	Project design document form **(Version 11.0)**
Complete this form in accordance with the instructions attached at the end of this form.	
BASIC INFORMATION	
Title of the project activity	Jorethang Loop Hydroelectric Project, India[1]
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	06
Completion date of the PDD	16/11/2019
Project participants	M/s DANS Energy Private Limited
Host Party	India
Applied methodologies and standardized baselines	Approved consolidated baseline methodology ACM0002, "Consolidated baseline methodology for grid connected electricity generation from renewable sources" Version 20.0, 28 November 2019
Sectoral scopes	Sectoral Scope: 01, Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	390,589

[1] https://cdm.unfccc.int/Projects/DB/DNV-CUK1188881385.79/view

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Jorethang Loop Hydroelectric project (JLHEP) is developed by DANS Energy Private Ltd (DANS Energy) on the Rangit River in the state of Sikkim, India. The Rangit River is a tributary of the Teesta River, which is the main river traversing the state of Sikkim. The project have Generator installed capacity of 96 MW, and will generate approximately 444.03 GWh (gross) per annum. The project involves the construction of a diversion barrage, 108 m in length and 17m in height, which create a small reservoir of approximately 14.489 ha.

The main purpose of the project is to use the hydro potential of the Rangit River to generate zero emission electricity. The electricity generated will be exported to the Eastern Regional grid (Central Transmission Utility (CTU)) through the Eastern Regional Load Dispatch Centre (ERLDC) and sold to third party consumers through open access market or through Power Purchase Agreement (PPA).

The unit I of 48 MW was declared as commissioned on 26/09/2015 and unit II of 48 MW was declared as commissioned on 01/10/2015 by Eastern Regional Power Committee.

The annual emission reductions from project activity are expected to be 390,589 tCO2e.

Contribution to Sustainable Development

The JLHEP will contribute strongly to the sustainable development of the region and surrounding areas in the following ways:

- The generation of electricity by the project will not result in the emission of greenhouse gases to the atmosphere.
- The electricity to be generated displaces grid-sourced electricity that is dominated by non renewable fossil fuel resources, thereby reducing the carbon intensity of the Eastern Regional grid.
- The project will result in a reduction in air borne pollutants, such as oxides of nitrogen, oxides of sulphur, carbon monoxide and particulates, through a reduction in the combustion of fossil fuels.
- The project will generate local employment, on a temporary basis during the construction phase, with more permanent on-going employment during the operational phase.
- The project will encourage the demand for materials, spare parts, equipment and on-going consumables.
- The project will not compromise access to the river resources for downstream users as the Raman River flows into the Rangit River approximately 4 kilometres downstream of the proposed diversion barrage, and two other streams, Ramam Khola and Chhoti Rangit flow into the Rangit River within this 4 kilometre stretch. In addition provisions have been made for approximately 0.3 cumecs of sacrificial discharge throughout the year. To ensure there is no negative impact on local fish populations, a hatchery (including hatchery, nursing ponds, rearing ponds and stocking ponds) is proposed to be built in the vicinity of Rangit River.
- A greenbelt of approximately 24.74 ha will be created around the reservoir, to mitigate soil erosion and prevent landslips.
- The project will not involve the construction of any major roads, except for a small length of approach road and minor link roads. The project will carry out maintenance and upgrade of existing roads, which will improve access to the area whilst limiting environmental disturbance.
- Twelve percent of the total electricity generated will be provided free to the Sikkim State Government as a royalty.
- Local villages partially depend on firewood for their daily energy needs, which can lead to adverse ecological impacts, such as forest degradation, soil erosion and reduction in fertility. Increased availability and reliability of power supply from this project to the villages will reduce the need for firewood.

The project is being developed in line with India's National Electricity Policy[2]. Section 5.2.5 of the policy outlines the Government's emphasis on the full development of feasible hydro potential in the country. Section 5.2.6 of the policy states that harnessing hydro potential is a priority as it will facilitate economic development, particularly in the North-Eastern States, Sikkim, Uttaranchal, Himachal Pradesh, Jammu and Kashmir, where a large proportion of India's hydro power potential is located. In addition the Ministry of Power has outlined several policy measures to accelerate the capacity addition from hydroelectric projects.[3]

A.2. Location of project activity

Country: India
Region: Eastern Region of India
State: Sikkim
Province (District) : South District
Community (Village) : Piple Village
Community (Town) : Jorethang Town

The proposed Jorethang Loop Hydroelectric project is located in the Namchi sub-division of the South District in the state of Sikkim, India. The project is to be developed on the Rangit River, a major tributary of Teesta River, which is the main river traversing Sikkim. . The Latitude of project activity is 27º 6' 23" North and Longitude is 88º 20' 7" East as depicted in map below:

The diversion barrage site is situated in the lower reaches of the Rangit River, upstream of its confluence with Ramam River, close to the village of Piple. Piple is approximately 5 km upstream of Jorethang Town. The power generating units is located in a surface power house approximately 13.5km downstream of the proposed barrage site, which is approximately 1.5 km downstream of the village of Manjhitar (Figure A1 and Figure A2).

[2] http://powermin.nic.in/indian_electricity_scenario/national_electricity_policy.htm

[3] http://powermin.nic.in

Figure A1: Location of Sikkim and its Districts

Figure A2: Location of the project

A.3. Technologies/measures

The proposed project is a hydroelectric project which will utilize the potential energy from a natural height drop of approximately 84m over a 12.8km stretch of the Rangit River. A diversion barrage, 108 m in length and 17m in height, is constructed which create a reservoir of approximately 14.489 ha. The flow is directed from the reservoir, through an intake tunnel on the east bank of the river, into a 7.1 km head race tunnel, through a surge shaft and pressure shaft to the powerhouse. The powerhouse is house 2 x 48.75 MW vertical shaft type Francis turbines, that is coupled with synchronous generators of capacity 2 x 48 MW. The flow is discharged via a 40m tail race channel back into the Rangit River. The project components from the head race tunnel to the flow discharge is located underground.

The power which is generated by the project is rated at 11kV. This is stepped up to 220 kV at the switchyard of the power house, which is located above ground. The electricity is exported through a 10 km double circuit 220 kV transmission line to the New Melli sub-station on the Eastern Regional Grid.

The proposed project have generator installed capacity of 96 MW and a gross generation of 444.03 GWh per annum

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (Host Party)	DANS Energy Private Limited	No

A.5. Public funding of project activity

The project is financed through private sources and as such no public funding is required

A.6. History of project activity

The project activity has already commissioned. The Commissioning details and the chronological details of the project activity can be referred from section A.1 of the PDD. The registration date of the project activity under CDM mechanism was 28/02/2008. Currently, the project is applying for Renewal of Crediting Period

A.7. Debundling

Not Applicable, as this is not a de-bundled project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

Approved consolidated baseline methodology ACM0002, “Consolidated baseline methodology for grid connected electricity generation from renewable sources” Version 20.0, 28 November 2019)[4].

Tool for the demonstration and assessment of additionality (Version 03; EB29)[5]

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4 https://cdm.unfccc.int/UserManagement/FileStorage/AG07ZJQ3EXD42LT5YV9HR16M8KINPO

5 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v3.pdf

B.2. Applicability of methodologies and standardized baselines

As per Section 2.2 of ACM0002 Version 20.0, the methodology is applicable under the following conditions:

S. N (Para as per Meth)	**Applicability Criterion**	**Project Case**
1. (Para 3)	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 the installation of a grid-connected Greenfield hydro power plant; hence, the Criteria 3 (a) is applicable.
2. (Para 4)	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 power plant/unit;	The project activity is the installation of a grid-connected Greenfield hydro power plant; hence, the Criteria 4(a) is applicable.
	(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 project activity is not a capacity addition, retrofit or replacement to an existing power generating plant, the criteria 4 (b) is not considered as relevant for the project activity.

3. (Para 5)	In case of hydro power plants, one of the following conditions shall apply:[6] (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density, calculated using equation (3), is greater than 4 W/m^2; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/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/m^2, all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m^2; (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/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 JLHEP has Generator installed capacity of 96MW and is result in an impoundment of 14.489 hectares. Power Density calculation is shown below as per Equation (7) of methodology: - $PD = \frac{CapPJ - CapBL}{APJ - ABL}$ Where: PD = Power density of the project activity (W/m2) $CapPJ$ = Installed capacity of the hydro power plant after the implementation of the project activity (W) $CapBL$ = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero APJ = Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m2) $A\ BL$ = Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m2). For new reservoirs, this value is zero Hence, PD = $\frac{(96000000-0)}{(144890-0)}$ = 662.571 W/m^2 As the power density of the power plant is greater than 4 W/ m^2, the criterion 5(c) is applicable to the project activity.
4 (Para 6)	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	The above mentioned points in Section 6 (a) &(b) of referred methodology are not applicable to the project activity as the project activity is not an integrated power project.

[6] 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.

	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.	
5 (Para 7)	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 above mentioned criterion in Section 7 of referred methodology are not applicable to the project activity as the project activity is not switching from fossil fuels to renewable energy or biomass fired power plant. Hence project activity meets the applicability criteria.
6 (Para 8)	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"	Since the project activity is not a retrofits, rehabilitations, replacements, or capacity additions, the Section 8 is not considered as relevant for the project activity.
7 (Para 9)	In addition, the applicability conditions included in the tools referred to below apply[7]	Please refer tables below.

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

Applicability Criterion	**Project Case**
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The project is a grid connected Greenfield wind power project and thus the tool is applicable.

[7] 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.

Applicability Criterion	Project Case
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, two sub-options under the step 2 of the tool are available to the project participants, i.e. option IIa and option IIb. If option IIa is chosen, the conditions specified in "Appendix 2: Procedures related to off-grid power generation" should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	Steps involved in calculation of Emission Factor is included in section B.6.2 of the PDD as per the requirement of the tool
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	Project is located in non-Annex 1 country and hence the tool is applicable
Under this tool, the value applied to the CO_2 emission factor of biofuels is zero.	The project is a wind power project and there is no involvement of biofuels.

As described above, the project activity meets all the relevant applicability conditions provided in the methodology. Hence, the methodology ACM0002 is applicable to the project activity.

B.3. Project boundary, sources and greenhouse gases (GHGs)

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table below: -

Source		GHGs	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	In accordance with ACM0002, the baseline should only generation in fossil fuel fired power that is displaced due to the project activity.
		CH_4	No	
		N_2O	No	
Project activity	For dry or flash steam geothermal power plants, emissions of CH4 and CO2 from noncondensable gases contained in geothermal steam	CO_2	No	Not applicable, as project activity is hydro power project not geothermal power plant
		CH_4	No	
		N_2O	No	
	For binary geothermal power plants, fugitive emissions of CH4 and CO2 from noncondensable gases contained in geothermal steam	CO_2	No	Not applicable, as project activity is hydro power project not geothermal power plant
		CH_4	No	
		N_2O	No	
	For binary geothermal power	CO_2	No	Not applicable, as project activity

	plants, fugitive emissions of hydrocarbons such as n-butane and isopentane (working fluid) contained in the heat exchangers	CH_4	No	is hydro power project not geothermal power plant
		N_2O	No	
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	Not applicable, as project activity is hydro power project not solar thermal or geothermal power plant
		CH_4	No	
		N_2O	No	
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	The project is a new hydro-electric project with a power density far greater than 10 W/m^2. Therefore in accordance with ACM0002 no project emissions need to be accounted for.
		CH_4	No	
		N_2O	No	

B.4. Establishment and description of baseline scenario

Updated baseline for the second crediting period in line with the "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period." Version 03.0.1.

This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 274 to 295 of Project Standard version 02.0.

The tool stipulates the following steps to be carried out.

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

The baseline scenario remains unchanged and is in compliance with all the relevant mandatory national and/or sectoral policies.

Step 1.2: Assess the impact of circumstances

The baseline scenario identified at the validation of the project activity was the 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 into the grid. Thus this project activity was a voluntary investment which intends to replace equivalent amount of electricity at grid from renewable source. PP was not bound to incur this investment; hence absence of project activity (i.e. the investment) does not lead to any continued baseline practice for PP within their scope whereas the continued operation of the project activity would continue to replace equivalent amount of electricity at grid. Hence, the same baseline as identified in the previous crediting period is still valid for the project. Therefore, the assessment of the changes in market characteristics is not required for the renewal of the project's crediting period under CDM.

Nevertheless, there is an impressive growth attained by the Indian Power Sector within the recent years, the installed capacity has grown from mere 1,713 MW in 1950 to 344,002.39 MW as on 31.03.2018, consisting of 222,906.59 MW Thermal, 69,022.39 MW Renew and 6,780 MW Nuclear.

Sector-wise details of installed capacity are shown in Table 1. However, it is evident from Table 1[8] that the installed capacity is predominantly coal based and therefore, is a major source of carbon dioxide emissions in India. Hence, there exists scope for reducing the CO_2 emissions in the country by increased use of renewable energy sources.

Furthermore, project participant has considered the latest available CO_2 Baseline Database (CEA database, version 14) at the time of requesting renewal of the crediting period for establishing the baseline emission factor, which itself considered all the new circumstances. Hence, the new circumstances do not have an impact on the baseline emission. As per below table, the fossil fuel based thermal power generation is dominant over the renewable based power generation, thus baseline scenario remains same as original.

Table 1: Sector- wise installed capacity (MW) as on 31/03/2018 (CEA Database version 14)

Sector	Thermal				Nuclear	Hydro	RES	Total
	Coal	Gas	Diesel	Total				
State	64670.50	7078.95	363.93	72113.38	0.00	29858.00	2003.37	103974.75
Central	56955.00	7237.91	0.00	64192.91	6780.00	12041.42	1502.30	84516.63
Private	75546.00	10580.60	473.70	86600.30	0.00	3394.00	65516.72	155511.02
All India	197171.50	24897.46	837.63	222906.59	6780.00	45293.42	69022.39	344002.39

Thus, current baseline remain same and there is no impact if circumstances, existing at the time of requesting renewal of crediting period.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested

As explained in step 1.2, the baseline scenario was the electricity import/generation from the power plants connected to the electricity grid. The project activity in green field project and there is no any baseline equipment or investment involved in project activity. Therefore, this condition is not applicable to the project activity.

Step 1.4: Assessment of the validity of the data and parameters

This step stipulates that “Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.”

In the context of the present project activity the emission factor has been updated along with the approach used to calculate the emission factor.

Step 2: Update the current baseline and the data and parameters

As evident from the explanation provided above the baseline scenario remains unchanged. Only the approach used to calculate the baseline emission factor is updated as per the latest version of CEA CO_2 baseline database available at the time of PDD submission for renewal.

In line with the project standard version 02.0, the impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant EB guidance with regard to renewal of the crediting period at the time of requesting renewal of crediting period; and the correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period

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

Impact of the national and/or sectoral policies and circumstances upon the baseline scenario of the project activity

The Government of India enacted the Electricity Act in the year 2003 to harmonize and rationalize the provisions in the existing laws. The Act consolidated the laws relating to generation, transmission, distribution, trading and use of electricity. With the Enactment of the act, the then existing laws viz, The Indian Electricity Act 1910, The Electricity Supply Act, 1948 and The Electricity Regulatory Commissions Act, 1998 were repealed. The Electricity Act 2003 was in force at the time of the completion of the baseline study for the registered PDD.

Section 3 of the said act required the Central Government to prepare the national electricity policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy. In accordance with the section 3 of the Electricity Act 2003, the Central Government notified the National Electricity Policy[9] on 12th February 2005 which was in force at the time of completion of the baseline study as stated in the registered PDD of the project activity. This policy has not been revised since then and is currently in force as well.

In addition to the above policies, State Electricity Regulatory Commissions (SERCs) have announced preferential tariffs and Indian Renewable Energy Development Agency (IREDA) provides term loan assistance towards establishing biomass power projects. All these fiscal and financial incentives were in force at the time of completion of the baseline study for the registered PDD of the project activity and still continue to exist.

The state electricity regulatory commission issues tariff order in respect of procurement of power generated wind generators and there is no mandatory national and/or sectoral policies have come into effect that would affect the compliance of the current baseline. Hence, it can be concluded the current baseline complies with all relevant mandatory national and/or sectoral policies that have come into effect after the submission of the project activity for validation and are applicable at the time of requesting renewal of the crediting period.

However, in spite of the financial incentives given by the government to renewable power projects in India the generation from the low cost must run resources connected to the Southern Grid has not increased to such an extent that this would lead to more than 50% contribution from the low cost must run resources towards the total generation from the Southern Grid.

The approved consolidated baseline methodology, ACM0002 (Version 20.0), has been used to determine the baseline and the estimation of emission reductions for the applicable crediting period. As referred in the methodology "*Tool to calculate the emission factor for an electricity system*" *(version 07.0)* has been used to determine continued validity of the baseline based on combined margin (CM) calculations.

As per CEA CO2 baseline database version 14, the fossil fuel dominated electricity is more than renewable sector and is continuing with same pattern. In light of the above discussion it is to be concluded that in accordance with relevant guidelines stipulated in the Project Standard version 02.0, national and/or sectoral policies and circumstances had been considered towards formulating the OM & BM baseline scenario. Hence the baseline scenario as applied for the present project activity remains justified.

As per the approved consolidated Methodology ACM0002 (Version 20.0) 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

[9] http://www.cercind.gov.in/Act-with-amendment.pdf

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".[10]

As the project activity is the installation of a Greenfield power plant and does not modify or retrofit an existing generation facility, the baseline scenario is the emissions generated by the operation of grid-connected power plants and by the addition of new generation sources. This is estimated by multiplying the Combined Margin emission factor with electricity delivered to the grid

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) and build margin (BM). Calculations for this combined margin must be based on data from an official source (where available) and made publically available. The CEA CO_2 baseline database version 14 is the latest available data at the time of PD submission to DOE for validation, hence same is considered for emission factor calculations.[11]

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

Parameter	Value	Nomenclature	Source
$EF_{grid,CM,y}$	0.8885[12] 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 (0.25) & build margin (0.75) values, sourced from Baseline CO_2 Emission Database, Version 14.0, Dec 2018 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 14.0, Dec 2018 published by Central Electricity Authority (CEA), Government of India
$EF_{grid,BM,y}$	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 14.0, May 2018 published by Central Electricity Authority (CEA), Government of India

B.5. Demonstration of additionality

[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf

[11] Information obtained from the CEA Baseline Calculations Baseline Carbon Dioxide Emissions from Power Sector - Version 14.0 Baseline. Carbon Dioxide Emission from Power Sector - Version 14
http://www.cea.nic.in/reports/others/thermal/tpece/cdm_co2/user_guide_ver14.pdf

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

86. The following default values should be used for wOM and wBM: (a) Wind and solar power generation project activities: wOM = 0.75 and wBM = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods; (b) All other projects: wOM = 0.5 and wBM = 0.5 for the first crediting period, and wOM = 0.25 and wBM = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool

The JLHEP generates electrical power without the emission of greenhouse gases. The power generated will be exported to the Eastern Regional grid where it displaces the electricity generated from a fossil fuel dominated generation mix, thereby reducing the carbon intensity of the grid, on a per megawatt basis, and the quantity of greenhouse gases emitted.

In the Eastern Regional grid there has been a 46% increase in capacity in the last 10 years. 87% of these capacity additions have been coal fired thermal power stations[13]. In the absence of the project activity, it is most likely that the required capacity additions to the grid will be met through the development of large thermal power stations, due largely to relatively high returns on investment, economies of scale and the availability of project finance. Furthermore, there are a limited number of feasible opportunities to develop hydroelectric power in India. This is further limited when potential project sites are screened for environmental or social reasons.

In total, the Project is estimated to result in a reduction in emissions of greenhouse gases of 2,808,428 tonnes of CO2 over a crediting period of 7 years. To demonstrate the additionality of the project the steps prescribed in "Tool for the demonstration and assessment of additionality" (Version 03; EB 29) have been used.

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

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

DANS Energy Private Ltd is a local hydropower developer. As such, the only realistic and credible alternatives to the project activity are:

Alternative 1 - the proposed 96MW JLHEP is not undertaken as a CDM project.
Alternative 2 –the 96MW JLHEP is not implemented and electricity demand would have to be continued to be met through the current carbon intensive grid mix.

Two additional alternatives were also considered:
Grid-connected power projects utilizing other renewable sources (wind, biomass) supplying the same amount of electricity as the project activity.
Grid-connected fossil fuel-fired power plant supplying the same annual amount of electricity as the project activity.

However, DANS Energy was established with the specific objective of providing services to the hydro power sector in India based upon the extensive experience of one of the company's directors in this sector. This is outlined in the DEPL Company Profile, which is included in Annex 5. AS DEPL was established to focus on the hydropower sector these two additional alternatives could not be considered to be realistic or credible in accordance with the provisions of the "Tool for the demonstration and assessment of additionality" (Version 03; EB 29) and were dismissed.

Sub-step 1b. Consistency with mandatory laws and regulations:
All of the alternatives to the project activity comply with all mandatory applicable legal and regulatory requirements for electricity generation in India.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method:
The option chosen to prove additionality is Option III – "Benchmark Analysis", as the only plausible investment decision for DANS Energy Private Ltd is whether or not to develop the project.

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Information obtained from the CEA Baseline Calculations *Baseline Carbon Dioxide Emissions from Power Sector - Version 2.0*aseline Carbon Dioxide Emission from Power Sector - Version 2
[http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm]

Sub-step 2b.- Option III Apply benchmark analysis:
The financial indicator chosen for this activity is the project internal rate of return (IRR). In order to utilize a benchmark comparable to the project IRR the project participant elected to use the Prime Lending Rate (PLR) published by the Reserve Bank of India (RBI). The PLR is the benchmark interest rate at which commercial banks in India lend to their most credit worthy customers. The RBI publishes the average PLR of the five major nationalized banks in India in its fortnightly publication.

Typically, projects in India would be borrowing debt at a rate equal to or higher than the PLR. Hence, for any project to be financially attractive, the IRR of the project must be higher than the rate of borrowing on debt (i.e. higher than the PLR). Accordingly, if any project's IRR does not exceed the PLR, it could be considered a financially unattractive project.

The use of the PLR is consistent with the "Tool for the demonstration and assessment of additionality" (Version 03; EB 29) which suggests that "*…benchmarks for IRR, NPV, etc. can be derived from….Estimates of the cost of financing and required return on capital (e.g.* ***commercial lending rates*** *and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds' required return on comparable projects".*

The PLR quoted by the Reserve Bank of India on April 20th 2007 was 12.75-13.25% [14] (see http://rbidocs.rbi.org.in/rdocs/Wss/PDFs/77110.pdf). In order to keep this benchmark conservative no risk premium associated with the project type or the project developer was added to it. Further, the RBI's PLR is in itself a conservative benchmark as it does not take into account the commercial lending rates of private sector banks which are typically higher than that of nationalized banks. For example,
The PLR of ICICI Bank, India's largest private sector bank, was 15.75% from 1 April 07 (http://www.icicibank.com/pfsuser/aboutus/investorelations/pressrelease/icicibank_pressrea lease/IBAR.pdf).
The PLR of HDFC Bank was 15% from 3 April 07 (http://www.hdfcbank.com/wholesale/default.htm# - see bottom left hand side – Benchmark PLR).

Sub-step 2c. Calculation and comparison of financial indicators:
The project IRR of the JLEP without additional revenue from the sale of CERs was 9.62%, which was lower than the PLR specified by the Reserve Bank of India. Key financial assumptions utilized to calculate the project IRR and contained in Table B1.

Table B1 Financial Assumptions used to Calculate Project IRR

Assumption	**Value**	**Unit**	**Comment**
Capacity	96	MW	
PLF	52.80%		
Auxiliary consumption plus losses	1.00%		
Free Energy to State	12%	Years 1-15	In accordance with the provisions of the Implementation Agreement executed with the Government of Sikkim a royalty in the form of free power is payable to the Government of Sikkim calculated as a percentage of net generation
	15%	Years 15-25	
Total Cost	5,486.31	Rs. Mn	
Debt	3,946.85	Rs. Mn	
Equity	1,539.46	Rs. Mn	

[14] http://rbidocs.rbi.org.in/rdocs/Wss/PDFs/77110.pdf

Installed Cost/MW	5.71	Rs. Cr/MW	
Tariff Escalation	1%		
Baseline Emission Factor	1.06	Tonnes CO2/MWh	CEA - Baseline Carbon Dioxide Emissions From Power Sector - Version 2.0)
Construction Start Date	1/07/07		
EPC Period	30 months		
Commercial Operation Date	1/01/10		
Debt Repayment Period	12.00	Years	
No of repayments per year	4.00		
Average Interest Rate	13.25%		
Interest on Working Capital	12.50%		
Spares	1.00%	6.00%	Escalation
Receivables	1.50	Month	
O&M	1.00		
O&M expenses (incl insurances)	1.50%	4%	Escalation
Corporate Taxes	33.99%		
MAT Rate	11.33%		

Sub-step 2d. Sensitivity analysis

A sensitivity analysis on the financial model was conducted by altering the following parameters:
total annual electricity generation (plus and minus 10%);
the electricity tariff (plus and minus 10%); and
project capital and operational costs (plus and minus 10%).

The results of the sensitivity analysis are presented in Table B2, which shows that the project IRR remains below the PLR even in the case where these parameters change in favour of the project.

Table B2 Project IRR Using Alternative Project Parameters

Scenario	**Parameter change**	**IRR**
Base case		9.62%
Total annual electricity generation	Plus 10%	10.96%
	Minus 10%	8.18%
Electricity tariff	Plus 10%	10.96%
	Minus 10%	8.18%
Project capital and operational costs	Plus 10%	8.17%
	Minus 10%	11.38%

The investment comparison analysis clearly demonstrates that the proposed CDM project activity is unlikely to be considered as a financially attractive course of action. As such, Step 3 – Barrier Analysis is not required.

Post Registration Changes –

The project activity is exporting electricity to Eastern Regional grid (Central Transmission Utility (CTU)) through the Eastern Regional Load Dispatch Centre (ERLDC) and will be sold to third party consumers through open access market or through Power Purchase Agreement (PPA). Due to open access market, the tariff rate varies on daily basis, hence PP has checked the additionality due to slight variation in tariff rate. Since commissioning, PP has taken average tariff rate based on daily tariff rate values for last 7 months (Oct 15 to April 16) and average tariff rate comes out to be INR 2.43 per KWh.

During validation/registration stage, the project activity was scheduled to commence on 01/10/2007 and it was expected that project activity will operational on 01/01/2010. The project activity got registered as CDM project activity on Feb 2008. There was delay in commissioning of project activity and units were commissioned on 26/09/2015 (for Unit I) and on 01/10/2015 (for Unit II).

Thus the financial assumption (particularly project cost) considered in IRR calculation at the time of validation/registration were substantially increased in actual case. These variations in project COST was due to natural (geological condition) circumstances which were not in control of PP. This led the PP to complete the erection and commissioning activities later than estimated during project conceptualisation stage. Due to Geological surprises, there were changes in construction methodology of project activity, changes / addition in design aspect which increased the civil infrastructure cost and electro mechanical cost.

The changes in project cost are as below

Particulars	Registered PDD input parameter	Revised input parameter
Hard cost (Building) in Million	3060	7709.40
Hard Cost (Plant) in Million	1440	1757.60
Total Hard Cost in Million	4664.50	9.973.40
Total project cost (both hard and soft cost) in Million	5486.3	11,326.1 (with increase in hard cost and excluding increase in soft cost)
		15185.22 (with increase in both hard cost and soft cost)

Due to changes in design aspect during erection and commissioning, the hard cost of project increased and total hard cost of project worked out to INR 9973.40 million. In line with this scenario, PP has further analysed the IRR with increased project cost due to changes in designs, changes in erection and commissioning activities than estimated.

PP has considered the increased hard cost of project of INR 9973.40 Million. Considering original soft cost and revised hard cost and average tariff rate of INR 2.43 per KWh in IRR calculation, it is found that project IRR is 2.02% which is well below the benchmark of project activity. The details of changes in designs, changes in erection and commissioning activities than estimated are provided to DOE. The revised IRR excel spreadsheet along with sensitivity analysis is submitted to DOE with these changes. It is observed that the revised IRR is well below the Benchmark even with +/- 10% sensitivity analysis.

The sensitivity analysis result is as below

Item Number	Scenario	Parameter change	Project IRR
	Base case		2.02%
1	Annual electricity generation	Plus 10%	3.12%
2		Minus 10%	0.80%

3	Electricity tariff	Plus 10%	3.12%
4		Min 10%	0.80%
5	Project capital and operational costs	Plus 10%	0.87%
6		Minus 10%	3.30%

Due to delay in commissioning, the expenses and overheads increased and there was increase in soft cost (expenses, overheads, Interest during construction and contingency) of project activity as well. The actual total project cost (after adding the soft cost increase) is INR 15185.2 million. The Chartered accountant certificate is provided to DOE for the actual cost incurred by the project activity. Also cost overrun report prepared by Power Finance Corporation Limited (Lead lender To Project) is provided to DOE for the actual total project cost of project activity. If actual project cost (INR15185.2 million) and actual tariff rate (INR 2.43 per KWh) are considered in IRR calculations, the IRR becomes negative (-1.41%). Further, with actual project cost, the threshold limit for tariff rate works out to be INR 8.33 per KWh at which rate the project IRR crosses the lower range of benchmark (12.75%). Such increase in tariff rate is unlikely scenario and not possible for the project activity duration. Thus it can be concluded that project activity remains additional in all scenarios. As per Indian Energy Exchange data, the last three years (2013-2015) average net realized tariff rate for E1 region is INR 2.41 per KWh, thus threshold limit of tariff rate (INR 8.33 per KWh) is unlikely scenario.

Step 4. Common practice analysis

The majority of investments in the Indian power sector are focused on medium to large-scale thermal power projects due largely to relatively high returns on investment, economies of scale and the availability of project finance. The favoured development of thermal power projects is illustrated through a consideration of five-year plans over the last 50 years (Table B2). Five-year plans are developed by the Planning Commission to identify the planned capacity additions to the national and regional grid. As Table B3 indicates, thermal power has dominated the planned development of the national and regional grid, with the contribution of the hydro sector steadily falling over the last 35 years.

Table B3 National and Regional Electricity Grid Composition Over the last 50 Years

Plan and Year	Hydro (%)	Thermal (%)	Other (Nuclear and Wind) (%)
1st Plan 1956	**35**	**65**	**0**
3rd Plan 1966	**46**	**54**	**0**
5th Plan 1979	**41**	**57**	**2**
7th Plan 1990	**29**	**69**	**2**
9th Plan 2002	**25**	**71**	**4**

Source: http://powermin.nic.in (see *Plans to augment power generation; Accelerating the Development of Hydro Projects)*

This lack of development of hydropower has occurred despite the existence of substantial undeveloped hydro resources in India, especially in the Eastern and North-Eastern states. The CEA estimates that as of April 2007, only 2.0 per cent of Sikkim's hydro potential has been developed, with another 14.2 per cent currently under development[15].

Table B4 describes other large hydro power projects, (installed capacity greater than 25 MW and less than 500 MW), that have been developed or are in the process of being developed by the private sector to date that are/will connect to the Eastern Regional grid.. As the table indicates all of the projects listed have a substantially lower installed cost/MW than that of the project activity.

The reasons for the higher installed cost/MW of the JLHEP are listed below:

- Gross Head: All other projects listed in table B3 (for which data is publicly available) have higher "gross head" in comparison to the project activity. As a result, the electro-mechanical equipment (Francis turbines) to be used by the project activity is more expensive due to the

[15] http://www.cea.nic.in/hydro/Status%20of%20Hydroelectric%20Potential%20Development.pdf

lower revolutions per minute (rpm) required. .

- Discharge: Due to the lower head associated with the project activity a considerably greater volume of discharge water is required to achieve a rated power comparable to other projects listed in Table B3. This requires a larger water carrying system, including the intake and head race tunnel, surge shaft, and pressure shaft, resulting in higher civil costs for the JLHEP compared to other projects
- Cost of Infrastructure: In the case of the first 3 projects listed in the Table B3, the Sikkim Government has agreed to construct roads, bridges, and transmission and distribution lines required by the projects at its own cost. This facility has not been provided to the JLHEP.

This higher installed cost/MW represents a serious change in the circumstances under which the JLHEP will be implemented compared to the circumstances under which these other similar projects will be carried out and supports the claim that the project activity is financially unattractive without the additional revenue from the sale of CERs.

Table B4 Private Sector Hydro Power Projects (greater than 25MW and less than 500MW) Connected to the Eastern Regional Grid.

Project Name	**Installed Capacity**	**Year of Commissioning**	**Project Developer**	**Cost/MW**	**Gross Head**	**Nominal Discharge**	**Comment**	**Source**
Chujachen HEP	99 MW	NA	M/w. Gati Infrastructure Pvt. Ltd	Rs. 4.53 Crores/MW (US$1.12 million)	297.5 meters	39.5 cumecs	The project has been awarded and is yet to start construction. The contractor has completed the preliminary mobilization at the site. Come civil works have been started. The estimated cost is Rs. 4.53 Crores/MW (US$1.12 million) compared with Rs. 5.71 Crores/MW (US$1.41 million) for the JLHEP.	Project Cost: http://www.cea.nic.in/hydro/project_monitoring/Status%20of%20Hydroelectric%20Projects%20under%20Execution.pdf Gross Head and Nominal Discharge: http://www.colenco.ch/_pdf/colencoinfo/ColencoInfo2004-11.pdf

Sada-Mangder HEP	71 MW	2009-2010	M/w. Gati Infrastructure Pvt. Ltd	Rs. 4.93 Crores/ MW (US$1.22 million)	546 meters (sada) and 144 meters (Mangder)	11.5 (Sada) and 13.7 (Mangder) cumecs	The estimated cost is Rs. 4.93 Crores/MW (US$1.22 million) compared with Rs. 5.71 Crores/MW (US$1.41 million) for the JHLEP.	Project Cost: http://www.gatiinfra.com/financials.htm http://northeast.nic.in/writereaddata/eventimages/17.pdf Gross Head and Nominal Discharge: http://www.colenco.ch/_pdf/colencoinfo/ColencoInfo2004-11.pdf
Bhasmey HEP	51 MW	2010-2011	M/w. Gati Infrastructure Pvt. Ltd	Rs. 4.90 Crores/ MW (US$1.21 million)	113 meters	55 cumecs	The estimated cost is Rs. 4.90 Crores/MW (US$1.21 million) compared with Rs. 5.71 Crores/MW (US$1.41 million) for the JLHEP.	http://www.gatiinfra.com/financials.htm http://northeast.nic.in/writereaddata/eventimages/17.pdf Gross Head and Nominal Discharge: http://www.colenco.ch/_pdf/colencoinfo/ColencoInfo2004-11.pdf
Rongnichu HEP	98 MW	2013-2014	Chhattisgarh Electricity Company Ltd	Rs. 5.10 Crores/ MW (US$1.26 million)	NA	NA	The estimated cost is Rs. 5.10 Crores/MW (US$1.26 million) compared with Rs. 5.71 Crores/MW (US$1.41 million) for the JLHEP.	http://northeast.nic.in/writereaddata/sublink3images/30.pdf http://northeast.nic.in/writereaddata/eventimages/17.pdf
Jorethang Loop HEP	96 MW	2010	DANS Energy Private Limited	Rs. 5.71 Crores/ MW (US$1.41 million)	84 meters	154 cumecs	NA	NA

Additionality Conclusion

As shown in Step 2 and 4 above, the JLHEP project is not a financially attractive project. The impact of registration of the project as a CDM project is as follows:

- If DANS Energy was able to sell certified emission reduction (CERs) from the project activity, the additional revenue generated by carbon sales would increase the project IRR to 12.92% (assuming a price of $US10/CER). The additional CDM revenue will increase the attractiveness of the project from an investment point of view by decreasing the installed cost/MW and mitigating some of the risk associated with developing a hydro power project in India, such as hydrological and geological risk, and the lack of key supporting infrastructure around remote hydro site.
- DANS Energy only decided to invest and go ahead with the project after taking into account the additional revenue from the sale of CERs.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

As per the approved consolidated Methodology ACM0002 (Version 20.0) para 39 (Equation 11):

Baseline emissions include only CO_2 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 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)

As per para 41, Equation 12, 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)

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

CO_2 Baseline Database for the Indian Power Sector, Version 14, Dec 2018[16] published by Central Electricity Authority (CEA), Government of India has been used for the calculation of emission reduction.

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

(a) Step 1: Identify the relevant electricity systems;

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

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

(d) Step 4: Calculate the operating margin emission factor according to the selected method;

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

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

Step 1: Identify the relevant electricity systems

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

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

Table: Geographical Scope of Indian Electricity Grid

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

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

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:
Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.
The Project Participant has chosen only grid power plants in the calculation.

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

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

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

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

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

	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[17]

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

The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

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

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

OR

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

PP has chosen ex-ante option for calculation of Simple OM emission factor using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PD to the DOE for validation.

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

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

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

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

Net Generation in Operating Margin (GWh) (incl. Imports)			
	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 (BM) emission factor ($EF_{grid,BM,y}$)

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

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

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

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

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

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

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

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

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

(a) Weighted average CM; or

(b) Simplified CM.

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

The combined margin emissions factor is calculated as follows:

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

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2/MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (t CO_2/MWh)

W_{OM} = Weighting of operating margin emissions factor (per cent)

W_{BM} = Weighting of build margin emissions factor (per cent)

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

Wind and solar power generation project activities: W_{OM}= 0.75 and W_{BM}= 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.

As per para 86 of Tool 07: Tool to calculate the emission factor for an electricity system (Version 07.0), The following default values should be used for wOM and wBM:

(a) Wind and solar power generation project activities: wOM = 0.75 and wBM = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;

(b) All other projects: wOM = 0.5 and wBM = 0.5 for the first crediting period, and wOM = 0.25 and wBM = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

Since project activity is of hydro power generation, the above weightage has been considered for OM and BM.

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

= 0.8885 t CO_2/MWh

Baseline emission factor (EF_y):

The baseline emission factor is calculated using the combined margin approach as described in Step 6 above:

Therefore, $EF_y = EF_{grid,CM,y}$ = 0.8885 t CO_2/MWh.

BE_y = 439,587 x 0.8885 = 390,589 tCO_{2e}

Leakage Emission

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

Project Emission

Since, the Power Density greater than 10 W/m ^{2} therefore project emission is not applicable.. Hence, as per the methodology, the Project Emissions can be calculated using the formula:

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

Where:

PE_y	=	Project emissions in year *y* (t CO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (t CO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of dry, flash steam or binary geothermal power plants in year *y* (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (t CO_2e/yr)

Since the project activity is a hydro power based project activity not a geothermal one, hence, $PE_{GP,y}$ is not applicable. Also the project activity utilizes the potential energy from a natural height drop of approximately 84m over a 12.8km stretch of the Rangit River using a diversion barrage, no reservoir has been built. Hence, $PE_{HP,y}$ and $PE_{GP,y}$ come out to be zero.

As per the para 31 of ACM0002, *for all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected*.

.

Hence, PE = 0

Emission reductions

Emission reductions are calculated as follows:

$ERy = BEy - PEy$

Where:

ERy = Emission reductions in year y (t CO2e/yr)
BEy = Baseline emissions in year y (t CO2/yr)
PEy = Project emissions in year y (t CO2e/yr)

ERy = 390,589 - 0 = 390,589 tCO_{2e}

B.6.2. Data and parameters fixed ex ante

Data/Parameter	**$EF_{grid,OM,y}$**
Data unit	tCO_2/MWh
Description	Operating Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 14, Dec 2018[18]
Value(s) applied	0.9610
Choice of data or measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07" 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, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of data	For the calculation of the Baseline Emission
Additional comment	This parameter is fixed ex-ante for the entire crediting period.

Data/Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	Build Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 14, Dec 2018[19]
Value(s) applied	0.8644
Choice of data or measurement methods and procedures	Calculated as per "Tool to calculate the emission factor for an electricity system, version 07" as per the latest data available for the most recent year 2017-18. The data is obtained from "CO_2 Baseline Database for Indian Power Sector" version 14, published by the Central Electricity Authority, Ministry of Power, Government of India.
Purpose of data	For the calculation of the Baseline Emission
Additional comment	This parameter is fixed ex-ante for the entire crediting period.

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

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

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined Margin CO_2 emission factor in year y
Source of data	Calculated from CEA database, Version 14, Dec 2018[20]
Value(s) applied	0.8885
Choice of data or measurement methods and procedures	The combined margin emissions factor is calculated as follows: $\mathbf{EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}}$ Where: $EF_{grid,BM,y}$= Build margin CO_2 emission factor in year *y* (tCO_2/MWh) $EF_{grid,OM,y}$= Operating margin CO_2 emission factor in year *y* (tCO_2/MWh) W_{OM} = Weighting of operating margin emissions factor (%) = 25% W_{BM}= Weighting of build margin emissions factor (%) = 75%
Purpose of data	For the calculation of the Baseline Emission
Additional comment	This parameter is fixed ex-ante for the entire crediting period.

B.6.3. Ex ante calculation of emission reductions

The ex-ante emission reductions were calculated using the steps described in Section B6.1 and the parameters described in Section B6.2. When these formulas, and data parameters, are applied the baseline emissions during the second crediting period are 390,589 tonnes of CO2 per year, or 2,734,123 tonnes of CO2, for the second crediting period, as outlined in Table B7 below

Table B7 Baseline Emissions Factors and Baseline Emissions during the first crediting period

Electricity Generated Emissions Reductions	Per Year	Crediting Period (7 years)
Baseline Emissions Factor (*EFy* in tCO2/MWh)	0.8885	-
Net Electricity Supplied to the Grid by the Project ($EG_{facility\ y}$ MWh)	439,587	
Baseline Emissions (*BEy* tCO2)	**390,589**	**2,734,123**

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2019	390,589	0	0	390,589
2020	390,589	0	0	390,589
2021	390,589	0	0	390,589
2022	390,589	0	0	390,589
2023	390,589	0	0	390,589
2024	390,589	0	0	390,589
2025	390,589	0	0	390,589
Total	2,734,123	0	0	2,734,123

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

Total number of crediting years	7			
Annual average over the crediting period	390,589	0	0	390,589

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	**$EG_{Facility, y}$**
Unit	MWh
Description	Net electricity supplied to the grid by the Project
Source of data	Metered on site/ Injection Schedule.
Value(s) applied	439,587 MWh per annum
Measurement methods and procedures	The net electricity supplied to grid is a calculated value and would be determined as the difference between the electricity exported to the grid and the electricity imported from the grid by the project activity. The value for the parameter will be sourced from the primary source i.e. metered data at site for net electricity supplied to grid and monthly energy bill for import. The Daily energy meter reading is duly signed by O&M personals at the site. The electricity export & import is measured continuously using energy meter installed at the site and the readings are recorded daily by the PP for export meters and by state utility for import meters. The PP prepares invoices on a monthly basis based on the quantity of electricity supplied to the grid. The monthly data will be considered for calculating the annual net electricity exported to the grid by the project activity during the year y.
Monitoring frequency	Monthly
QA/QC procedures	The monitoring meters will include a main meter and a check meter. All meter data will be stored in electronic and paper formats as specified in the monitoring plan.

Instrument Name	Location	Serial No.	Make	Accuracy Class
Electronic Trivector Meter	Line 1 Main Meter	NP8762A	Larsen & Toubro	0.2s
Electronic Trivector Meter	Line 1 Check Meter	NP8763A	Larsen & Toubro	0.2s
Electronic Trivector Meter	Line 2 Main Meter	NP8764A	Larsen & Toubro	0.2s
Electronic Trivector Meter	Line 2 Check Meter	NP8765A	Larsen & Toubro	0.2s

For export meters:
Accepted industry standard: National standard as described in the Power Purchase Agreement.
Measurement equipment: Energy meters
Calibration frequency: once in 5 years
Accuracy of the meters: 0.2 class
Measurement interval: continuous measurement, monthly recording

For import meters:

	Accepted industry standard: State Utility practice. Measurement equipment: Energy meters (Electronic Trivector Meter ER 300P) Make: Larsen & Toubro Sr. No.: 15001231, 3 Phase 4 wire Accuracy Class: 0.5 s Calibration frequency: Not under the control of the PP Measurement interval: continuous measurement, monthly recording Invoices/Obligation Reports for the quantity of electricity exported and sold (Receipt of sale) will also be stored and will allow cross checking of the net metered generated electricity.
Purpose of data	To Determine Baseline Emissions
Additional comment	Further details of the data collection, recording and storage procedures and the QA/QC procedures are contained in the Monitoring Plan, in Section B7.2 The data will be archived electronically for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter	A
Unit	m^2
Description	Surface area of the reservoir at full volume
Source of data	To be measured by DANS Energy at the time of commissioning
Value(s) applied	14.489 hectares = 144,890 m^2
Measurement methods and procedures	A detailed topographical survey will be undertaken on project commissioning to confirm the size of the reservoir
Monitoring frequency	Once
QA/QC procedures	As described in the project monitoring plan, Section B7.2.
Purpose of data	To calculate Power Density and Project emissions criteria
Additional comment	The surface area of the reservoir will vary depending on drawdown of water by the turbines. The area of 14.489 ha is the maximum area of submergence.

B.7.2. Sampling plan

Not Applicable

B.7.3. Other elements of monitoring plan

The monitoring methodology to be used is approved consolidated baseline methodology ACM0002, "Consolidated baseline methodology for zero-emissions grid-connected electricity generation from renewable sources" (Version 20.0, 28 November 2019).

Section B.7.1 outlines the data and parameters that will be monitored.

The selected methodology is appropriate for the proposed project as the Project activity is a grid connected hydropower project with a power density greater than 4W/ m2, where the grid's geography and system boundaries are explicit and information on characteristics of the grid are available. On this basis the conditions for applying ACM0002 are met.

The purpose of the monitoring plan is to ensure that the required data is accurately monitored and recorded to enable the calculation of the emission reductions achieved by the project.

Operational and Management Structure

DANS Energy proposes to appoint a CDM Management Team with the responsibility of overseeing the collection, recording and storage of the data required to calculate and monitor the greenhouse gas emission reductions from the project activity. The data that is required to be monitored is described in detail in Section B7.1. The team consists of three key positions and will be supported by the company's Quality Assurance Officer. An outline of responsibilities and reporting function of each of these key positions are contained in Table B9. The specific monitoring provisions are described in more detail following the table.

Table B9 CDM Management Team

Position	Outline of Responsibilities	Reporting
CDM Monitoring Officer	• Overseas the collection, recording and storage of data. • Reviews the monthly reports and investigates any • irregularities. • Ensures ongoing compliance with the CDM monitoring plan. • Prepares surface area at full reservoir level report at project commissioning • Supervises meter testing/calibration requirements • Prepares Emission Reduction Quarterly Report • Prepares Baseline Emission Factor report at the end of each crediting period	Reports to the General Manager (Projects).
Site Supervisor	• Responsible for the completeness and reliability of the data. • Responsible for carrying out meter test/calibration. • Calculates Emission Reductions on a monthly basis. • Generates monthly reports	Reports to the CDM Monitoring Officer
Shift Supervisor (Shift Based)	• The person appointed for each shift must be an experienced officer involved in the operation and maintenance of the hydro power plant. • Responsible for monitoring measurements, generating daily reports, and ensuring that meters are functioning correctly.	Reports to the Site Supervisor
Quality Assurance Officer	• Undertakes regular internal audits of the project. • Ensures compliance with Company Quality Assurance Procedures.	Reports to the General Manager (Projects).

Monitoring Provisions

Training
All persons that form part of this CDM Project Team will be suitably qualified and trained in the operation and maintenance of the plant. The training for operating and maintaining the plant will be provided by the supplier of electro-mechanical and hydro-mechanical equipment, which is a part of the contract terms with the equipment suppliers. All members of the CDM Project Team shall also receive appropriate training in the CDM monitoring requirements, which will include an overview of the CDM and all elements of the monitoring plan in detail. A copy of the project monitoring plan will be distributed to all of the CDM Project Team during the training, and an additional copy will be easily accessible at appropriate locations on site.

Specific Data Monitoring Procedures

Installation of the Meters: The electricity export will be monitored through state-of-the-art sealed and tested meters. The metering system will comprise of two sets of meters. The main meters will record the net electricity exported by the project to the grid and the second set of meters will be used as check

meters by the project. Both sets of meters will include a main meter and a check meter. The accuracy class of electricity meters shall be as defined in applicable IEC/Indian Standards.

Calibration/Testing of Meters: The CDM Monitoring Officer will ensure that a manufacturer's test certificate accompanies all purchased meters. A report summarising meter calibration requirements will be prepared by the CDM Monitoring Officer on project commissioning, and updated with each recalibration.

Surface Area at Full Reservoir Level: The surface area of the reservoir at full volume at project commissioning will be measured from a detailed topographical survey. This data will be used to confirm that the power density of the project is greater than the minimum requirement specified by the ACM0002.

Metered Net Electricity Export Data: Metered net electricity export data will be measured continuously. A monthly report of metered net electricity export data will be generated by the Site Supervisor, and saved in electronic and paper form. The monthly report will be generated using a template, approved by the CDM Monitoring Officer, to ensure that the data is reported consistently and can be compared to previous months. The CDM Monitoring Officer will review this report on a monthly basis and cross check the data against the invoices/obligation reports for the quantity of electricity exported and sold. Any irregularities will be investigated as described below in "Review of Reports and Treatment of Uncertainty". The auxiliary loads and losses (gross metered electricity generation minus net generated electricity) will be recorded in the monthly report, to be used in the event of meter failure, as described below in "Emergency Preparedness".

Emission Reductions: Emission reductions will be calculated on a monthly basis using the project and baseline emission data. Emission reductions occurring as a result of the project activity will be summarized in a quarterly report that will be prepared by the Site Supervisor. The quarterly report will be generated using a template, approved by the CDM Monitoring Officer, to ensure that the data is reported consistently and can be compared to previous quarters. The quarterly report will be reviewed by the CDM Monitoring Officer and submitted to the General Manager (Projects).

Updating the Baseline Emission Factor: The baseline emission factor will be updated at the end of the each crediting period through reference to data supplied by the CEA. If this data is unavailable the baseline emission factor will be calculated in accordance with ACM0002 and the methodology stipulated in A6.1. A report summarizing this information will be prepared at the end of teach crediting period by the CDM Monitoring Officer. The report will be submitted to the General Manager (Projects).

Emergency Preparedness: The project has the necessary provisions for emergency preparedness to deal with any unforeseen events such as fire or an electrical blackout. These provisions include installed fire fighting systems, and standby features for critical items. In the situation where an emergency causes unintended emissions, these emissions will be quantified and recorded on a monthly basis by the Site Supervisor and summarized in a discrete section of the Emission Reductions quarterly report.

In the event that the main meter, which is used to record the net electricity exported by the project, is found to be faulty it will be repaired or replaced and the data from the check meter will be used in its place. In the unlikely event that the check meter fails it will also be repaired or replaced and the net electricity will be obtained from the gross generation data, minus the average the auxiliary loads and losses. The average auxiliary loads and losses will be calculated as the average over the most recent six months, using the values recorded in the Metered Net Electricity Generation monthly reports, described above. In the event of meter failure, the details will be recorded by the Site Supervisor and summarized in a discrete section of the Emission Reductions quarterly report.

Reporting

A summary of the monitoring reports is contained in Table B10. All reports will be reviewed by the CDM Monitoring Officer and then sent to DANS Energy's General Manager (Projects) for review and acceptance.

Table B10 Monitoring Reports

Report	Responsibility	Frequency
Surface Area at Full Reservoir Level	CDM Monitoring Officer	At project commissioning
Meter Calibration Report	CDM Monitoring Officer	At project commissioning and updated with each recalibration
Metered Net Electricity Export Data	Site Supervisor	Monthly
Emission Reductions	Site Supervisor	Quarterly
Baseline Emission Factor	CDM Monitoring Officer	End of each crediting period
Emergency Report: Unintended Emissions	Site Supervisor	Monthly (as required)
Emergency Report: Meter Failure	Site Supervisor	Monthly (as required)
Internal Audit Report	Quality Assurance Officer	Quarterly

Review of Reports and Treatment of Uncertainty

When reviewing the Metered Net Electricity Export Data and Emission Reductions report the CDM Monitoring Officer will examine the report for data anomalies and compare the report with previous months for consistency.

If any discrepancies are found they will be investigated and corrected. The discrepancies and corrective actions will be recorded in an appendix to the relevant report. If the corrective actions result in any adjustments to monitoring data then the relevant report will be revised, after the adjustments have been made.

The company's Quality Assurance Officer will undertake an internal audit of the project every three months to ensure the operational and maintenance regime of the project and data collection and recording practices are compliant with the content of this Project Design Document. The results of the audit will be summarised in a report, which will be sent to the General Manager (Projects) for review. The report will also list any corrective actions required to ensure project compliance.

Record Storage

A paper copy of all documentation will be stored in a secure area within the site head office. All reports will be signed and date stamped after review by the CDM Monitoring Officer, prior to being filed in storage. All electronic reports will be backed-up on a monthly basis and sent to DANS Energy's Head Office. All archived data will be kept until two years after the last issuance of CERs for this project. The documents that will be stored include:

- Surface area of reservoir at full volume
- Manufacturer's test certificate accompanies and meter calibration reports
- Monthly report of metered net electricity export data
- Quarterly report of emission reductions
- Internal audit reports
- Baseline emission factor

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

Project construction started on 1st October 2007

C.2. Expected operational lifetime of project activity

35 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable

C.3.2. Start date of crediting period

.
01/01/2019

C.3.3. Duration of crediting period

7 year

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

In accordance with the Environmental (Protection) Act (1986), the proposed project submitted an application for approval to the Ministry of Environment and Forests (MoEF). As part of the approval process, a comprehensive environmental assessment of the Project was prepared in accordance with the requirements of MoEF[21]. Relevant documents submitted to MoEF include:

- Environmental Impact Assessment Report;
- Environmental Management Plan; and
- A report on the proceedings of the public hearing.

Copies of each document are available upon request.
Environmental clearance was obtained from MoEF on July 26th 2006

D.2. Environmental impact assessment

The EIA study report has identified several environmental impacts which will occur as a result of the project. The report also identifies a number of positive environmental impacts associated with the project. These range from environmental benefits in the form of mitigation of climate change, to a number of socio-economic benefits for the area in which the project is located.

Measures to mitigate the environmental impacts that were identified in the EIA have been addressed in the Environmental Management Plan (EMP). Approximately Rs. 3.28 Crores ($US 921,951) has been allocated by the project developer to implement these measures, a summary of which is outlined below.

(i) Biodiversity Conservation Management Plan

The proposed project aims to mitigate any potential disturbance or pressure on land and biological resources and ensure conservation and preservation of natural ecosystems. The conservation policies and plans for the State are administered by the Department of Forests and Wildlife. The Project Developer will allocate funding to the Department of Forests and Wildlife to manage and execute biodiversity conservation issues associated with the Project.

A Board, chaired by the Chief Wildlife Warden of Sikkim shall govern the conservation work. It shall include appropriate representation from the State Forest Department, Ecologists/Conservationists and local NGOs. The main activity/responsibility of the board will be to define a conservation area, monitor and enforce regulatory provisions relating to the protection of this area and ensure that the natural ecosystem structure and functions are not changed or subjected to any threat.

[21] http://www.envfor.nic.in/legis/eia/so-60(e).html

Documentation of the existing biological diversity in the area (flora/fauna surveys) will be carried out and special attention will be paid to the prevention of overexploitation of forest resources. The inhabitants of the area will be encouraged to adopt sustainable forest conservation practices. This will ensure that the habitat is protected and will minimise the disruption, disturbance and fragmentation of the wildlife habitats. South and West Sikkim Forest Divisions are rich in a variety of medicinal plants and in order to augment the natural stock of medicinal plants in the forests, it is proposed to take up planting of medicinal plants and establish a medicinal plants nursery.

(ii) Action Plan for Catchment Area Treatment

Due to the terrain of the area the Rangit River catchment is susceptible to erosion and landslides. Project related construction activities have the potential to accentuate natural erosion processes, and may also trigger minor landslides

The catchment area treatment plan has been formulated with the main objective of arresting soil erosion in the catchment area. Suitable remediation measures will be implemented as necessary, including construction of check dams/walls, retaining walls and wire crates for gully control; and stabilisation of flood prone nallahs, landslides/slopes, river banks and roads.

(iii) Fisheries Development

The Rangit River is a known breeding ground for several fish species. In order to ensure protection of these populations, trash racks will be fitted before the power intake to prevent any fish from being sucked in. In addition, it is proposed to build a hatchery (including nursing ponds, rearing ponds and stocking ponds) in the vicinity of Rangit River. Sufficient funding has been allocated by the Project Developer for this purpose.

(iv) Public Health Delivery System

Existing health services in the project area are insufficient to cater for an influx of labour force from outside of the area. The project proposes to have all labourers, including their family members registered,quarantined, tested and vaccinated prior to registration. The project authorities will ensure that the contractors follow this strict quarantine procedure with a clause included in the award of contracts/works. Sufficient medical facilities will be provided by the project authorities for this purpose, in addition to upgrading existing medical facilities in the area.

(v) Solid Waste Management

The project authorities will ensure that the colony of labourers and workers will be provided with proper sewage treatment including septic tanks and soak pits for individual dwellings; waste disposal; and sanitary facilities. Four community latrines, of adequate size, will be constructed at suitable locations in the colony area.

(vi) Provision for Fuel wood/ LPG Depots and Energy Conservation Measures

The consumption of fuel wood by the local population has been identified as a significant environmental concern. Consequently it is likely that the influx of a labour force will exert immense pressure on the forest areas in the vicinity of the project. In order to meet the labourers' fuel wood requirements, it is proposed to provide free fuel wood/kerosene/ LPG from depots. This will discourage illicit tree felling and removal of fuel wood and timber from the adjoining forests.

(vii) Relocation and Rehabilitation of Dumping Sites

Material which is excavated during construction of the project will be relocated and rehabilitated. Most of the excavated material will be piled at four suitable locations identified specifically for this purpose. Efforts will be made to relocate and rehabilitate the material within short distances from the generation site, and a detailed work plan for revegetation has been formulated.

(viii) Landscaping and Restoration of Construction Areas

Project construction activities can potentially result in modification of the existing landscape of the area. The project authorities have therefore made provisions to ensure that restoration works will be carried out at the completion of construction to return disturbed areas to similar or near-similar pre-construction conditions and land use.

(ix) Creation of Green Belt around Reservoir

A green belt of approximately 24.74 ha will be created around the reservoir to prevent soil erosion and land slips from spilling directly into the reservoir. The green belt will start from the immediate vicinity of the reservoir rim on both the banks, up to the tail of the reservoir, wherever moderately steep slopes are available for plantation. Indigenous, economically important, soil binding tree species, which are able to thrive well under high humidity and flood conditions, will be planted. The creation and maintenance of the greenbelt involves a high level of technical expertise and therefore will be carried out by the South & West Sikkim Forest Divisions, with funding set aside by DANS Energy. Their staff are suitably trained and experienced.

(x) Resettlement and Rehabilitation Plan

A total of approximately 36.87 ha of land is required for the project. Of this, 4.82 ha of the required land belongs to private landholders, with the remaining 32.05 ha belonging to forest land. A plan for compensation and rehabilitation has been formulated in consultation with the project-affected families. No family will become landless as a result of the project.

(xi) Environmental Monitoring Programme

In order to monitor the impact and efficacy of the above mentioned plans the project authorities have specified detailed monitoring parameters, which are contained in the EMP. Additionally, the developer shall deploy trained staff for monitoring and implementation of the EMP under guidance of the CISMHE

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

A public hearing was conducted by the State Pollution Control Board of Sikkim, on the 9th April 2006. The meeting took place in the village of Pipley, which is the nearest village to where the project will be located (see Section A.2.). At the public meeting the proposed project was presented and comments were invited.

Participants in the meeting included local villagers and representatives from:

- State Land Use and Environment Board
- Area MLA, Jorethang – Nayabazar Constituency
- State Pollution Control Board
- Sikkim Power Development Corporation
- Department of Forest and Environment
- Sub-Divisional Magistrate, Soreng
- Sub-Divisional Magistrate, Namchi
- Delhi University
- Sikkim Government College
- Panchayats
- Senior Citizens
- NGO (local area) - Shri S.P. Shestra, Sadbhavana Samithi, Pipaley-Rothak.

101 local attendees signed the register as present at the meeting.

No Objection Certificates (NOCs) were obtained from the Panchayats have been obtained from the following local villages: Tinik Chisopani, Poklok Denchong, Salaghari, Majithar and Lower Goom

E.2. Summary of comments received

A summary of issues raised by the stakeholders at the meeting is given below:

1. It was stated that the employment, supply and contract of the works pertaining to the project should be preferentially allotted to locals of area.
2. Concern was expressed with regards to the provisions made to address any potential drying up of the river and quarry, and the quantum of water that would be released.
3. A question was asked about the provisions for the prevention of pollution.
4. Concerns were raised about landslides, slips and settlement problems that could be caused by the project activity.
5. A question was asked regarding the acquisition of private land for the project.
6. Concerns were raised with regards to the migration of people to the area and resultant social consequences. It was stated that no changes to the social fabric should occur.
7. It was stated that the Catchment Area Treatment plan (CAT plan) should be vetted by the Forest Department.
8. A concern was raised that the description of the flora and fauna surveyed was too general.
9. A concern was raised with regards to the aquatic ecosystem management. It was stated that the impact on migratory fish populations will be dependent on the project authorities releasing adequate water down stream of the project and that aquatic specialists may need to be consulted to confirm whether the potential threats to the migratory fish population will be mitigated by the proposed fisheries development.
10. Concerns were raised with regards to dumping the silted muck beside the river. It was suggested that an alternative dumping location be identified away from the river.
11. It was suggested that the measures proposed in the Environmental Management Plan for solid waste management, provision for fuel wood, LPG, energy conservation measures

landscaping and restoration of construction areas and creation of green belts need revision and enhancement.
12. Concerns were raised regarding the definition of area in the CAT.
13. It was stated that the basis for the rates used in the CAT was not as per the Forest Department of the Government of Sikkim.
14. Concerns were raised that the EIA is only based on models and not actual measurement
15. Concerns were raised regarding the methods used for testing the water samples. Storing water samples beyond a certain time period has a bearing on the validity of the data.

A report containing detailed proceedings of the public hearing is available on request

E.3. Consideration of comments received

The project proponents have taken due account of the suggestions and views expressed during the Public Hearing as follows:

1. A committee is to be formed under the local Minister and MLA to supervise the provision of employment opportunities for local people. A Memorandum of Understanding has also been signed with the Sikkim government outlining the agreed terms with regards to employment.

2. The project will not compromise access to the river resources for downstream users as the Raman River flows into the Rangit River approximately 4 kilometres downstream of the proposed diversion barrage, and two other streams, Ramam Khola and Chhoti Rangit flow into the Rangit River within this 4 kilometre stretch. In addition provisions have been made for 0.3 cumecs of sacrificial discharge throughout the year. All the provisions for prevention of pollution which are outlined in the Environmental Management Plan will be implemented.
3. The EMP which has been prepared for the project, and approved by the MoEF, outlines specific provisions for the prevention of pollution that will be implemented as part of the project.
4. Provisions shall be made to address the potential problems of slips and landslides, as outlined in the EMP.
5. The project will not render any people landless or homeless. Owners of the private land required for the project shall be suitably compensated.
6. The project will not lead to any permanent immigration. A committee will be established to ensure there is no change to social fabric. The NGO who raised the concern has been invited to participate in the committee.
7. The CAT has been presented to the State committee constituted for EIA and EMPs. They have provided the necessary feedback.
8. The flora and fauna information was from the executive summary. Further detail is provided in the full report and the DPR.
9. A meeting of the Expert Committee for River Valley and Hydroelectric Projects (of MoEF) on the 17th May 2006 concluded that the Biodiversity Management and Conservation Management Plan contained sufficient provisions to mitigate the negative environmental impacts of the project and that sufficient provisions have been made in the EMP to maintain the ecosystem. This includes the release of sufficient water into the downstream stretch of the river to maintain the aquatic ecosystem. It was also stated that the Ramam Khola River discharges sufficient water into the Rangit River at Jorethang, to sustain the aquatic ecology.
10. Muck from the project will only be dumped in allocated areas where retaining walls have been constructed. The dumping sites have been revised according to community

requests.

11. Sufficient provisions have been made for activities such as solid waste management, fuel wood, LPG, landscaping and creation of a green belt as outlined in the EMP.
12. The CAT has been prepared for the free draining catchment of the Project in accordance with the Government norms.

    The rates which have been adopted are approved by the Himachal Pradesh Forest Department. These rates are appropriate for Sikkim as the terrain in Himachal Pradesh and Sikkim are similar. However, if there is any discrepancy, only approved rates will be used in the CAT.
13. The models used within the EIA have been recommended by the Centre for Atmospheric Sciences, IIT, Delhi, as appropriate for the project, as there is a high level of correlation between the estimated data and actual data.
14. Most of the physical-chemical water sample parameters were recorded in the field. The chemical characteristics were tested in the lab. The samples were properly preserved and maintained at a low temperature during transport to minimise any degradation. The analysis of biological characteristics was also conducted offsite. These characteristics are not affected by the time period required for transportation and analysis.

15. A community development plan is currently being negotiated that documents all the commitments made by the project developer to the local community.

SECTION F. Approval and authorization

The Host Country Approval having reference number 4/18/2006-CCC dated 29/12/2006

Appendix 1. Contact information of project participants

Organization name	DANS Energy Private Limited
Country	India
Address	5th Floor, Tower C, DLF Building No.8, DLF Cyber City, Phase II, Gurgaon, Haryana - 122002
Telephone	+91-124-4693100/ 101
Fax	+91-124-4693111
E-mail	nagendrarao@dansenergy.com
Website	
Contact person	Nagendra T. Rao

Appendix 2. Affirmation regarding public funding

No public funding, either national or international, was sourced in order to undertake any aspect of this Project Activity. The project will be funded solely by private entities

Appendix 3. Applicability of methodologies and standardized baselines

Please refer section B.2 of PDD

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

Appendix B – Assumptions for CO_2 Emission Calculations

Fuel Emission Factors (EF) (Source: for Indian Coal/Lignite - Initial National Communication; for Imported Coal Gas/Oil/Diesel/Naphtha - IPCC 2006; for Corex - own assumption)

	Unit	Coal	Imported Coal	Lignite	Gas	Oil	Diesel	Naphtha	Corex
EF based on NCV	gCO_2 /MJ	95.8	89.5	106.2	54.3	75.5	72.6	69.3	0.0
Delta GCV NCV	%	3.6%	5.0%	3.6%	10%	5%	5%	5%	n/a
EF based on GCV	gCO_2 /MJ	92.5	85.2	102.5	49.4	71.9	69.1	66.0	0.0
Oxidation Factor	-	0.98	1.00	0.98	1.00	1.00	1.00	1.00	n/a
Fuel Emission Factor	gCO_2 /MJ	90.6	85.2	100.5	49.4	71.9	69.1	66.0	0.0

n/a = not applicable (i.e. no assumptions were needed)

Assumptions at Station Level (only where data was not provided by station)

	Unit	Coal	Lignite	Gas-CC	Gas-OC	Oil	Diesel-Eng	Diesel-OC	Naphtha	Hydro	Nuclear
Auxiliary Power Consumption	%	8.0	10.0	3.0	1.0	3.5	3.5	1.0	3.5	0.5	10.5
Gross Heat Rate	kcal /kWh (gross)	2,500	2,713	2,013	3150	2,117	1,975	3,213	2,117	n/a	n/a
Net Heat Rate	kcal /kWh (net)	2,717	3,014	2,075	3,182	2,193	2,047	3,330	2,193	n/a	n/a
Specific Oil Consumption	ml /kWh (gross)	2.0	3.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
GCV	kcal /kg (or m3)	3,755	n/a	8,800	n/a	10,100	10,500	10,500	11,300	n/a	n/a
Density	t /1,000 lt	n/a	n/a	n/a	n/a	0.95	0.83	0.83	0.70	n/a	n/a
Specific CO_2 emissions	tCO_2 /MWh	1.04	1.28	0.43	0.66	0.66	0.59	0.96	0.61	n/a	n/a

n/a = not applicable (i.e. no assumptions were needed)

Assumptions at Unit Level (by capacity; only for units in the BM, where data was not provided by station)

Coal	Unit	67.5 MW	120 MW	200-250 MW	300 MW	500 MW Type 1	500 MW Type 2	600 MW	660 MW Type 1	660 MW Type 2	800 MW
Gross Heat Rate	kcal /kWh	2,750	2,500	2,500	2,350	2,425	2,380	2,380	2,178	2,126	2126
Auxiliary Power Consumption	%	12.0	9.0	9.0	9.0	7.5	6.5	6.5	6.5	6.5	5.25
Net Heat Rate	kcal /kWh	3,125	2,747	2,747	2,582	2,622	2,545	2,545	2,329	2,274	2,244
Specific Oil Consumption	ml /kWh	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.5
Specific CO_2 Emissions	tCO_2 /MWh	1.19	1.05	1.05	0.99	1.00	0.97	0.97	0.89	0.87	0.85

Lignite	Unit	75 MW	125 MW	210/250 MW
Gross Heat Rate	kcal /kWh	2,750	2,560	2,713
Auxiliary Power Consumption	%	12.0	12.0	10.0
Net Heat Rate	kcal /kWh	3,125	2,909	3,014
Specific Oil Consumption	ml /kWh	3.0	3.0	3.0
Specific CO_2 Emissions	tCO_2 /MWh	1.32	1.23	1.28

Gas	Unit	0-49.9 MW	50-99.9 MW	>100 MW
Gross Heat Rate	kcal /kWh	1,950	1,910	1,970
Auxiliary Power Consumption	%	3.0	3.0	3.0
Net Heat Rate	kcal /kWh	2,010	1,969	2,031
Specific CO_2 Emissions	tCO_2 /MWh	0.42	0.41	0.42

Diesel	Unit	0.1-1 MW	1-3 MW	3-10 MW	>10 MW
Gross Heat Rate	kcal /kWh	2,350	2,250	2,100	1,975
Auxiliary Power Consumption	%	3.5	3.5	3.5	3.5
Net Heat Rate	kcal /kWh	2,435	2,332	2,176	2,047
Specific CO_2 Emissions	tCO_2 /MWh	0.70	0.67	0.63	0.59

Naphtha	Unit	All sizes
Increment to Gas Heat Rate	%	2%
Gross Heat Rate	kcal /kWh	2,117
Auxiliary Power Consumption	%	3.5
Net Heat Rate	kcal /kWh	2,193
Specific CO_2 Emissions	tCO_2 /MWh	0.61

Combined Margin	Unit	
Weight OM	%	50%
Weight BM	%	50%

Conversion Factors	Unit	
Energy	kJ /kcal	4.1868
	MJ /kWh	3.6

Oil		
Specific Emission	gCO_2 /ml	2.89

Appendix C – Grid Emission Factors

Note: Values are rounded off at two decimals here. See Database (Excel File, Worksheet "Results") for additional decimals.

Table A: Values for FY 2013-14 to 2017-18, excluding cross-border electricity transfers.

Emission Factors (tCO_2/MWh) (excl. Imports)	2013-14	2014-15	2015-16	2016-17	2017-18
Weighted Average Emission Rate	0.82	0.83	0.82	0.83	0.82
Simple Operating Margin (1)	1.01	1.00	0.97	0.97	0.96
Build Margin	0.95	0.93	0.91	0.87	0.86
Combined Margin (1)	0.98	0.96	0.94	0.92	0.91

(1) Operating margin is based on the data for the same year. This corresponds to the *ex post option* given in "Tool to Calculate the Emission Factor for an Electricity System", Ver. 6.0 (p.16)

Table B: Values for FY 2013-14 to 2017-18, including cross-border electricity transfers.

Emission Factors (tCO_2/MWh) (incl. Imports)	2013-14	2014-15	2015-16	2016-17	2017-18
Weighted Average Emission Rate (2)	0.82	0.82	0.82	0.82	0.82
Simple Operating Margin (1) (2)	1.00	0.99	0.97	0.96	0.95
Build Margin (not adjusted for imports)	0.95	0.93	0.91	0.87	0.86
Combined Margin (1) (2)	0.98	0.96	0.94	0.92	0.91

(1) Operating margin is based on the data for the same year. This corresponds to the *ex post option* given in "Tool to Calculate the Emission Factor for an Electricity System", Ver. 6.0 (p.16)

(2) For Adjustments of imports from other countries, an emission factor of zero is used. See "Tool to Calculate the Emission Factor for an Electricity System", Ver. 6.0 (p.10), options a+b

EMISSION DATA

	2013-14	2014-15	2015-16	2016-17	2017-18
Absolute Emissions Total (tCO2)	7273,64,166	8053,84,471	8462,61,119	8883,41,294	9221,82,366
Absolute Emissions OM (tCO2)	7273,64,166	8053,84,471	8462,69,450	8883,41,294	9221,82,366
Absolute Emissions BM (tCO2)	1712,18,145	1808,08,003	1868,63,159	1884,56,479	1943,01,045
Net Imports (GWh)	3,405	1,594	0.0	0.0	0.0
Share of Net Imports (% of Net Generation)	0.4%	0.2%	0.0%	0.0%	0.0%

Appendix 5. Further background information on monitoring plan

All details of the monitoring plan are provided in Section B7

Appendix 6. Summary report of comments received from local stakeholders

A summary of comments received from local stakeholders has been mentioned in Section E.2. of this PDD

Appendix 7. Summary of post-registration changes

The below changes has been made in PDD as Post Registration Changes

1. The information about export of electricity to grid and selling it to third party consumers through open access market or through Power Purchase Agreement (PPA) has been clearly provided.

2. The latitude and longitude are corrected in PDD. The district name is corrected as South district instead of West District. The correction in barrage height and reservoir area and consequent change in power density are clearly mentioned in PDD. The correction in turbine capacity as 48.75 MW instead of 48 MW and mention of Generator capacity as 48 MW has been clearly mentioned.

3. The Emission Reduction (ER) estimation is revised with consideration of new start date of crediting period (01/01/2012) and taking into account of commissioning date.

4. Additionality -The project cost has substantially increased due to natural (geological condition) circumstances which were not under control of PP. The natural circumstances led PP to change in erection and commissioning activities than estimated during project conceptualisation stage. Due to Geological surprises, there were change in construction methodology of project activity, changes/ addition in design aspect which increased the civil infrastructure cost and electro mechanical cost. Also project activity electricity will be sold to third party consumers through open access market or through Power Purchase Agreement (PPA). Thus there is variation in tariff rate on daily basis. Thus PP has analysed the IRR calculations with changes in project cost (hard cost) and actual average tariff rate. Also IRR with actual increased total project cost has been determined. The threshold limit of tariff rate with actual project cost is clearly mentioned in PDD. The details of the Hard and Soft cost incurred by the project are submitted separately as a write up.

5. Section B.7.1 - Due to connection of project activity to Central Transmission Utility (CTU), the main source for parameter net electricity export is mentioned as Injection Schedule and the same will be cross checked with either invoices or obligation reports. The information about metering and information of recording gross electricity generation for cross check purpose is removed. The calibration/testing frequency is revised as once in five years (not being in control of PP) as per User manual of Power System Operation Corporation Limited (POSOCO), Eastern Regional Load Dispatch Centre. Section B.7.3 is revised in terms of ER calculation frequency, metering information and mention of obligation reports for cross check

6. Start date of crediting period is revised as 01/01/2012 (allowable maximum 2 years shifting from earlier date) due to delay in commissioning.

7. The contact information of responsible person/entity for application of selected methodology has been changed

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
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01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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