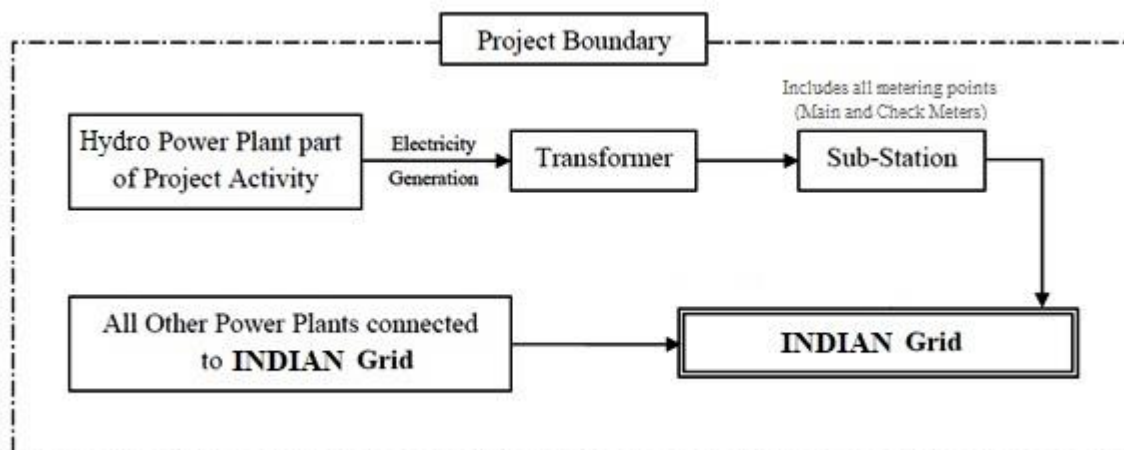
Applicability conditions of “Tool to calculate the emission factor for an electricity system”		
Applicability Criterion (with Para number reference)		Project Case
1.	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	This condition is applicable. OM, BM and CM are estimated using the tool under section 3.1 for calculating baseline emissions.
2.	Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in “Appendix 1: Procedures related to off-grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total	Since the project activity is grid connected, this condition is applicable and the emission factor has been calculated accordingly.

³ The condition in “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality” that all potential alternative scenarios to the proposed project activity must be available options to project participants; does not apply to this methodology, as this methodology only refers to some steps of this tool.

	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.	
3.	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project activity is located in India, a non-Annex I country. Therefore, this criterion is not applicable for the project activity.
4.	Under this tool, the value applied to the CO ₂ emission factor of biofuels is zero.	The project activity is a grid connected hydro power plant. Therefore, this criterion is not applicable for the project activity.

2.3 Project Boundary

As per ACM0002 version 19, 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 Indian Grid.



Source		Gas	Included	Justification/Explanation
Baseline	CO ₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO ₂	Yes	Major emission source
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
Project	For hydro power plants, emissions	CO ₂	No	Minor emission source

Source	Gas	Included	Justification/Explanation
of CH ₄ from the reservoir	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 19,

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

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

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

The combined margin ($EF_{grid,CM,y}$) is the result of a weighted average of two emission factor pertaining to the electricity system: the operating margin (OM) (having weightage 50%) and build margin (BM) (having weightage 50%). Calculations for this combined margin must be based on data from an official source⁴ (where available) and made publically available.

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

Parameter	Value	Nomenclature	Source
$EF_{grid,CM,y}$	0.9126 tCO ₂ /MWh	Combined margin CO ₂ emission factor for the project electricity system in year y	Calculated as the weighted average of the operating margin (0.50) & build margin (0.50) values, sourced from Baseline CO ₂ Emission Database, Version 14 published by Central Electricity Authority (CEA), Government of India
$EF_{grid,OM,y}$	0.9610 tCO ₂ /MWh	Operating margin CO ₂ emission factor for the project electricity system in year y	Calculated as the last 3 year (2015-16, 2016-17 & 2017-18) generation-weighted average, sourced from Baseline CO ₂ Emission Database, Version 14, published by Central Electricity Authority (CEA), Government of India

⁴ http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

EF _{grid,BM,y}	0.8644 tCO ₂ /MWh	Build margin CO ₂ emission factor for the project electricity system in year y	Baseline CO ₂ Emission Database, Version 14, published by Central Electricity Authority (CEA), Government of India
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2.5 Additionality

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

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

The proposed project activity is not the first-of-its-kind. Hence not applicable.

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

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

Outcome of Sub-step 1a: As the baseline scenario is prescribed by applied methodology for Greenfield Project, hence no further analysis is carried out to identify alternatives

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 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.

- 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

As per Tool for demonstration and assessment of Additionality; Sub-step 2a, Paragraph (1), as the project activity is selling the generated electricity & getting financial benefits other than CDM benefits hence, Option- I (Apply simple cost analysis) is not applicable under this situation. Also as per EB-62, Annex 05, clause no.19 "If the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate". Hence Option-II (Apply investment comparison analysis) is also not applicable under this situation. So the project promoter has chosen Option- III or benchmark analysis as an appropriate analysis method to demonstrate the investment barrier.

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.

Choice of Financial Indicator:

According to the "Tool for demonstration and assessment of Additionality", *the financial indicator can be based either on (1) project IRR or (2) equity IRR. There is no general preference between the approaches (1) or (2). The benchmark chosen for analysis shall be fully consistent with the choice of approach.* Therefore in accordance with the guidance, the relevant financial indicator for project activity has been chosen as Project IRR.

Choice of Benchmark:

As per para 12 of Guidelines on the assessment of the investment analysis (Annex 05, EB 62),

In cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. **Local commercial lending rates** or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR.

In the project activity, PP has considered the local lending rate as the benchmark for the project. These lending rates are available on the Reserve Bank of India (RBI) website and relate to the prime lending rates (PLR) of five major banks in the country.

The PLR as on 02-Jan-09⁵ is considered as the Benchmark for the project i.e. 12.50%.

Sub-step 2c: Calculation and comparison of financial indicators

The Project IRR is evaluated for the entire lifetime of the project activity, i.e. 35 years. It is calculated based on the cash outflows from and cash inflows into the project activity.

Key Assumptions supporting financial projections:

Input values are based on publicly available data sources which can be clearly validated by the DOE, thus it complies with guidance 13 of EB 62, Annex 5.

Details of the Project		Source
Generation and Sale of Electricity		
Annual Energy Generation (MWh)	1,712,960	As per CERC Petition http://cercind.gov.in/2018/orders/43G.pdf
Auxiliary Consumption	0.70%	As per DPR
Transformer Loss	0.50%	As per DPR
Free Power to Home State	12.00%	As per DPR
Sale price at Bus Bar for first year (INR/kWh)	3.29	As per DPR
Estimated Life of the plant (Yrs.)	35	As per DPR
Operation & Maintenance cost		
O & M Expenses (INR Cr.)	54.63	As per DPR
Escalation in the operational expenses (%)	4.00%	As per DPR
O & M free for (Yr.)	-	As per DPR
Financial Parameters		
TOTAL COST (INR Cr.)	3,642.05	As per DPR
Debt-Equity Ratio	70:30	As per DPR
Term Loan		
Loan Amount (INR Cr.)	168.99	Calculated Value
Interest rate (%)	11.50%	As per DPR
Loan Tenure (Half Year)	20	As per DPR
Sub Loan		
Loan Amount (INR Cr.)	2,380.44	Calculated Value
Interest rate (%)	1%	As per DPR

⁵ <https://rbi.org.in/Scripts/WSSView.aspx?Id=13111>

Loan Tenure (Half Year)	20	As per DPR
Working Capital Loan		
Working Capital will cover:		
O & M expenses for 1 month		As per DPR
Billing equivalent to 2 months average		As per DPR
Interest rate (%)	12.50%	As per DPR
Book Depreciation (SLM Method)		
Salvage Value (%)	10.00%	CERC (Terms and Conditions of Tariff) Regulations 2004, Pg. 42 http://cercind.gov.in/13042007/Terms_and_conditions_of_tariff.pdf
Land Cost (INR Cr.)	225.63	As per DPR
Book Depreciation (INR Cr.)	87.85	Calculated Value
IT Depreciation (WDV Method)		
Civil Works	3.40%	As per Income Tax Act
Electro - Mechanical Works	3.40%	http://www.incometaxindia.gov.in/charts%20%20tables/depreciation%20rates.htm
Tax rates		
Income tax rate (%)	33.99%	Calculated Value
MAT (%)	11.33%	Calculated Value
Service Tax (%)	12.36%	Calculated Value

The result of the analysis is as follows:

Project IRR	Benchmark
6.39%	12.50%

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

Sub-step 2d: Sensitivity Analysis:

As per Guidance 20 and 21 of EB 62 Annex 5, the sensitivity analysis of the project parameters which may substantially influence the Project IRR is carried out to assess the robustness of the conclusion. The results of the sensitivity analysis are presented below:

Factor	% Change	Project IRR	Remarks
Generation	+10%	7.21%	This is lower than Benchmark
	-10%	5.52%	This is lower than Benchmark
	Variation required to reach	91.99%	As per the CER Petition the Design Generation is 1712.96 and an increase in the Generation by 91.99% over a period of 35 years consistently is

	benchmark		highly unrealistic. Further, Generation values are a result of changes in water availability which is beyond the control of PP and/or changes in equipment availability. Moreover the actual values would be available when Actual project is in operation.
O&M cost	+10%	6.24%	This is lower than Benchmark
	-10%	6.55%	This is lower than Benchmark
	Variation required to reach benchmark	-571.26%	Highly unrealistic scenario as O&M Cost can never negative
Tariff Rate	+10%	7.21%	This is lower than Benchmark
	-10%	5.52%	This is lower than Benchmark
	Variation required to reach benchmark	91.99%	The Tariff Rate is calculated on approval-based tariff approach which is arrive based on Cost plus approach and depends on the CERC Tariff Regulations and Approval.
Project Cost	+10%	5.61%	This is lower than Benchmark
	-10%	7.29%	This is lower than Benchmark
	Variation required to reach benchmark	-47.91%	It is quite unlikely that the project cost will decrease from the approved cost, as completion cost of the project increases due to cost over-run & time over-run over the development phase of the project. Hence, increase in project cost would only lead to decrease in returns from the project to PP.

It can be observed from above table that in various scenarios wherein there are changes in tariff, O&M cost, Electricity Generation and project's capital cost, the Project IRR does not cross the benchmark. Thus, it can be concluded that revenue from sale of VERs 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:

The common practice analysis is carried out step by step as per "Methodological tool: Common Practice, version 03.1" para 5. Stepwise approach for common practice are as follows:

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%	495	MW
Capacity of the proposed project activity	330	MW
-50%	165	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 in host country - India. Therefore, Project is located India 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 165 MW to 495 MW.
- f. The start date of the project activity is 13-Mar-18. As Kyoto Protocol was ratified by India on 26/08/2002⁶, therefore projects, which had started commercial operation between 26/08/2002 to 13/03/2018, have been identified.

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

⁶ http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php

Particulars	No. of Projects	Source
N _{Hydro}	19	Central Electricity Authority: CO ₂ Baseline Database version 14.0

Sources: CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE Version 14

Refer Common Practice Analysis Excel Sheet for Project Details & Analysis

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} .

Out of the projects identified in step-2, 7 projects are either registered or project activities submitted for registration, or project activities undergoing validation.

Thus $N_{all} = 12$

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} .

With reference to Methodological tool: Common Practice, version 03.1 para 12 (d) (iv); Investment climate has been considered for identifying Different technologies, as each state in India has different set of policies and legal regulations. The project activity is located in the state of J&K of India and the policies and legal regulations applicable for the project is regulated by J&K Government. Therefore, it can be assumed that the policies and legal regulations are different in different states and hence projects installed in other states have been considered in N_{diff} .

From the identified projects in N_{all} (step 3) located in states other than Jammu & Kashmir come under different investment climate and have been considered under N_{diff} .

As $N_{all} = 12$; thus $N_{diff} = 10$

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 $N_{all} = 12$ thus, $N_{all}-N_{diff} = 2$; is less than 3

Outcome of Step 5:

As,

- i. $F = 0.167$; is less than 0.2
- ii. $N_{all} - N_{diff} = 2$; 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 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

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

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

Where:

BE_y	=	Baseline emissions in year y (t CO ₂ /yr)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (t CO ₂ /MWh)

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

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

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

Where:

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

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

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

For hydro projects, the PP need to provide schedule for electricity to be injected and based on electricity meters measured data, the actual injected electricity is monitored.

There is some difference in scheduled electricity and injected electricity and the same is called as deviation. The state load dispatch centre (Northern Regional Power Committee) issues statement on deviation also called as Deviation Settlement Account document.

The electricity supplied or transmitted is sourced from “Deviation Settlement Account document” and is cross checked from “Monthly Generation Reports”. “Deviation Settlement Account document” which are publically available documents issued by the ‘Northern Regional Power Committee’⁷, Ministry of Power; Government of India entity, this entity coordinates planning and maintenance of generating machines of various generating companies of the region.

The project being a hydro project the invoices are based on scheduled energy. The actual energy exported might vary from the scheduled energy, this information gets reflected in the “Deviation Settlement Account document”. Therefore, “Monthly Generation Reports” is used for cross-check for the electricity exported by the hydro project.

Thus, for proposed project activity, actual electricity supplied or transmitted to grid is sourced from “Deviation Settlement Account document” and cross checked from “Monthly Generation Reports” .

Therefore,

$$EG_{PJ,y} = 1,712,960 \text{ MWh}$$

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

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

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

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

The methodology provides following approaches for emission factor calculations:

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

OR

⁷ <https://nrpc.gov.in/>

- (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 14, December 2018⁸, published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

As per the "Tool to calculate the emission factor for an electricity system" Version 07.0, EB 100, Annex 4, the following steps have been followed.

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

STEP 1: Identify the relevant electricity power systems

The tool defines that “for determining the electricity emission factors, identify the relevant electricity system. Similarly, identify any connected electricity systems”. It also states that “If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used”. Keeping this into consideration, the Central Electricity Authority (CEA), Government of India has divided the Indian Power Sector into five regional grids viz. Northern, Eastern, Western, North-eastern and Southern. However, all the 5 zones have now been synchronized and called as Indian Grid.

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

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

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

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

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

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

⁸ http://cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

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

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

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

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

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

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

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

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

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

- **Ex ante option:** If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required.

OR

- **Ex post option:** If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

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

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

STEP 4: Calculate the operating margin emission factor ($EF_{grid,OM,y}$) according to the selected method

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

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

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

Weighted Generation Operating Margin	
Indian Grid	0.9610

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

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

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

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

Option 1 as described above is chosen to calculate the build margin emission factor for the project activity. BM is calculated ex-ante based on the most recent information available at the time of submission of PDD and is fixed for the entire crediting period.

Build Margin (tCO ₂ /MWh) (not adjusted for imports)	
	2017-18
Indian Grid	0.8644

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

Combined Margin – The combined margin is the weighted average of the simple operating Margin and the build margin. In reference to para 81 (b) of the Tool to calculate the emission factor for an electricity system, Version 04.0.0, EB 75, Annex 15, all projects other than wind and solar photovoltaic :

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

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

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

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

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

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

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

Where,

W_{OM}	50% weight of operating margin emissions factor (%)
W_{BM}	50% weight of operating margin emissions factor (%)
$EF_{grid,OM,y}$	Build margin CO ₂ emission factor of a particular grid in year y; calculated as described in Steps 3&4 above (tCO ₂ /MWh)
$EF_{grid,BM,y}$	Build margin CO ₂ emission factor of a particular grid in year y; calculated as described in Steps 5 above (tCO ₂ /MWh)

Baseline Emission factor (Indian Grid)

$$\begin{aligned} EF_{Grid,CM,y} &= 0.50 * 0.9610 + 0.50 * 0.8644 \\ &= 0.9126 \text{ tCO}_2/\text{MW} \end{aligned}$$

Therefore, Baseline Emissions:

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

$$BE_y = 1,712,960 \times 0.9126 = 1,563,247 \text{ tCO}_2$$

3.2 Project Emissions

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

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

Where:

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

$$PE_{FF,y} = \text{Project emissions from fossil fuel consumption in year y (t CO}_2\text{/yr)}$$

$PE_{GP,y}$ = 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 19,

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

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

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

3.4 Estimated 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:

$$ER_y = BE_y - PE_y$$

$$ER_y = 1,563,247 - 0 = 1,563,247 \text{ tCO}_2$$

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	1,563,247	0	0	1,563,247
Year 2	1,563,247	0	0	1,563,247
Year 3	1,563,247	0	0	1,563,247
Year 4	1,563,247	0	0	1,563,247
Year 5	1,563,247	0	0	1,563,247
Year 6	1,563,247	0	0	1,563,247
Year 7	1,563,247	0	0	1,563,247
Year 8	1,563,247	0	0	1,563,247
Year 9	1,563,247	0	0	1,563,247
Year 10	1,563,247	0	0	1,563,247
Total	15,632,470	0	0	15,632,470

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 ⁹
Value applied:	0.9610 (Indian Grid)
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per “Tool to calculate the emission factor for an electricity system, version 07.0.0” as 3-year generation weighted average using data for the years 2015-16, 2016-17 & 2017-18. The data are obtained from “CO ₂ Baseline Database for Indian Power Sector” version 14.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

⁹ http://www.cea.nic.in/reports/planning/cdm_co2/user_guide_ver10.pdf

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:	0.8644 (Indian Grid)
Justification of choice of data or description of measurement methods and procedures applied	Calculated as per “Tool to calculate the emission factor for an electricity system, version 07.0.0” as 3-year generation weighted average using data for the years 2017-18. The data are obtained from “CO ₂ Baseline Database for Indian Power Sector” version 14.0, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of Data	For the calculation of the Baseline Emission
Comments	This parameter is fixed ex-ante for the entire crediting period.

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO ₂ /MWh
Description	Combined Margin CO ₂ emission factor in year y
Source of data	Calculated from CEA database, Version 10, December 2014
Value applied:	0.9126 (Indian Grid)
Justification of choice of data or description of measurement methods and procedures applied	The combined margin emissions factor is calculated as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$ Where: $EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh) $EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/MWh) W_{OM} = Weighting of operating margin emissions factor (%) = 50% W_{BM} = Weighting of build margin emissions factor (%) = 50%
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 electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Deviation Settlement Account statement issued by NRPC

Description of measurement methods and procedures to be applied	Data Type: Measured Monitoring equipment: Energy Meters are used for monitoring Recording Frequency: Continuous monitoring and Monthly recording from Energy Meters, Summarized Annually Archiving Policy: Paper & Electronic Calibration frequency: 5 years Electricity exported by the project to the grid at project site switch yard is the actual generation recorded and monitored by the metering system installed at the project site switch yard. The metering system comprises of three individual special energy meters (SEMs) (acts as standby meters) installed at the power station, for each generating units. These are connected via four transmission lines of 220 kV, each having its own SEM meter (main meter and check meter). In case, anyone transmission line in not in service than complete load will be shifted to other transmission line which is in operation. The energy meters are special energy meters which are installed and sealed by the Power Grid Corporation of India Limited in the presence of the representatives of the power producer. The check meter shall be used during the period the main metering system is not in service. Further in case of failure of both main meter and check meter, sum of the net electricity generation recorded by three individual special energy meters (SEMs) and individual auxiliary meters shall be used for accounting and billing purpose.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied:	1,712,960 MWh
Monitoring equipment	Special Energy Meters (SEMs) of 0.2s accuracy class
QA/QC procedures to be applied	Energy meters will be calibrated once in a five year and faulty meters will be duly replaced immediately. This data may be cross checked with the Monthly Generation Reports
Purpose of data	Calculation of Baseline emissions
Calculation method	N/A
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.

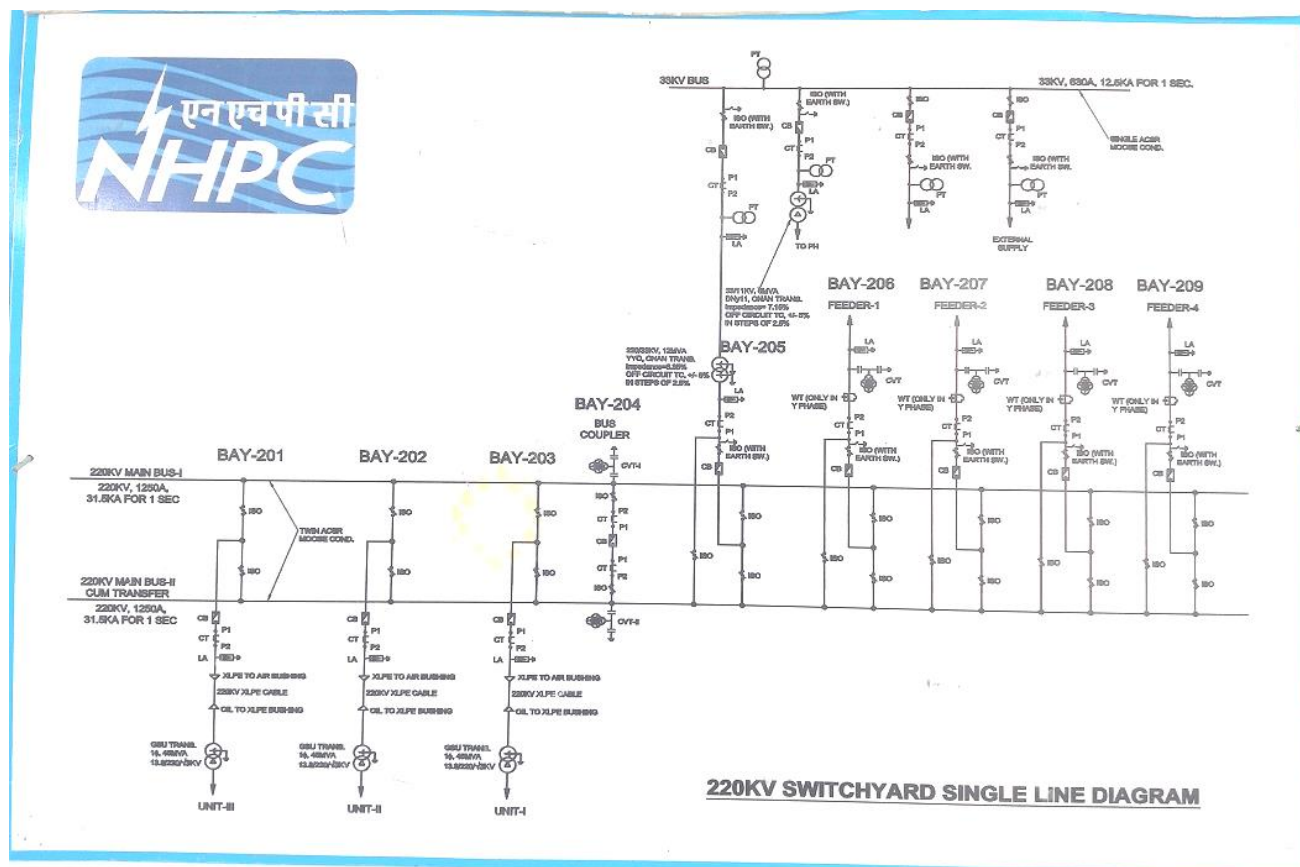
The methodology requires monitoring of the net electricity supplied from the project activity.

The 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 - $EGP_{J,y}$ in MWh and periodical calibrations of monitoring equipment's.
3. Meter Details and Line Diagram:

The Metering system comprises of 12 New-calibrated meters which were installed at the power station switch yard. All the meters are of accuracy class 0.2s and sealed by the Power Grid Corporation of India Limited and will be calibrated once in 5 years.

From the 12 Meters, three individual special energy meters (SEMs) (acts as standby meters) were installed at the power station switch yard for each generating unit for monitoring and recording of electricity generation through individual unit after transformation losses. These 3 units are were further connected to 4 feeders or transmission lines of 220 kV (Amargarh-1, Amargarh-2, Wagoora-1, Wagoora-2). Each feeder line has 2 separate energy meters (main meter and check meter) installed at the power station switch yard for measurement and recording the electricity supplied to the grid by the project activity. In order to monitor auxiliary power consumption, one separate meter of same technical specification is installed at power station switch yard.



Meter location ID no-	MAKE	METER.NO	ACCURACY CLASS	CATEGORY	INSTALLED ON	PLACE OF INSTALLATION OF SEM
KG-01	Elster	NR-3292-A	0.2s	M	Feb-2018	220 kV Amargarh-1
KG-02	Elster	NR-3314-A	0.2s	C	Feb-2018	220 kV Amargarh-1
KG-03	Elster	NR-3504-A	0.2s	M	Feb-2018	220 kV Amargarh-2
KG-04	Elster	NR-3236-A	0.2s	C	Feb-2018	220 kV Amargarh-2
KG-05	Elster	NR-3241-A	0.2s	M	Feb-2018	220 kV Wagoora-1
KG-06	Elster	NR-3243-A	0.2s	C	Feb-2018	220 kV Wagoora-1
KG-07	Elster	NR-3245-A	0.2s	M	Feb-2018	220 kV Wagoora-2
KG-08	Elster	NR-3247-A	0.2s	C	Feb-2018	220 kV Wagoora-2
KG-09	Elster	NR-3258-A	0.2s	S	Feb-2018	GT-1 (220kV)
KG-10	Elster	NR-3288-A	0.2s	S	Feb-2018	GT-2 (220kV)
KG-11	Elster	NR-3291-A	0.2s	S	Feb-2018	GT-3 (220kV)
KG-12	Elster	NR-3325-A	0.2s	S	Oct-2018	220 kV Aux Transformer (220kV/33kv)

Where, M - MAIN METER, S - STANDBY METER, C - CHECK METER

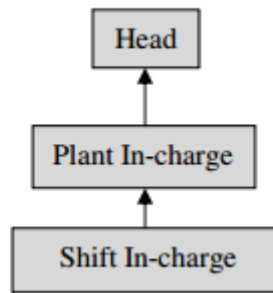
4. Monitoring times and periods - The data will be monitored on a continuous basis but will be recorded on a monthly basis with the energy meters installed at the site.
5. Data Accuracy - As per clause 4.0, Metering Arrangement of the Power Purchase Agreement (PPA) the metering arrangement including its installation, testing, maintenance and collection transportation and processing of data required for energy exchange shall be governed as per the notification/ directives issued/or to be issued by Central Electricity Regulatory Commission and as per relevant provisions contained in IEGC as amended from time to time. The Central Electricity Authority (CEA) notification regarding Installation and Operation of meters regulations, 2006, says that meters are required to be tested once in 5 years (refer clause 18 of the guideline)¹⁰. Thus, the meters recording the electricity exported will be calibrated at least once 5 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. The calculation approach is explained in detail under section 3 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 monitoring plan. 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

The Organisational structure for GHG data collection and management system is as below:

¹⁰ CEA metering regulation clause 18 on page 12 of the regulation

http://www.powermin.nic.in/whats_new/pdf/Metering_Regulations.pdf

Organisational Structure for Monitoring



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 SAFEGUARDS

5.1 No Net Harm

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

5.2 Environmental Impact

Centre for Inter-Disciplinary Studies of Mountain & Hill Environment, University of Delhi North Campus, New Delhi 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 & Diversity Management Division 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 has been setup at project location for the planning and implementation of Environmental Management Plan. Under the rehabilitation and resettlement¹¹, affected families are provided with a compensatory package. Also, there are plans for development of green belt around the project area, compensatory afforestation plan and Catchment Area Treatment (CAT) plan for the overall conservation of surrounding ecosystem. There is provision of release of 9 cumecs water as Environmental Flow through Dam Toe.

5.3 Local Stakeholder Consultation

A detailed stakeholder consultation process has been conducted by NHPC. This task was accomplished by the J&K State Pollution Control Board. The Member Secretary has issued public notice for environmental public hearing on 05-Jul-2003 & 17-Jul-2003 and Environmental public hearing was conducted successfully on 04-Sep-2003 near power house site at village Bandipora & on 06-Sep-2003 in Gurez valley at Dam site PWD Guest House.

¹¹ <http://www.nhpcindia.com/r-and-r-initiative.htm>

The stakeholders participated in the Public Hearing are as follows:

1. Government Officials
2. Local Citizens
3. Representatives of affected people residing in the project area.
4. Representatives of villages

The discussions mainly aimed at–

- Displacement due to submergence.
- Social issues like rehabilitation, compensation
- The basic protection of the biodiversity and environment affected due to the project
- Impacts in the region due to the project
- To understand various stakeholder perceptions
- Stakeholder awareness of project related issues

The comments of various stakeholders are reviewed below:

- One major issue raised during public consultation was related to impact of project on ethnic community in Gurez and submergence of Villages. People requested NHPC to consider lowering of Dam height to reduce submergence.
- 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 development has led 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.

Keeping in view the request of locals for reducing Dam height, the dam height was reduced and now only one village is getting submerged. The change in Dam height was communicated to MoEF and revised Environmental Clearance was accorded by MoEF to the project vide letter dated 09-Mar-2006. As per condition stipulated in the revised Environmental Clearance for the project, a fresh socio-economic survey for the project affected families was conducted through University of Kashmir, Srinagar and a revised Rehabilitation and resettlement plan was prepared. MoEF had accepted the socio-economic survey report and R&R plan for project affected families vide its letter dated 23-Oct-2007.

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

After completion of the public hearing, the final EIA & EMP reports and proceedings of Public Hearing were submitted to MoEF for appraisal by the Expert Appraisal Committee (EAC) of

MoEF. After recommendation of EAC, Environmental clearance was issued to the project on Date 19-Apr-2004 which was revised on 09-Mar-2006.

5.4 Public Comments

The project shall be listed for 30 days period. In case any comments are received they shall be incorporated during the validation.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored

Data / Parameter	EG _{PJ,y}
Data unit	MWh
Description	Quantity of net electricity supplied (MWh) to the grid as a result of the implementation of the project activity instances in this monitoring period.
Value applied:	751,127
Comments	

6.2 Baseline Emissions

As per description earlier under this document:

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

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” (tCO₂/MWh) (i.e., 0.9126 tCO₂/MWh).

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

BE_y : Baseline emissions in year y (tCO₂e/yr)

Here,

$$EF_{grid,CM,y} = 0.9126$$

$$EG_{PJ,y} = 751,127$$

$$BE_y = 751,127 * 0.9126 = 685,478 \text{ tCO}_2\text{e}$$

6.3 Project Emissions

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

6.4 Leakage

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

6.5 Net GHG Emission Reductions and Removals

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

$$ER_y = BE_y - PE_y$$

Where,

ER_y = Emission Reduction in tCO₂/year

BE_y = Baseline emission in tCO₂/year

PE_y = Project emissions in tCO₂/year

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2018 (from 13-Mar-2018 to 31-Dec-2018)	401,259	-	-	401,259
2019 (from 1-Jan-2019 to 31-May-2019)	284,219	-	-	284,219
Total	685,478	-	-	685,478

Further, the comparison for estimated emission reductions as per validated VCS PD and actual observed are detailed below. The emission reductions are lower than the estimated value.

Parameters	tCO ₂ e
Estimated Annual Emission Reduction	1,563,247
Emission Reductions for the monitoring period (445 days)	1,905,876
Emission reductions achieved in monitoring period	685,478
Percentage of variation when compared with estimated ERs in VCS PD	-64.03%

Reason for Lower ER:

Unit1 & Unit2 had major breakdown during the monitoring period detailed below:

MAJOR BREAKDOWN

Sr.no.	Unit	Duration	Details
1	Unit # 1	2/08/2018 to 2/11/2018	One no. bucket of runner was sheared off from runner which further lead to breaking of One no. Nozzle cover of Nozzle no. 3 , shearing of bolts of turbine housing , damage to TGB shell, oil drained due to damaged oil pipeline of Nozzle-4
2	Unit # 3	10/11/2018 to 28/03/2019	During opening of MIV, right hand side lever of MIV was dislodged and tilted towards outside by around 50 mm which further lead to damage of Maintenance and Service seal of MIV.

APPENDIX 1: CENTRAL ELECTRICITY AUTHORITY: CO2 BASELINE DATABASE

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

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

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

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

Weighted Generation Operating Margin	
Indian Grid	0.9610

Combined Margin Emission Factor	
Indian Grid	0.9126