Project design document form for small-scale CDM project activities

(Version 07.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	4 MW Small Hydro Project by Shansha Hydro Power Project Co-Operative Society Ltd.
Version number of the PDD	04
Completion date of the PDD	07/06/2016
Project participant(s)	The Shansha Hydro Power Project Co-Operative Society Ltd.
Host Party	India
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	Methodology: AMS I.D "Grid Connected Renewable Electricity Generation" (Version 18.0)
Sectoral scope(s) linked to the applied methodology(es)	Mandatory Sectoral Scope: 1
Estimated amount of annual average GHG emission reductions	18,725 tCO_2e/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> The project activity is a run of the river scheme for power generation of 4 (2*2) MW capacity on shansha stream of Chandra Bhaga (Chenab) river in Lahual & Spiti district of Himachal Pradesh in India. The project proponent for the project activity is The Shansha Hydro Power Project Co-Operative Society Ltd. As per the DPR, the catchment area of shansha stream is 48 Sq. Km. upto diversion site.

Purpose of the project Activity:
The project will serve the purpose of producing clean electrical energy in a sustainable manner. The project activity involves implementation of 4 MW small hydro power project which will utilize potential energy available for power generation. Therefore, no fossil fuels are involved for power generation in the project activity. The proposed project activity will also reduce the anthropogenic emissions of greenhouse gases into the atmosphere by avoiding business as usual operation of existing fossil fuels-based power plants to produce equivalent amount of Electricity.

Pre-project scenario: No Project Activity:

The proposed project activity is a Greenfield project, which means no power generation facility existed at the project site in the pre-project scenario. In the pre-project scenario, this was an open hilly area. The electricity thus produced will be displacing the grid electricity which would have been otherwise generated through sources dominated by fossil fuel based power plants. The project activity thereby reduces the emission of greenhouse gases which would have been generated from such fossil fuel based power plants.

Baseline Scenario:
The generated electricity by the project is planned to be supplied into NEWNE regional grid, which is dominated by fossil fuel-fired power plants, thereby precluding the emission of greenhouse gases (GHGs) that would resulted in the absence of this renewable energy-based power project activity. Hence, NEWNE grid has been considered for baseline emission calculations for the proposed project activity.

Estimated amount of emission reductions over the chosen crediting period:
Project activity will lead to an annual average GHG emission reduction of 18, 725 tCO_2e and a total of 1,87,250 tCO_2e during a crediting period of 10 years.

Project activity's contribution towards sustainable development
The National CDM Authority, Ministry of Environment and Forests (MoEF), Government of India**,** has stipulated four important indicators of sustainable development[1], which a proposed CDM project activity should conform with, in order to be considered as a valid CDM activity that contributes to the ultimate objective of the Convention. These indicators are social well-being, economic well-being, environmental well-being and technological well-being.
The proposed project activity seeks to comply with these stipulations in the following manner:

Social well-being:

- It will lead to the development of an otherwise under-developed area, with the development

[1] http://www.cdmindia.gov.in/approval_process.php

of infrastructural in the areas around the project.

- Employment generation, infrastructure development around the project activity area and increase in the energy availability of the region will also improve the living standard of the local population.

Economical well-being:

- Increased availability of power in the region will attract more investment in the region.

Environmental well-being:

- Since the project uses renewable hydro resources for power generation, it does not lead to any harmful emissions into the environment.
- The project will help avoid further depletion of the already over-exploited, limited non-renewable sources like coal, oil, gas etc.

Technological well-being:

- The generation of electricity by the project activity will improve availability of electricity to the state grid and also it will provide more opportunities for industries to invest in such cleaner technologies. Success of such projects shall be an example for other industries to invest in such technologies and further strengthen the energy security of the country.
- The technology selected for the power project, which is based on the conversion of kinetic energy of moving water into electrical energy, is environmentally safe and sound. The project activity would promote the use of such technology.

Hence, the proposed project activity is in line with the sustainable development criteria laid down by the National CDM Authority. Moreover, the proposed project activity is single greenfield project, which is not a CPA of any proposed/registered PoA.

A.2. Location of project activity

A.2.1. Host Party

>> The host party to the project activity is India.

A.2.2. Region/State/Province etc.

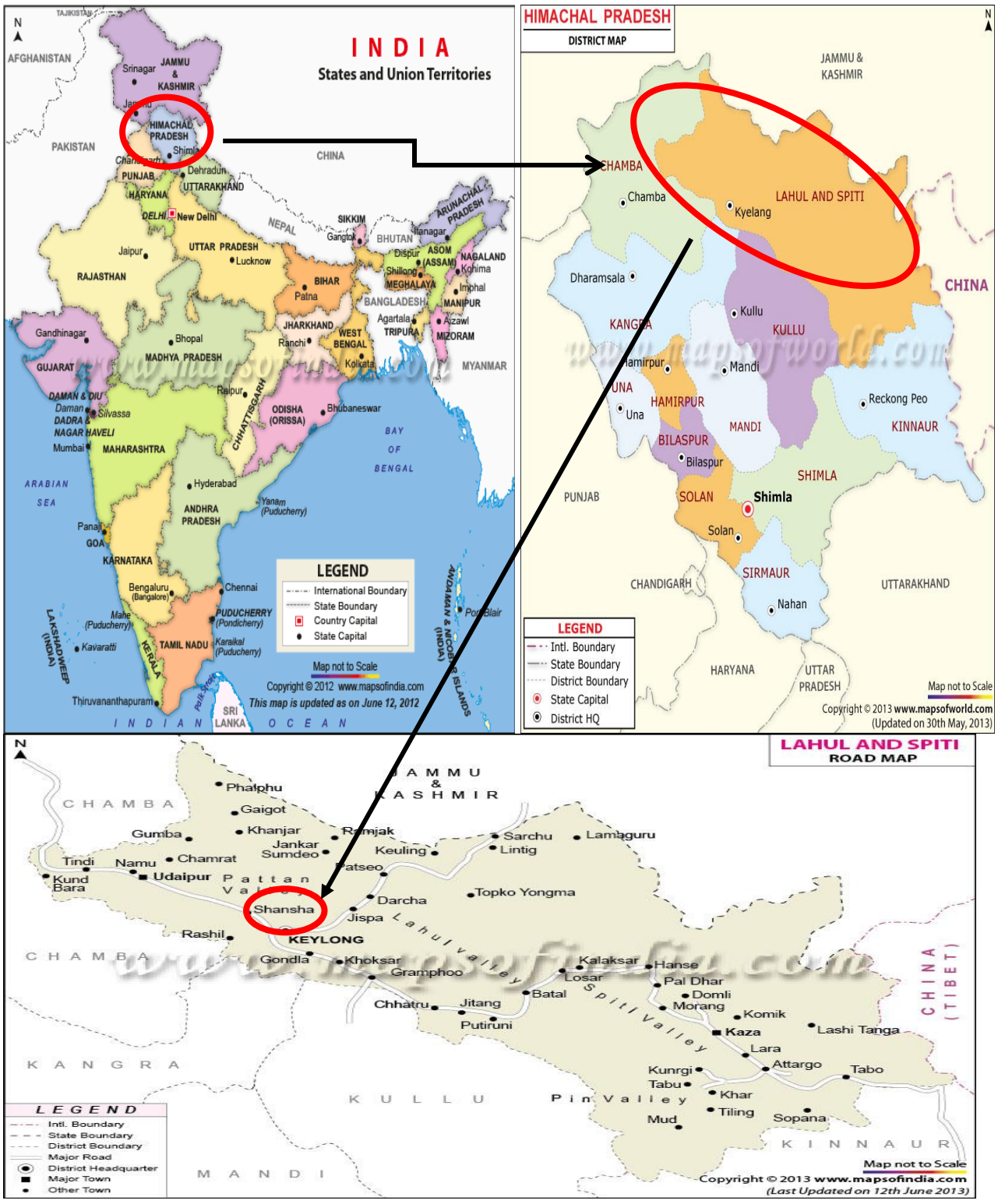
>> State: Himachal Pradesh

A.2.3. City/Town/Community etc.

>> Village: Shansha
District: Lahual & Spiti

A.2.4. Physical/Geographical location

>> The accessibility to intake weir at Shansha nallah is very poor because it is not connected by road. But, the proposed project activity is accessible from Tandi-Udaypur road. The nearest airport and railway station is at Kullu and Kirtpur respectively. The project location can be seen in the map below:



Further geographical coordinates are given below:

	Weir	**Power house**
Latitude	32° 37’ 31” N	32° 36’ 54” N
Longitude	76° 55’ 09” E	76° 54’ 43” E

A.3. Technologies and/or measures

>> The proposed project activity is a new installation of 4 MW hydro power project, which involves setting up of two pelton wheel turbine having rated capacity of 2000 kW each. All the installations are new and do not involve in any technological transfer. The power will be generated at voltage of 33 kV. The generated power will be fed to the nearest 33/11 kV HPSEB substation at Karga at a distance 10 km from the shansha power house site.

There is no reservoir upstream and instead the project involves construction of a diversion and intake structure, desilting tank, Power duct, spill channel, surge tank, penstock and power house. List of the facilities, systems and equipment that will be installed and/or modified by the project activity have been tabulated below:

Systems/Equipments	Description
Hydrology	
Stream/Khad	Shansha
Catchment area upto weir site	48 sq. km
Design Discharge	1.5 cumecs
Gross head	353 m
Diversion Structure	
Type of structure	Trench weir type
Size	15.00 m X 3.00 m X 2.5m
Shape	Trapezoidal
Intake Structure	
Type	Rectangular Box
Material	R.C.C & HDP pipe (burred)
Size	60.00 m X 3.00 m X 3.00 m
Water conductor system	
Feeder channel type	Rectangular box
Power Channel Type	RCC
Size of Channel	3.0 m X 2.5 m X 17 m

Power House	
Turbine	The project activity employs two Pelton wheel turbine of rated capacity 2000 kW each. A volume of 1.35 cumecs of water will be discharged from a net head of 373 m to drive the turbine, which in turn will run the generator.
Generator	The project activity will employ two horizontal synchronous, brushless generator to produce 21,030 MWh/annum of electricity. The technical specifications of the Generator will be finalized during the purchase process.
Transformer	The transformer will step up the generation to a 33 kV for delivery into the NEWNE grid, whose interconnection point will be the switchyard located close to the power plant.
Electronic metering panels	The electronic meter will record gross generation of electricity by the project activity. Gross generation will, therefore, be monitored by the PP through these meters.
Switchyard	
Main meter and check meter	The switchyard of the power plant will be equipped with these two energy meters, both of which are sealed by DISCOM. These meters are capable of measuring both export and import energy units. Net electricity export by the project activity will be monitored at these metering points.

The proposed hydropower project is a new installation and its lifetime is 40 years. The capacity of the project will remain constant at 4 MW throughout its lifetime. Based on the existing hydrology of the project, it is expected to operate at a PLF of 60%[2].

The project activity falls under:

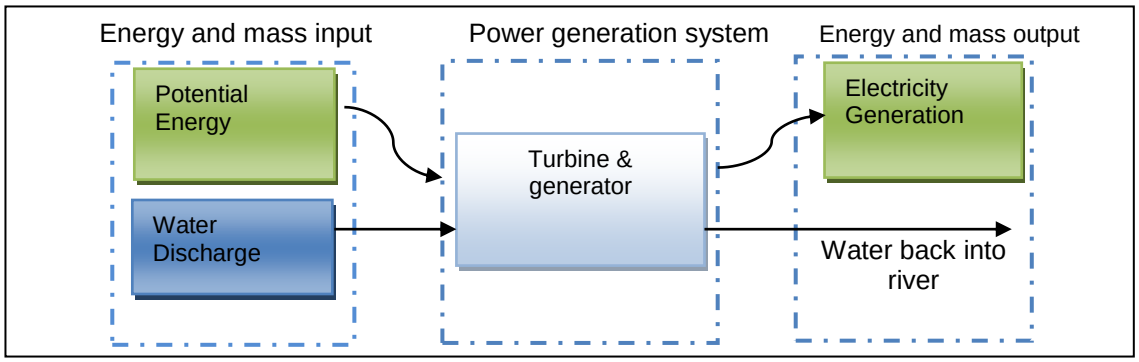
Type **: I -** Renewable Energy Projects

Category **: D -** Grid Connected Renewable Electricity Generation

[2] calculated as per DPR

Mass and Energy balance:

Based on the hydrological studies commissioned by the project proponent for the proposed project activity at its site, the following energy and mass is expected balance would emerge during the operation of the project:



The level of service provided by the project activity is not dependent on any other manufacturing system outside the project boundary. The power generation depends only on the flow rate of the water in the river. As the project activity is constructed based on the historic flow condition, the mass balance is not envisaged to be subjected to major changes.

Facilities, systems and equipment in operation in pre-project activity:

Since this is a greenfield project, no power generation facility existed at the project site in the pre-project scenario;

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	The Shansha Hydro Power Project Co-Operative Society Ltd. (Private Entity)	No

A.5. Public funding of project activity

>> The projects have not received any public funding from Annex I countries and neither from Official Development Assistance (ODA).

A.6. Debundling for project activity

>> The project activity is not a debundled component of a larger project activity as explained below. As per clause 12(c) of the Simplified Modalities and Procedures for small scale clean development mechanism project activities (decision 4/CMP.1, Annex II), “To use simplified modalities and procedures for small-scale CDM project activities, a proposed project activity shall: Not be a debundled component of a larger project activity, as determined through appendix C to this annex.”

As per para 5 of the tool "Assessment of de-bundling for SSC project activities, Version 4, EB83, Annex-13), “A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

(a) With the same project participants;

(b) In the same project category and technology/measure; and

(c) Registered within the previous 2 years; and

(d) Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point.”

There is no other project activity by project proponent applied with UNFCCC under CDM. Hence, the project activity is not a de-bundled component of a large-scale project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

>> Methodology: AMS-I.D, “Grid connected renewable electricity generation”, Version 18[3]

Type : I - Renewable Energy Projects

Category : D - Grid Connected Renewable Electricity Generation

Tool: Tool to calculate the emission factor for an electricity system, Version 04.0[4]

B.2. Project activity eligibility

>>

Applicability Criteria for AMS-I.D.	Justification
1. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass a) Supplying electricity to a national or a regional grid b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	The project activity is a small hydro based power generation project with aggregated installed capacity 4MW, the net generated electricity will be supplied to NEWNE regional grid.
2. Illustration of respective situations under which each of the methodology (i.e. “AMS-I.D.: Grid connected renewable electricity generation”, “AMS-I.F.: Renewable electricity	As per Table No 1 of AMS – I. D. / Version 18, the AMS I.D is applicable to the project activity.

[3] https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf

Applicability Criteria for AMS-I.D.	Justification
generation for captive use and mini-grid" and "AMS-I.A.: Electricity generation by the user) applies is included in the appendix.	
3. This methodology is applicable to project activities that (a) Install a Greenfield plant; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	The project activity is a Greenfield plant[5]. It is a hydro-based power project developed at the tributary of the Chandra Bhaga river located in Lahaul & Spiti, Himachal Pradesh, where no such renewable energy-based power plant existed prior to it. This is a new power plant and hence there is no capacity addition involved in the project activity. Therefore option (b) is not applicable. This is a new power plant and hence there is no retrofitting of an existing plant. Therefore option (c) is not applicable. This is a new power plant at a new site and hence there is no rehabilitation of an existing plant. Therefore option (d) is also not applicable. This is a new power plant at a new site and hence there is no replacement of an existing plant. Therefore option (e) is also not applicable Hence, condition (a) is applicable to this project activity.
4. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; b) The project activity is implemented in an existing reservoir , where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.	The proposed activity doesn't have a reservoir and is a run of a river based small hydro power project. Hence, this criteria is not applicable for the project activity.
5. If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the	Neither there is any non-renewable component to this project activity nor does it involve any co-firing with the fossil fuel. The entire capacity of the project of 4 MW is

[5] NOCs and Approvals serve as testimony.

Applicability Criteria for AMS-I.D.	Justification
renewable component. If the new unit co fires fossil fuel , the capacity of the entire unit shall not exceed the limit of 15MW.	renewable energy-based and, thus, falls into small scale category. This condition is, therefore, not applicable to the proposed project activity.
6. Combined heat and power (co-generation) systems are not eligible under this category.	Project activity is neither a retrofit or nor a rehabilitation or nor a modification of existing facility, but a green field project. Hence, this condition is not applicable here.
7. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Since the proposed project activity is a greenfield project. Hence, the condition of capacity addition is not applicable to the project activity. Hence, this criterion is fulfilled by the project activity.
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Project activity is neither a retrofit or nor a rehabilitation or nor a modification of existing facility, but a green field project. Hence, this condition is not applicable here.
9. In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as “AMS-I.C.: Thermal energy production with or without electricity” shall be explored.	Since the proposed project activity is a small hydro power project, it cannot be counted as a landfill gas, waste gas, wastewater treatment and agro-industries projects.. Hence, this criterion is fulfilled by the project activity.
10. In case biomass is sourced from dedicated plantations, the applicability criteria in the tool “Project emissions from cultivation of biomass” shall apply.	Since the proposed project activity is a small hydro power project, therefore no biomass is involved in the project activity. Hence, this criterion is fulfilled by the project activity.

Table 1: Applicability of AMS-I.D, AMS-I.F and AMS-I.A based on project types

	Project type	AMS-I.A	AMS-I.D	AMS-I.F
1	Project supplies electricity to a national/regional grid		√	
2	Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)			√
3	Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)		√	
4	Project supplies electricity to a mini grid system where			√

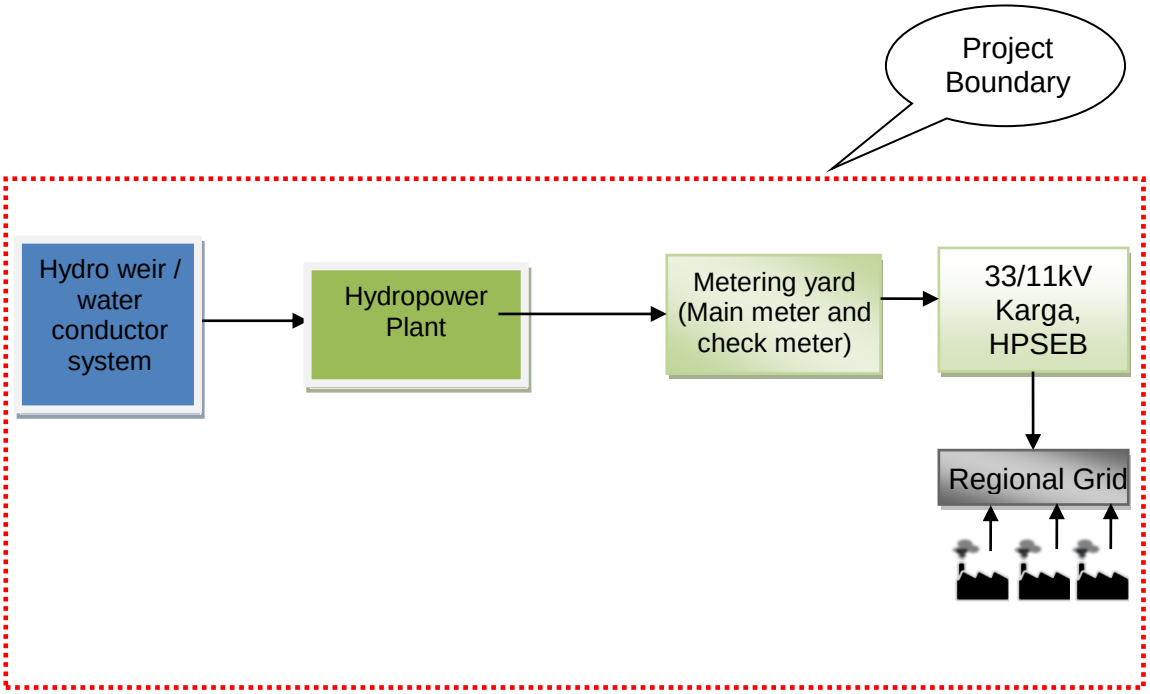
	in the baseline all generators use exclusively fuel oil and/or diesel fuel			
5	Project supplies electricity to household users (included in the project boundary) located in off grid areas	√		

The above analysis clearly demonstrates that the project activity under consideration meets the applicability criterion of the methodology AMS-I.D, Version 18.

B.3. Project boundary

The proposed project activity is a fresh installation of 4 MW small hydropower plant that will supply electricity to NEWNE grid. According to AMS-I.D., Version 18, "*The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system*[6] *that the CDM project power plant is connected to.*"

Thus, the project boundary is the spatial extent of the proposed project activity and the Integrated NEWNE grid, as depicted below:



Following emission sources and GHGs are included in the project boundary:

Source	GHGs	Included	Justification / explanation
(BASELINE) Electricity	CO_2	Yes	Major emission sources
	CH_4	No	Excluded for simplification. This is Conservative

[6] Refer to the latest approved version of the "Tool to calculate the emission factor for an electricity system" for definition of an electricity system.

Generation at NEWNE Grid	N_2O	No	Excluded for simplification. This is Conservative
(PROJECT ACTIVITY) Electricity Generation by Hydro Power	CO_2	No	As it is a renewable hydro power project, hence not applicable
	CH_4	No	The proposed project is hydro power project, hence not applicable
	N_2O	No	The proposed project is hydro power project, hence not applicable

B.4. Establishment and description of baseline scenario

>> The Indian Electricity Act, 2003, does not restrict the choice of fuel for power generation. Moreover, it does not mandate electricity generation from hydropower projects, although there are specific state policies to promote the utilisation of hydropower potential existing there in, so as to cut dependence on coal, which is the mainstay fuel for power generation in India. Notably, the National Electricity Policy, 2005, asserts that 'coal would necessarily continue to remain the primary fuel for meeting future electricity demand'.

Given the fact that the proposed project activity is a grid-connected power generation system, it follows from the above discussion that in the absence of this project activity, an equivalent amount of electricity would have been delivered by fossil fuel-fired units, which dominate the NEWNE grid.

According to paragraph 19 of AMS-I.D., Version 18, "*The baseline scenario is that 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."*

In light of the above, the baseline could be aptly assumed to be the scenario, in the absence of this project activity, where electricity delivered to the grid would have been generated by the operation of grid-connected power plants.

Baseline emissions:

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. According to paragraph 22 of AMS-I.D., Version 18, *"Baseline emissions include only CO2 emissions from electricity generation in 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: "*

$BE_y = EG_{PJ,y} \times EF_{grid,y}$ *.....(A)*
where,

BE_y = Baseline Emissions in year y (t CO_2)

$EG_{PJ,y}$ = 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)

$EF_{grid,.y}$ = Combined margin CO2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO2/MWh)

Accordingly, the emission factor of the grid will be used to estimate emission reductions. This emission factor can be calculated in a transparent and conservative manner, in line with paragraph 23 of AMS-I.D., Version 18, as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system";

OR

(b) The weighted average emissions (in t CO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

However, PP has chosen option (a) and used the combined margin (CM) approach to calculate emission factor, as official data is available for operating margin (OM) and build margin (BM) values, whereas no such data exists in the public domain to support choice of option (b).

Hence,

$$EF_{grid,y} = EF_{grid,CM,y} \quad .....(B)$$

This data is published by Central Electricity Authority (CEA) (a statutory body constituted under Electricity Act and having its office attached to Ministry of Power, Government of India) on their website[7]. "Baseline Carbon Dioxide Emission Database Version 10.0" is the latest available data and is, therefore, being used in calculation of the baseline emissions.

All the data used to establish the baseline emissions have been tabulated below:

The approach proposed in the "Option (a)" i.e. "Combined Margin" has been used for ascertaining baseline emissions and corresponding emission reductions. The OM and BM emission factor have been considered from the information (CO_2 Baseline Database for the Indian Power Sector - Version 10.0) published by the Central Electricity Authority (CEA), Ministry of Power, Govt. of India. Considering the individual weightings assigned to the OM and the BM emission factors respectively, as prescribed in the 'Tool to calculate the emission factor for an electricity system (Version 04.0)', the combined margin emission factor for the NEWNE Grid has been estimated at 0.9679 tCO_2/MWh.

According to paragraph 24 the AMS- I.D. version 18, calculations shall be based on data from an official source (where available) and made publicly available. The baseline emission factor has been worked out by Central Electricity Authority (CEA) based on detailed authenticated information obtained from all the operating Power Stations in the country. The database is an official publication of the Government of India for the purpose of CDM baselines.

Project emission:

As per para-39 of AMS I.D. version 18, for most renewable energy project activities, project emission is zero. This project activity is a run-of-river hydro power project and does not have any reservoir. Also this project activity is not a geothermal project activity as per the para 39 of the Applied methodology. Hence, for this project activity, project emission remains zero.

[7] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

Leakage:

Here energy generating equipment is not transferred from another activity hence as per para-42 of AMS I.D. version 18, leakage need not to be considered.

Estimation of Emission reduction resulting from Project Activity:

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

Where:

ER_y	Emission reductions in year *y* (t CO_2e/y)
BE_y	Baseline Emissions in year *y* (t CO_2/y)
PE_y	Project emissions in year *y* (t CO_2/y)
LE_y	Leakage emissions in year *y* (t CO_2/y)

B.5. Demonstration of additionality

>> Para 44 of the CDM Project Standard Version 09.0 states that national and/or sectoral policies or regulations have to be taken into account when establishing the baseline. Para 45 (a) states that only those national and/or sectoral policies or regulations considered under paragraph 46(a) i.e. type E+ policy that increase GHG emissions, that have been implemented before adoption of the Kyoto Protocol by the COP (decision 1/CP.3, 11 December 1997), shall be taken into account when establishing the baseline scenario. The Electricity Act of 2003[8] promoted cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity. The National Electricity Policy, 2005[9] also emphasized the urgent need to promote generation of electricity based on non-conventional energy sources. Therefore, it can be seen that the national, provincial and sectoral policies are E- i.e., policies that decrease GHG emissions, and are after November 2001. Hence as per para 45 (b) need not be taken into account in establishing a baseline scenario.

Therefore, the baseline scenario is the electricity generation by grid connected fossil fuel dominated power plants confirming to para 45 of the CDM Project Standard. Additionally, the project proponent is under no compulsion to opt for any particular technology or even a renewable mode of power generation. There is no governmental body or state electricity board policy which requires a particular kind of fuel to be chosen.

As per EB-83, Annex-14, Demonstration of additionality of small-scale project activities (version 10.0) the project participants are required to demonstrate that the proposed CDM project activity is additional and would not have occurred due to at least one of the following barriers:

[8] http://www.powermin.nic.in/acts_notification/electricity_act2003/preliminary.htm

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

(a) **Investment barrier**: a financially more viable alternative to the project activity would have led to higher emissions;

(b) **Technological barrier**: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

c) **Barrier due to prevailing practice**: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

d) **Other barriers**: Without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The project participant selected **Investment barrier** to demonstrate in a conservative and transparent manner that the proposed CDM project activity is financial unattractive. In line with the guidelines stipulated under Annex -34 of EB 35 ("Non-binding best practice examples to demonstrate additionality for SSC project activities"), a benchmark analysis is used in the project case under investment barrier.

Benchmark estimation

The benchmark of the project activity has been established in accordance with "Investment Analysis" Version 06, Annex 12, EB 85[10]. According to paragraph 16 of these guidelines, *the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for an equity IRR. Benchmarks supplied by relevant national authorities are also appropriate*.

In this project activity, PP has considered post tax equity IRR as the financial indicator to demonstrate the additionality. Therefore, Return on Equity has been considered as the benchmark as post tax equity IRR has been chosen as the financial indicator of the project.

The Return on equity could be calculated in accordance with paragraph 20, which states that, *"If the benchmark is based on parameters that are standard in the market, the cost of equity should be determined either by: (a) selecting the values provided in the Appendix; or by (b) calculating the cost of equity using CAPM. The default values in the Appendix are based on long term historical returns and therefore may also be applied by projects with a start date prior to the adoption of the default values by the Board"*

The project proponent has calculated the cost of equity on the basis of option (a), by selecting the values provided in Appendix. The proposed project activity falls under Group 1 category, mentioned in paragraph 5 of this Appendix. The default cost of equity (real) for Indian Group I projects is 11.1%. However, as per paragraph 17 *"In situations where an investment analysis is carried out in nominal terms and the available IRR benchmarks are in real terms, project participants shall convert the real term values of benchmarks to nominal values by adding the inflation rate. The inflation rate shall be obtained from the inflation forecast of the central bank of the host country for the duration of the crediting period*."

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

In the context of above, project investor have used option (a) "Default Value" for deciding benchmark for this project activity- accepting the fact that the same has been defined by UNFCCC CDM-EB itself, so suitable, credible & appropriate to consider. Methodology deployed for arriving at a suitable value of Benchmark using Default Value has been described below:

- As the proposed project activity generates power utilising hydro power energy, Group 1 as per para 5 of Appendix of EB 85, Annex 12 has been identified as a suitable category.
- The investment analysis has been carried out in Nominal terms and thus the after tax Default value as given in Table 1 of Appendix of Annex 12 of EB 85[11] has been adjusted by adding suitable inflation rate taken from Reserve Bank of India (Central Bank, India) for the duration of crediting period.
- Project Investor has calculated Benchmark based on WPI median inflation[12] rate for 10 years which was the latest data available during decision making. The WPI inflation rate used is 6.0%.
- Required Return on Equity ,
  R_E[13] = ((1+ Default Value in real terms)*(1+Inflation Rate))-1

Appendix in EB85 Annex 12 specifies default value of expected return on equity in real terms for Energy Industries (Group 1) in India = **11.1%**

Thus, benchmark of the project = ((1+11.1%)*(1+6.0%))-1

= 17.77%

Key Assumptions supporting financial projections:

The assumptions for calculating the equity IRR have been tabulated below:

Parameters	Assumptions	Source
Installed capacity (MW)	4.00	DPR
Annual gross generation (MWh)	21030	DPR
Loss (auxiliary consumption 0.5%, Transmission Losses 2%, Transformation Losses 0.5% and Outage 5%)	8.00%	DPR
Plant Load Factor	60%	Calculated from DPR
Power Tariff (INR/kWh)	2.95	HPERC Tariff Order dated 9th Feb 2010
Royalty Paid to Govt. by PP For first 12 years (% of generation)	0%	DPR

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

[12] https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/01SPFMD291012.pdf

[13] Page no.320,Corporate Finance by Aswath Damodaran.

Parameters	Assumptions	Source
from 13th year (% of generation)	12%	
Post Commissioning LADF Contribution (% of Generation)	1%	DPR
O&M costs including insurance (as a fraction of project cost)	3.00%	DPR
Yearly increase in O&M cost	5.00%	DPR
Total Project Cost (INR Million)	300.801	TEC* (based on DPR)
Pre-Commissioning LADC @ 1% of the project cost (INR Million)	2.98	DPR
Debt: Equity Ratio	70:30	DPR
Rate of Interest on loan	12%	DPR
Loan Repayment Period	40 Quarters	http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf
Book Depreciation on Plant and machinery	5.28%	http://www.mca.gov.in/Ministry/latestnews/Explanatory_Statement_alongwith_Schedule_XIV_4dec2008.pdf
Book Depreciation on Civil	3.34%	http://www.mca.gov.in/Ministry/latestnews/Explanatory_Statement_alongwith_Schedule_XIV_4dec2008.pdf
Book Depreciation on Transmission Works	5.28%	http://www.mca.gov.in/Ministry/latestnews/Explanatory_Statement_alongwith_Schedule_XIV_4dec2008.pdf
Working Capital Requirement		
Period in Months of O&M Expenses	1	http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf
Period in Months of Receivables Revenue	2	http://www.cercind.gov.in/2010/November/Signed_Order_256-2010_RE_Tariff_FY_11-12.pdf
Interest on working capital	12%	DPR
Tax Rate		
MAT Rate	20%	https://www.wirc-icai.org/(X(1)S(kve5eiq0brs1h4ea45ccvt55))/material/Tax-matters-for-Mutual-Fund-18022012.pdf
Income tax	32.445%	https://www.wirc-icai.org/(X(1)S(kve5eiq0brs1h4ea45ccvt55))/material/Tax-matters-for-Mutual-Fund-

Parameters	Assumptions	Source
		18022012.pdf
Incentives		
Tax holiday / years	10	http://www.mca.gov.in/Ministry/notification/pdf/AS_22.pdf
Total Capital Subsidy (INR 20 million for 1st MW+ (additional Capacity) x INR 3 Million)	29	http://mnre.gov.in/file-manager/UserFiles/presentations-pwc-workshop-06092012/IREDA.pdf

***** *Project cost is considered from TEC (Techno Economic Clearance) accorded by Himachal Pradesh State Government, which was a more appropriate source. Moreover, the mentioned cost was the most updated cost available at the time of making an investment decision.*

Based on the above assumptions, the post tax equity IRR of the project activity turns out to be 11.13%, which is lower than the estimated benchmark of 17.77%.

Sensitivity Analysis

It is a prudent business practice to assess the sensitivity of the financial indicator to the variations in major parameters of the project. Therefore, in accordance with paragraphs 28 and 29 of Annex 12, EB 85, the sensitivity of the equity IRR with respect to the variations in electricity generation, project cost, O&M cost and tariff has been assessed. These important variables are either only increased decreased, but not both, as the initial objective of this sensitivity analysis is to determine in which scenarios the project activity would pass the benchmark or become more favourable than the alternative. The following effects of sensitivity on the equity IRR were observed:

Parameters	% of variation	Equity IRR (%)	Benchmark
Base case		**11.13%**	**17.77%**
Annual generation	+10%	13.73%	
Project Cost	-10%	14.15%	
O&M Cost	-10%	11.73%	
Tariff	+10%	13.73%	

It is evident from the above analysis that the even a 10% increase or decrease in these important parameters does not allow the IRR to cross the benchmark returns in the absence of CDM

benefits. This implies that the financial returns are not sensitive to these variables. Clearly, the slated benchmark cannot be achieved without the help of CDM revenues, a fact that precludes the possibility of any gainful execution of this project without carbon revenues. Hence, the project is financially additional.

Serious consideration of CDM:

As per the CDM Project Standard Version 09.0 Para 28, for project activities with start date after 02 August 2008, PP must inform the Host Party DNA and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. The expected project start date (01/04/2016) is after 02/08/2008.

The project participants had considered CDM benefits during conceptualization of the project activity Furthermore, a chronology of parallel serious CDM actions has been constructed below:

Date	Project Implementation	CDM Implementation	Proof of action
10/07/2010		Intimation to UNFCCC and NCDMA	Email Communication to UNFCCC and NCDMA
13/07/2010		Acknowledgement mail from NCDMA	Email communication from NCDMA
28/07/2010		Acknowledgement mail from UNFCCC	Email communication from UNFCCC
15/09/2010	Local Stake Holders Meeting		Newspaper advertisement for local stakeholder meeting
27/07/2011	Irrigation Public Health clearance		IPH NOC
07/06/2012	Techno Economic Clearance (TEC)		Copy of TEC
15/11/2012	Date of investment decision making		Board resolution
15/03/2013	Power Evacuation clearance		HPSEB Letter
25/07/2013	Implementation Agreement Signed		Implementation Agreement

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plants by renewable electricity. As per para 43 of the methodology AMS I D Version 18, the emission reduction ER_y by the project activity during a given year y is the difference between baseline emissions (BE_y), project emissions (PE_y) and emissions due to leakage (LE_y), as follows:

$ER_y = BE_y - PE_y - LE_y$ *…..(C)*

where:

ER_y = Emission reductions in year y (t CO_2/y)
BE_y = Baseline Emissions in year y (t CO_2/y)
PE_y = Project emissions in year y (t CO_2/y)
LE_y = Leakage emissions in year y (t CO_2/y)

Baseline Emissions:

Baseline emissions in the project activity is calculated as per para-22 of AMS I.D. version-18:

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

Where:
BE_y = Baseline Emissions in year y (t CO_2)

$EG_{PJ,y}$ = 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)

$EF_{grid,.y}$ = Combined margin CO2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO2/MWh)

Emission factor of the grid can be calculated as per para-23 of the AMS I.D. version-18 in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system" version-04.0;

OR

(b) The weighted average emissions (in t CO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations shall be based on data from an official source (where available) and made publicly available. Project participant has chosen to calculate emission factor as per option (a)

Calculation of the CO_2 emission factor of the grid

As per "Tool to calculate the Emission Factor for an electricity system version-05.0", following steps has to be applied
STEP 1. Identify the relevant electricity systems;

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

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

STEP 4. Calculate the operating margin emission factor according to the selected method;

STEP 5. Calculate the build margin (BM) emission factor;

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

"Baseline Carbon Dioxide Emission Database Version 10.0, December 2014" has been published by the Government of India with the purpose of providing a ready reference for the emission factors to be used in CDM projects. This database is an official publication of the Government of India for the purpose of CDM baselines. It is based on the most recent data available with the Central Electricity Authority (CEA), Government of India.

Step 1: Identify the relevant electricity systems.

Indian electricity system comprises of two regional electricity grids i.e. NEWNE regional grid and Southern grid. Power exchange takes place between these regional grids and a small exchange also occurs with few neighbouring countries like Bhutan & Nepal, which all form a connected electricity system. Thus, depending on the demand and generation, there are electricity exports and imports between them.

The regional grid represents the largest electricity system where power plants can be dispatched without significant constraints and, thus, represents the project electricity system for the project activity. Project activity is connected to the NEWNE regional grid of India, which, therefore, can be identified as the project electricity system.

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.

As the project is exporting electricity to the NEWNE regional grid, thus, the project participants have chosen Option I for the calculation of the operating and build margin emission factor i.e. off-grid power plants are not being included 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:

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

As per the tool, any of the four methods can be used. For the proposed project activity, simple OM method has been chosen to calculate the operating margin emission factor ($EF_{grid, OM, y}$). However, the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. The low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of

the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

The Share of Low Cost / Must-Run (% of Net Generation) in the generation profile of the different grids in India in the last five years is as follows:

	2009-10	2010-11	2011-12	2012-13	2013-14
NEWNE	15.9%	17.6%	19.0%	17.2%	18.0%

Source: Baseline Carbon Dioxide Emission Database, Version 10, December, 2014

In Integrated (NEWNE) Grid, the low-cost/must run resources vary from 15.9% to 19.0% of the total net grid generation (From Year 2009-10 to Year 2013-14). The calculation above shows that the generation from low-cost/must-run resources constitutes less than 50% of total grid generation, hence usage of the **Simple OM method** in the project case is justified.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) *y*:

- Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period,

or

- Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

PP has chosen *ex ante* option, thus, no monitoring and recalculation of the emissions factor during the crediting period is required. PP has considered a data vintage of 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM method has been selected as justified above. The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units using the following formula:

$$EF_{grid,OM,simple,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,OM,simple,,y}$ = Simple operating margin CO_2 emission factor of in year y (tCO_2/MWh)

$FC_{i,m,y}$ = Amount of fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fuel type i in year y (GJ / mass or volume unit)

$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type i in year y (tCO_2/GJ)

$EG_{m,y}$ = Net electricity generated and delivered to the grid by power unit m in year y (MWh)

m = All power units serving the grid in year y except low-cost / must-run power units

I = All fuel types combusted in power plant / unit m in year y

y = Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

In India, the Central Electricity Authority (CEA) has estimated the baseline emission factor for the power sector. This data has also been endorsed by the DNA and is the most authentic information available in the public domain. The details of same can be found on CEA website.

Following tables shows the simple OM and Net generation[14] respectively for the recent three years:

Simple Operating Margin (tCO2/MWh) (incl. Imports) (1) (2)			
	2011-12	**2012-13**	**2013-14**
NEWNE	0.9699	0.99	1.00

Net Generation in Operating Margin (GWh)			
	2011-12	**2012-13**	**2013-14**
NEWNE	5,08,004.38	5,46,941	5,69,216

Therefore the 3 years net generation weighted OM average for NEWNE grid comes out to be 0.9862 tCO_2/MWh

i.e. $EF_{grid,OM,y}$ = 0.9862 tCO_2/MWh

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

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

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

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.

The project proponents wish to choose option 1.

[14] CO_2 Baseline Database for the Indian Power Sector, Version 10.0, Dec 2014

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%,}$ in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

In India, the installed capacity and corresponding annual generation from power plants is quite high. The Central Electricity Authority (CEA) has estimated the annual electricity generation from $SET_{\geq 20\%}$ to be larger than the generation from $SET_{5\text{-units}}$. The details of same can be found on CEA website. Further, none of the power units in $SET_{\geq 20\%}$ started to supply electricity to the grid more than 10 years ago.

Therefore, SET_{sample} is selected as $SET_{\geq 20\%}$ for the estimation of build margin.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2 / MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year y (tCO_2 / MWh)
M	=	Power units included in the build margin
Y	=	Most recent historical year for which electricity generation data is available

Calculations for the Build Margin emission factor $EF_{grid,BM,y}$ is based on the most recent information available on the plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of the power plant capacity additions in the electricity system that comprise 20 % of the system generation and that have been built most recently ($SET_{\geq 20\%}$). PP has sourced the data from CEA website and same in inline with the Tool to calculate the emission factor of the electricity system.

Build margin emission factor is calculated, ex-ante as per the most recent data available. So, build margin emission factor for NEWNE grid for 2013-2014 is 0.9495 tCO2/MWh

i.e. $EF_{grid,BM,y}$ = 0.9495 tCO_2/MWh

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

The combined margin is the weighted average of the simple operating Margin and the build margin. In particular, for intermittent and non-dispatchable generation types such as wind and solar photovoltaic, the 'Tool to calculate the emission factor for an electricity system (Version 4.0)', allows to weigh the operating margin and Build margin at 50% and 50%, respectively**.**

$$EF_{grid,CM,y} = (EF_{grid,OM,y} \times w_{OM}) + (EF_{grid,BM,y} \times w_{BM})$$

$$= (EF_{grid,OM,y\ y} \times 50\%) + (EF_{grid,BM,y} \times 50\%)$$

Electronic spreadsheet showing calculation of all these parameters is being submitted separately and the final values are presented below:

Parameter	Value
Operating Margin : $EF_{grid,OM,y}$	0.9862
Build Margin : $EF_{grid,BM,y}$	0.9495
Combined Margin : $EF_{grid,CM,y}$	0.9679

Baseline Emission (BEy):

As per para 22 of the methodology AMS.I.D Version 18, The baseline emissions BE_y are the product of electrical energy baseline $EG_{PJ,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor $EF_{grid,y}$

$BEy = EG_{PJ,y}$ X $EF_{grid,y}$ Also, If the project activity is the installation of a greenfield power plant, then:

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

BEy = 19, 348 MWh/annum x 0.9679 tCO2e/MWh

= 18, 725 tCO2e per year

Project Emissions:

As per paragraph 39 of AMS-I.D., Version 18, which states that: "*For most renewable energy project activities, PEy = 0. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of ACM0002: Grid-connected electricity generation from renewable sources":*

- *Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity / fossil fuel consumption)*
- *Emissions from water reservoirs of hydro power plants"*

Thus, Project emissions in year y, **PE_y = 0** tCO_2e

Leakage:

Project activity is installation of new hydropower project and does not involve transfer of any kind of generating equipment from another activity. Hence, in line with paragraph 42 of AMS-I.D., Version 18:

Leakage emissions in year y, $\mathbf{LE_y = 0}$ tCO_2e

And referring para 43 of AMS I D Version 18, Emission reductions are calculated as follows:

$ER_y = BE_y - PE_y - LE_y$

$ER_y = (EG_{PJ,y} \times EF_{grid,y}) - PE_y - LE_y$

$\mathbf{ER_y = EG_{PJ,facility,y} \times EF_{grid,CM,y}}$

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{OM,y}$
Unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year *y*
Source of data	CO2 Baseline Database for the Indian Power Sector, Version 10.0, Dec 2014 http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value(s) applied	0.9862
Choice of data or Measurement methods and procedures	Calculated in line with "*Tool to calculate the emission factor for an electricity system (Version 4.0)*" using data from Central Electricity Authority of India's (CEA) "*Baseline Carbon Dioxide Emission Database Version 10.0*". Justified in section B.6.1
Purpose of data	Calculation of baseline emissions
Additional comment	This database is an official publication of Government of India for the purpose of CDM baseline. It is based on most recent data available to the Central Electricity Authority and hence considered authentic. As the calculation of baseline emission has been done *ex ante* its value will remain fixed for the entire crediting period.

Data / Parameter	$EF_{BM,y}$
Unit	tCO_2/MWh
Description	Build margin CO_2 emission factor for the project electricity system in year *y*
Source of data	CO2 Baseline Database for the Indian Power Sector, Version 10.0, Dec 2014
Value(s) applied	0.9495
Choice of data or Measurement methods and procedures	Calculated in line with "*Tool to calculate the emission factor for an electricity system (Version 4.0)*" using data from Central Electricity Authority of India's (CEA) "*Baseline Carbon Dioxide Emission Database Version 10.0*". Justified in section B.6.1
Purpose of data	Calculation of baseline emissions

Additional comment	This database is an official publication of Government of India for the purpose of CDM baseline. It is based on most recent data available to the Central Electricity Authority and hence considered authentic. As the calculation of baseline emission has been done *ex ante* its value will remain fixed for the entire crediting period.

Data / Parameter	$EF_{grid,y}$
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year *y*
Source of data	Calculated
Value(s) applied	0.9679
Choice of data or Measurement methods and procedures	The baseline emission factor ($EF_{grid,CM,y}$) is calculated as the weighted average of the simple OM emission factor ($EF_{grid,OM,y}$) and the BM emission factor ($EF_{grid,BM,y}$). By default, both margins have equal weights (50%). Data obtained from "Baseline Carbon Dioxide Emissions Database - Version 10.0" published by the CEA. The baseline emission factor is fixed ex ante for the duration of the crediting period.
Purpose of data	Calculation of baseline emissions
Additional comment	This database is an official publication of Government of India for the purpose of CDM baseline. It is based on most recent data available to the Central Electricity Authority and hence considered authentic. As the calculation of baseline emission has been done *ex ante* its value will remain fixed for the entire crediting period.

B.6.3. Ex ante calculation of emission reductions

>>

Relevant equation to calculate the Emission Reductions

$$ER_y = BE_y – PE_y - LE_y$$

where:

ER_y = Emission reductions in year *y* (tCO_2e).

BE_y = Baseline Emissions in year *y* (tCO_2e).

PE_y = Project emissions in year *y* (tCO_2e).

LE_y = Leakage emissions in year *y* (tCO_2e).

Emission reduction calculations have been carried out as per monitoring guidelines mentioned in paragraph 43 Baseline Methodology “AMS-I.D” Version 18.

Baseline Emission (BE_y):

(BE_y) is calculated by multiplying the net energy export in year y (EG_y) with CO_2 Emission factor for the electricity displaces due to the project activity (i,.e. $EF_{grid,CM,y}$) as follows:

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

$BE_y =$ 19, 348 MWh/Yr x 0.9679 tCO_2e/MWh

= 18, 725 tCO_2e per year

Project emissions

$PE_y = 0$

Leakage

No leakage emissions are considered.

Emission reductions

Emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$

= 18, 725-0
= 18, 725 tCO_2e

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

Year	Baseline emissions (t CO2e)	Project emissions (t CO2e)	Leakage (t CO2e)	Emission reductions (t CO2e)
Year 1	18, 725	0	0	18, 725
Year 2	18, 725	0	0	18, 725
Year 3	18, 725	0	0	18, 725
Year 4	18, 725	0	0	18, 725
Year 5	18, 725	0	0	18, 725
Year 6	18, 725	0	0	18, 725
Year 7	18, 725	0	0	18, 725
Year 8	18, 725	0	0	18, 725
Year 9	18, 725	0	0	18, 725
Year 10	18, 725	0	0	18, 725
Total	1, 87, 250	0	0	1, 87, 250
Total number of crediting years	10			
Annual average over the crediting period	18, 725	0	0	18, 725

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{PJ, facility,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Electricity meter(s)

Value(s) applied	Will be monitored ex post
Measurement methods and procedures	For measuring the energy import and export by the project activity at the grid interconnection point, bi-directional tri vector meter will be installed. **Recording Frequency:** Continuous Monitoring, Hourly Measurement & Monthly Recording **Monitoring Equipment:** Bi-directional tri vector meters (main and check) of accuracy class 0.2s **Calibration Frequency**: Once in a year
Monitoring frequency	Continuous Monitoring , Hourly Measurement & Monthly Recording
QA/QC procedures	Meters will be calibrated once in year. The data will be cross checked as per the sales invoice raised by the project proponent.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived on electronically. Archived data will be kept during the crediting period plus 2 years or the last issuance of CERs for this project activity, whichever occurs later.

B.7.2. Sampling plan

>> This section is not applicable to the project activity.

B.7.3. Other elements of monitoring plan

>> The monitoring plan is developed in accordance with the modalities and procedures for small-scale CDM project activities as the proposed project activity is a grid-connected small hydroelectric project being implemented in Himachal Pradesh. The monitoring plan, which will be implemented and taken care by the project proponent, describes the monitoring organization, parameters to be monitored, monitoring practices, quality assurance, quality control procedures, data storage and archiving.

Structure of the monitoring team

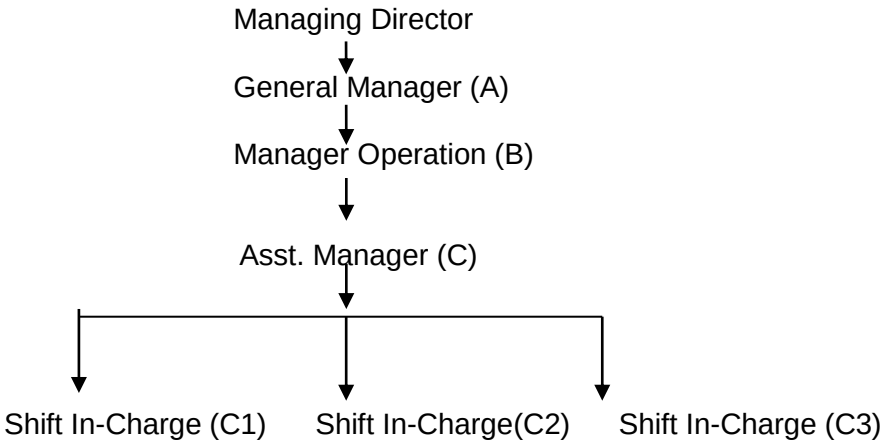
The Project will be managed by the Managing Director (MD). The MD will appoint a full time General Manager who will be assisted by a Manager (Operations), in-charge of all technical aspects. The Manager (Operations) who will be responsible for the hydro project will have under him one Asst. Manager for the hydro project.

The authority and responsibility for registration, monitoring, measurement, reporting and reviewing of the data rests with the MD. The MD would be delegated to a competent person identified for the purpose. The identified person will be the in charge of GHG monitoring activities and prepare necessary audit reports for review by the management.

The identified person in charge will be assisted by a team of experienced personnel in disciplines such as mechanical and electrical with experience in plant operation, measurements and management. The primary responsibility of the team is to collect, measure, monitor, record and reports the information on various data items to the person in charge and the General Manager, in accordance with the applicable standards. Periodic calibration of various instruments used in the monitoring of the data and record keeping of the same also will be the responsibility of the team.

The responsibility of storage and archiving of information in good condition also lies with the designated person in charge. The person in charge will undertake periodic verifications and onsite inspections to ensure the quality of the data collected by the team.

The Management Structure will be as follows:



A	General Manager is the responsible for the overall project activities
B	Manger Operation is responsible for the technical aspects of the project including calibration of the energy in due time.
C	Asst. Manager (C) will assist the Manager Operation and will be look after the day to day shift activity of the project.

C1, C2, C3 Shift In Charge will be there who will be placed in 3 shifts and also take care of the technical faults occurring in the plant.

The monitoring plan includes monitoring of electricity export, electricity import and net energy export to the grid. Net electricity exported to grid will be calculated based on the difference of export and import of electricity to the NEWNE grid. Emission reductions resulted from the project activity will be calculated based on the net energy export to the grid system in accordance with the calculations illustrated in Section B.6.3 of the PDD. Emission reductions generated by the project shall be monitored at regular intervals. The crediting period chosen for the project activity is fixed 10 years.

Metering System

Monitoring equipment comprises of tri-vector energy meters, which will monitor the electricity export, electricity import by the plant to the grid system by the proposed project. Two energy meters, one is main meter and the other is check meter will be installed at grid interconnection point. Main meter reading will be considered for the emission reduction calculation. If main meter is not operational, value of check meter will be considered emission reduction calculation. Both the meters will be calibrated on in a year.

QA/QC Procedures

The main meter and check meter will be test checked for accuracy. The test for the main meter and the check meter will be done with reference to a Standard meter, which will be of accuracy class compatible with the class of meter under test. Sales bills / invoice would be used for cross-

checking the net amount of power exported to the grid. The energy meters will be calibrated as per Industry norms but at least once in a year. Accuracy class of the meter would be 0.2s.

Data Management and Data Archiving

The data will be archived both electronically and on paper till a period of two years from the end of the crediting period or the date of last issuance, whichever occurs later.

Emergency preparedness plan

In case of any abrupt breakdown, the fault will be immediately identified by the O& M personnel. All minor faults shall be handled by the O& M personnel, In case of any major faults, the grid personnel will be informed and replacement of the equipment shall be made within 24 hours.

Operation and Maintenance team will be trained for emergency situations also the team is trained to combat safety issues if occur any.

The periods of plant shut down, non-operational times, force majeure events can be recorded in the plant daily log books.

Training

Operation and maintenance team will train the staff on operation and maintenance aspects of the plant. The training will ensure preventive maintenance and better operational control for the plant.

Data adjustments/uncertainties

- Two energy meters, one is main meter and the other is check meter will be installed at grid interconnection point. Main meter reading will be considered for the emission reduction calculation. If main meter is not operational, value of check meter will be considered emission reduction calculation.
- If a situation appears that all meters are faulty then the meters will be sent for maintenance and maintaining a conservative approach, CERs will not be counted for the duration when all meters are under replacement.
- In case meters are faulty, immediate replacement would be done.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
Date: 10/07/2015
Entity: The Shansha Hydro Power Project Co-Operative Society Ltd. (Project Participant)
Jasmeet Singh (Project Consultant)

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

The date of implementation agreement has been considered as start date, which is 25/07/2013.

C.1.2. Expected operational lifetime of project activity

>>
40 Years and 0 months

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>> Fixed crediting period

C.2.2. Start date of crediting period

>> 15/01/2018 or the date of commercial operation or the date of submission of project activity to UNFCCC, whichever is later.

C.2.3. Length of crediting period

>> 10 years 0 Months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> As per the notification from MoEF dated September 14, 2006[15] and its amendment notification S.O.- 3067(E) dated 1/12/2009[16] , List Of Projects Or Activities Requiring Prior Environmental Clearance includes the river valley project 1(C), < 50 MW > 25MW hydroelectric power generation projects Environment impact assessment is required. As per the notification EIA need not to be conducted for the projects of capacity less than 25 MW. Since the capacity of the project is 4 MW, the project activity doesn't call for EIA study.

Proposed project will not result in displacement of any population at the project site. The scheme does not involve any submergence of land and therefore, no rehabilitation activity is needed. There shall be no adverse impact on forest, wildlife or aquatic life due to implementation of this project. There is neither any reserved forest area nor any wild life reserved area near to this project. Construction of this project will thus not interfere with any reserved forest land nor reserved wild life area.

Local population will be greatly benefitted and living conditions will improve as local people will be engaged during the construction as well as during operation and maintenance of the project activity. From the above discussions, it is evident that the proposed project is not likely to have any significant adverse environmental effects during execution or after commissioning.

Hence from the above discussion it is clear that no significant environmental impacts considered due to implementation of project activity by the host party.

[15] http://envfor.nic.in/legis/eia/so1533.pdf

[16] http://moef.nic.in/downloads/rules-and-regulations/3067.pdf

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>> "The Shansha Hydro Power Project Co-Operative Society Ltd." has convened a stakeholder meeting for their hydro power project on 15/09/2010 at the project site. Public news paper advertisement in Hindi & English local News paper was given 7 days in advance on 07/09/2010 intimating the stakeholders about time, venue, and purpose of the meet and were requested to attend the meet.

The agenda of the stakeholders' consultation included:

- Description of the project activity and its benefits to the local stakeholders, national as well as global.
- Description of the Clean Development Mechanism (CDM) process and how the proposed project activity will be eligible for CDM
- Feedback from the stakeholders about the proposed project activity.

Stakeholder consultation procedure was done as below:

- Description of the hydro project and the associated benefits by project proponent.
- Question and Answer session between the project proponent and the stakeholders
- Vote of thanks
- Signing of the attendance sheet

Consultant welcomed all the stakeholders and briefed them about the agenda for the meeting.

The project proponent made a presentation on the phenomenon of CDM in Hindi language. He gave a non-technical description of the project activity. The impacts of the project activity on the environment and its contribution to the improvement in country's power situation were also put across. It was also explained by him how the GHG emissions would have occurred in the absence of the project activity. The Project Proponent invited the stakeholders to come up with their queries or concerns that they may have.

E.2. Summary of comments received

>> Positive feedback for the project in the form of letters from the villagers and the local governing bodies were received. The stakeholders were unanimously in favor of the project and had the opinion that it would bring prosperity to the area.

The specific concerns expressed by the participants are summarized below along with clarifications provided on such concerns:

Stakeholder Name and concerns / question	Answer / clarifications
Mr. Pritam Singh Rawat: What is the step towards the biodiversity conservation?	The project proponent will plant more trees for every tree cut down in construction and is doing the same activity on continuation basis.
Mr. Prem Chand: Is there any job opportunity and incomes for local people?	Villagers will be given employment during the construction phase of the project based on their skills.

Mr. Baldev Singh: What is a run-off-the-river system?	The natural flow of the river is used to generate electricity. This kind of project activity is built up on rivers which are having a consistent and steady flow of water. Run of river hydro projects do not require impoundment of water like large reservoir hydro project. The water from the run of river water is diverted from a river, and sent into a pipe called a penstock. The penstock feeds the water downhill to the power station's turbines. The natural force of gravity creates the energy required to spin the turbines that in turn generate electricity. The water leaves the generating station and is returned to the river without altering the existing flow or water levels.

The comments received from the local stake holders for the project are:

a) Employment opportunities for the local people will increase.
b) Infrastructure facilities of the locality will improve.
c) As this is a clean source of energy, no pollution is involved due to the project activity.

The project activity leads to saving in the fossil fuels.

E.3. Report on consideration of comments received

>> No adverse comments were received. Only minor queries were raised which were satisfactorily answered

SECTION F. Approval and authorization

>> The Host Country Approval from Ministry of Environment & Forest has been received reference no. 4/3/2015 dated 16th November 2015.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	The Shansha Hydro Power Project Co-Operative Society Ltd.
Street/P.O. Box	151/1, Ramshilla
Building	Akhara Bazar
City	Kullu
State/Region	Himachal Pradesh
Postcode	175101
Country	India
Telephone	+91-1902- 222518
Fax	+91-1902- 222320
E-mail	bugintl@yahoo.com
Website	
Contact person	
Title	MD
Salutation	Mr.
Last name	Gharsangi
Middle name	Krishan
First name	Baldev
Department	
Mobile	
Direct fax	+91-1902- 222320
Direct tel.	+91-1902- 222518
Personal e-mail	gharsangi@yahoo.co.in

Appendix 2. Affirmation regarding public funding

No public funding is involved in this project activity

Appendix 3. Applicability of methodology and standardized baseline

Applicability of selected methodology has been adequately illustrated in section B.2

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

Ex ante emission reductions have been calculated in section B.6.3 and all the necessary data, measurements results and data sources have been mentioned. No further information is available.

Appendix 5. Further background information on monitoring plan

Monitoring plan has been adequately explained in section B.7. No further information is required to present here**.**

Appendix 6. Summary of post registration changes

Not Applicable.

Document information

Version	*Date*	*Description*
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	Revisions 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; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • 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 **Error! Reference source not found.**; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02.0	08 July 2005	EB 20, Annex 14 • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

Version	*Date*	*Description*

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project design document, SSC project activities