CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

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Title: 24 MW Bhilangana - III Hydro Power Project
Current Version: Version 05
Date of completion: 22/02/2010

A.2. Description of the project activity:

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Project Profile:

Bhilangana - III (B-III) is a run-of-the-river 24 MW Hydro Power Project located at Village Ghuttu, Tehsil Ghansali, District Tehri, Uttarakhand State, India. The project activity contemplates utilization of waters of Bhilangana River, a tributary of the river Bhagirathi, for setting up an environmentally benign project for generation of electricity. The project is implemented by Bhilangana Hydro Power Limited (BHPL) which is being promoted by Mr. Sanjiv Saraf and his associates. BHPL has been created with the objective of ensuring effective and efficient utilization of natural resources, coupled with responsible environmental considerations, which are vital for achieving sustainable development in India.

The main components of the project comprise of a diversion weir, head regulator constructed integrally with the weir, intake channel, desilting chamber, power channel, head race tunnel, surge shaft, steel lined tunnel and penstock with its trifurcations, power house to accommodate 3x8 MW horizontal axis Francis turbine, switchyard and tailrace system. The project is essentially a run-of- the river reservoir scheme having a power density of 16,849 W/ m^2. Construction work at project site has been started and the project activity is expected to start generation of power from April 2010. The project energy benefits have been assessed at 170.88 GWh per annum in a 50% dependable year.

Since the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is predefined in the approved consolidated baseline methodology ACM0002 (Version 08) as being "Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the' Tool to calculate the emission factor for an electricity system'". This is in line with the scenario existing prior to the implementation of the proposed project activity wherein the electricity demand was met by the power plants already operating in the grid (dominated by fossil fuel based power plants) and planned to be added in the grid.

Purpose

This project has been developed with the following broad objectives:

(i) Tapping the potential of a natural resource i.e. flowing water and utilising it to generate clean energy, which would have been otherwise remained unutilised.
(ii) Generation of environmentally clean electricity and contribution towards meeting the existing / anticipated shortfall of energy in the country. The electricity produced from the project will be fed into the regional electricity grid thereby reducing the power deficit in the Northern grid.
(iii) Contribution towards reducing dependence on fossil fuels and hence reduction in Greenhouse Gas (GHG) emissions in the atmosphere.
(iv) Correction of existing imbalance in the power mix (thermal : hydro) in the country.
(v) Adhering and contributing to India's national policy of promoting clean power.

Emission Reductions from anthropogenic sources

The electricity generated from the project site will be displacing the grid electricity (a grid mix contributed from different fuel sources) by its equivalent units. Thus, the project activity will be preventing the anthropogenic green house gas (GHG) emissions generated by the fossil fuel (coal, diesel, furnace oil and

gas etc.) based thermal power stations in the grid and will be contributing to sustainable development through conservation of environment.

Contribution of the project activity to Sustainable Development

The Designated National Authority (DNA) for the Government of India (GoI) in the Ministry of Environment and Forests (MoEF), called the National CDM Authority (NCDMA), has stipulated four indicators for sustainable development in the interim approval guidelines for CDM projects[1] (mentioned below):

- Social well being
- Economic well being
- Environmental well being
- Technological well being

The project participants' views on the contribution of this project activity towards sustainable development with respect to the four indicators are explained below:

A. **Social well being** –.

- The project activity would lead to alleviation of poverty by establishing direct and indirect benefits through employment generation at all levels from unskilled to skilled workers during the construction and operation phases.
- The project activity would augment grid supply and would contribute in mitigating the shortage in power necessary for the sustenance and development of the society
- The project activity would also require support services such as machine repair, spares, transport logistics, accommodation facilities and general day-to-day requirements during its different phases (construction and operations) which shall accelerate business and commercial activities in and around the project area.
- The project activity would also involve infrastructural development like roads etc. which would benefit the local community.

B. **Economic well-being** -

- The project activity would lead to capital investments in the developing region which otherwise would not have happened in the absence of this project activity.
- The project activity would generate employment for the local population. Further, the business opportunities would be enhanced by the project activity for local stakeholders such as consultants, suppliers, manufacturers, contractors etc.
- The project activity also leads to diversification of the national energy supply, which is at present, dominated by conventional fuel based generating units.

C. **Environmental well being** -

- The project activity is a renewable energy power project utilising hydro / water resources for power generation. The electricity generated would substitute the power generation by thermal power plants and would contribute towards the reduction in use of finite and non-renewable natural resources like coal etc.
- The project activity by generating clean power has excellent environment benefits in terms of reduction of GHG emissions and conservation of natural resources.
- The Catchment Area Treatment (CAT) plan envisaged & approved for the project by Government of Uttarakhand (GoU) would treat the degraded catchment areas of the project and would control soil erosion in the project area resulting in regeneration of natural forests and other ecosystems.

D. **Technological well being** -

- The project uses a proven and well established state of the art technology. Efficient turbines and generators are being used in the project and the power transmission will be at high voltage to ensure low losses.

[1] http://www.envfor.nic.in/cc/cdm/criteria.htm

- Preliminary design computations have been based upon design criteria laid down relevant to Indian Standard Institute (ISI) codes, geological conditions and seismicity of the area. The project activity would have PLC based control system for better operation and control.

A.3. Project participants:

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Name of Party involved ((host) indicates a host party)	Private and/or public entity (ies) Project participants (as applicable)	Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)
Government of India (Host Country)	Bhilangana Hydro Power Limited (BHPL)	No

A.4. Technical description of the project activity:

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A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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India

A.4.1.2. Region/State/Province etc.:

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Uttarakhand

A.4.1.3. City/Town/Community etc:

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District: Tehri Garhwal
Tehsil: Ghansali
Village: Ghuttu

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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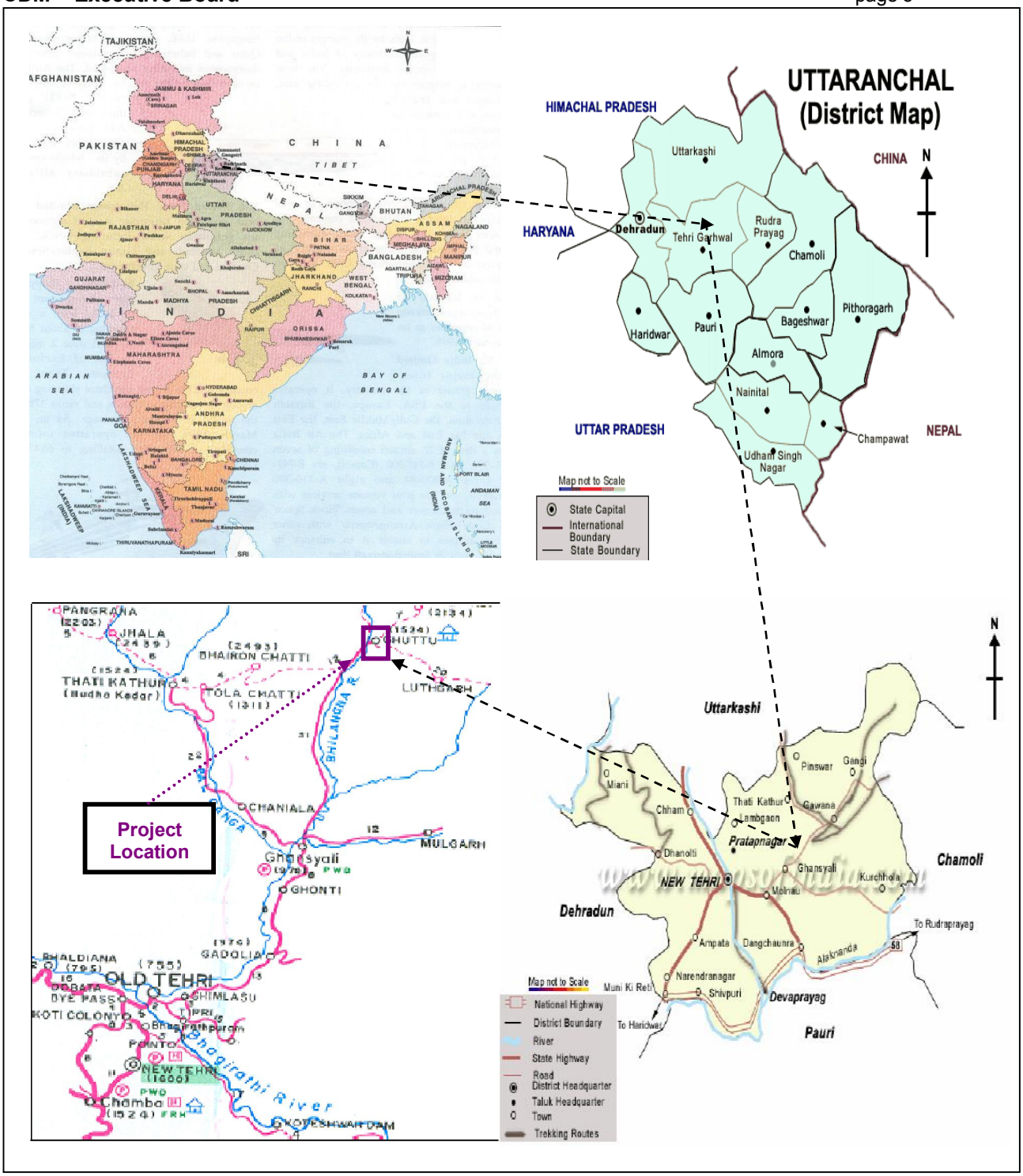
The project activity is located on Ghansali-Ghuttu road at a distance of about 170 km from Rishikesh via New Tehri Township. The nearest railhead is Rishikesh, which is well connected to the rest of the country by rail and road. The nearest airstrip is at Jolly Grant, Dehradun at 171 Km from the project site. The project area is located between the latitude 30°33'07" N to 30°31'25" N and Longitude 78°48'26" E to 78°46'16" E. Diversion weir of the scheme is located near Devling village, which is about 2 - 3 km upstream of Ghuttu. The powerhouse is located on the right bank of the river at a location, which is about 150 m away from the road connecting Ghuttu with Ghansali. The location is about 2 km downstream of Ghuttu village on the left of the road and about 50 - 60 m below the level of the road. The area has an undulating and rugged terrain.



Map of the Location (not to scale)

A.4.2. Category(ies) of project activity:

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The project activity is considered under "Grid-connected electricity generation from renewable sources", and has a capacity more than 15 MW. Therefore as per the scope of the project activities enlisted in the latest version of the "List of Sectoral Scopes and related approved baseline and monitoring methodologies", the project activity may principally be categorized in:

Scope Number – 1

Sectoral Scope – Energy Industries (renewable/non-renewable sources).

A.4.3. Technology to be employed by the project activity:

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The Project is a run-of-river hydropower project on Bhilangana river with a total installed capacity of 24 MW (consisting of three 8 MW turbines) with suitable overload. The principal components of the project are:

- Diversion weir
- Head Regulator constructed integrally with the weir
- Intake channel
- Desilting Chamber
- Power Channel
- Intake Pool
- Head Race Tunnel
- Surge Shaft
- Steel lined tunnel and Penstock with its trifurcations
- Power House with three Horizontal Axis Francis Turbine
- Switchyard
- Tailrace system

The project comprises of gravity type concrete diversion weir 44 m long and 3.66 m high (above the average river bed level at the axis of weir) with an intake structure to divert and regulate the waters into the 200 m long box type rectangular channel, which leads the water into a 85 m long, 24.3 m wide and 11.6 m deep trough shaped desilting basin after which de-silted water is fed to 500m long power channel and then to Intake Pool (Starting Point of Head Race Tunnel). The water is then led to a surge shaft via a 2.55 m diameter D-shaped Head Race Tunnel (HRT), which is lined with concrete. HRT terminates into the circular surge shaft of 8 m dia and 50 m high. Following the surge shaft at the exit portal emerges a steel lined tunnel (25 m long) and then a single steel penstock, which trifurcates to feed the three generating units just before entering the powerhouse. The powerhouse is a surface type power house, which houses three Francis type turbo generators – each of 8 MW capacities. The tail water emerging out from the three machines is led back to Bhilangana River via three short 3.7 m wide, 10 m deep (average) and 20 m long tailrace channel having rectangular box section. Table 1 summarizes the main characteristics of the project.

Table 1: Main Project Characteristics

Parameter	Value	Source
Turbine Type	Francis	Detailed Project Report
Net Head (rated)	210.0 m	Detailed Project Report
Net Discharge (rated)	12.92 m^3/s without considering overload	Detailed Project Report
Gross Generation	170.88 GWh in a 50% dependable year	Detailed Project Report
Transmission Voltage	220 kV	MoU with State Transmission Utility (STU)

Three units of single phase each of 12.5 MVA Generator – Transformers and one unit of the same capacity as spare have been provided for stepping up the voltage from 11kV to 220kV. The details of generator and turbines are as under:

Quantity	Type	Make	Model	Power Factor	Year of Manufacture
3 Nos.	Horizontal Synchronous	T D Power Systems Pvt. Ltd.	WD250	0.85	2009
3 Nos.	Horizontal Francis Turbine	VOITH	Francis	-	2009

The project activity would be using well established hydro power generation technology for electricity generation as mentioned below:

- Digital electronic hydraulic governors for speed and output regulation of turbines
- Fully automatic Turbine-Generator (TG) unit with manual override facility :
  - Programmable Logic Controller (PLC) based control system for generating units and its auxiliaries, intake gate, penstock gate.
  - PC based and LAN connected Man Machine Interfaces (MMI) for operating and monitoring of generating units.
- 220 kV Air Insulated Switchgear and Transmission lines to have minimum transmission losses.

The project activity utilises hydro potential for generation of electricity. The technology consists of conversion of the energy available in the water flow to mechanical energy using a hydro turbine and by connecting to a generator, mechanical energy is converted into electricity energy. In this process, there are no greenhouse gas emissions or burning of any fossil fuels. Thus electricity is generated through sustainable means without causing any negative effect on the environment and hence the technology is environmentally safe and sound.

Transfer of technological know-how is not a part of the project activity. Construction activities for the project activity started in January 2007. The project is likely to be commissioned in April 2010.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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Year	Annual estimation of emission reductions in tonnes of CO_2 e
2010-11	137,096
2011-12	137,096
2012-13	137,096
2013-14	137,096
2014-15	137,096
2015-16	137,096
2016-17	137,096
2017-18	137,096
2018-19	137,096
2019-20	137,096
Total estimated reductions (tonnes of CO_2e)	**1,370,960**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**137,096**

A.4.5. Public funding of the project activity:

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No public funding from parties included in Annex – I is involved in the project activity. The project proponent hereby confirms that there is no divergence of Official Development Assistance (ODA) to the project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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Title of the approved baseline and monitoring methodology: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

Reference: ACM0002, Version 08 (EB 44), Sectoral Scope: 1.
It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC CDM website (http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html)

The approved methodology also draws upon Version 05.2 of the "Tool for demonstration and assessment of additionality" and Version 01.1 of the "Tool to calculate the emission factor for an electricity system"

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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This methodology is applicable to grid-connected renewable power generation project activities that involve electricity capacity additions.

The project activity is Grid connected renewable power generation and meets the applicability conditions of the chosen methodology as follows:

S.No	Applicability Conditions in the ACM0002/Version08	Position of the project activity vis-à-vis applicability conditions
1.	*The project activity is the installation or modification/retrofit of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation 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 hydro power project (run-of-river reservoir) for renewable electricity generation on River Bhilangana in Uttarakhand. Thus, it meets the first applicability condition.
2.	*In case of hydro power plants:* - *The project activity is implemented in an existing reservoir, with no change in the volume of reservoir.* - *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.* - *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 project activity results in new reservoir of area 1455.5 m^2 and the power density of the project is 16,489 W/m^2 (Calculated according to the definition given in the Project emissions section). The calculated value is thus significantly greater than the threshold value of 4 W/m^2 and hence the project meets the second applicability condition.
3.	*The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;*	In India, the electrical transmission system is broadly classified into regional grids namely Northern, Eastern, Western, North Eastern and Southern Grid

		The project activity is located in the state of Uttarakhand which lies in the Northern Region. The power generated at project activity would be fed into Northern Grid of India. The geographic and system boundaries of the Northern regional grid are clearly identified by the Central Electrical Authority (CEA) of India and grid information is also published by them. The information on the characteristics of the grid is available on their website (http://www.cea.nic.in) and is also being documented in this PDD.
4.	*Applies to grid connected electricity generation from landfill gas capture to the extent that it is combined with the approved "Consolidated baseline methodology for landfill gas project activities" (ACM0001)*	This condition is not required to be satisfied by the proposed project activity as it is not grid connected electricity generation from landfill gas capture.
5.	*5 years of historical data (or 3 years in the case of non hydro project activities) have to be available for those project activities where modification/retrofit measures are implemented in an existing power plant.*	This condition is not required to be satisfied by the project activity as it is not a modification / retrofit measure in an existing power plant.
6.	*The methodology is not applicable to the following:* *• Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;* *• Biomass fired power plants;* *• Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m2.*	This is a greenfield project activity and involves only renewable energy, hence switching from fossil fuels to renewable energy at the project site is not involved. Thus, this condition is not pertinent to the said project activity. This is not a biomass fired power plant The project activity is a hydro power project that results in new reservoirs, with a power density of 16,489 W/m^2 (greater than 4 W/m^2). Hence, this applicability condition is also satisfied.

B.3. Description of the sources and gases included in the project boundary

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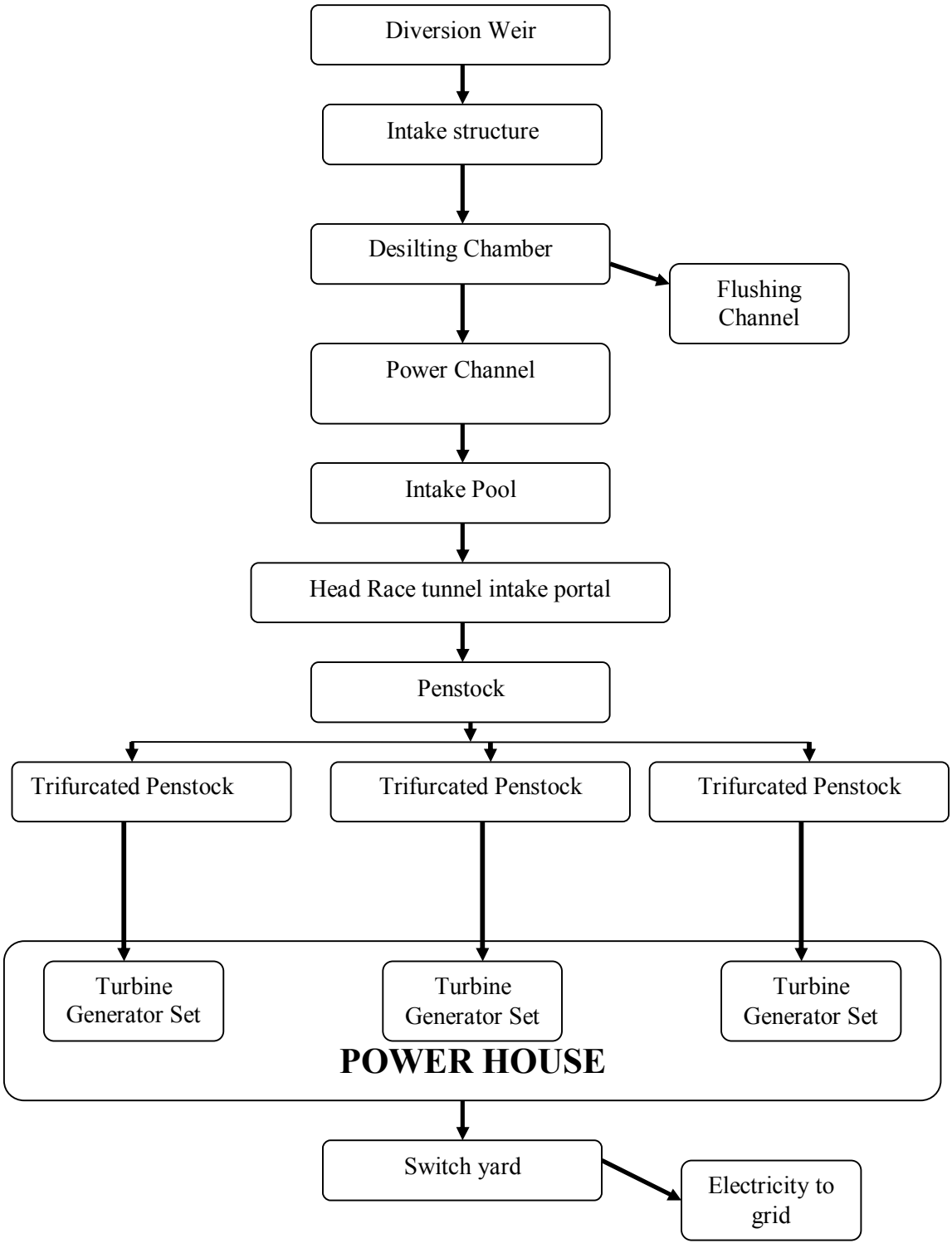
ACM0002 version 08 (EB 44) specifies that the project boundary will be:
*The **spatial extent** of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.*

The project activity would be feeding the electricity in the Northern Regional Grid which has a pool of state & private owned power generating plants. The grid is managed by Northern Region Electricity Board (NREB) which constitute of eight states (viz. Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand) and one Union territory (Chandigarh). The project would have marginal impact on all the generation facilities in the Northern grid and the **spatial extent** of the project boundary includes the project site and all power plants connected physically to the electricity system that the

project power plant is connected to. Thus, all the power generation facilities connected to the northern grid forms the project boundary for the purpose of baseline estimation.

The northern grid is also connected with other regional grids. However, the net exchange of energy among the regional grids is very small, and thus the other regional grids are not included in the project boundary (however for conservative and accurate estimation, the imports of electricity from other regional grids has been included in the baseline calculation).Therefore, Northern Regional Grid of India would be a part of the geographical and system boundary for the project activity. A diagram depicting the project boundary is shown below:



The project activity has a distinctive physical demarcated boundary. The following section shows the greenhouse gases and emission sources included in or excluded from the project boundary:

	Source	Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity.	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non condensable gases contained in geothermal steam.	CO_2	No	The project activity is a run-of-the-river hydroelectric project and not a geothermal project. Thus, these emission sources are not applicable to the proposed project.
		CH_4	No	
		N_2O	No	
	For geothermal power plants, CO_2 emissions From combustion of fossil fuels required to operate the geothermal power plant.	CO_2	No	The project activity is a run-of-the-river hydroelectric project and not a geothermal project. Thus, these emission sources are not applicable to the proposed project.
		CH_4	No	
		N_2O	No	
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	The power density of the project activity is 16,489 W/m^2. Since the power density of the project is greater than 10 W/m^2, the project activity emissions are not required to be estimated and are taken as zero.
		CH_4	No	
		N_2O	No	

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The step-wise methodology followed for selection of baseline scenario is detailed below:

Step 1: Identification of baseline scenario:

The project activity is a newly installed run-of-river hydro power project. It is not a modification or retrofit of an existing electricity generation facility. Hence, as per the methodology ACM0002 version 08, the baseline scenario is the following:

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

For full assessment on other alternatives available to the project activity, refer to Section – B.5 under Step 1a of additionality determination as well as Annex 3.

Step 2: Process and assumptions in combined margin calculation:

The consolidated methodology ACM0002 version 08 requires calculation of the combined margin CO_2 emission factor for grid connected power generation using the Version 01.1 of the "Tool to calculate the emission factor for an electricity system". This methodological tool determines the combined margin CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, by

calculating the "operating margin" (OM) and "build margin" (BM). The operating margin refers to a cohort of power plants that reflect the existing power plants whose electricity generation would be affected by the proposed CDM project activity. The build margin refers to a cohort of power units that reflect the type of power units whose construction would be affected by the proposed CDM project activity.

Step 2.1: Choice of grid:
In India, there is no general guidance provided by the DNA for selection of grid. India being a large country having dispatch system up to state level, regional grid definition needs to be used for the identification of grid as per the "Tool to calculate the emission factor for an electricity system" version 01.1.

There are five regional grids in India: Northern, Western, Southern, Eastern and North-Eastern. The project activity is in the state of Uttarakhand, which is connected to the Northern Regional Grid, hence all the power plants connected with the northern regional grid have been considered within the project grid boundary. Details on Northern Grid are provided in Annex 3.

For the purpose of calculating the emission reductions achieved by any CDM project, the "Tool to calculate the emission factor for an electricity system", version 01.1 requires that the "*project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints"*. The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to (grid).

The choice of a regional grid minimizes the effect of inter state power transactions which are dynamic and vary widely. The regional grids have minimal interchange of electricity between themselves therefore a regional grid can be safely considered as the relevant electricity grid rather than going for the state grid or the national grid. This also implies that the grid emission factors are most appropriately calculated at the level of the five regional grids[2]. In this case, since the project activity is in the state of Uttarakhand, which is in turn is a part of the Northern Regional Grid; the Northern Regional Grid can be clearly identified as the relevant electricity grid.

Step 2.2 Choice of data vintage:
'Ex ante' option has been chosen for this project activity. The data for the most recent three years (2004-05, 2005-06, 2006-07), that was available at the time of PDD finalization has been considered for the OM calculation and the data for the most recent year i.e. 2007-08 has been considered for the BM calculation. The details of variables, formula for calculation of OM and BM has been presented in Section B.6 of this document.

Step 2.3: Combined margin (CM) calculation:
The combined margin emission factor is calculated as the weighted average of the OM emission factor and the BM emission factor. The OM and BM emission factors are calculated using the power generation data published in the "CO_2 Baseline Database for the Indian Power Sector" Version 3.0 by Central Electrical Authority of India (CEA), India. Since the project activity is a hydro power plant, the weightage factor for OM is taken as 0.50 and for BM is taken as 0.50, following the "Tool to calculate the emission factor for an electricity system" version 01.1.

Step 3: Sources of data collection:
Calculation for this combined margin is based on data from publicly available "CO_2 Baseline Database for the Indian Power Sector" report of Central Electrical Authority of India", an official source of the Government of India.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

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The project proponent needs to demonstrate that the CDM was seriously considered in the decision to implement the project activity. In accordance with the "Guidance on the demonstration and assessment of prior consideration of the CDM" (EB 41, Annex 46), the CDM consideration is established as follows:

The project proponent was aware of the benefits in terms of the possible revenues through CDM to mitigate risks associated with investments in a hydro power project and therefore considered CDM incentive for the project activity at the financial planning stage. The extracts from the minutes of the meeting of the Board of Directors of BHPL dated 22/02/2006 clearly illustrates that the CDM was a decisive factor in the decision to proceed with the implementation of the proposed project activity.

BHPL had been taking continuing and real action to secure CDM funds from the inception of the project itself. The evidences to substantiate this fact are available in the form of correspondences of the project proponent with the lending agency and CDM consultants. The summarized chronology of the actions to secure CDM along with the project implementation timeline is provided below:

S.No.	Date	Event
1	12/9/2003	Letter from Govt. of Uttaranchal to Polyplex Corporation Ltd. Regarding letter of award for development, implementation and operation of Bhilangana III small hydro project.
2	21/11/2003	Project Development Agreement for Bhilangana III small hydro power project between Polyplex Corporation Ltd. And Govt. of Uttaranchal.
3	4/10/2005	Internal Email correspondence of BHPL between Mr Piyush Jain and Mr Pramod Arora regarding consideration of CDM in the financial analysis of the project Detailed Project Report.
4	17/10/2005	Email from Mr Pramod Arora to Mr SK Garg and Mr Rakesh Mahajan regarding consideration of carbon credits at initial stages of setting up of the project.
5	22-02-2006	Letter containing resolution of board of directors of BHPL to implement Bhilangana III hydro project.
6	20-04-2006	Letter from Dept. of Energy, Govt. of Uttarancal to Polyplex Corporation Ltd. with reference to approval of DPR and signing of implementation agreement.
7	28-06-2006	Email circulation from Polyplex regarding review meeting on Bhilangana III with consideration of CDM and other issues.
8	29-08-2006	Letter from Uttaranchal environment protection and pollution control to BHPL regarding consent for Bhilangana III small hydro project.
9	1/9/2006	NOC from Water Dept., Uttaranchal
10	8/9/2006	Letter from PWD to BHPL with issuance of NOC in reply to letter dated 19/8/2006
11	26-10-2006	Letter from MoEF to BHPL regarding site clearance for Bhilangana III hydro project stating it does not require environmental clearance as per EIA notification.

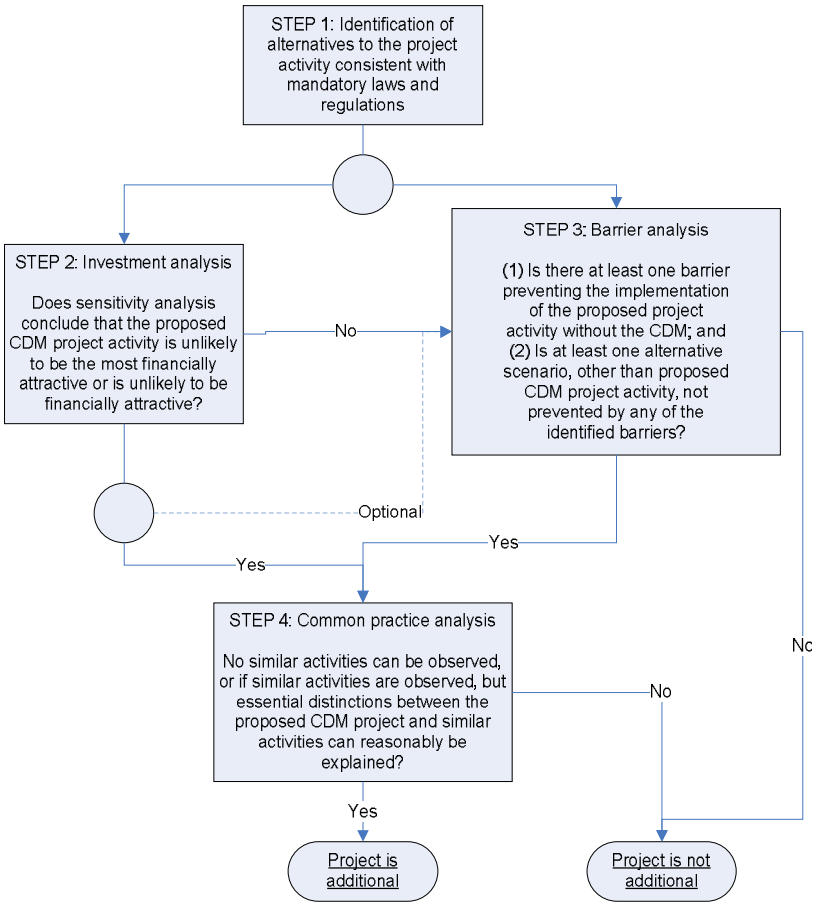
12	14/11/2006	Internal Email from Piyush Jain to BHPL regarding Halcrow's CDM presentation on Bhilangana III project.
13	21/12/2006	Letter from Fishery Dept. to BHPL regarding approval for Noc for Bhilangana III hydro project.
14	25-01-2007	Implementation agreement for Bhilangana III small hydro project between BHPL and Govt. of Uttaranchal.
15	15/03/2007	Email from the CDM consultants to BHPL with CDM advisory proposal for services related to Polyplex's Hydro project.
16	**19/03/2007**	**Civil contract with Srinivasa Constructions Limited (Project activity start date)**
17	26-03-2007	Rupee loan facility agreement between BHPL and Finance lenders.
18	15-05-2007	BHPL letter of acceptance to Voith Seimens Hydro Pvt. Ltd. For ex-works of Bhilangana III Hydro Power Project.
19	4/7/2007	Email from Piyush Jain with feedback on CDM advisory proposal sent by the CDM consultants
20	5/7/2007	Email from the CDM consultants to Mr Piyush Jain (BHPL) regarding CDM advisory.
21	10/7/2007	Contract agreement between BHPL and Voith Seimens Hydro Pvt. Ltd. For Bhilangana Hydro Power Project.
22	2/8/2007	Engagement letter between BHPL and the CDM consultants for CDM services for Bhilangana III small hydro project
23	29/11/2007	Stakeholder consultation was carried out for the purpose of CDM
24	27-12-2007	PPA between BHPL and Tata Power Trading Company Ltd.
25	22/01/2008	Initial proposal from DOE TUV SUD
26	15/02/2008	Revised proposal from the DOE TUV SUD
27	27/02/2008	Final proposal from the DOE TUV SUD
28	17/03/2008	Letter from MoEF to BHPL regarding Host Country Approval for 24 MW Bhilangana III Hydro Power Project.
29	8/4/2008	Appointment of DOE TUV SUD for conducting validation of the proposed project activity under CDM

30	22/05/2008-20/06/2008	Webhosting of the project for global stakeholder consultation by the DOE TUV SUD on the UNFCCC website
31	22-05-2008	Letter from Voith Seimens Hydro Pvt. Ltd. To BHPL confirming the supply of equipment.

The above events clearly demonstrate that the CDM was considered as being essential for the implementation of the project activity and serious steps were taken by BHPL to secure CDM for the project activity from the initial stages itself much before the start date.

As per the decision 17/cp.7, paragraph 43, a CDM project activity is additional if anthropogenic emissions of green house gases by sources are reduced below those that would have occurred in absence of registered CDM project activity.

Demonstration of Additionality for the project activity
As required in ACM0002 Version 08, additionality has been demonstrated and assessed using the latest version of the *"Tool for the demonstration and assessment of additionality"*, *Version 05.2.*



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

Define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

Sub-step (1a): Define alternatives to project activity

The alternatives available with the project proponent which are realistic, credible and provide outputs comparable with the project activity are:

a. **Alternative 1**: *Project activity not undertaken as a CDM project;*
In the said alternative, BHPL would have gone ahead with the implementation of the project, generating electricity and feeding the same to the grid thereby displacing equivalent units of power generated by fossil fuel dominated grid. There would be no emissions of greenhouse gases to the atmosphere. This alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline scenario. However, there exist barriers which prohibit the implementation of the project activity without CDM as explained below.

b. **Alternative 2:** *Continuation of the current situation in the grid with no project activity and equivalent amount of energy have been produced by the grid electricity system through its currently running power plants (which are mostly thermal) and or by new capacity addition to the grid;*
Northern Region has been witnessing an average power shortage of 10.95% and 15.64 % in terms of energy and peak MW requirements, respectively[3] during the year 2006-2007. Such a power deficit translates into substantial loss to the economy of the region and the country as well. Growing at a rate of 9% per annum, India will require an additional 100,000 MW of generating capacity by 2012[4] to continue with its current growth trajectory and to provide universal access to electricity, even with a significant pace of loss reduction and enhanced efficiency gains. A "no-project" scenario will imply that the current demand-supply gap for electricity would be fulfilled either by the existing capacity of the fossil fuel dominated grid or by capacity enhancement of the existing grid. In India, economics of power generation favors coal based production (given India's abundant coal reserves); hence, any future capacity addition is more likely to be coal based. Annex 3 further details how any shortage is more likely to be met with fossil fuel based existing plants or future additions.

Thus, "no project option" wherein the equivalent amount of energy would be produced by the project grid electricity system through its currently running power plants and by new capacity additions is the most plausible alternative as baseline option for the project. Suitable grid mix has therefore been selected as baseline option for calculation of baseline emissions.

c. **Alternative 3 :** *Equivalent Power generation using other sources of renewable energy*
In the said alternative, equivalent power (24 MW) would have been generated using various other renewable energy alternatives like wind, biomass, solar etc. These alternatives are in compliance with all applicable legal and regulatory requirements and may be a part of the baseline scenario.

Wind Power
Power generation from wind is not a feasible alternative since the region (Uttarakhand) has no wind power potential[5] and even the installed capacity of wind power generation in the region is nil[6], according to the statistics provided by Ministry of New And Renewable energy (MNRE) in their Annual reports. Thus, wind energy based power generation is excluded from further consideration as a baseline option.

Biomass
The installed capacity of biomass power generation in the region is nil[7], according to the latest statistics provided by MNRE in their Annual reports (2006-07 and 2007-08). Thus, this indicates that biomass

[3] NREB Annual Report (2006-07)

[4] http://powermin.nic.in/indian_electricity_scenario/blue%20print/executive_summary.htm

[5] http://www.indianwindpower.com/potential.html

[6] MNRE Annual Reports (2006-07 and 2007-08)

[7] MNRE Annual Reports (2006-07 and 2007-08)

based power generation is not a feasible option in the region. Therefore, biomass based power generation has been excluded from further consideration as a baseline option

Solar
Solar power being an expensive technology[8] is not feasible and hence has been excluded from further consideration as a baseline option.

Sub-step (1b): Enforcement of applicable laws and regulations

The alternatives identified above are in compliance with the applicable legal and regulatory requirements as follows:

- The implementation of project activity is a voluntary initiative and it is not mandatory or legal requirement. For power generation, the Indian Electricity Act of 2003 does not restrict or empower any authority to limit the fuel choice.
- The applicable environmental regulations do not restrict the use of hydro energy
- There is no legal requirement on the choice of a particular technology.

Thus, considering that the above alternatives are in line with the applicable legal and regulatory requirements, the "no project option" i.e. continuation of current practise where in the equivalent amount of energy would have been produced by the project grid electricity system through its currently running power plants and by new capacity additions is the chosen baseline scenario which would have happened in the absence of the proposed project activity. Please refer Annex 3 for more information on the chosen baseline.

The "Tool for the demonstration and assessment of additionality" (Version 05.2) states that project participants may choose to apply Step 2 (Investment analysis) OR Step 3 (Barrier analysis) to demonstrate the additionality of the project. In the present case, Step 2 is used to demonstrate the additionality of the project.

Step 2: Investment Analysis

Sub-step 2a. Determine appropriate analysis method

As the electricity generated from the project activity will be sold to various customers connected to the grid, it will generate financial benefits in terms of revenues from the sale of electricity units. Thus simple cost analysis (option I) cannot be applied to the proposed CDM project activity.

Amongst the other two options – investment comparison analysis (option II) and benchmark analysis (option III), the benchmark analysis has been adopted in accordance with the guidance on the assessment of investment analysis wherein the Internal Rate of Return (IRR) of the project activity serves as a benchmark to assess the financial attractiveness of the project activity. Option III assesses if the project's returns are sufficient for investors to make the initial investment and further bear the associated costs of successfully operating the project activity over the crediting period of the project.

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

The financial indicator chosen for the project activity is the Project Internal Rate of Return (IRR). Project IRR has been calculated based on project cash outflows and cash inflows only, irrespective the source of financing. Financial and economic theory holds that a firm must expect an after-tax project IRR on the funds

[8] http://economictimes.indiatimes.com/The_Big_Story/Potential_for_solar_energy_large_in_India/articleshow/2531030.cms

it invests that is at least sufficient to induce investors to purchase and hold the firm's debt and equity. In assessing the viability of a project, a firm should theoretically only invest in the project if the project IRR is greater than the weighted cost of debt and equity. The "Guidance on the Assessment of Investment analysis", (EB 41, Annex 45) Paragraph 11 states that "... *weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR*".

The guidance also states that in the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on publicly available data sources which can be clearly validated by the DOE. Such data sources may include local lending and borrowing rates, equity indices, or benchmarks determined by relevant national authorities.

Thus in view of the above, the Weighted Average Cost of Capital (WACC) has been chosen as the benchmark for assessment against the project IRR. The WACC methodology, as described below is a widely accepted method for calculating the cost of capital which is understood by both the finance community and the industry. WACC has been calculated by taking the respective proportion of debt and equity in the financing pattern as weights. Please note that in India, a debt to equity ratio of 70:30 is considered as the norm for financing hydro power projects[9]. The benchmark for the project has been derived based on the cost of equity financing representing the required return on capital by investors and the cost of debt financing representing required rate of return on capital by the creditors as illustrated below:

WACC= {D/(D+E)}*{1-T/100}*Cost of Debt + {E/(D+E)}*Cost of Equity

Of the examples suggested by the additionality tool, the project proponent has identified the *Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type* [paragraph 6(a) of sub-step 2b)] as the benchmark for cost of equity. The appropriate cost of debt has been taken as the *Prime lending rate* prevailing at the time of investment decision in accordance with "Guidance on the Assessment of Investment analysis", (EB 41). The same has been adjusted to tax rate in order to serve as a benchmark comparable to post tax IRR computations.

Cost of Debt:

Cost of debt is defined as the rate at which lenders agree to lend money to a project. The additionality tool and the guidance on assessment of investment analysis clarify that the benchmark for project with more than one potential developer should not be based on project specific parameters but should represent the standard in the market. Accordingly, the bank prime lending prevailing at the time of project start date has been considered as the cost of debt. The prime lending rate at the time of investment was in the range of 10.25% - 10.75% [Source Reserve Bank Web-link][10], the average PLR of 10.50% has been considered. Interest costs are tax deductible, therefore in order to arrive at the post tax cost of debt, the cost of debt is multiplied with marginal tax rate. The loan tenure of the project is 10 years, it may be noted that for the first 10 years of their operation, the power projects in India typically pay MAT owing to tax exemption as per the provisions of the Section 80IA of the Income Tax Act. Accordingly the marginal tax rate has been considered as 8.415% (MAT rate for the year 2005-06).

The post tax cost of debt therefore works out to: 10.50% * (1-8.415%) = 9.616%

Calculation of Required rate of return on Equity:

[9] Several regulations and orders refer this as the normative debt equity ratio for hydro power projects e.g. CERC (Terms & Conditions for the determination of Tariff) Regulations, Uttarakhand Electricity Regulatory Commission Regulations, IREDA's norms for financing renewable energy projects (http://www.ireda.in/pdf/Financing%20Norms.pdf) etc.

[10] http://www.rbi.org.in/scripts/WSSView.aspx?Id=10693

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM). The CAPM is a generally accepted methodology used worldwide to determine the required/expected return on equity based on potential risk of an investment.

Ke = Rf + β x (Rm - Rf)

where:

Ke = Rate of return on equity capital;

Rf = Risk-free rate of return;

β (Beta) = The stock's risk relative to that of the whole market;

Rm – Rf = Market risk premium;

Risk free rate:

The risk free rate is understood as the rate of return on an asset that is theoretically free of any risks, therefore the weighted average yield of Government of India Securities are considered as risk free rate determined at the time of project start i.e. at that point in time, the company had the alternative of this long term risk free investment. This data is published by Reserve Bank of India. (Source: Table – 7.5, Reserve Bank of India, Annual Report 2008, http://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/72360.pdf .

The applicable risk free rate is 7.34%.

Risk Premium:

The market risk premium, as measured and applied in practice, is the premium above the risk-free rate of return that investors expect to earn on a well-diversified portfolio of equities. The most common approach for estimating the risk premium is to base it on historical data. In the CAPM, the premium is estimated by looking at the difference between average return on stocks and return on government securities over a period of time.

The risk premium has been calculated as the difference in compounded annual return between the broad well diversified market portfolio represented by BSE-500 index and the Government bond rates since the year of inception of BSE 500, i.e. February 1999. The detailed calculations are presented in the attached excel sheet.

Source: BSE Stock Exchange (www.bseindia.com)

The applicable risk premium is 14.85%.

Beta:

Beta (β) indicates the sensitivity of the company to market risk factors. For companies that are not publicly listed, the beta is determined by referring beta values of publicly listed companies that are engaged in similar types of business. The project activity type is hydro power generation; the approach therefore should be to base the beta for the project on the beta values of listed hydro power generation companies in India. However, in the absence of adequate data on companies which are exclusively into the exactly same type of business (i.e. hydro power projects), the next best option for assessing the risk of these projects is to consider the data available on companies which are involved in similar businesses.

Therefore, we have considered beta values of all electricity generating companies in India. The group of companies considered includes renewable as well as conventional power generating companies. Investors demand a higher return from renewable energy projects than from conventional energy ones, given the higher risks in renewable, including risks of technology, risks from significantly varying and unpredictable resource availability (e.g. water in a run of the river project), and a lower established support base for such projects relative to that for conventional power (e.g. grid connections, bank finance, suppliers, etc.). The use of this Beta value is therefore considered conservative, as it does not add for the higher risk of non conventional energy.

The applicable Beta value has been determined on the basis of three year Beta values of all power generating companies in India which were listed on the stock exchange at the time of this investment. However, at the

time that BHPL took the decision to invest in the project, there were some power companies that were recently listed and hence did not have sufficient historical data for calculation of Beta. The following companies have thus been excluded due to lack of sufficient historical data as they were listed close to or after 22nd February 2006 (date of investment decision):

Sl. No.	Company	Date of Listing	Remarks
1.	Jaiprakash Hydro	18th April, 2005	Insufficient trading data available
2.	NTPC	5th November, 2004	Insufficient trading data available
3.	GVK Power	27th February, 2006	Listed post investment decision
4.	LITL	27th November, 2006	Listed post investment decision
5.	Torrent Power	28th November, 2006	Listed post investment decision

The equity betas for the power sector companies (having sufficient historical data) considered provide an estimated beta for the power sector. Beta values of individual companies have been sourced from Bloomberg.

The table below summarizes the equity beta values:

Name	Equity Beta
Tata Power	1.275
Reliance Infrastructure	0.921
BF Utilities	1.377
Neyveli Lignite	1.521
CESC	1.421
Gujarat Inds Power Co Ltd	1.323
Average	**1.306**

Source: Bloomberg[11]

The measured equity beta for a particular firm relates to the unique capital structure of that firm and that a change in the capital structure will change the degree of financial risk borne by the equity holders and hence the equity beta. Since financial leverage can vary across industries, countries and firms, and, furthermore, financial leverage is a determinant of beta, it is common to de-lever (i.e. stripping out the gearing component) comparable betas to arrive at an un-levered beta then to re-lever at the target financial leverage considered appropriate for the business in question. The asset beta (which is the equity beta that would apply if the assets were financed wholly with equity) is obtained with the following formula:

Modigliani - Miller Formula: $\beta_{asset} = \beta_{equity} / (1+(1-t)*(D/E))$

Where β_{asset} corresponds to the un-levered β and the β_{equity} to the levered β.

The following table illustrates the asset beta values of the companies estimated using the above formula:

Company Name	Asset Beta (Unlevered)
Tata Power	0.91
Reliance Infrastructure	0.61
BF Utilities	Company had net loss for the year 2006[12]
Neyveli Lignite	1.36
CESC	0.96

[11] The beta value used, are the regression betas calculated by Bloomberg based on periodic stock returns

[12] http://www.moneycontrol.com/stocks/company_info/directors_report.php?sc_did=BFU

Gujarat Inds Power Co Ltd	0.92
Average Asset Beta	**0.953**

The average asset beta of companies engaged in power sector is thus 0.953 and the same has been used to estimate the benchmark return on equity. Since the un-levered or asset beta is the least and most conservative beta (as opposed to re-levered beta and equity beta), the same has been chosen as a conservative estimate of the risk for the power sector.

The WACC is calculated as per the following formula:

WACC= {D/(D+E)}*{1-T/100}*Cost of Debt + {E/(D+E)}*Cost of Equity

The WACC thus estimated is equal to 13.18%. (Detailed calculations of WACC are explained in the Benchmark estimation excel sheet).

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):

The project internal rate of return for the proposed project activity without CDM revenues has been computed for a period of 10 years in accordance with the "Guidance on the assessment of Investment Analysis" paragraph 3, which states that *'a minimum period of 10 years and a maximum of 20 years* period of assessment *will be appropriate'*. Further, since the project activity is being setup through 70% debt, the project proponent would be required to repay the principal as well as interest on outstanding debt within the ten year period. Also, the "Guidance on the Assessment of Investment Analysis" Version 2 (EB 51, Annex 58) paragraph 9, states that "the purpose of the project IRR calculation is to determine the viability of the project to service debt". Hence, the period of assessment of project IRR should be representative of the period of loan repayment, in line with the expectations of the debt creditors and since the loan forming 70% of the project cost is to be repaid within ten years of project operation, consideration of revenue beyond this period for financial analysis would no longer represent the interests of the debt creditors.

The IRR computation is based on the following assumptions[13] including various benefits available to the project activity from the National and Sectoral policies for promoting renewable energy generation in India. In compliance with the 'Guidance on the Assessment of Investment Analysis' (EB 51), Paragraph 6, which clarifies that 'Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant', assumptions adopted for the IRR analysis have been sourced from the DPR prepared during project inception by a reputed independent engineering consultancy 'TCE Consulting Engineers Ltd.' as envisaged at the time of investment decision making. The same has duly been approved by Department of Energy, Govt. of Uttrakhand and implementation approval for the project has been granted on the basis of this DPR. Please note that the DPR was finalised and submitted to the GOU on 30/01/2006 (Attachment 14), which was only twenty two days before the investment decision, and thus were valid and applicable at the time of investment decision.

The assumptions used to calculate the project IRR are listed below:

Particulars	**Units**	**Input**	**Source**
Installed Capacity	MW	24	Detailed Project Report
Primary Energy (90% dependable yr)	Million kWH	134.7	Detailed Project Report
Generation at 50% dependable year (LUs)	Million kWH	170.9	Detailed Project Report The generation figure corresponds to a Plant Load Factor (PLF) of 81.28%. Since the DPR has been prepared by a

[13] The Investment analysis includes various benefits available to the project activity from the national and sectoral policies for promoting renewable energy generation in India such as tax holidays etc.

			contracted third party engineering consultancy (TCE Consulting Engineers Ltd.) and has been further approved for implementation by the Government of Uttarakhand, it complies with "Guidelines for the reporting and Validation of Plant Load Factors", Version 01 (EB48, Annex 11). Suitability: Since 50% dependable year has been chosen instead of 75% or 90%, which gives a higher generation figure, the value used is conservative.
Capacity Index Achieved (CIA) (%): First Year Second Year onwards	 % %	 100% 100%	Detailed Project Report assumes 90% CIA from the 1st year and 95% CIA from the 2nd year, however, IRR analysis assumes 100% CIA for conservativeness in line with the Emission Reduction Calculations of the PDD.
Auxiliary Consumption (%)	%	0.5%	Detailed Project Report and also as per UERC Notification Regulation No. 3 Page 8, dated 14/05/2004
Transformation Loss (%)	%	0.5%	Detailed Project Report and also as per UERC Notification Regulation No. 3 Page 8, dated 14/05/2004
Water Royalty (%) first 15 years	%	0%	Policy on Hydro Power Development in the state of Uttarakhand Page 5
TARIFF	Detailed Project Report assumes sale to Uttaranchal Power Corporation Limited (UPCL)		
Annual Capacity Charges	The Capacity Charges are computed in accordance with the following formula: Capacity Charges = (Annual Fixed Charges - Primary Energy Charges). The Annual Fixed Charges (AFC) consists of (a) Interest on Loan Capital; (b) Depreciation including Advance against depreciation; (c) Return on equity; (d) Operation & Maintenance expenses and (e) Interest on working capital.		
Primary Energy Charges			
Lowest variable charges of the central sector thermal power generating station of the concerned region	INR/kWh	0.66	Detailed Project Report
Annual Escalation	%	2%	Detailed Project Report
O&M EXPENSES			
- O&M Charges (% of project cost)	%	1.50%	DPR and also as per UERC Notification Regulation No. 3 Page 16, dated 14/05/2004. As per the DPR, O&M Expenses for first five years of operations are fixed at 1.5% of the capital cost to be escalated at 4% per annum. The O&M Costs are re-set on every fifth anniversary to the average O&M Costs over the last 5 years with an
- Escalation on O&M	%	4.00%	

			escalation of 4% per annum.
DEBT PARAMETERS			
- Quantum of Debt financing	%	70%	Detailed Project Report
- Amount of Debt	INR	13271	Detailed Project Report
- Repayment Period	years	10	Detailed Project Report
- Moratorium after start of operations	yrs	0	Detailed Project Report
- Interest on term loan	%	9.50%	Detailed Project Report. The analysis in the DPR assumes interest at a rate of 9.5% throughout the repayment program, which is about 75 basis points below SBI-BPLR (10.25%).
Return on Equity	%	14%	As per DPR & UERC Notification Regulation No. 3 Page 15, dated 14/05/2003
WORKING CAPITAL			
- Maintenance Spares (% of project cost)	%	1%	DPR and also as per UERC Notification Regulation No. 3 Page 16, dated 14/05/2004
- Escalation on spares	%	6%	DPR and also as per UERC Notification Regulation No. 3 Page 16, dated 14/05/2004
- Interest on working capital	%	10.25%	Detailed Project Report
TAXATION - INCOME TAX PARAMETERS			
Fringe Benefit Tax (FBT)			In accordance with the Income Tax Act, Detailed Project Report assumes that 10% of the O&M expenses would relate to expenses under the ambit of Fringe Benefit Tax (FBT). 20% of these expenses will be subject to payment of FBT at the rate of 33.66% (30% tax + 10% surcharge + 2% education cess).
O&M Expenses in the ambit of FBT	%	10.0%	
O&M Expenses subject to FBT	%	20.0%	
Rate of FBT	%	33.66%	
MAT including surcharge and including Education Cess	%	8.42%	Income Tax Act
Regular Tax including surcharge and including Education Cess	%	33.66%	Income Tax Act
Tax Exemption under Section 80 IC - For first 5 years	%	100%	In accordance with the Income Tax Act, Detailed Project Report assumes availability of tax benefit under Sec 80 I.C. to be available for the project. As per section 80IC of the IT Act, hydropower generation projects in the state of Uttaranchal are eligible for 100% tax exemption for a period of first 5 years and 30% for the next 5 years.
Tax Exemption under Section 80 IC - For next 5 years	%	30%	
DEPRECIATION RATES			
Depreciation Rate for Book purposes	%	4.32	Detailed Project Report, Table 10.6 a. and b. The Companies Act prescribes the rate for

			charge of depreciation on SLM / WDV basis. The prescribe rates of depreciation on SLM basis are applied to arrive at the weighted average rate of depreciation (4.32%) across all depreciable assets.
Depreciation rate for Tax purposes	%	12.5	Detailed Project Report, Table 10.6 a. and b. The project is eligible for deduction of depreciation at prescribed rates on SLM / WDV basis. The prescribe rates of depreciation are applied on WDV basis to arrive at the weighted average rate of depreciation (12.52%) across all depreciable assets.
Fair Value/Salvage Value	INR Million	760.6	The fair value includes both the book value of the asset at the end of 10th year and the cost of land (non-depreciable asset).

Using the assumptions in the table above, the post-tax project IRR for the project activity works out to be **10.49%,** calculated in accordance with the "Guidance on the Assessment of Investment Analysis" Version 03, which clearly depicts the fact that the project activity is not very attractive as an investment option since the returns are much below the selected benchmark.

Sub-step 2d: Sensitivity analysis

The sensitivity analysis of the Project IRR for the project activity was carried out in accordance with the "Guidance on the Assessment of Investment Analysis" Version 03 which states that **"***Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation".* Accordingly, four scenarios have been identified, viz., variation in energy generation, tariff, capital cost and Operation and Maintenance cost. Besides analysis is also carried out to indicate at what percentage of change in the critical parameters IRR reaches the benchmark return.

Based on the hydrological studies and the discharge data available for Bhilangana river, the DPR estimates the power potential based on total power generated (in Million kWh) with 90%, 75% and 50% dependability. For conservativeness, 50% dependable annual generation being the highest has been assumed for IRR calculation. The probability for increase in annual generation above this value during the project lifetime is very less and beyond the control of project proponent. Further, the DPR also states that the power plant will achieve a capacity index of 90% in the first year and 95% from the subsequent years of operation, however, in the estimation of IRR, the power plant has been assumed to achieve 100% capacity index in accordance with the emission reduction calculations in the PDD, in all years of operation for conservativeness. Nevertheless, a sensitivity of 10% increase and decrease has been performed.

The UERC has notified detailed regulations titled "Uttaranchal Electricity Regulatory Commission (Terms and Conditions for Determination of Hydro Generation Tariff) Regulations, 2004" (UERC Regulations) for determination of tariff which is calculated in the DPR for the proposed project activity. The tariff is determined using cost plus approach wherein the tariff is two-part and comprises of recovery of Annual Capacity Charges and Primary Energy Charges. The Capacity Charges are computed in accordance with the following formula:

Capacity Charges = (Annual Fixed Charges - Primary Energy Charges).

The Annual Fixed Charges (AFC) consists of (a) Interest on Loan Capital; (b) Depreciation including Advance against depreciation; (c) Return on equity; (d) Operation & Maintenance expenses and (e) Interest on working capital. Rate of primary energy will be equal to the lowest variable charges of the central sector thermal power generating station of the concerned region. A sensitivity of increase and decrease in tariff by 10% has been performed.

The capital cost of the project activity mainly comprises of the cost of plant and machinery and the civil works. With the expected trend of rise in steel and cement prices in the future, the capital cost is expected to only increase and not decrease from the assumed values. Nevertheless, a sensitivity of 10% increase and decrease has been performed.

The operation & maintenance expenses have been assumed (as being 1.5 % of the project Cost with an escalation of 4% per annum) from the DPR in accordance with the UERC (Terms and Conditions for Determination of Hydro Generation Tariff) Regulations. A sensitivity of increase and decrease in these expenses by 10% has also been performed.

The results of the sensitivity analysis are summarized below:

Results of Sensitivity Analysis	**-10%**	**0%**	**10%**
Energy Generation	9.87%	10.49%	11.10%
Tariff	8.67%	10.49%	12.28%
Capital Cost	10.72%	10.49%	10.30%
O&M Cost	10.48%[14]	10.49%	10.49%

The results of the sensitivity analysis clearly illustrate that even with variation in critical parameters of the project activity, the project IRR remains lower than the benchmark rate of return (Weighted Average Cost of Capital). Thus it can be justifiably concluded that the proposed project activity is unattractive and would not have been implemented without benefits from sale of revenues through CDM. Hence the project activity is additional.

Step 4 : Common Practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity:
Provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis. Provide documented evidence and, where relevant, quantitative information. On the basis of that analysis, describe whether and to which extent similar activities have already diffused in the relevant region.

Small Hydro Power Scenario (SHP) in India (with focus on Northern region, particularly Uttarakhand)

[14] The project IRR reduces with the decrease in O&M costs owing to the corresponding decrease in tariff applicable to the project activity. This is attributed to the cost plus approach in the determination of tariff which is dependent on O&M costs being one of the parameters to derive annual capacity charges.

In India, hydro projects up to 25 MW station capacity have been categorized as Small Hydro Power (SHP) projects and the mandate for the subject small hydro power (up to 25 MW) is given to Ministry of New and Renewable Energy. Small hydro power projects are further classified as[15]:

Class	Station Capacity in kW
Micro Hydro	Up to 100
Mini Hydro	101 to 2000
Small Hydro	2001 to 25000

As per the statistics available (as on 31.03.2007), share of SHP in the total installed generation capacity of the country is very paltry, i.e. a mere 1975.60 MW[16], against the total power generation capacity of 132329.21 MW. Further, since the estimated potential of Small Hydro Power is about 15,000 MW[17] in the country and the total installed capacity of SHPs is only 1975.60 MW[18], this reflects that only 13% of the overall potential has been exploited.

Considering Northern region, the total installed capacity of power plants is 36,359.4 MW (Annex 3) against the small hydro installations is around 564.6 MW[19], thereby indicating that small hydro projects account only to a negligible 1.55% of total generation in the northern region.

In Uttarakhand alone, the potential for small hydro projects (below 25 MW) is approx. 1478 MW[20]. However, the total installed capacity of small hydro power plants is only 75.6 MW (as on 31.03.2007)[21] thereby indicating a huge untapped potential of small hydro power (around 95%) in Uttarakhand. This lack of development of SHP has occurred despite the existence of substantial undeveloped hydro resources in the state. This can be further substantiated by the data published on hydro power schemes in India in the New Hydro Power Policy.[22]

According to the tool for demonstration and assessment of additionality Version 05, projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. The project activity under consideration is a small hydro project with installed capacity 24 MW. Similar project activity is being considered as any small hydro project with an installed capacity between 2 MW to 25 MW[23] (projects classified as being small hydro by the Ministry of Non-Conventional Energy Sources) and set up by a single private investor within a particular time frame in the state of Uttarakhand for the sale of power to the grid.

The projects excluded from the definition of a similar scale project and the justification for the exclusions is provided below:

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[15] http://www.mnre.gov.in/

[16] http://www.cea.nic.in/power_sec_reports/Executive_Summary/2007_03/22-28.pdf

[17] MNRE Annual report (2006-07)

[18] http://www.cea.nic.in/power_sec_reports/Executive_Summary/2007_03/22-28.pdf

[19] http://mnes.nic.in/ (Small Hydro Power Programme) : Calculated as sum of states coming under the Northern regional grid

[20] http://www.Uttaranchaljalvidyut.com/newsite/small_hydroplants.htm

[21] http://mnes.nic.in/ (Small Hydro Power Programme)

[22] Hydro Schemes in Operation (Source : Hydro Power Policy 2008)

[23] http://mnes.nic.in/prog-smallhydro.htm

1. Public sector projects – The access to finance is completely different and hence is exposed to a different investment climate than a private investor.
2. Mini/Micro (1kW to 2000kW) hydro projects have not been considered for the analysis as the scale of these projects and the scale of investment is not comparable to the project activity under consideration.
3. CDM Project activities – Projects which are under the CDM pipeline have to be excluded as per the guidance provided by the tool for demonstration and assessment of additionality.
4. Project activities implemented post the start date of the project activity i.e. post 26th March 2007, since for common practice analysis as per the guidance, only those projects can be compared which are under operation prior to the start of the proposed project activity.

As per the information available on the small hydro power plants (plants with capacity less than 25 MW) in Uttarakhand (UJVNL website), majority of the 23 Small hydro power plants operational in the state are less than 2 MW[24] i.e. most of them fall in the classification of mini or micro hydro projects and hence excluded. Only 7 small hydro power plants listed below are in operation with capacities between 2 and 25 MW[25]:

Projects in Operation (2 to 25 MW)

No.	Name of the Project	Name of River / Canal	Run-of the-river (ROR) / Canal	Capacity (MW)
1	Kanchauti	Kanchautigad	ROR	2.0
2	Pathri	Upper Ganga Canal	Canal	20.4
3	Pilangad	Pilangad	ROR	2.25
4	Urgam	Kalpganga	ROR	3.0
5	Galogi	Bhattafall	ROR	3.0
6	Mohamadpur	Upper Ganga Canal	Canal	9.30
7	Relagad	Relagad	ROR	3.0
	Total			**42.95 MW**

All of these seven projects have been implemented by Uttarakhand Jal Vidyut Nigam Limited (UJVNL)[26]. UJVNL is a wholly owned corporation of the Government of Uttarakhand (public sector) mandated for managing hydro power generation at existing power stations and development of new hydro projects with the purpose of harnessing hydro power resources of the state. Being public sector projects, these projects have easier access to funds and lower expectations in terms of financial return. Thus these projects cannot be compared to a private sector investment of the scale of the proposed Bhilangana III hydro project.

Thus, after exclusion of the above project activities, as stipulated by the guidance for conducting common practice analysis provided by the additionality tool, **it was found that there were no similar scale project activities under operation in the state of Uttarakhand at the time of start of the proposed project activity.**

Sub-step 4b: Discuss any similar options that are occurring:

[24] http://www.uttaranchaljalvidyut.com/

[25] http://www.uttaranchaljalvidyut.com/

[26] UJVNL is a wholly owned Corporation of the Government of Uttarakhand set up for managing hydro power generation at existing power stations and development, promotions of new hydro projects with the purpose of harnessing the hydro power resources of the State. ([26] http://www.Uttaranchaljalvidyut.com/newsite)

As discussed in the sub-step above, it is evident that there are no small hydro plants with private sector participation similar to the project activity are operational in Uttarakhand and thus the project activity is not a common practice in the region.

Considering the barriers described in sections above, the impact of CDM registration of the project activity would be very much beneficial and multi-fold.

- The approval and registration of the proposed project activity as a CDM project would lead to annual flow of additional revenue to the project proponent for a period of ten years thereby improving the returns from the project activity alleviating investment and institutional risks to a certain extent.
- The successful registration also provides an incentive for other entrepreneurs to invest in small hydro power projects and contribute to development of the identified SHP existing in the region. As has been seen by the statistics presented in section above, there is tremendous potential of generating clean power by the development of SHP potential identified. All these potential sites are usually in the hilly regions and thereby posing similar barriers as mentioned above. Thus, CDM registration would give a boost towards the development of such environment friendly projects.
- Additionally the project activity leads to reduction of greenhouse gases which would have been released in the absence of the proposed project activity by the operation of fossil fuel based plants in the grid.
- Also the project activity leads to reduction in imbalance of the grid mix resulting in diversification of regional grid supply and making it more sustainable in the long term.

Thus, CDM revenues would act as a risk mitigation tool in overcoming barriers and imparting viability to the project activity. In the absence of the project activity, equivalent electricity would have been generated in the regional grid which is primarily fossil fuel based and would have lead to GHG emissions.

B.6. Emission reductions:

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B.6.1. Explanation of methodological choices:

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Emission Reductions

The project activity mainly reduces carbon dioxide through displacement of grid electricity generation with fossil fuel based power plants by renewable energy based electricity. 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 (L_y), as follows:

$$\mathbf{ER_y = BE_y - PE_y - L_y}$$

According to the consolidated methodology ACM0002 version 08, baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

$$\mathbf{BE_y = (EG_y - EG_{baseline}) * EF_{grid,CM,y}}$$

Where:

BE_y	=	Baseline emissions in year y (tCO_2e/yr).
EG_y	=	Electricity supplied by the project activity to the grid (Mwh).
$EG_{baseline}$	=	Baseline electricity supplied to the grid in the case of modified or retrofit facilities (Mwh). For new power plants this value is taken as zero.
$EF_{grid,CM,y}$	=	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".

Since the project activity is the installation of a new grid-connected renewable power plant, $\mathbf{EG_{baseline} = 0}$

Thus, $\mathbf{BE_y = EG_y * EF_{grid,CM,y}}$

The baseline emission factor ($EF_{grid,CM,y}$) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors calculated according to the version 01.1 of "Tool to calculate the emission factor for an electricity system", using the following six steps:

Step 1: **Identify the relevant electric power system**
As explained in Step 2 of Section B.4 above, Northern Regional Grid has been identified as the relevant electric power system in this case.

Step 2: **Selecting an Operating Margin (OM) method**
Version 01.1 of "Tool to calculate the emission factor for an electricity system" provides four options for calculating the operating margin emission factor ($EF_{grid, OM, y}$), and guidance for choosing the option for the corresponding project activity. The options are:
a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch Data Analysis OM, or
d) Average OM.

The tool does not rely on any one method as a preferable methodological choice and states that any of four methods can be used. In this case, simple OM method has been chosen to calculate the operating margin emission factor ($EF_{grid, OM, y}$).

The choice of using this option for calculating the operating margin emission factor depends on the generation of electricity from low cost/must run sources. Simple OM method (option a) can be used only if low-cost/must-run resources constitute less than 50% of total grid generation in:
1) Average of the five most recent years, or
2) Based on long-term averages for hydroelectricity production.

In the context of Version 01.1 of the "Tool to calculate the emission factor for an electricity system", 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.

Table 3: Share of Low Cost / Must-Run (% of Net Generation)

Share of Low cost / Must-Run (% of Net Generation)						
	2001-02	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**
North	25.7%	26.1%	28.1%	26.8%	28.1%	27.1%
East	13.4%	7.5%	10.3%	10.5%	7.2%	9.0%
South	25.5%	18.3%	16.2%	21.6%	27.0%	28.3%
West	8.5%	8.2%	9.1%	8.8%	12.0%	13.9%
North-East	41.7%	45.8%	41.9%	55.5%	52.7%	44.1%
India	18.9%	16.3%	17.1%	18.0%	20.1%	20.9%

Ref: CO_2 Baseline Database for the Indian Power Sector – CEA, Version 3, December 2007

Percentage of total grid generation by low cost/must run plants in the northern grid (on the basis of average of five most recent years) = 27.3 %

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 for the project activity is justified.

In terms of data vintage, 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 calculating 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.*

In this case, *Ex ante* option has been chosen for estimating the simple OM emission factor wherein as described above, 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) during the crediting period will be undertaken, without requirement to monitor and recalculate the emission factor.

Step 3: **Calculating the Operating Margin emission factor ($EF_{grid, OM, y}$)**
Among the aforesaid four options, the **Simple Operating Margin** is used for the project activity as justified above.

Simple OM: The Simple OM emission factor ($EF_{grid, OMsimple, y}$) 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-operating cost and must-run power plants. It may be calculated:

- Based on data on fuel consumption and net electricity generation of each power plant / unit (Option A), or
- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit (Option B), or
- Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option C)

Option A is the preferred choice according to the "Tool to calculate the emission factor for an electricity system", version 01.1. 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 CEA has compiled the CO_2 Database based upon generation, fuel consumption and fuel gross calorific value (GCV) data furnished by each power station. The simple OM emission factor has thus been calculated using **option A** i.e. based on data on fuel consumption and net electricity generation of each power plant / unit. The details of same can be found on CEA website at http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm. Hence in this case, Option A has been used.

According to Option A, the simple OM emission factor is calculated as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} FC_{i,m,y} \; \mathbf{GCV_{i,y}} \; EF_{CO2,i,y}}{\sum_{m} EG_{m,y}}$$

Where :

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

$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power plant / unit *m* in year *y* (mass or volume unit)
$GCV_{i,y}$	=	Gross calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ) based on GCV
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by power plant / unit *m* in year *y* (MWh)
m	=	All power plants / units serving the grid in year *y* except low-cost / must-run power plants / units
i	=	All fossil 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

Since ex-ante option has been selected for data vintage, the Simple OM emission factor ($EF_{OM,simple,y}$) is taken for the most recent three years and an average value has been considered as the OM emission factor for the baseline ($EF_{grid, OM,y}$).

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 at http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm.

Operating Margin Estimation for Northern Grid (tCO_2 / MWh)	
OM, 200-05	0.9801
OM, 2005-06	0.9992
OM, 2006-07	0.9985
Average OM ($EF_{grid, OM,y}$)	**0.9926**

Step 4: Identify the cohort of power units to be included in the build margin

The sample group of power units m used to calculate the build margin consists of either:

a) The set of five power plants that have been built most recently, or

b) The set of power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

From these two options, the sample group that comprises the larger annual generation should be chosen.

Since in India, the installed capacity and corresponding annual generation from power plants is quite high, the sample group containing set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently comprise the sample group with the larger annual generation. Thus, the sample group *m* consisting of option (b) is used for the estimation of build margin.

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.

Option 1 has been chosen in this case.

Step 5: Calculation of the Build Margin Emission Factor $EF_{grid, BM,y}$

The Build Margin emission factor ($EF_{grid, BM, y}$) is calculated as 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 :

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid, BM, y}$ = Build margin CO_2 emission factor in year y (tCO2 / 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 (tCO2 / Mwh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

The emission factor ($EF_{EL,m,y}$) is determined as follows:Central Electricity Authority (CEA) has estimated 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. In this case, CEA data has been used as :

Build Margin Estimation for Northern Grid (tCO_2 / MWh)	
BM ($EF_{grid, BM, y}$), 2006-07	0.6283

Step 6. Calculation of Combined Margin Emission Factor

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

$$\mathbf{EF_{grid, CM, y}} = w_{OM} \cdot \mathbf{EF_{grid, OM,y}} + w_{BM} \cdot \mathbf{EF_{grid, BM,y}}$$

Where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{grid, OM, y}$ and $EF_{grid, BM, y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh.

For wind and solar projects, the default weights are as follows: $w_{OM} = 0.75$ and $w_{BM} = 0.25$ (owing to their intermittent and non-dispatchable nature).

Being a hydro power project, default value of the weights for Operating and Build Margin are being used.
i.e., $w_{OM} = w_{BM} = 0.5$

As aforesaid, Central Electricity Authority (CEA) has calculated the baseline emission factors for the various regional grids in India according to the formulas specified above. As this is the most authentic information

available in the public domain, the baseline emission factor used in the calculation of baseline emissions for the proposed project activity is being referred from the same for transparency and conservativeness[27].

Combined Margin Estimation for Northern Grid (tCO_2 / MWh)	
OM, 2004-05	0.9801
OM, 2005-06	0.9992
OM, 2006-07	0.9985
Average OM ($EF_{grid, OM,y}$)	**0.9926**
BM, 2006-07 ($EF_{grid, BM, y}$)	**0.6283**
Combined Margin ($EF_{grid, CM,y}$)	**0.8104**

Project activity emissions

According to the chosen baseline methodology ACM0002 Version 08, *for hydro power project activities that result in new reservoirs and hydro power project activities that result in the increase of existing reservoirs, project proponents shall account for project emissions, estimated as follows*.

a) If the power density (*PD*) of power plant is greater than 4 W/m2 and less than or equal to 10 W/m^2:

$$PE_y = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Where,

PE_y = Emission from reservoir expressed as tCO_2e/year

ES_{Res} is the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO_2e /MWh.

TEG_y = Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh).

b) If the power density of the project is greater than 10 W/m^2: $PE_y = 0$.

Since the BHPL project activity is a run-of-river hydro project that results in a new reservoir with power density of 16,489 W/m^2, (greater than the threshold value of 10 W/m^2), hence according to the chosen baseline methodology ACM0002 Version 08, project emissions are nil. i.e. $PE_y = 0$.

The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

PD = Power density of the project activity, in W/m^2.

Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W).

Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.

A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).

A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

[27] http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Thus, for the BHPL project activity:
PD = (24 x 10^6 – 0) / (1455.5 – 0) = 16,489 W/m^2

Further, another possible source of project emissions at the site can be the emissions due to Diesel consumption in the DG sets proposed to be installed at the site. The emissions on account of this will be estimated as follows:

$$\mathbf{PE_{y,\,diesel} = Q_{diesel}\ x}\ \rho_{diesel} \times EF_{diesel}/1000$$

Where

Q_{diesel} = Quantity of diesel consumed, litre
ρ_{diesel} = Density of diesel, 0.860 kg/ litre[28]
EF_{diesel} = Emission factor of diesel, 3.186 tCO_2e/ tonne (IPCC Default value)

And

$EF_{diesel} = NCV_{diesel} \times COEF_{diesel}$
Where;
NCV_{diesel} = Net calorific value of diesel; TJ/ Gg (43.0 - IPCC default)[29]
$COEF_{diesel}$ = Effective CO_2 emission factor of diesel; tCO_2e/ TJ (74.1 - IPCC default)

For the ex-ante estimation, the project emissions from diesel generation are considered to be zero.

Leakage
According to ACM0002 Version 08, the main emissions potentially giving rise to leakage in the context of electricity sector projects are emissions arising due to activities such as power plant construction, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects). Project participants do not need to consider these emission sources as leakage in applying this methodology. Project activities using ACM0002 Version 08 shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario. Thus, the leakage emissions are nil.

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	$GCV_{i,y}$
Data unit:	Kcal/kg
Description:	Gross calorific value (energy content) of fossil fuel types
Source of data used:	Utility Records
Value applied:	Refer Attached excel sheet and User Guide
Justification of the choice of data or description of measurement methods and procedures actually applied :	Monitoring Frequency – Determined once for the crediting period (exante approach) Station specific GCV's are used. Further, default values were used for some thermal stations where station-specific GCVs were not available.
Any comment:	The data will be archived for two years beyond the crediting period.

[28] http://www.iocl.com/Products/DieselSpecifications.pdf , page 1, sl.no. xiv. Maximum value of density i.e. 0.860 kg/ l has been considered for the conservative estimation of project emissions for diesel combustion.

[29] Source of IPCC default value: 2006 IPCC guidelines for National GHG Inventories - Table 1.2 for NCV value of diesel, and Table 1.4 for effective CO2 emission factor for diesel

Data / Parameter:	$FC_{i,m,y}$
Data unit:	Tonnes
Description:	Amount of fossil fuel type consumed by power plant / unit
Source of data used:	Utility Records
Value applied:	Refer Attached excel sheet and User Guide
Justification of the choice of data or description of measurement methods and procedures actually applied :	Monitoring Frequency – Determined once for the crediting period (exante approach) For the calculation of Build Margin emission Factor, the amount of fossil fuel type consumed has been calculated at unit level based on heat rates in the absence of unit level data on fuel consumption.
Any comment:	The quality of station-level data was ensured through extensive plausibility testing and interaction with the station operators.The data will be archived for two years beyond the crediting period.

Data / Parameter:	$EFCO_{2,i,y}$
Data unit:	gCO_2/MJ
Description:	CO_2 emission factor of fossil fuel type based on GCV
Source of data used:	India's Initial National Communication to UNFCCC, IPCC 2006
Value applied:	Refer Attached excel sheet and User Guide
Justification of the choice of data or description of measurement methods and procedures actually applied :	Monitoring Frequency – Determined once for the crediting period (exante approach) The emission factors for coal and lignite were based on the values provided in India's Initial National Communication under the UNFCCC (Ministry of Environment & Forests, 2004). The emission factor for coal is supported by the results of an analysis of approx. 120 coal samples collected from different Indian coal fields. Since the values in the National Communication are based on the NCV (Net Calorific Value), they were converted to GCV basis using a formula also furnished in the National Communication. For all other fuels, default emission factors were derived from the IPCC 2006 Guidelines. In line with the Grid Tool, the low end values of the 95% confidence intervals indicated by IPCC were used. The IPCC default factors were converted to GCV basis using IEA default conversion factors.
Any comment:	The data will be archived for two years beyond the crediting period.

Data / Parameter:	$EG_{m,y}$
Data unit:	GWh
Description:	Net electricity generated and delivered to the grid by power plant / unit
Source of data used:	Utility records
Value applied:	Refer Attached excel sheet and User Guide
Justification of the choice of data or description of measurement methods and procedures actually applied :	Monitoring Frequency – Determined once for the crediting period (exante approach) At the station level, the following assumptions were made where the relevant data could not be provided by a station: - For hydro stations, only gross generation was available, but not net generation data. Therefore, the CEA standard value for auxiliary power consumption in hydro units (0.5%) was applied to derive the net generation from the gross generation data reported by the stations. - Likewise, CEA standard values for auxiliary power consumption had to be applied for some of the gas- and diesel-fired thermal stations. At unit level, the following assumptions were made for those units falling into the build margin (i.e. the most recently built units comprising 20% of net generation):

	- For some stations, gross generation data were not available at unit level. Therefore the plant load factor of the respective station was used to derive the gross generation of the units. For units commissioned after the start of the relevant fiscal year, the gross generation was further adjusted pro rata the number of days since commissioning. Net generation data is generally not measured at unit level. Two distinct approaches were applied to estimate net generation: 1. The auxiliary consumption (in % of gross generation) of the unit was assumed to be equal to that of the respective stations in the following cases: a. All units of a station fall into the build margin; or b. All units of a station have the same installed capacity; or c. The units in the station have different capacities but do not differ with respect to the applicable standard auxiliary consumption. 2. In all other cases, standard values for auxiliary consumption adopted by CEA were applied.
Any comment:	The quality of station-level data was ensured through extensive plausibility testing and interaction with the station operators.The data will be archived for two years beyond the crediting period.

Data / Parameter:	$EF_{grid, OM, y}$
Data unit:	tCO_2/MWh
Description:	Operating Margin emission factor for Northern Regional Grid
Source of data used:	Referred from CO_2 Baseline Database for the Indian Power Sector prepared by Central Electricity Authority, Version 3.0, December 2007.
Value applied:	0.9926
Justification of the choice of data or description of measurement methods and procedures actually applied :	CEA has calculated it as per ACM0002 (Version 08) and Tool to calculate Emission Factor for Electricity System (Version 01) with 3 years vintage data (2004-05, 2005-06 and 2006-07) and option of ex ante calculation based on Simple Operating Margin Method. Computed once during PDD finalization.
Any comment:	The data will be archived for two years beyond the crediting period.

Data / Parameter:	$EF_{grid, BM, y}$
Data unit:	tCO_2/MWh
Description:	Build Margin emission factor for Northern Regional Grid
Source of data used:	Referred from CO_2 Baseline Database for the Indian Power Sector prepared by Central Electricity Authority, Version 3.0, December 2007.
Value applied:	0.6283
Justification of the choice of data or description of measurement methods and procedures actually applied :	CEA has calculated it as per ACM0002 (Version 08) and Tool to calculate Emission Factor for Electricity System (Version 01) for the year 2006-07. The build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation and option of ex ante calculation. Computed once during PDD finalization.
Any comment:	The data will be archived for two years beyond the crediting period.

Data / Parameter:	$EF_{grid, CM, y}$
Data unit:	tCO_2/MWh
Description:	Combined Margin CO_2 emission factor for Northern Regional Grid
Source of data used:	CEA has calculated it as per ACM0002 (Version 08) and Tool to calculate

	Emission Factor for Electricity System (Version 01) with option of *ex-ante* based on 50% of OM and 50% of BM values. Computed once during PDD finalization,
Value applied:	0.8104
Justification of the choice of data or description of measurement methods and procedures actually applied :	CEA has calculated it as per ACM0002 with 3 years vintage data and option of ex ante calculation based on "50% of OM and 50% of BM values approach". Computed once during PDD finalization.
Any comment:	The data will be archived for two years beyond the crediting period.

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data to be used:	BHPL Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since it is a new hydro plant, as mentioned in the chosen methodology ACM0002, version 08, the value is taken to be zero.
Any comment:	-

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m_2). For new reservoirs, this value is zero.
Source of data to be used:	BHPL Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the reservoir in the project case is new, as mentioned in the chosen methodology ACM0002, version 08, the value is taken to be zero.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

>>

The ex-ante emission reductions calculations are as follows:

$$\mathbf{ER_y = BE_y - PE_y - L_y}$$

Where:
ER_y : Emission reduction (tCO_2)
BE_y : Baseline emissions (tCO_2)
PE_y : Project Emissions (tCO_2)
L_y : Leakage emissions (tCO_2)
y: a given year

Project activity emissions (PE_y)
Since the power density of the project activity is greater than 10 w/m^2, according to ACM0002 version 08, greenhouse gas emissions from the new reservoir created due to the project activity are zero. Further, for the ex-ante estimation, the project emissions (CO_2) from diesel generation are also considered to be zero.
Hence $PE_y = 0$

Leakage (L_y)
According to the methodology (ACM0002, version 08), the leakage of the proposed project is not considered. No leakage is expected.
Therefore, $L_y = 0$.

Hence: $\mathbf{ER_y = BE_y}$

Baseline emissions are given by:
$$\mathbf{BE_y = EG_y * EF_{grid,CM,y}}$$

Where:
EG_y : Electricity supplied by the project activity to the grid (MWh)
$EF_{grid, CM, y}$: 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". (tCO2 / MWh)

$$\mathbf{EF_{grid, CM, y} = w_{OM} EF_{grid, OM, y} + w_{BM} . EF_{grid, BM, y}}$$

Where:
w_{OM}: Operating Margin weight, which is 0.5 by default
$EF_{grid, OM, y}$: Operating Margin emission factor (tCO_2 / MWh)
w_{BM} : Build Margin weight, which is 0.5 by default
$EF_{grid, BM, y}$: Build Margin emission factor (tCO_2 / MWh)
y: a given year

$\mathbf{EG_y}$ is calculated as follows based on the study conducted by the 3rd party engineering company TCE Consulting Engineers Limited contracted by BHPL (thus complying with EB 48, Annex 11):

S.No.	Description	Value	Source
A	Energy at Generator Terminal for a 50% dependable year[30] (MWh) - TEG_y	170,880	Detailed Project Report

30 Generation forecast for hydro-projects is done on the basis of 90% and 50% dependable years discharge data. While planning the hydro projects, long term continuous discharge data is taken into consideration. Thereafter, unrestricted energy generation of these hydrological years is arranged in descending order and exceedance probability computed. Based on the exceedance probability, dependable years are identified. If discharge data for 'N' years is available, the 50% dependable year is defined as (N+1) x 0.5 year in the

B	Auxiliary Consumption (%)	0.5%	Detailed Project Report
C	Transformation Losses (%)	0.5%	Detailed Project Report
D	Electricity supplied by the project activity to the grid (MWh) in subsequent years i.e. 2010-11 onwards	169,171	Calculated (D=A*(1-B-C)

Combined margin CO_2 emission factor for grid connected power generation in year y ($\mathbf{EF_{grid, CM, y}}$) = 0.8104 (tCO_2 / MWh). (Refer section B.6.1 and Annex 3 for details).
Baseline Emissions from 2010-11 onwards = 137,096 tCO_2

Emission Reduction from 2010 -11 onwards =137,096 **tCO_2**

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Year	Estimation of Project activity emissions (tonnes of CO_2e)	Estimation of Baseline emissions (tonnes of CO_2e)	Estimation of Leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2010-11	0	137,096	0	137,096
2011-12	0	137,096	0	137,096
2012-13	0	137,096	0	137,096
2013-14	0	137,096	0	137,096
2014-15	0	137,096	0	137,096
2015-16	0	137,096	0	137,096
2016-17	0	137,096	0	137,096
2017-18	0	137,096	0	137,096
2018-19	0	137,096	0	137,096
2019-20	0	137,096	0	137,096
TOTAL	0	**1,370,960**	0	**1,370,960**

B.7 Application of the monitoring methodology and description of the monitoring plan:

>>

B.7.1 Data and parameters monitored:

Data / Parameter:	**TEG_y**
Data unit:	MWh
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads and losses in the year *y*.
Source of data to be	Records at BHPL site

table arranged in descending order. In simple terms, dependable flow is the quantity of water that may be assuredly expected at a given point on the river.

For the said project activity, long term discharge data of the said river is used for computation of 90% / 50% dependable years. For CER computation, 50% dependable year values are chosen, since 50% dependable flow means that the flows are expected to be equal to or higher than the number in 50 years out of 100, hereby indicating an average flow value.

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	170,880
Description of measurement methods and procedures to be applied:	This parameter would be monitored by the multifunction meters of 0.5 accuracy class installed at the generator panels. Three such meters would be installed at each of the three generator panels. This parameter would be measured continuously and recorded monthly.
QA/QC procedures to be applied:	The meters will be calibrated for accuracy once in every two years by an accredited government / private agency. The standard reference meter of better accuracy class than the meter under test shall be used.
Any comment:	The data will be archived electronically and will be kept at least for 2 years after the end of the last crediting period.

Data / Parameter:	**EG_y**
Data unit:	MWh
Description:	Net Electricity fed by the project activity into the grid
Source of data to be used:	Records at BHPL site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	169,171 (2010-11 onwards)
Description of measurement methods and procedures to be applied:	The electricity fed by the project activity into the grid is calculated as the difference between the energy exported to the grid and energy imported from the grid. The formula for calculation of Net Energy Exported to the Grid is as under: *Net energy exported to the Grid = Energy Exported to the Grid –Energy imported from the Grid* The Energy Exported to the Grid and the Energy Imported from the Grid will be measured by bi-directional main meter and back-up check meter of 0.2s accuracy class installed at the interconnection point i.e. the switchyard. This parameter would be measured continuously and recorded monthly. In case of failure of the main meter, check meter readings would be used for the purpose of calculation of emission reductions. The procedures for metering will be as per the provisions specified in the latest Indian Electricity Grid Code (IEGC) / Uttarakhand State Grid Code.
QA/QC procedures to be applied:	The main and check meter would be calibrated for accuracy once in a year by an accredited government / private agency. The calibration shall be in accordance with the latest applicable guidelines as laid down in the latest Indian Electricity Grid Code and /or Uttarakhand Electricity Grid Code and / or Uttarakhand Electricity Regulatory Commission (UERC) guidelines. The standard reference meter of better accuracy class than the meter under test shall be used. The net metered generated energy shall be cross checked by Invoices / Statements including Invoices raised on the trader and / or Invoices raised on the third party for the energy not taken by the trader and / or Statement of

	Unscheduled Interchange and / or Statement from Power Transmission Corporation of Uttarakhand Limited.
Any comment:	The data will be archived electronically and will be kept at least for 2 years after the end of the last crediting period.

Data / Parameter:	**Cap_{PJ}**
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$24 * 10^6$
Description of measurement methods and procedures to be applied:	Yearly monitoring and recording
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**A_{PJ}**
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1455.5
Description of measurement methods and procedures to be applied:	The surface area of reservoir at full level has been calculated as per the projects drawings and would remain fixed during the operation phase as the weir has un-gated crest
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**Q_{diesel}**
Data unit:	Litre
Description:	Quantity of diesel consumed during the year y
Source of data to be used:	Measured at project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0

Description of measurement methods and procedures to be applied:	For measuring diesel consumption, a level indicator is provided on the fuel tank of DG set. Monitoring Frequency: Daily monitoring with monthly recording of data.
QA/QC procedures to be applied:	The D.G. set will have static graduated level indicator on the fuel tank. Graduations on the level indicator will be marked by pouring diesel in tank using standard measuring jar. The level of the graduated glass tubing on the tank will correspond to the diesel level and the consumption will be regularly recorded in the log book and can be verified.
Any comment:	The data will be archived electronically and will be kept at least for 2 years after the end of the last crediting period.

B.7.2 Description of the monitoring plan:

>>

The monitoring plan is formulated as per the Monitoring methodology specified in the approved consolidated monitoring methodology ACM0002, version 08.

The following parameter will be monitored:

- Electricity fed into the grid from the project activity;

Since the simple OM emission factor is calculated *ex-ante* based on a 3 year average of the most recent statistics available at the time of PDD preparation, its updation based on *ex post* monitoring is not required. For BM calculation, option 1 (refer "Tool to calculate the emission factor for an electricity system") has been chosen, which is calculated *ex ante* based on the most recent information, hence its monitoring is also not required.

BHPL would be formulating a CDM Project Team comprising of Shift operator, Shift-in-charge and Project Manager at the plant site to ensure proper and continuous monitoring of the parameters related to emission reduction calculations.

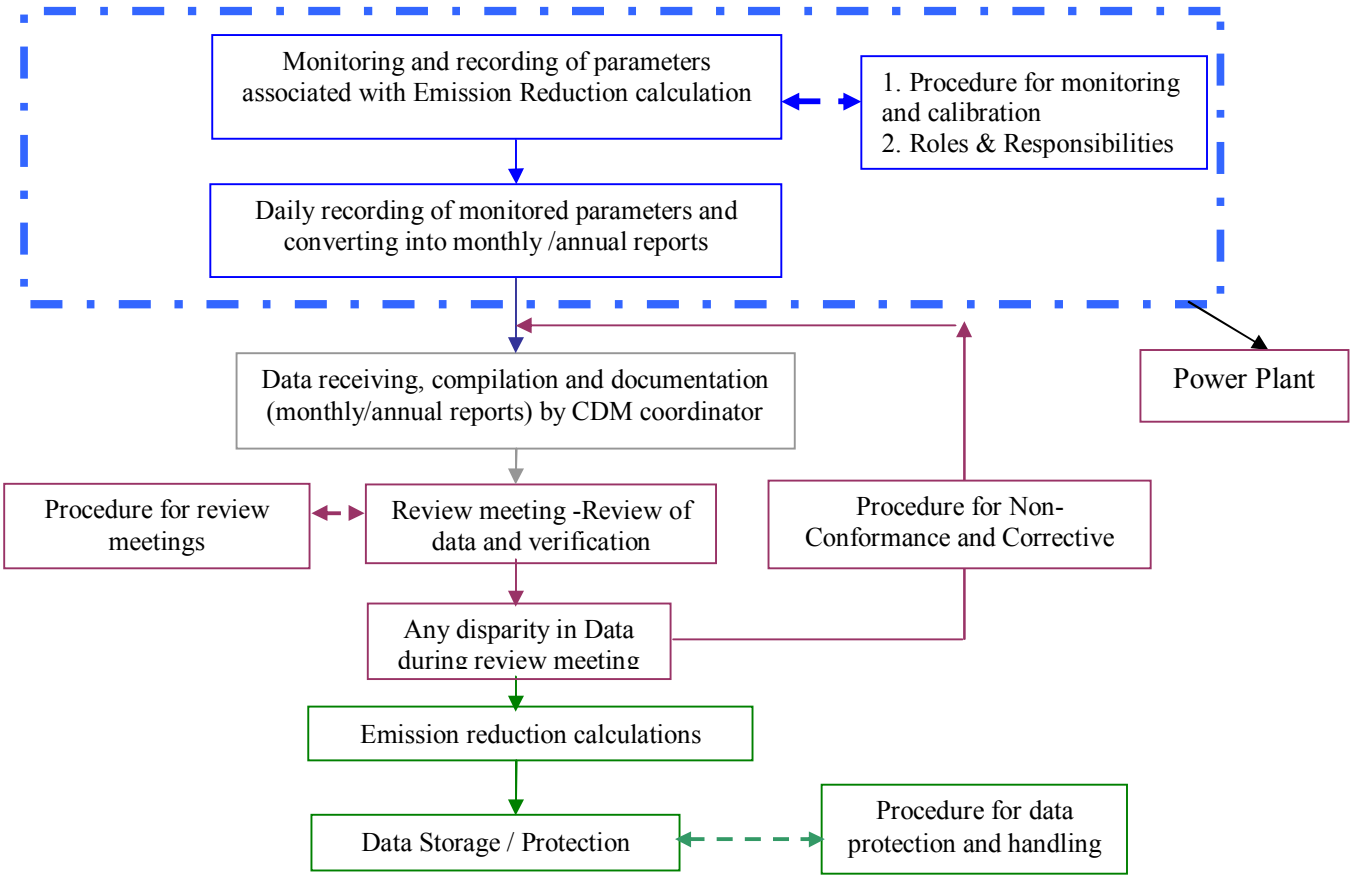
Shift operators would be assigned with the responsibility of continuous monitoring and monthly recording of data of net deliverable energy at the power house for their corresponding shifts in the plant log sheets. At the end of each shift, the recorded data would be reviewed by the Shift –in-charge. In case, any irregularity is observed, necessary action would be taken immediately. On a bi-monthly basis, the plant log sheets would be checked and discussed with project manager. The project manager would be forwarding the bi-monthly data to the CDM Coordinator through email, who would verify these and compile them into monthly reports.

The Project Manager would retain the bi-monthly collected data till the verification of CERs of the project activity. The Coordinator CDM would retain the bi-monthly data collection sheets and the compiled monthly report till 2 years after the completion of the crediting period.

The data used would be reviewed by conducting a review meeting once in 6 months. The Coordinator CDM will discuss the data (received from the project manager) with CDM Team members. Once the data is compiled and checked, it will be handed over to Verifier (BHPL official) for Verification. After data verification, Auditor (BHPL official) will be informed to carry out the Audit for concerned data.

The following flow chart indicates the procedure for data monitoring, recording and storage:

Flow Chart for CDM Data Monitoring, Recording and Storage



The general conditions set out for metering, recording, meter readings, meter inspections, Test & Checking and communication would be as per the latest Indian Electricity Grid Code (IEGC) / Uttarakhand State Grid Code.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:
04/01/2008

Name of person/entity determining the baseline:
Bhilangana Hydro Power Limited (BHPL) has determined the baseline for the project activity. The entity is a project participant listed in Annex-I, where the contact information has also been provided.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

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19/03/2007
According to EB 41, the start date should be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. BHPL entered into civil contract with Srinivasa Constructions Limited on 19/03/2007 which represents firm commitment to expenditures related to implementation of the project and hence is considered as the project start date.

The substantiation of the above date representing real action w.r.t. the implementation/construction of the project activity is as follows:

a) In the state of Uttaranchal, Uttaranchal Jal Vidyut Nigam Limited (UJVNL) is the nodal agency appointed by the Government of Uttaranchal (GOU), which pre-identifies potential projects/sites on the basis of initial pre-feasibility studies. The allotment of project/site is in accordance with the "Policy on Hydro Power Development by Private Sector in the State of Uttaranchal". Under this policy, there is a requirement of payment of upfront premium per MW in case of each project (subject to a minimum threshold premium of INR 0.5 Million/MW) from qualified project developers. The Letter of Award (LoA) is issued to the qualified project developer and is subsequently required to execute Project Development Agreement (PDA) with the GoU under which it is required to deposit the premium amount.
b) The PDA entitles the project developer to carry out the requisite studies and investigations (confirmatory surveys and investigation as per prevailing regulatory norms) at the project site, identify the transmission system for evacuation of power, carry out the techno-economic studies and submit the Detailed Project Report in relation to the Project. Project developer on being satisfied with the techno economic viability then confirms their view on the implementation of the Project to GOU. If on completion of the DPR, the Project Developer establishes to the GOU / UJVNL that the Project is not techno-economically viable, it has an option to surrender the Project back to the GOU / UJVNL (refer page 8, clause 5.4 of the PDA). On such surrender, the premium above threshold is refunded back to the Project Developer.

In the context of the proposed project activity, as per the pre-feasibility study done by GOU, the installed capacity of the project was indicated at 8.4 MW. The project proponent on allocation of the project, as per the PDA signed with GOU, deposited an upfront premium payment of INR 8.55 million corresponding to this capacity on 25th September 2003. This upfront premium represented the compensation for expenditure incurred by the Government of Uttaranchal (GOU) for preliminary investigation, site selection, initial feasibility report and related activities for the project undertaken by them before allocation to project developer.

The project proponent appointed TCE Consulting Engineers Limited to carry out the detailed assessment (Detailed Project Report preparation) including techno economic viability of the project. On completion of the technical studies including site investigations, it was revealed that the actual power generation capacity of the project would be 24 MW and accordingly the Detailed Project Report was prepared and submitted to GOU for its approval on 30th January 2006. The Board of Directors of BHPL finally decided to implement the proposed project activity with an installed capacity of 24 MW in their meeting on 22/02/2006. Subsequently the final DPR was approved by GOU on 20th April 2006.

On approval, the Project Developer, in a separate letter from the Principal Secretary of the GOU, was asked to deposit an additional premium of INR 15.88 Million corresponding to the incremental capacity. Although

there was no provision either in the policy of GOU i.e. "Policy for Development of Small Hydro Power up to 25 MW in Uttaranchal" or the "Project Development Agreement" indicating to deposit additional premium in case of capacity enhancement from the pre-feasibility stage, the project proponent was asked to deposit the additional premium on the increased capacity. The project proponent thus deposited this additional premium amount under protest on 25th May 2006.

The above details clearly show that neither the date of payment of initial premium amount corresponding to 8.4 MW, after which the detailed techno-economic viability for the project was carried out, nor the date of payment of additional premium, worked out on the basis of enhanced capacity (24 MW) which was paid under protest, represent firm commitment of the finance towards implementation of the project. They were in fact preliminary expenses incurred prior to commencement of implementation of the project activity. In accordance with EB guidelines "*the contracting of services /payment of fees for feasibility studies or preliminary surveys should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project*". Accordingly, the date of premium payments have not been considered as the project activity start date.

C.1.2. Expected operational lifetime of the project activity:

>>

40 years, 0 months

C.2 Choice of the crediting period and related information:

>>

The project activity shall use the fixed crediting period.

C.2.1. Renewable crediting period

>>

Not Applicable

C.2.1.1. Starting date of the first crediting period:

>>

Not Applicable

C.2.1.2. Length of the first crediting period:

>>

Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/04/2010

BHPL hereby confirms that the crediting period will not commence prior to the date of registration.

C.2.2.2. Length:

>>

10 years, 0 months

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including trans boundary impacts:

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As per the recent notification dated 14th September, 2006 of the Ministry of Environment and Forests (MoEF), Government of India regarding the requirement of Environmental Clearance, the hydro power projects with an installed capacity of less than 25 MW does not require any Environmental Clearances. Therefore, the project activity does not require any environmental clearance.

In this regard, MoEF has also issued a letter to the project activity stating that the project is exempted from such clearance as its installed capacity is less than 25 MW.

However, being an environmentally conscious organization, an Environment Impact Assessment Study was conducted to assess impacts of the project activity on the environment. The following section summarizes the impact on the environment from the project.

Impact due to project location

The project would involve construction of various components on ground like diversion weir, intake channel, desilting basin, tunnel, penstock and powerhouse etc., and construction of infrastructure facilities like access roads, dumping area etc which may result in change in land use. Around 8 ha of the forest land shall be diverted for the project activity. Necessary compensation like Net Present Value of the forest land and compensatory afforestation has been paid by the project developers to the concerned government instrumentality. Necessary forest clearance has also been obtained by the developer from the Forest Department. The project activity does not result in any loss of any natural reserves, wildlife habitat or corridor and endangered species of wildlife / trees.

Further, there is no loss of historical, religious, cultural monuments as well as infrastructure facilities like schools, hospitals, post office , community resources and other built in area due to the project location/ activities .The project requires private agricultural land, for which compensation has been paid at the rates higher than prevailing market rates. Besides, No Objection Certificate (NOC) has also been obtained by the developer from the State Irrigation Department and the concerned land owners / Gram Panchayats.

Impact during Construction & Operation Phase

Impact on air

Consumption of fuel in construction activities, movement of material, excavation at project site, blasting etc during construction will have some impact on the air. However, the increase in concentration of air pollutants during construction phase would be of temporary nature. Provision has been made for sprinkling water on the roads at least once a day during the entire construction period. The project is unlikely to cause any kind of air pollution during the operation.

Impact on water

The project activity does not involve any discharges into the river water from the construction activity. The construction debris would be disposed off at pre defined / pre allotted muck dumping areas and will not affect the river water. Proper sanitation facilities are included in the project for managing human waste disposal. During operation, the wastewater generated from the office complex and the staff colony shall be disposed off through compost pit. The drinking water facility and sewage disposal sites would be located away from each other. The water shall be subject to the preliminary treatment like chlorination and sedimentation before its use. Hence, no significant impact can be envisaged.

Impact due to noise
Construction activities like excavation, blasting, drilling etc, are expected to produce noise in the range of 80-130 db (A), which will decrease with the increase in distance. The impact of noise pollution will be limited to a distance of 50 to 200 meters at which the noise level will come down to 55 db (A). Moreover, the local villages are all located at a distance of more than 200 meters and hence would not have significant impact of the noise. Also, there are no sensitive receptors around the project site to have direct noise impact Specific canopy for controlling noise levels from equipments like DG sets etc have been provided to mitigate the effects of noise pollution. . The project is unlikely to cause any kind of noise pollution during operation phase.

Impact on Flora and Fauna
The project activity does not involve submergence of forests, cultivable land or inhabited areas. The project structures to be constructed are small in size to cause an appreciable disturbance to the eco-system during the construction as well as operational phase. The construction debris is also likely to be small and measures for appropriate disposal of the same have been planned and would be carried out. Moreover, there are no known migratory birds/endangered species in the region of project activity. Therefore, no harm on the ecological environment is envisaged.

Socio-Economic Impacts
The project activity will have a positive socio-economic impact in the region. The project activity would lead to capital investments which otherwise would not have happened in the absence of this project activity. It would lead to alleviation of poverty and upliftment of social status of the local populace by establishing direct and indirect benefits through employment generation at all levels from unskilled to skilled workers during the construction and operation phases. The project activity would also require support services such as machine repair, spares, transport logistics, accommodation facilities and general day-to-day requirements during its different phases (construction and operations) which shall accelerate business and commercial activities in and around the project area. The project activity would also involve creation of infrastructural facilities like roads, housing, medical facilities which would be used by the local community. The project activity would augment grid supply and would contribute in mitigating the shortage in power necessary for the sustenance and development of the society. The project activity also leads to diversification of the national energy supply, which is at present, dominated by conventional fuel based generating units and would generate eco-friendly, GHG free power which will contributes to the sustainable development of the region.

Thus, the project activity does not have any major adverse impacts on environment during its construction or operational phase. Moreover, Consent to establish the project activity has already been granted by the Uttaranchal State Environmental Protection & Pollution Control Board. The magnitude of the impacts during the construction phase is negligible and exists for a temporary period of time till the end of construction phase. Overall, all necessary abatement measures have been adopted. The human interest parameters would show positive impacts due to increased job opportunities at the facility as well as other ancillary units coming up.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>
As mentioned in D.1 above, the project activity is exempted from environmental clearance as per the notification of the Ministry of Environment and Forest, Government of India, as the total installed capacity of the project activity is less than 25 MW. Hence Environmental Impact Assessment (EIA) is not required to be undertaken by the host party. Nevertheless, an Environmental Impact Assessment (EIA) Study was conducted to assess impacts of the project activity on the environment, the results of which have been summarized in Section D.1 above.

Moreover, as outlined above, mitigation measures have been considered in all phases of the project and the following clearances have been obtained from the State and / or Central regulatory authorities:

- Pollution Clearance which involves Consent to establish the project accorded by Uttarakhand Environment Protection and Pollution Control Board
- Forest Clearance for diversion of forest land for non-forest purpose under The Forest Conservation Act, 1983 from Ministry of Environment and Forests, Government of India;
- Forest / Government Land Lease deed.
- Geological and Mining Clearance from Geological and Mining unit, Government of Uttarakhand
- NOC from State Fishery department
- NOC from the State Irrigation department
- NOC from the PWD department
- NOC from drinking water from Uttarakhand Jal Sansthan

In addition, to mitigate and control the environmental impacts, the project proponents have developed a detailed **Social Response Program**. In this program, due care has been taken for various aspects affected by the project activity and a Catchment Area Treatment (CAT) Plan has been framed for the project activity with the help of the State Government. The main highlights of the CAT plan are narrated as under:

a) Emphasis to be laid on the preservation of land & water in the forest area
b) Promotion of Afforestation
c) Availability of animal fodder & bio fuel to reduce dependence on forest land.
d) Plantation of Medicinal plants
e) Activities to uplift and promote the socio-economic condition of the local populace
f) Preservation of Wild Life
g) Support Research & development activities.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

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Stakeholders include individuals, groups or communities, affected, or likely to be affected, by the project activity, hence their views form a valuable input in realizing a vital objective of the project i.e. sustainable development. The key local stakeholders identified for the project activity apart from the project proponent includes:

- **Local people and their representatives**
  - Land owners and local villagers
  - Representatives of village governing body i.e. Gram Panchayats / Sarpanch
  - Local people including but not limited to policemen, doctors, postman, acting principal of intermediate college etc
  - Representative from Garhwal Mandal Vikas Nigam Limited (GMVNL), a Government of Uttarakhand enterprise which is responsible for local maintenance and development.
- **Ministry of Environment and Forests (MoEF), Government of India**
- **Government of Uttarakhand (GoU)**
- **Uttaranchal Jal Vidyut Nigam Limited (UJVNL)**
- **Various State Departments such as Labour, Irrigation, PWD, Forest, Drinking Water and Fisheries.**
- **Uttaranchal Environment Protection and Pollution Control Board (UEPPCB)**

As a part of the social responsibility and to facilitate consultation with the stakeholders in a transparent manner, BHPL organized a stakeholder consultation meeting at project site office at Ghuttu village on 29th November, 2007. It was an effort to consult with different sections of stakeholders and to receive their opinion on the project activity.

A formal invitation letter (citing the date, time and venue of the said consultative meeting) was sent to the stakeholders, to attend the meeting and communicate any suggestions / concerns regarding the project activity. A brochure in the local language was circulated to the stakeholders before the meeting, describing the salient features as well as the social, economic and environmental impacts of the project. The main objective of this consultation meeting was to:

- Disseminate information on the project to the stakeholders
- Seek meaningful contribution and support of the stakeholders for the project;
- Address stakeholder concerns for reducing potential conflicts
- Ensure sustainability of the project

The meeting started with a warm welcome by Mr. Pramod Kumar Arora, project head of BHPL. He introduced the members on the dais and elaborated about the project activity of BHPL which has been carried out with a view of sustainable development, conservation of natural resource and green house gas emission reduction. He also informed about various welfare / social activities being organised by BHPL in different villages in and around the project activity and requested people to continue their support to the project. After the introductory proceedings, the forum was left open for the views and opinions of the stakeholders regarding the project.

The comments received during the stakeholder consultation were recorded as minutes of the meeting for taking suitable relevant action by the project authorities.

In addition to the consultation meeting, BHPL circulated questionnaires to the stakeholders, requesting them to provide their comments /views on the project activity in writing. The same is also documented and recorded.

Section E.2 presents the results of consultation with different stakeholders.

E.2. Summary of the comments received:

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The summary of the comments received from the various stakeholders are as follows:

Local people and their representatives

During the stakeholder consultation meeting organized at project site office at Ghuttu village on 29th November, 2007, participation of about 90 local people was witnessed. This included representatives of village governing bodies, Tehsildar (Ghansali), local villagers, doctor, policemen and acting principal of intermediate college at Ghuttu.

The comments and concerns that were discussed / raised by the local stakeholders have been summarised as under:

a. Tree plantation should be undertaken in the region to conserve the natural beauty of the region.
b. Dust generated by movement of project vehicles should be checked
c. Necessary action should be initiated to improve the state of the road leading to the cremation ground.
d. Villagers should be provided aid for beautification of the temples in the project area.
e. Information regarding measures taken by the project to address the hazards in the region pertaining to seismicity.
f. Welfare activities (for instance insurance of houses and livestock of villages coming under the projet area, installation of water pipeline network for irrigation and drinking purposes, construction of access roads, concretization of existing motorable roads, beautification of local temples, construction of rooms for village schools etc.) should be completed within the construction span of the project.
g. Damage to the water supply lines running through the villages in the project area should be prevented during haulage activities.
h. Employment should be provided to the local populace on a priority basis.
i. Increase in criminal activities in the region should be checked by having a proper police booth in the region.

Ministry of Environment & Forest (MoEF), Government of India

The Ministry of Environment and Forests (MoEF), Government of India is the apex regulatory body for providing Environmental and Forest clearance to developmental projects in the country. BHPL communicated about their project activity to MoEF, following which the ministry issued a letter to the project activity stating that the project is exempted from environmental clearance since its installed capacity is less than 25 MW.

Moreover, MoEF is also the Designated National Authority in India and is encouraging project participants to take up such environmentally benign and climate friendly projects. BHPL had submitted the Project Concept Note (PCN) and Project Design Document (PDD) to the MoEF and has successfully obtained the Host Country Approval for the proposed project activity.

Government of Uttarakhand

An implementation agreement has been signed between the Government of Uttarakhand (GoU) and BHPL on 25th January, 2007 wherein the GoU has granted rights to implement and develop this renewable / clean energy project for a concession period of forty years.

Uttaranchal Jal Vidyut Nigam Limited (UJVNL)

UJVNL is a state agency of GoU which is assigned the responsibility of acting as a state nodal body between the project proponent and the state government instrumentality for the development of hydro power project

in the state of Uttarakhand. As per the implementation agreement between GoU and BHPL, BHPL has been submitting quarterly progress reports on the project activity to UJVNL which is being duly accepted.

Various State Departments

BHPL communicated with various state departments of Uttarakhand like Labour, PWD, Irrigation, Forest, Drinking Water and Fisheries to inform them about the project activity and henceforth obtain their approvals for implementation. In response, these departments have provided their consent by means of "No-Objection Certificates" being granted to BHPL.

Uttaranchal Environment Protection and Pollution Control Board (UEPPCB)

UEPPCB is the state regulatory body responsible for Environment Protection and Pollution Control. BHPL had communicated the project activity to them, following which the Board provided its "Consent to Establish" to the project activity.

E.3. Report on how due account was taken of any comments received:

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Due account has been taken for all the comments received by the various stakeholders as follows:

Local Stakeholder Consultation

The issues raised by the stakeholders were duly considered by the BHPL. The following summarizes how due account was taken of the comments raised by the local stakeholders:

a. Replying to the request to undertake tree plantation in the region, the company informed that they had approached the Forest department on this issue and had deposited fund for compensatory afforestation in the region, well ahead of the scheduled time. It was also informed that the company is regularly following with the forest officials to ensure proper utilization of these funds.

b. BHPL acknowledged the air pollution caused due to dust created by movement of the project vehicles and informed the villagers that tractor trolley is being employed for water sprinkling on the affected route. It was assured to the villagers that if required, an additional tractor trolley would be arranged to mitigate the dust problem.

c. On the state of the road leading to the cremation ground, the company informed the stakeholders that they shall aid in re-constructing the road.

d. For providing assistance in beautification of temples, the people were assured that this matter would be deliberated with senior BHPL management and necessary action would be taken.

e. On the query on measures taken by BHPL regarding seismicity of the region, the company apprised the people that seismicity has been considered while preparing the detailed design report of the project by the technical consultants. Moreover, to safeguard interests of the villagers, BHPL has taken insurance for all the villagers (as well as their properties and livestock) coming under the project.

f. On the subject of completion of welfare activities within the construction span of the project, the company assured that it would ensure the same.

g. Replying on the concern of damage to water supply line, it was apprised that the company is taking adequate care to prevent damage to water supply line running the villages during haulage activities. It was also expressed that still if any damage is caused, the company shall undertake the necessary repair works.

h. On the subject of providing employment to local populace on priority basis, the company assured to provide maximum employment to local people on priority basis depending on their eligibility.

Summing up the meeting, it was informed to the stakeholders that committees have been set up the company to take stock of concerns of the villagers coming under the project area and for monitoring the progress of social welfare activities planned / implemented by the company in the region. The company thanked the people for their continued support and requested them to apprise the company of any concerns, objections, and grievances etc. on a continuous basis in the future.

Ministry of Environment & Forest (MoEF), Government of India
Certain conditions have been laid down by the MoEF for the project activity while according the in-principal approval for forest land. These conditions are being fully complied by BHPL.

Government of Uttarakhand
There are certain obligation clauses in the implementation agreement signed between the GoU and BHPL. These obligations are being met by BHPL.

Uttaranchal Jal Vidyut Nigam Limited (UJVNL)
BHPL is providing monthly reports to UJVNL on the status of progress on the project activity.

Various State Departments
State departments like Labour, Forest, and Fisheries have laid down certain conditions while according NOC to the project activity. These conditions are being met by BHPL.

Uttaranchal Environment Protection and Pollution Control Board (UEPPCB)
Certain conditions have been laid down by the UEPPCB for the project activity while according consent to establish. These conditions are being fully complied by BHPL.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Bhilangana Hydro Power Limited
Street/P.O.Box:	--
Building:	B 37, Sector 1
City:	Noida
State/Region:	Uttar Pradesh
Postfix/ZIP:	201301
Country:	India
Telephone:	+91-95120-4621300
FAX:	+91-95120-4621333
E-Mail:	akagarwal@polyplex.com
URL:	--
Represented by:	--
Title:	Manager
Salutation:	Mr.
Last Name:	Agarwal
Middle Name:	Kumar
First Name:	Amit
Department:	Hydro
Mobile:	+91-9910107544
Direct FAX:	+91-95120-2443723
Direct tel:	--
Personal E-Mail:	akagarwal@polyplex.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Parties included in Annex I in the said project activity.

Annex 3

BASELINE INFORMATION

Grid Scenario in India

As evident from Table 1, the grid electricity in India today is **clearly dominated by thermal generation**, predominantly coal. Thermal power dominates the nation-wide installed capacity with a whopping 65% (as on 31st March 2007). The dominance of thermal generation is also evident for northern region, where thermal generation accounts for 58.7% of the overall power generation. Given the availability of abundant indigenous coal resources, relatively cheap coal-fired power stations are likely to continue to be the preferred generation alternative for years to come[31] and thus in the absence of the project activity, the power would have been supplied by the grid which is primarily fossil fuel based and would lead to the production of GHG emissions.

Table 1: Region wise installed capacity (MW) as on 31.03.2007[32]

Region	Hydro	Thermal				Nuclear	R.E.S*	Total
		Coal	Gas	Diesel	Total			
Northern	13000.38	18027.50	3323.19	14.99	21365.68	1180.00	813.37	36359.43
Western	6918.83	22441.50	5820.72	17.48	28279.70	1840.00	1874.76	38913.29
Southern	11071.71	16172.50	3586.30	939.32	20698.12	880.00	4971.55	37561.38
Eastern	2496.53	14149.88	190.00	17.20	14357.08	0.00	46.76	16900.37
North Eastern	1221.07	330.00	771.50	142.74	1244.24	0.00	48.91	2514.22
Islands	5.25	0.00	0.00	70.02	70.02	0.00	5.25	80.52
All India	**34653.77**	**71121.38**	**13691.71**	**1201.75**	**86014.84**	**3900.00**	**7760.60**	**132329.21**

*R.E.S.: Renewable Energy Sources includes Small Hydro Projects (<25 MW), biomass gasifier, biomass power, urban and industrial waste power and wind power

Northern Regional Grid Scenario

The installed capacity of Northern Region at the end of financial year 2006-07 as per Northern Regional Power Committee (NRPC) was 36359.44 MW. The Northern Regional grid registered maximum demand of 31516 MW in July 2006 during the year, indicating an increase of 8.51% over the previous year. The capacity shortage in the region was of the order of 10.14% to 15.64% during the year 2006-07.

The maximum gross energy availability of Northern Region was 147.53 MUs/day during the month of September 2006. The net energy requirement of the Northern Region for the year 2006-07 was 555.01 MU /day, while the net energy availability was 494.47 MU / day, indicating a shortage of 10.91%. The monthly regional energy shortages varied from 6.79% to 15.41%. The maximum monthly energy shortages were of the order of 38.21% in Jammu and Kashmir, 25.40% in Uttar Pradesh, 19.24% in Punjab and 15.74% in Uttarakhand[33]. From the above data it is clear that states in the northern grid including the state of Uttarakhand, is incurring substantive energy shortages.

The following table further illustrates the historic power supply position in the Northern Region[34]:

Table 4: Annual Power Supply Position in Northern Grid

	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Energy (MUs)						
Requirement	148025.61	155640.67	163320.18	177065.84	190950.37	202742.75
Availability	140057.06	143029.09	153712.68	159261.41	168979.86	180538.31
Shortage (%)	5.38	8.10	5.88	10.06	11.51	10.95
Peak (MW)						
Requirement	23137	24092	24067	26808	29044	31516
Peak Met	21586	21773	22746	24209	25362	26644
Shortage (%)	6.7	9.63	5.49	9.69	12.68	15.46

Table 4 above depicts that the average requirement of power in the northern grid is much higher than the availability leading to consistent power shortages in the grid for various years reaching to a maximum energy shortage of 11.51% in the year 2005-06. The peak load is further showing an increasing trend in the amount of shortage between peak requirement and peak met.

Thus in the absence of the project activity by BHPL, taking into account high energy shortages in the region, the electricity delivered to the grid by the project would have otherwise been generated by the continued operation of grid-connected power plants and by the addition of new generation sources to meet the existing and future power requirement, which is the chosen baseline scenario.

The Emission Factor for the Grid

The Central Electricity Authority (CEA) under the Ministry of Power, Government of India, has estimated the Combined Margin emission factor for the Northern grid, the details of which are available on the following website.
http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

The procedures and formulas used for estimation of the baseline factor and the assumptions made have already been stated under Section B.6.1. and B.6.2.. As per the **Carbon Dioxide Emission Factor database, version 3.0**, given by **CEA**[35]**,** a statutory body under the Ministry of Power, the Emission factor for the Grid is the following:

Simple Operating Margin (kg CO_2 /KWh)	**2004-05**	**2005-06**	**2006-07**	**Average**
	0.9801	0.9992	0.9985	**0.9926**
Build Margin (kg CO_2 /KWh)	0.6283			
Combined Margin (kg CO_2 /KWh)	0.8104			

Thus the emission factor for the northern region grid is **0.8104 kg CO_2/kWh**

35 http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

BASE PARAMETERS AND ASSUMPTIONS

Fuel Emission Factors (EF) (Source: Coal/Lignite - Initial National Communication, Gas/Oil/Diesel/Naphta - IPCC 2006, Corex - own assumption)

	Unit	Coal	Lignite	Gas	Oil	Diesel	Naphta	Corex
EF based on NCV	gCO2 /MJ	95.8	106.2	56.1	77.4	74.1	73.3	0.0
Delta GCV NCV	%	3.6%	3.6%	10%	5%	5%	5%	n/a
EF based on GCV	gCO2 /MJ	92.5	102.5	51.0	73.7	70.6	69.8	0.0
Oxidation Factor	-	0.98	0.98	1.00	1.00	1.00	1.00	n/a
Fuel Emission Factor	gCO2 /MJ	90.6	100.5	51.0	73.7	70.6	69.8	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	Naphta	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	0	3150	0	1,975	3,213	0	n/a	n/a
Net Heat Rate	kcal /kWh (net)	2,717	3,014	0	3,182	0	2,047	3,330	0	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 CO2 emissions	tCO2 /MWh	1.04	1.28	0.00	0.68	0.00	0.60	0.98	0.64	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	500 MW
Gross Heat Rate	kcal /kWh	2,750	2,500	2,500	2,425
Auxiliary Power Consumption	%	12.0	9.0	9.0	7.5
Net Heat Rate	kcal /kWh	3,125	2,747	2,747	2,622
Net Efficiency	%	28%	31%	31%	33%
Specific Oil Consumption	ml /kWh	2.0	2.0	2.0	2.0
Specific CO2 Emissions	tCO2 /MWh	1.19	1.05	1.05	1.00

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
Net Efficiency	%	28%	30%	29%
Specific Oil Consumption	ml /kWh	3.0	3.0	3.0
Specific CO2 Emissions	tCO2 /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
Net Efficiency	%	43%	44%	42%

Specific CO2 Emissions	tCO2 /MWh	0.43	0.42	0.43	
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 CO2 Emissions	tCO2 /MWh	0.72	0.69	0.64	0.60

Naphta	Unit	All sizes
Increment to Gas Heat Rate	%	2%
Gross Heat Rate	kcal /kWh	0
Auxiliary Power Consumption	%	3.5
Net Heat Rate	kcal /kWh	0
Specific CO2 Emissions	tCO2 /MWh	0.00

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

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

Oil		
Specific Emission	gCO2 /ml	2.96

Annex 4

MONITORING INFORMATION

The monitoring plan has been already explained in section B.7.2. Furthermore a CDM manual has been prepared outlining all the responsibilities and procedures related to monitoring of emission reductions in the CDM project activity.