CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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4.80 MW renewable energy project by Aleo Manali Hydropower Pvt. Ltd.
Version: 5.0
Date: 24/12/2012

A.2. Description of the small-scale project activity:

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The ALEO II Hydro Electric Project (4.8 MW) has been contemplated as Run-of-River Scheme from tail race water release of Allain Duhangan Hydro Electric Project (ADHEP) on Allain Nala near Manali town in Kullu District of Himachal Pradesh and is proposed on the right bank of Allain Nala with the install capacity of 4.8 MW. The scheme proposes to generate 4.8 MW (2.4 MW X 2) by utilizing a head of 40 metres. The generated power shall be fed into 33/11 KV Sub-Station of HPSEB at Prini, Manali which is within 1.2 Km from proposed power station of Aleo – II HEP. The catchment is primarily snow, rain and spring fed. The project activity will intake water from the tail race of the 192 MW AD hydro project situated upstream.

The project proponent has another registered hydro CDM project of capacity 3 MW (Aleo I, UNFCCC ref no. 0244). The intake of the 3 MW project is in the Allain stream. This proposed project activity is at a distance of 500 m from the earlier project but is not a debundled component of a large scale project activity as the total capacity is still less than 15 MW and the earlier project has been registered more than 4 years ago. The Aleo II (4.8 MW) project will not utilise water from the tail race of Aleo I (3 MW).

Purpose of the Project Activity

The purpose of the 4.8 MW project activity (Aleo II) is to generate electricity from hydro power, and sell the electricity generated to the state grid of Himachal Pradesh through a Power Purchase Agreement (PPA) with HPSEB. The Project will lead to reduced greenhouse gas emissions because it displaces electricity from fossil fuel based electricity generation plants.

Pre-project scenario

The project activity is a Greenfield project. There was no activity at the site of the project participant prior to the implementation of this project activity.

Baseline

The baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources. In the absence of the CDM project activity, the equivalent amount of electricity would have been generated from the connected / new power plants in the NEWNE grid. The installed capacity in these grids is predominantly fossil fuels based and therefore is a major source of carbon dioxide emissions in India. The main emission source in the pre-project scenario is the power plants connected to the grids and main GHG involved is CO_2.

Project Scenario

The project activity is a 4.8 MW capacity small hydro plant in the Indian state of Himachal Pradesh. It will sell the power units to the Himachal state electricity grid which is part of the NEWNE regional electricity grid.

Nature of Project

The Project harnesses renewable resources in the region, and thereby displacing non-renewable natural resources and ultimately leading to sustainable economic and environmental development. The project activity leads to an emission reduction of 17613 tCO_2e.

Contribution to Sustainable Development:

The Ministry of Environment and Forests, Govt. of India has stipulated the social well being, economic well being, environmental well being and technological well being as the four indicators for sustainable development in the interim approval guidelines host country approval eligibility criteria for Clean Development Mechanism (CDM) projects[1]. The following paragraphs give details on how the project activity contributes towards the four indicators of sustainable development of India:

A. Social well being

- The project does not involve any displacement of human inhabitation in the area as the land requirement is very small.
- The project has lead to direct and indirect employment for the local population as the construction and maintenance staff has been drawn from the nearby local areas.
- The project will lead to improved infrastructure, such as roads, in and around the project area

B. Economic well being

- The project proponent has invested approximately Rs 324.30 Million in the proposed project, which is a considerable additional investment in a rural area which would not have happened otherwise, in the absence of the project activity.
- The project activity will lead to a reduction in demand-supply gap in the power deficit NEWNE regional grid

C. Environmental well being

- Aleo-II SHP is a run-of-river hydel scheme, which involves no storage, the water is diverted into water conductor by construction of a weir. Thus there is no submergence of forest and cultivated lands due to construction of any components of the scheme. Thus, there is no negative impact on the environment which would have occurred due to submergence.
- The project activity reduces GHG emissions which would have taken place in the absence of the project due to generation of the similar proportion of electricity generated by the project from fossil fuel based generating stations.

[1] http://cdmindia.nic.in/host_approval_criteria.htm

D. Technological well being

- The project makes use of efficient environmentally safe technology for power generation.
- The generation of electricity from the project leads to strengthening of the grid, increasing the energy availability and quality of power in the nearby rural areas thereby meeting the energy demand to a certain extent leading to technological well being.

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)**
India	Aleo Manali Hydropower Pvt. Ltd. (Private)	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale 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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Northern region/Himachal Pradesh/Kullu

A.4.1.3. City/Town/Community etc:

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Aleo Village, Manali Tehsil

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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Access - The project area is located in lesser Himalayans with maximum altitude in the range of 1900m and falls in the state of Himachal Pradesh, district Kullu and is 260 Km from the state's capital Shimla and 41 Km from district headquarter Kullu. The proposed project is well connected with motor able roads from Shimla and other major cities of Himachal Pradesh. There is negligible habitation as of now.

By Air: The nearest airport is Bhuntar, Kullu (50 Kms)
By Rail: The nearest rail head is Kiratpur Sahib (248 kms)
By Road: Nearest road head is from Aleo (0.5 kms)

Geographical location of Aleo II Hydro Plant:

Power House: Latitude: North 32°13’00’’ Longitude: East 77°11’00’’
Weir Site: North 32°13’00’’ Longitude: East 77°12’00’’

Location maps have been presented in Appendix 1

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Project Type and Category:

The type and category of the project activity as per Appendix B to the simplified modalities and procedures for small-scale CDM project activities is as under:

Project Type: **I, Renewable energy project**

Project Category: **I D, “Grid Connected Renewable electricity generation “**

The technical specifications are provided below. The main civil structures of the project shall be as under:

- Diversion from tail race of AD HEP
- Intake Channel & Intake Gate
- Forebay Tank
- Penstock
- Power House
- Tail race Channel

Diversion Structure	The diversion structure of the project is situated in the tail race section of the 192 MW AD hydro project. The diversion shell be through a RCC trench constructed below the bottom of the tail race so that no obstruction in the tail race flow is created.
Intake Channel	A RCC type intake with MS fabricated gate of size 4.00 m x 2.5 m has been proposed to regulate the discharge received from Diversion trench.
Forebay Tank	The forebay has been designed to have storage of more than 2 minutes. Full supply level in the tank shall be 1859.8 m. The tank shall be provided with trash rack and bell mouth entry to the penstock.
Penstock, Anchor Blocks and Saddle Blocks	The water from Forebay shall be carried to the Francis turbines through steel penstock. At Forebay end Bell mouth shall be provided in the penstock to reduce entry losses. Vent pipe shall be provided just after steel gate, to prevent collapse of the penstock pipe due to sudden closure of entry gate. Surface penstock has been proposed to deliver water under pressure from forebay to the turbines. Anchor blocks made up of RCC shall be provided at every bend to keep the penstock in position. Saddle supports shall be provided in between the anchor blocks to support the penstock pipe at regular interval. Expansion joints shall be provided wherever required. Inlet valves shall be provided in both the penstock inside the powerhouse.
Power House	Surface Power House is proposed with two units each of 2400 KW capacity. Horizontal Francis turbines with draft tubes are proposed to utilize the head. Steel roof trusses have been provided over framed RCC structure covered with CGI sheets.. Substructure of the powerhouse has been designed as an RCC raft. The superstructure shall consist of RCC columns over which the girder and rails for movement of the crane shall be supported.
Tail Race Channel	The discharge from each turbine shall be fed into individual tailrace channel through draft tubes. Each individual tailrace channel will join common tailrace. The size of the each tailrace is 4.0 m x 1.50 m with a bed slope of 1: 400. The tailrace shall be made up of RCC and will discharge water back in to Allain nal or in the intake channel.

There is expected to be no transfer of technology in the project. The project will employ technology that is environmentally safe and sound technology.

The technical specifications of the major equipment are provided below:

EQUIPMENT	VALUE	UNIT
Hydrology & River Details		
Water availability	Tail race water discharge of ADHEP	
Catchment area	151	Sq km
River	Alain & Duhangan nallah	
Highest elevation in the catchment	± 6000	M
Stream	Snowfed + Rainfed + Springfed	
Diversion and Intake Structure		
Type	R.C.C. drop intake	
Length	13	m
Design discharge capacity	15.80	Cumecs
App. elevation	EL ± 1860 m above MSL	
Feeder Channel		
Length	45	m
Size	4000 x 2500 RCC duct	mm
Gradient	1 in 250	
Design Discharge	15.80	cumec
Forebay		
Type	RCC tank	
Size	90 x 40 x 3 (average)	m
Capacity	10,800	Cumecs
Penstock		
Diameter	2200	mm
Length	500	m
Design discharge	15.80	Cumecs
Turbine		
Type	Horizontal Francis	
Rated output	2400	kW
Turbine speed	500	RPM
Generator		
Type	Synchronous	

Rated Output	2400	kW
Power Factor	0.80	
Excitation system	Self excited self regulated, Brushless	
Power House		
Type	Surface	
Design Head	36.30	m
Length	35	m
Width	12	m
Height	12	
Installed Capacity	2 x 2400	kW
Tail Race (Individual for each turbine)	4.00 x 2.00, Length - 30	m

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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The emission reductions during the first renewable crediting period are-

Years	**Estimation of annual emission reductions in tonnes of CO_2e**
Year 1	17,613
Year 2	17,613
Year 3	17, 613
Year 4	17, 613
Year 5	17, 613
Year 6	17, 613
Year 7	17, 613
Total estimated reductions (tonnes of CO_2e)	**123,290**
Total number of crediting years	**7**
Annual average of the estimated reductions over the crediting period (tCO_2 e)	**17,613**

A.4.4. Public funding of the small-scale project activity:

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There is no ODA financing involved in the Project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:
(a) With the same project participants;
(b) In the same project category and technology/measure; and
(c) Registered within the previous 2 years; and
(d) Whose project boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point

The project is not a de-bundled component of a large scale project activity.
There is a project under the same project developer but it is of capacity 3 MW in the vicinity of the project. The project is a registered CDM project:

Title: Aleo Manali 3 MW Small Hydroelectric Project, Himachal Pradesh, India
Reference Number: 0244
Registration Date: 14 April 2006
Distance from the proposed project activity: Less than 1 Kilometre

The previous project is within 1 Km of the proposed project activity. However, the total capacity of both the projects is less than 15 MW and registration of the previous project took place in 2006 which is more than 4 years before the current project activity. As per the "Guidelines on Assessment of Debundling for SSC Project Activities" (Annex 13, EB 54), the proposed 4.8 MW project is therefore, not a debundled component of a large scale 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 small-scale project activity:

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Title: Grid connected renewable electricity generation,

Reference: AMS-I.D. version 17

Tool: Tool to calculate the emission factor for an electricity system" (Ver. 2.2.1[2])

General guidance to SSC CDM methodologies" (Ver 19.0)

B.2 Justification of the choice of the project category:

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[2] As per CDM website, the tool is applicable till 23 July 2013, (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v3.0.0.pdf/history_view)

The project activity produces renewable energy by using hydel energy. The project activity would follow the small-scale methodology. Therefore the applicability of the methodology to this project activity would be.

<table>
<tr><th><u>Applicability Criteria</u></th><th><u>Justification</u></th></tr>
<tr><td>This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:
(a) Supplying electricity to a national or a regional grid; or
(b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.</td><td>The criteria are satisfied and the project comprises renewable energy generation units from hydel source which supplies electricity to a national or a regional grid (NEWNE regional grid)</td></tr>
<tr><td>Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A[3]) applies is included in Table 2.

<table>
<tr><th></th><th>Project type</th><th>AMS-I.A</th><th>AMS-I.D</th><th>AMS-I.F</th></tr>
<tr><td>1</td><td>Project supplies electricity to a national/regional grid</td><td></td><td>√</td><td></td></tr>
<tr><td><u>2</u></td><td>Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)</td><td></td><td></td><td>√</td></tr>
<tr><td><u>3</u></td><td>Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td><td></td><td>√</td><td></td></tr>
<tr><td>4</td><td>Project supplies electricity to a mini grid[4] system where in the baseline all generators use exclusively fuel oil and/or diesel fuel</td><td></td><td></td><td>√</td></tr>
<tr><td>5</td><td>Project supplies electricity to household users (included in the project boundary) located in off grid areas</td><td>√</td><td></td><td></td></tr>
</table>
</td><td>The project activity supplies electricity to a national/regional grid. Hence, as per the Table 2 of the approved methodology AMS-I.D version 17, the project activity is justified to use AMS-I.D.</td></tr>
<tr><td>This methodology is applicable to project activities that:
(a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the</td><td>This criteria is satisfied as the project activity Greenfield plant where there was</td></tr>
</table>

[3] AMS-I.D “Grid connected renewable electricity generation”, AMS-I.F “Renewable electricity generation for captive use and mini-grid” and AMS-I.A “Electricity generation by the user”

[4] The sum of installed capacities of all generators connected to the mini-grid is equal to or less than 15 MW.

implementation of the project activity (Greenfield plant); (b) Involve a capacity addition; (c) Involve a retrofit of (an) existing plant(s); or (d) Involve a replacement of (an) existing plant(s).	no renewable energy power plant operating prior to the implementation of the project activity
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • 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 is a run-of-the river hydro project and thus there is no reservoir. Hence, this condition is not applicable to the project activity.
If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project activity does not have any non-renewable component. The entire capacity of 4.8 MW is from renewable energy (hydro power), which is less than 15 MW.
Combined heat and power (co-generation) systems are not eligible under this category	This criterion is not applicable to this project as the project is a hydro power project and does not involve co-generation.
In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units	The project proponent has an existing 3 MW hydro project nearby (CDM ref. Number 0244). However, the two projects, i.e. 3 MW and the proposed 4.8 MW project, are physically distinct from each other and the total capacity is less than 15 MW.
In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	This criterion is not applicable to the project as there is no retrofit or replacement. The project activity is a Greenfield project.

The above comparison confirms that the chosen methodology is applicable for this project activity.

The project capacity is 4.8 MW which is less than the limit of 15 MW as specified in general guidance to SSC CDM methodologies. The project proponent hereby confirms that the capacity of the project activity will not exceed 15 MW during the crediting period.

B.3. Description of the project boundary:

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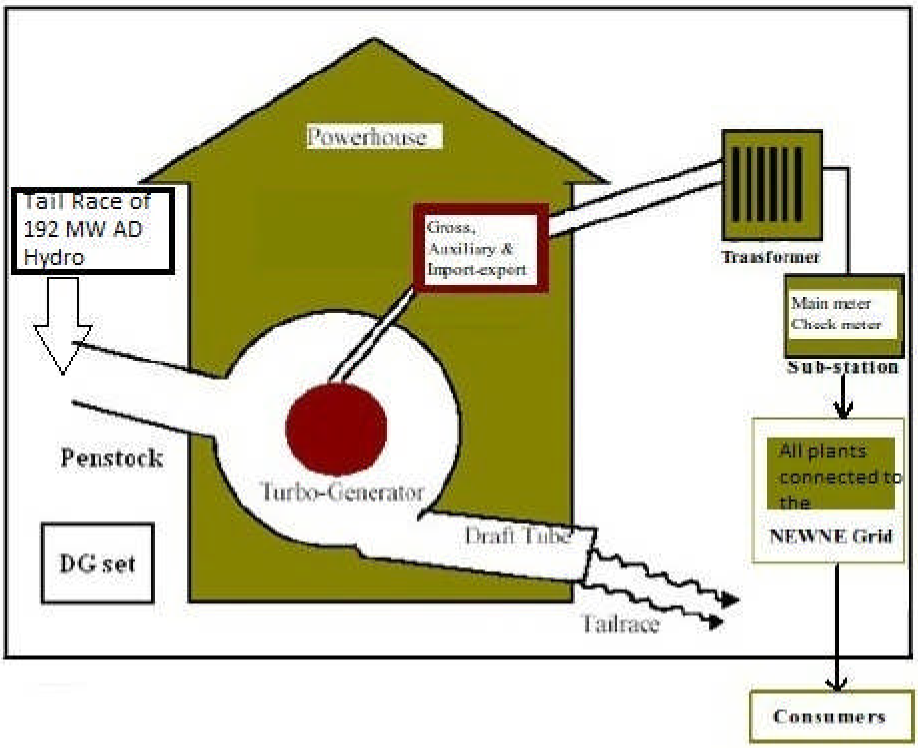
As per AMS I-D ver 17, "*the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to*". The project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

The Indian electricity system is divided into two regional grids, viz. NEWNE (Northern, Eastern, Western, and North-Eastern) and Southern grid. Each grid covers several states. As the regional grids are interconnected, there is inter-state and inter-regional exchange. The project activity will be connected to the NEWNE grid.

The project activity takes in water from the tail race of the 192 MW AD hydro project. Thus, in case of a shutdown in the AD hydro project, generation in the project activity will get effected. Accordingly, the project boundary encompasses project's electrical and mechanical equipments, project site, feeders leading up to the substation and the physical extent of the NEWNE regional electricity grid which includes all power plants connected physically to the electricity system and the tail race of the AD hydro project.

Flow Diagram of the project boundary:



Sources and gases considered in project boundary are detailed below:

	Source	Gas	Included?	Justification / Explanation
Baseline	Electricity generation from power plants connected to the NEWNE Grid	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project Activity	On-site fuel combustion due to implementation of the project activity	CO_2	Yes	This has been included as there may be use of DG sets which use diesel.
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	There is no reservoir as the project activity is a run-of-the-river hydro power project.
		CH_4	No	
		N_2O	No	

B.4. Description of baseline and its development:

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The project category is renewable electricity generation for a grid system, which is also fed by both fossil fuel fired generating plants (using fossil fuels such as coal, natural gas, diesel, naphtha etc.) and non-fossil fuel based generating plants (such as hydro, nuclear, biomass and wind). Hence, the applicable baseline, as per AMS ID, is the kWh or MWh produced by the renewable generating unit multiplied by an emission factor (measured in $kgCO_2$/kWh or tCO_2/MWh) calculated in a transparent and conservative manner.

As per para 10, AMS ID version 17, if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

As per para 11, AMS ID version 17, the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$\mathbf{BE_y = EG_{Bl,y} * EF_{CO2,grid,y}}$$

Where,

Parameter	Description	Source
BE_y	Baseline Emissions in year y (t CO2)	Calculated
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)	$EG_{BL,y}$ is calculated as a difference between the measured values of export to grid and import from grid, which are sourced from the monthly JMR

$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year y (t CO2/MWh)	Calculated from values published by the CEA version 05

The Calculation of CO2 emission factor of grid is as follows:

According to AMS I.D, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2e/kWh) calculated in a transparent and conservative manner as:

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

or

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The project proponents have chosen the combined margin approach to calculate the emission coefficient for the grid.

Details of Baseline data:
Operating margin emission factor and Build Margin emission factor calculations:
Data of Operating Margin for the three financial years from 2002 to 2005 and Build Margin for the year 2004-09 has been obtained from -
The CO_2 Baseline Database for the Indian Power Sector
Ministry of Power: Central Electricity Authority (CEA)
Version 5
Dated: November 2009
Key baseline information is reproduced in annexure 3.
The detailed excel sheet is available at:
http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

The details of calculations are presented in Section B.6.1.

Note: This project is a Greenfield project and hence paras 15, 16, 17, 18 and 19 of AMS I.D. Ver 17 are not applicable to this project as they deal with the retrofit projects and other renewable energy projects.

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 small-scale CDM project activity:

Investment in hydro power projects in the state of Himachal Pradesh is not mandatory. There are no national or local laws or regulations that mandate this investment i.e. setting up of hydro power projects, to be undertaken. Setting up of hydro power projects in Himachal Pradesh is a voluntary activity. The description of the relevant national and sectoral policies for hydro power generation is as below[5]:

[5] http://www.gwec.net/fileadmin/images/India/IWEO_2011_FINAL_April.pdf

The Electricity Act 2003 provides for policy formulation by the Government of India and mandates the State Electricity Regulatory Commissions (SERCs) to take steps to promote renewable and non conventional sources of energy within their jurisdiction.

Under section the SERCs are also made responsible for the following:
i. Ensuring suitable measures for connectivity of renewable power to the grid
ii. Sale of renewable based electricity to any person
iii. Mandating purchase of a certain percentage of total energy consumption from renewable.

Further, in compliance with the Electricity Act 2003 the central government notified the National Electricity Policy (NEP) in February 2005. The NEP stipulates several conditions to promote and harness renewable energy sources.

Certain incentives are available for renewable energy projects:
• Income tax holiday for a period of 10 years in the first 15 years of operation.
• Accelerated depreciation of 80%.

The above benefits have been considered in the financial analysis for the project activity.

The Government of Himachal Pradesh has been laying the desired thrust for encouraging generation of power through renewable energy sources as well as the small hydro projects including and up to a capacity of 5 MW through an agency called "HIMURJA".

The PP is yet to sign the Power Purchase Agreement for the project activity. Hence, the power sale rate available during the decision making (i.e. the one provided by the state tariff order) has been considered for the investment analysis. The Central Electricity Regulatory Commission (CERC) had launched the Renewable Energy Certificate (REC)[6] policy under the Renewable Purchase Obligation (RPO) to promote renewable sources of energy. Under this scheme, a renewable power producer can claim RECs for supplying electricity produced from renewable sources of energy. As clarified by UNFCCC (letter no. 2011-047-DOE dated 10 February 2012, sent to Bureau Veritas Certification Holding SAS), the investment analysis is to be based on policies in place as on 11 November 2001. The first order on RECs was issued in January 2010[7] to promote investment in renewable energy. Since, REC is an E+/E- policy, the REC mechanism benefits have not been considered. Moreover, the project activity has considered the preferential tariff for sale of power to the grid in the financial analysis. Thus, following the "approach I (adopt a fixed tariff)" as mentioned in the clarification from UNFCCC, the analysis has been made on the preferential tariff.

The additionality is being demonstrated via 'General guidance to the small-scale CDM methodologies, Information on additionality (Guidelines on the demonstration of additionality of small-scale project activities, version 9, EB 68 Annex 27)'.The Project Proponents propose to use **Option a – Investment barrier** and the financial indicator that is identified is equity IRR.

Investment barrier

Suitability of the Benchmark used for Comparison

[6] https://www.recregistryindia.in/index.php/general/publics/AboutREC

[7] https://www.recregistryindia.in/pdf/REC_Regulation/2(a)CERC_Regulation_on_Renewable_Energy_Certificates_REC.pdf

IRR is a widely accepted financial metric used by many corporations and financial institutions for investment decision-making and is a long-established benchmark for investment decisions in the Indian power sector. Hence IRR has been chosen as the most appropriate financial indicator for the project type and decision making context.

As per "guidance on assessment of investment analysis" version 05, paragraph 12, Annex 5, EB 62, Required/expected returns on equity are appropriate benchmarks for equity IRR. It is also worthwhile to note that the captioned project is a Greenfield hydropower generation project that generates and supplies electricity to the state grid, therefore the project can not have only one possible project developer. The guidance under Para 13 also states that in cases where the project has more than one potential developer, the benchmark cannot be based on internal rates of expected / required return on equity and shall be based on publicly available data sources which can be clearly validated by the DOE. Accordingly, the expected return on equity applicable to the project type has been calculated using publicly available financial data sources and has been considered as the benchmark. The benchmark has been derived based on the data of power generating companies having renewable-energy based power installations at the time of investment decision in the project activity. The expected / required rate of return on equity has been determined using the Capital Asset Pricing Model (CAPM) considering Beta values of power generating companies in India that were listed at the time of investment decision of the project activity and which also had renewable energy based installations. Hydro power producing companies were also included in the analysis.

The benchmark return on equity works out to **18.36%.** The detailed calculations are in Appendix 2.

Financial Analysis

Table below provides the basic assumptions used to calculate the equity IRR. Most of these assumptions are taken from the third party DPR. This was submitted in August 2009 and was awarded Techno Economic clearance on 9th June 2010 by HPSEB[8].

Assumptions are as follows:

	INR Million		
Preliminary & Preoperative Expenses	5.7		**As per the Detailed Project Report Chapter 13, available at the time of investment decision**
Land	17.600		
Civil Works	135.968		
Diversion structure and intake	6.497		
Forebay	18.327		
Penstock, anchor and	64.825		

[8] Himachal Pradesh State Electricity Board

saddle blocks			
Power house building including turbine foundation etc	33.757		
Tail race and flood protection work	8.562		
Design & Consultancy charges	4.000		
E&M Works I/C Transmission works	103.324		
Power Plant	96.878		
Transmission and Distribution	6.446		
Others	30.442		
Buildings	5.021		
Plantation	1.200		
Miscellaneous	1.803		
Maintenance	1.500		
special T&P	2.809		
Communicatio n	3.700		
Losses to Stock @ 0.25% of C works	0.340		
Establishment charges	5.579		
Ordinary Tools & Plants	1.395		
Indirect charges, audit & accounts etc	1.395		
Project Cost	287.334		
Escalation	7.995		**As per the Techno Economic Clearance dated 09/06/2010, available at the time of investment decision**
IDC (Interest during construction)	26.98		

Financial & Other Expenses	1.978		
LADC @ 1%	1%		
Total Capital Cost	324.30		
Working Capital			
Period in Days of O&M Expenses	30		**HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007, applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Period in Days of Receivables Revenue	60		
Cost of Maintenance spares for Working Capital (% of capital cost)	1%		
Escalation on maintenance spares for Working Capital	6%		
Margin Money as % of Working Capital	30%		**This is the equity contribution in working capital, taken in line with the 70:30 debt equity ratio; HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007, applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Implementation Period Proposed in Years	3		**As per the DPR Chapter 14 submitted to HIMURJA**
First Year of Implementation ending	Mar-10		
Capital cost schedule			
First Year	5%		**As per the DPR Chapter 14 submitted to HIMURJA**
Second Year	45%		
Third Year	50%		
Expenses			

Annual O&M cost at % of Capital Cost	2.25%		**HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007, applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Annual Escalation on O&M	4.00%		
Energy			
Capacity of unit in kW	2400		**As per the DPR submitted to HIMURJA, available at the time of investment decision**
Number of Units	2		
Project Capacity in MW	4.80		
Expected Project Commissioning Date	31-Mar-12		
Project Cost per MW (Rs. In Millions)	67.6		
Units Generated			
Designed Plant Load Factor	50.37%		
Gross units generated at designed capacity (MU)@95% availability	21.18		
Auxillary consumption & Transformation losses	1.0%		**HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007, applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Free energy to Local area	1.00%		**As per the Techno Economic Clearance dated 09/06/2010, available at the time of investment decision**
Net Energy after free energy to local area	20.86		**Calculated value**
Water Royalty Charges for First 12 years	9.00%		**As per the letter from the principle secretary Govt. of HP to HPSEB regarding self identified stand alone hydro power project dated 17/11/2008.** **As per HIMURJA(http://himurja.nic.in/invguide.html,**
Water Royalty Charges from	18.00%		

13th to 30th Year			**para 6 and 19), a 3% additional royalty is applicable if the capacity addition is more than 20%.**
Water Royalty Charges from 31st Year	27.00%		
Energy Unit Price			
Basic Selling Price	3.24		**HPERC COMMISSION'S ORDER ON SMALL HYDRO POWER PROJECTS TARIFF AND OTHER ISSUES 10 February, 2010 available at http://www.hperc.org/orders/supshp.doc[9]**
Selling price from 13th year	3.17		
Selling price from 31st year	3.31		
Interest Rate			
Interest rate on term loan	12.0%		**RBI PLR as on 25/06/2010, available at the time of decision making http://www.rbi.org.in/scripts/WSSView.aspx?Id=14942**
Interest Rate on Working Capital	12.0%		
Tenure	12.00	years	**HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007, applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Moratorium	24.00	months	
Debt Equity Ratio			
With IDC			
Equity	30.00%		**HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007, applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Loan	70.00%		
Book Depreciation Rate (Straight Line Method basis)			
Civil Works, Plant	2.25%		**HPERC Commission's Order on Small Hydro Power Project Tariff and Other Issues dated December 18, 2007,**

[9] A supplementary tariff order with a few changes was published in February 2010. In this order, only the revised paragraphs were mentioned. For all other parameters/paragraphs, the previous tariff order dated December 2007 is to be referred.

Equipment & Others			**applicable during investment decision (http://www.hperc.org/orders/shpp.doc)**
Transmission Lines	2.25%		
Other Fixed Assets	2.25%		
Book Depreciation up to (% of asset value)	90%		
Income Tax			
Income Tax rate	33.99%		**Income Tax Act for FY 2010-11, http://www.caclubindia.com/forum/tax-rates-for-a-y-2011-12-74951.asp**
Minimum Alternate Tax	19.93%		
IT depreciation rate	80%		**http://www.scribd.com/doc/24559879/Depreciation-Rates-as-Per-Income-Tax-Act**
CER Revenues			
Exchnage Rate (INR/EURO)	60.00		**Assumed**
CER Price (Euro)	0		
Grid Emission Factor (NEWNE) Ton/Gwh	840.00		

***Sensitivity analysis*:**

To further demonstrate additionality, a sensitivity analysis has been carried out, to assess the sensitivity of the IRR to variations in the most critical parameter of the project; the Plant Load Factor (PLF) and project cost. As per para 20 of the guidance on investment analysis version 5, Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. Para 21 of the guidance states that as a general point of departure, variations in the sensitivity analysis should at least cover a range of +10% and 10%. Thus, the following parameters were selected:

- Plant Load Factor
- Project Cost
- Tariff
- O&M Cost

Plant Load Factor (PLF)

Sensitivity analysis of the Equity IRR to the Plant Load Factor (PLF) (the most critical assumption) has been carried out at 10% variation from the base PLF considered.

	Benchmark rate	-10%	Base case	+10%
Equity IRR	18.36%	13.24%	16.64%	20.14%

Project cost

Sensitivity analysis of the Equity IRR to the project cost has been carried out at +/-10% variation from the actual cost (taken from DPR).

Variation	Benchmark rate	-10%	Base case	+10%
Equity IRR	18.36%	21.00%	16.64%	13.20%

Tariff

The sensitivity analysis for variation in tariff has been presented below:

	Benchmark rate	-10%	Base Case	+10%
Equity IRR	18.36%	13.81%	16.64%	19.79%

O&M Cost:

The sensitivity analysis for the variation in O&M costs is presented below:

	Benchmark rate	-10%	Base Case	+10%
Equity IRR	18.36%	17.19%	16.64%	16.07%

The scenarios under which the IRR crosses the benchmark is as follows:

Parameter	Base IRR	IRR crosses benchmark at
PLF	16.64%	5% increase in base PLF
Tariff		5.7% increase in tariff
Project Cost		4.3% decrease in project cost
O&M Cost		32% decrease in the O&M cost

The probability of occurrence in increase of PLF increase by the percentages detailed above is practically negligible as the PLF value is based on Technical Feasibility Analysis. The probability of occurrence in increase of tariff by the percentages detailed above is limited. The tariff is as per HPERC

COMMISSION’S ORDER ON SMALL HYDRO POWER PROJECTS. There is limited probability of a revision in tariff. Moreover, in case of a new tariff order, the revised tariff is applicable the upcoming projects and not on the existing projects. The project cost is fixed as per the TEC approval and thus there is no possibility of the same decreasing. Moreover, with time, due to inflation, the cost may increase to some extent. Also, the project is dependent on the tail race discharge of the 192 MW AD hydro project. In case of a stoppage in the AD hydro project, the project activity will face a loss of generation due to unavailability of water in the tail race of AD hydro. Thus, achieving a consistently high generation is unlikely for the project activity.

Actual Scenario:
The actual debt equity ratio of the project activity is 40:60. The lender specifically asked the project proponent to increase its equity participation in the project as the bank wanted to reduce its exposure in the project activity due to various uncertainties associated with the project. This can be evidenced through the clarification letter issued by Rural Electrification Corporation, the lender for the project activity and the loan sanction letter. The IRR and the sensitivity analysis at the actual debt equity ratio are as follows:

Parameter	-10% variation	Base Case	+10% variation
PLF	11.77%	13.92%	16.01%
Project Cost	16.52%	13.92%	11.75%
Tariff	12.22%	13.92%	15.70%
O&M	14.28%	13.92%	13.56%

It can be seen that the actual debt equity ratio, the IRR does not cross the benchmark of 18.36% for a 10% variation in any of the parameters.

The project activity is financially not attractive without CER revenues. Therefore, the project activity is additional.

Prior Consideration of CDM

The start date of the project activity is 17/10/2011 (date of Letter of Intent for Civil Works for Powerhouse and Forebay tank). Thus, the start date for the project activity is after 2nd August 2008 and hence as per EB 62, Annex 13 “Guidelines on the demonstration and assessment of prior consideration of the CDM” version 04, project proponent has intimated the UNFCCC as well as the host country DNA of their intention of setting up the hydro power project as a CDM project. The letter to the UNFCCC as well as the Indian DNA was sent on 16/07/2010, which is before the start date of the project activity. The project is yet to be commissioned.

The PDD was webhosted on the UNFCCC website for global stakeholder from 05/12/2010 to 03/01/2011. As the PDD was web-hosted even before the project start date; **therefore in accordance with Annex 13 of EB 62, the PP has taken real and continuing actions for securing CDM status for the project activity.**

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Emission reductions are calculated as:

ERy = BEy – PEy – LEy

Where: *BEy* is the baseline emissions
PEy is project activity emissions and;
LEy is the amount of emissions leakage resulting from the project activity.

Baseline Emissions for the amount of electricity supplied by project activity, *BEy* is calculated as

$$BEy = EGy * EF_{CO2,grid,y}$$

Where: *EGy* is the electricity supplied to the grid,
$EF_{CO2,grid,y}$ is CO_2 emission factor of the grid

A. Calculation of electricity supplied to the grid

Total generation yearly (Estimated) = Total Capacity x Designed PLF x Generating Hours (in a year) - Losses

B. Calculation of CO2 emission factor of grid

According to AMS I.D ver. 17, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2e/kWh) calculated in a transparent and conservative manner as:
(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'
(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

The project proponents have chosen the combined margin approach to calculate the emission coefficient for the grid. According to the tool the baseline emission coefficient will be determined using the following steps:

STEP 1. Identifying the relevant electricity systems

Historically, the Indian power system was divided into five independent regional grids, namely Northern, Eastern, Western, Southern, and North-Eastern. Each grid covered several states. Since August 2006, however, all regional grids except the Southern Grid have been integrated and are operating in synchronous mode, i.e. at same frequency. Consequently, the Northern, Eastern, Western and North-Eastern grids will be treated as a single grid and is being named as NEWNE grid from FY 2007-08 onwards as depicted in the CO_2 Baseline Database. The Southern grid has also been planned to be synchronously operated with rest of all Indian Grid by early 12^{th} Plan (2012-2017).

As the Project is connected to the NEWNE electricity grid, the same is the "project electricity system".

Accordingly, the project boundary encompasses the physical extent of the NEWNE electricity grid, which includes the project site and all power plants connected physically to the electricity system. The following are the main emission sources that could be a part of the project boundary:

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

Only grid power plants are included in the calculation of OM & BM

STEP 3. Select a method to determine the operating margin (OM)
According to the tool the calculation of the operating margin emission factor is based on one of the following methods:

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

Any of the four methods can be used, however, the simple OM method (option a) can only be used if low cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

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

	Share of Must-Run (Hydro/Nuclear) (% of Net Generation)				
	2004-2005	2005-06	2006-07	2007-08	2008-09
NEWNE	11.4%	18.0%	18.5%	19.0%	17.3%
South	21.6%	27.0%	28.3%	27.1%	22.8%
India	18.0%	20.1%	20.9%	21.0%	18.6%

Source: CO_2 Baseline Database for the Indian Power Sector – Central Electricity Authority

The above data clearly shows that the percentage of total grid generation by low cost/must run plants (on the basis of average of five most recent years) for the NEWNE regional grid is less than 50 % of the total generation. Hence the Simple OM method can be used to calculate the Operating Margin Emission factor.

The project proponents choose an ex ante option for calculation of the OM with 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.

STEP 4. Calculate the operating margin emission factor according to the selected method ($EF_{grid,OM,y}$)
The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. 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)

The Central Electricity Authority, Ministry of Power, Government of India has published a database of Carbon Dioxide Emission from the power sector in India based on detailed authenticated information obtained from all operating power stations in the country. This database i.e. The CO2 Baseline Database provides information about the Combined Margin Emission Factors of all the regional electricity grids in India. The Combined Margin in the CEA database is calculated ex ante using the guidelines provided by the UNFCCC in the “Tool to calculate the emission factor for an electricity system”. We have, therefore, used the Combined Margin data published in the CEA database, for calculating the Baseline Emission Factor.

The CEA database uses the option B i.e. data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit, to calculate the OM of the different regional grids.
The simple OM emission factor is calculated based on the electricity generation of each power unit and an emission factor for each power unit, as follows:

$$\mathbf{EF_{grid,\,OMsimple,\,y} = \Sigma\,(EG_{m,\,y} \times EF_{EL,\,m,\,y}) / \Sigma EG_{m,\,y}}$$

Where:
$EF_{grid,\,OMsimple,\,y}$ Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m All power units serving the grid in year y except low-cost / must-run power units
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

The emission factor of each power unit m has been determined using Option B1

$$\mathbf{EF_{EL,m,y} = (\Sigma\, FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,I,y}) / EG_{m,y}}$$

Where:
$EF_{EL,\,m,\,y}$ CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$FC_{i,\,m,y}$ Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,\,y}$ Net 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)
$EG_{m,\,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m All power units serving the grid in year y except low-cost / must-run power units
i All fossil fuel types combusted in power 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

The ex-ante OM value obtained is 1.0049tCO2/MWh

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

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

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

(b) The 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.

Project participants should use the set of power units that comprises the larger annual generation. Accordingly, the CEA database calculates the build margin as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation.
The build margin emission factor has been calculated 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. This option does not require monitoring the emission factor during the crediting period.

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

$$\mathbf{EF_{grid, BM, y} = (\Sigma\ EG_{m, y}\ x\ EF_{EL, m,}\ ) / \Sigma\ EG_{m, y}}$$

Where:

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

The CO2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the procedures given in step 3 (a) for the simple OM, using options B1 using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

The Build Margin value obtained is 0.6752 tCO2/MWh

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

The emission factor *EFy* of the grid is represented as a combination of the Operating Margin (OM) and the Build Margin (BM). Considering the emission factors for these two margins as $EF_{OM,y}$ and $EF_{BM,y}$, then the *EFy* is given by:

$$\mathbf{EF\mathit{y} = \mathit{w}_{OM} * EF_{grid,OM,\mathit{y}} + \mathit{w}_{BM} * EF_{grid,BM,\mathit{y}}}$$

Where:

$EF_{grid, BM, y}$ Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid, OM, y}$ Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} Weighting of operating margin emissions factor (50%)
w_{BM} Weighting of build margin emissions factor (50%) (where $w_{OM} + w_{BM} = 1$).

Using the values for operating and build margin emission factor provided in the CEA database and their respective weights for calculation of combined margin emission factor, the baseline carbon emission factor (CM) is 840.1 tCO2e/GWh or 0.8401tCO2e/MWh.

Project Emissions:

The project activity uses hydro power to generate electricity and hence there are no emissions from the hydro plant. However, the project has a diesel generator set for emergency use. $PE_{FF,y}$ have been calculated as per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. The emissions from the diesel generator are considered as follows-
$PE_{FC,j,y}$ are the emissions from fossil fuel combustion in process j during the year y. These are given as:

$$PE_{FC,j,y} = \sum FC_{i,j,y} \times COEF_{i,y}$$

Where:

$PEFC_{,j,y}$ (tCO2/yr);	=	Are the CO2 emissions from fossil fuel combustion in process j during the year y
$FC_{i,j,y}$ volume unit/yr);	=	Is the quantity of fuel type i combusted in process j during the year y (mass or
$COEF_{i,y}$ unit)	=	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume
i	=	Are the fuel types combusted in process j during the year y
	=	Diesel

The $COEF_{i,y}$ is calculated as per Option B.

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

$COEF_{i,y}$ unit)	=	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume
$NCV_{i,y}$	=	Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
	=	43.3 TJ/Gg (Source: IPCC, to be kept fixed ex-ante)
$EF_{CO2,i,y}$	=	Is the weighted average CO2 emission factor of fuel type i in year y (tCO2/GJ)
	=	74.8tCO2/TJ (Source: IPCC, to be kept fixed ex-ante)
i	=	Are the fuel types combusted in process j during the year y

Leakage:

As per AMS I.D. ver. 17, the main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected. Since no equipment is transferred from another project activity or that any existing equipment is transferred to another activity, leakage as per AMS ID ver. 17 para 22 is taken as zero.

LEy = 0

Details of Baseline data:

Data of Operating and Build Margin for the three financial years from 2006-07 to 2008-09 has been obtained from -

The CO_2 Baseline Database for the Indian Power Sector
Ministry of Power: Central Electricity Authority (CEA)
Version 5
Dated: November 2009
Key baseline information is reproduced in annexure 3.
The detailed excel sheet is available at:
http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

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

Data / Parameter:	$EF_{grid,CM,y}$ / $EF_{CO2,grid,y}$
Data unit:	tCO_2e/MWh
Description:	Combined Margin Emission Factor of NEWNE Electricity Grid
Source of data used:	Calculated from the operating margin and build margin emission factors (explained below) in the following way: $EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$ = 0.75*1.0049 + 0.25*0.6752 = 0.8401 tCO_2e/MWh
Value applied:	0.8401
Justification of the choice of data or description of measurement methods and procedures actually applied :	Combined Margin Emission Factor has been calculated in accordance with “Tool to calculate the emission factor for an electricity system”, version 2.2.1
Any Comments	This parameter is fixed throughout the crediting period

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2e/MWh
Description:	Operating Margin Emission Factor of NEWNE Electricity Grid
Source of data used:	“CO2 Baseline Database for Indian Power Sector” published by the Central Electricity Authority, Ministry of Power, Government of India. The “CO2 Baseline Database for Indian Power Sector” version 05 is available at http://www.cea.nic.in/reports/planning/cdm_co2/database_publishing_ver5.zip
Value applied:	1.0049

Justification of the choice of data or description of measurement methods and procedures actually applied :	Operating Margin Emission Factor has been calculated by the Central Electricity Authority using the simple OM approach in accordance with "Tool to calculate the emission factor for an electricity system" version 2.2.1.
Any Comments	This parameter is fixed throughout the crediting period

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2e/MWh
Description:	Build Margin Emission Factor of NEWNE Electricity Grid
Source of data used:	"CO2 Baseline Database for Indian Power Sector" published by the Central Electricity Authority, Ministry of Power, Government of India. The "CO2 Baseline Database for Indian Power Sector" version 05 is available at http://www.cea.nic.in/reports/planning/cdm_co2/database_publishing_ver5.zip
Value applied:	0.6752
Justification of the choice of data or description of measurement methods and procedures actually applied :	Build Margin Emission Factor has been calculated by the Central Electricity Authority in accordance with "Tool to calculate the emission factor for an electricity system".
Any Comments	This parameter is fixed throughout the crediting period

Data / Parameter:	NCV_{DG}
Data unit:	TJ/Gg
Description:	Net Calorific value of Diesel
Source of data used:	IPCC, 2006 guidelines
Value applied:	43.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been taken from IPCC guidelines for default values (upper uncertainty limit), a reliable and conservative source. IPCC, 2006 guidelines Table 1.2 of Chapter 1, Volume 2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
Any Comments	This parameter is fixed throughout the crediting period. However, if there is any revision in the IPCC guidelines, the revised values will be used.

Data / Parameter:	***OF***
Data unit:	-
Description:	Oxidation factor of Diesel

Source of data used:	IPCC, 2006 guidelines
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been taken from IPCC guidelines for default values, a reliable and conservative source. IPCC, 2006 guidelines Table 1.4 of Chapter 1, Volume 2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
Any Comments	This parameter is fixed throughout the crediting period. However, if there is any revision in the IPCC guidelines, the revised values will be used.

Data / Parameter:	EF_{DG}
Data unit:	tCO_2/TJ
Description:	Emission factor of Diesel
Source of data used:	IPCC, 2006 guidelines Table 1.4 of Chapter 1, Volume 2 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
Value applied:	74.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been taken from IPCC guidelines for default values (upper limit), a reliable and conservative source
Any Comments	This parameter is fixed throughout the crediting period. However, if there is any revision in the IPCC guidelines, the revised values will be used.

Data / Parameter:	D_{DG}
Data unit:	Kg/Litre
Description:	Density of Diesel
Source of data used:	Indian Oil Corporation Limited, http://www.iocl.com/Products/HSD_BS_IV_Specification.pdf
Value applied:	0.832
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value has been taken from IPCC guidelines for default values, a reliable and conservative source
Any Comments	This parameter is fixed throughout the crediting period.

B.6.3 Ex-ante calculation of emission reductions:

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Emission reductions = Baseline emissions – Project emissions - Leakage

Ex-ante calculation of emission reductions is equal to ex-ante calculation of baseline emissions and project emissions, as leakage are nil.

As per para 23 of AMS I.D version 17, baseline Emissions for the amount of electricity supplied by project activity, *BEy* is calculated as

$BEy = EGy * EF_{CO2,grid,y}$ (as per equation 1 of AMS. I-D ver. 17)

Where: *EGy* is the electricity supplied to the grid,
$EF_{CO2,grid,y}$ is CO_2 emission factor of the grid

CO_2 emission factor (combined margin) for the grid
= 0.8401 tCO2e/MWh

Annual electricity supplied to the grid by the Project

= Total Capacity x Designed PLF x Generating Hours (in a year) – Losses

= 4.80 MW (Capacity) x 50.37% (PLF) x 8760 (hours) – 1.0% losses (auxiliary consumption & Transformation losses)

= 20.9687 million units (saleable units)

Annual baseline emissions, BE_y
= 0.8401 tCO2e/MWh x 20968 MWh
= 17,613 tCO2e

Project Emissions

As per para 20 of the methodology, For most renewable energy project activities, $PE_y = 0$.

For the purpose of ex-ante estimations, $PE_y = 0$

During verification, CO_2 emissions from on-site consumption of fossil fuels due to the project activity shall be calculated using the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

Leakage Emissions:

In line with para 22 of the methodology, since the energy generating equipment is not transferred from another activity, leakage is not to be considered.

Thus, as per equation 10 of AMS I.D ver. 17,

$$ER_y = BE_y - PE_y - LE_y$$

ERy = 17613 – 0 – 0
= 17613 tCO_2/y

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

>>

Year	Estimation of project activity emissions (tCO2 e)	Estimation of baseline emissions (tCO2 e)	Estimation of leakage (tCO2 e)	Estimation of overall emission reductions (tCO2 e)
Year 1	0	17,613	0	17, 613
Year 2	0	17, 613	0	17, 613
Year 3	0	17, 613	0	17, 613
Year 4	0	17, 613	0	17, 613
Year 5	0	17, 613	0	17, 613
Year 6	0	17, 613	0	17, 613
Year 7	0	17, 613	0	17, 613
Total (tonnes of CO2e)	**0**	123,290	0	123,290

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{BL,y}$
Data unit:	MWh
Description:	Net Electricity exported to the grid by the project
Source of data to be used:	Joint Meter Reading documents
Value of data	21180 MWh
Measurement Procedures	- The project is connected to the HPSEB substation. - The electricity exported by the project activity and imported by the project activity will be measured with the help of two-way trivector meters installed at the HPSEB substation (Prini, Manali). For measuring the electricity exported and imported by the project activity, HPSEB has installed a trivector energy meter at the grid interconnection point. Monthly readings are taken jointly by HPSEB and AMHPL and a generation statement is prepared. Both export and import readings are taken and net export is calculated by deducting the power imported by the project activity from the power exported by the project activity. Monitoring Frequency: Continuous Recording Frequency: Monthly

	Meter Accuracy class: 0.5 or better accuracy class Calibration Frequency: At least once in three years
QA/QC procedures to be applied:	Electricity exported by the project activity to the grid can be cross-checked from the invoices raised by the PP to HPSEB. The energy meters will be calibrated at least once in three years by HPSEB and records will be maintained by the PP.
Any comment:	Data shall be archived electronically and on paper format till the last issuance + a period of 2 years

Data / Parameter:	$FC_{i,j,y}$
Data unit:	Litres/yr
Description:	Quantity of diesel used in a year
Source of data to be used:	Plant log books
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Measurement Procedures	The quantity of diesel consumed will be measured and recorded in the log book present at the project site. The fuel will be supplied by small daily tanks and the fuel will be sourced from local stations. The fuel measurements will take place by ruler gauges (part of the daily tanks) on a daily basis and the same will be recorded in log books. The monitoring will be done by the project proponent personnel employed at the project site.
Monitoring frequency Recording frequency	Continuously Daily
QA/QC procedures to be applied:	The consumption from the log book will be verified against the receipts of diesel bought. The ruler gauges will be calibrated annually by the project proponent through an external agency.
Any comment:	Data shall be archived electronically and on paper format till the last issuance + a period of 2 years

B.7.2 Description of the monitoring plan:

>>

Metering of the electricity generated

The generated electricity from the project is evacuated at the state electricity utility (HPSEB) for the complete project lifespan. Thus throughout the project cycle (crediting period) the electricity generated from the project will be monitored by both the project proponent and a third party, namely the HPSEB.

The generated electricity, before entering into the grid, at the grid interconnection point will be measured by digital sealed kilowatt hour (kWh) meters on a monthly basis and will be documented in paper format. The generation records will be signed by the officials from project proponent and third party (HPSEB). This Joint Meter Reading report will contain details of import and export by the project activity to the NEWNE grid. This JMR will form the basis of payment by HPSEB to the project proponent. Such records will be maintained and would be made available on demand till the last issuance plus a period of 2 years.

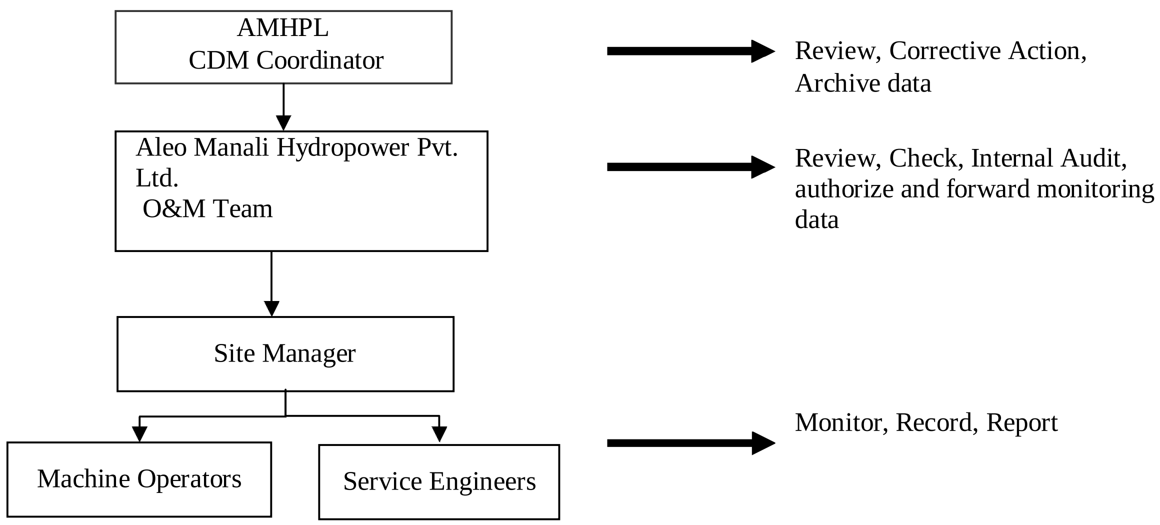
There is also a check meter installed as a backup of the main meter.

Authority and Responsibility for project management

The proponent has appointed a well-defined hierarchy of personnel for the overall management of the project. At each level the appointed persons report to the authority above them. There is a dedicated team of 15 people stationed at the site for the operation and maintenance of the plant. 3 people work in a shift of 8 hours each. Any technical problem is rectified by the stationed staff and if needed, the supplier is contacted in case of extreme events.

The project office in Manali is responsible for the overall project management. The project proponent will maintain the JMR and raise invoices to HPSEB for the electricity generated. The project office will also archive the JMRs and invoices for crediting + 2 years.

The operation and maintenance structure is as follows-



Other monitoring measures and practices

Documentation

Documentation and archiving is carried out systematically and regularly. The following records shall be maintained after regular measurements and strict monitoring of the parameters. The records shall be verified by the project In-charge and maintained at both the on-site office and corporate head

- Monthly Outage statement
- Daily power generation attested at the end of each month.
- Maintenance work carried out each month
- Gauge readings taken diurnally.
- Load versus discharge readings
- Hourly log book readings for generator temp, oil level and pressure in power pack & transformer, etc.

Data Archiving:
The data will be archived electronically and on paper format for a period of 2 years after the last issuance.

Project performance reviews
The project In-Charge shall carry out performance reviews of the plant, its upkeep and maintenance on a monthly basis. In addition, the MD (head of the company) shall visit the plant regularly to survey and observe the plant performance. All corrective actions are carried out under the guidance of the In-Charge and the higher management committee is continually apprised of the actions and outcomes, by mails or telephonically.

Addressing Corrective actions
This section is relevant if any additional or unplanned investments have been made during the project construction that reflects upon the continuous improvement procedures observed by the company.

Emergency Preparedness
Being a small hydro plant of only 4.8 MW capacity, intensive emergency preparation is not needed, however, the following may be highlighted:

- There are no critical loads that may require emergency power supply in case of total outage.
- A fire extinguisher has been installed in case of small fires
- Information regarding any safety earthing systems in place

For measuring the energy exported, a check meter will also be installed with the main meter. In case the main meter is found to be faulty, reading from the check meter shall be considered for that period of time.

Training
Adequate training shall be imparted to the employees for successful operations of the SHP. As the staff to be stationed at the site shall be experienced and many of them professional engineers, a comprehensive training is not required. Further, the staff from the equipment supplier is always reachable to rectify any major issues in operation of the plant.

Leakage
The project activity does not involve any leakage within the project boundary because no alternate fuel (Fossil fuel or any other GHG emitting fuel) can be used to run the turbines and generate electricity.

Procedures for handling data uncertainty:

a- In case main meter is faulty- Check meter is used to calculate the electricity exported to the grid. Main meter is immediately replaced by a new meter and meter reading from the replaced meter is used thereafter.

b- In case the check meter is faulty- The check meter is immediately replaced. The emission reduction calculation would not be affected as reading from main meter is used to calculate the net electricity exported to the grid.

c- In case error is identified during bi-annual accuracy testing- If during the annual tests, the meter is found to be beyond the permissible limits of error, the meter shall be immediately calibrated and replaced, if necessary. The error that is identified in the bi-annual accuracy testing would be applied to all the readings of electricity exported as indicated in the JMR from the date of last accuracy testing. Billing for the period thereafter shall be as per the calibrated meter.

Apportioning procedure used by PP in case of a mismatch in dates of verification period and JMR

The emission reduction will be calculated from the date of first JMR after the date of registration or start date of a monitoring report during verification.

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

>>

Date of completion: 21/09/2012

Name of responsible person/entity: Aleo Manali Hydropower Private Limited (details are given in Annex-1) and their CDM advisors. The CDM advisors are not the Project Proponents.

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:

>>

17/10/2011 (date of Letter of Intent for Civil Works for Powerhouse and Forebay tank)

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

>>

40 years 0 months

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

Renewable crediting period (to be renewed upto a maximum of two times)

C.2.1. Renewable crediting period

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

The starting date of the crediting period shall be 01/02/2013 or the effective date of registration for the project activity, whichever is later. Effective date of registration for the project activity will be the date that the DOE submits a complete request for registration.

C.2.1.2. Length of the first crediting period:

>>

7 years and 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

Not applicable

C.2.2.2. Length:

>>

Not applicable

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

As per the Schedule 1 of Ministry of Environment and Forests (Government of India) notification dated January 27, 1994 and EIA Notification (S.O 1533) dated 14th September 2006, a list of activities that require undertaking environmental impact assessment studies has been provided. EIA is not a regulatory requirement in India for small hydro energy projects and the PP does not expect any adverse impacts of the proposed CDM project activity on the environment.

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:

>>

The environmental impacts from the proposed CDM project activity are not considered significant.

There are no trans-boundary impacts of the proposed CDM project activity.

SECTION E. Stakeholders' comments

>>

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

>>

The local stakeholder consultation for the project was organized on 21st September 2010 at Village Aleo, District Kullu, Himachal Pradesh at the project site to understand the concerns of the stakeholders with

regard to the project activity. The local stakeholders were intimated of the stakeholder consultation by two Newspaper advertisements dated 28th August 2010 (Dainik Jagran) and 1st September 2010 (Amar Ujala) respectively. The stakeholders included the members of the local village Panchayat, resident villagers of the area, Project Proponent (PP) representatives.

Welcome Speech:

Mr. N. K. Sharma started with brief introduction and welcomed all the stakeholders. He explained that meeting has been convened for discussing opinions, concerns and benefits from the hydro power project established in this region.

Introduction to 'Clean Development Mechanism'

Mr. N. K. Sharma explained about CDM to all the stakeholders. In his speech he explained how carbon levels in the atmosphere is increasing and to reduce the green house gas emission various Non-Polluting initiatives are to be initiated. He further explained how hydroelectric Projects generate pollution free energy and helps in creating employment opportunities to the villagers. He further added that these projects also help in catering the power shortages faced by the nation.

Speech by Representatives of Aleo Manali Hydropower Private Limited

Mr. N. K. Sharma**,** begun his speech with brief background of the company Aleo Manali Hydropower Private Limited and explained that is committed to protect the environment and to be part of the process, company has developed the hydro power plant which generates pollution free power and it adds to national resources and above all it generates employment to the Local Villager and helps in increasing the standard of living of the society. These projects, apart from providing employment opportunities are also providing the Education, Medical and Infrastructure facilities to the society.
He also said that these projects help in economic well being of the society through various job opportunities i.e. Civil Construction, Drivers, Security Personnel, Technicians, and Casual Labours etc.

E.2. Summary of the comments received:

>>

Mr. Suresh Kumar, Age – 46 yrs, had asked the question about how this project will benefit the villagers.

Mr. N. K. Sharma replied that this project does not emit any gases or liquid and so it is non polluting project. It keeps the environment clean & there is no disturbance to the surrounding area. The project will also provide employment to the local people. It will provide electricity to the area. The promoters will also help in the development of the village by making foot paths for the village, helping in education etc.

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

>>

There were no negative comments received from the stakeholders.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Aleo Manali Hydropower Pvt Ltd
Street/P.O.Box:	
Building:	B – 173, Sector 41
City:	Noida
State/Region:	Uttar Pradesh
Postfix/ZIP:	201303
Country:	India
Telephone:	+91-120-2501220
FAX:	+91-120-4340870
E-Mail:	akgoel.hydro@gmail.com
URL:	
Represented by:	Mr. Ashwani Kumar Goel
Title:	
Salutation:	Mr.
Last Name:	Goel
Middle Name:	Kumar
First Name:	Ashwani
Department:	
Mobile:	+919810642876
Direct FAX:	
Direct tel:	+91-120-2501220
Personal E-Mail:	akgoel.hydro@gmail.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in the project

Annex 3

BASELINE INFORMATION

Baseline Emission Factor:

The Operating Margin data for the most recent three years and the Build Margin data for the NEWNE Electricity Grid as published in the CEA database are as follows:

Grid Emission Factors[10]:

The Operating Margin data for the most recent three years and the Build Margin data for the NEWNE Electricity Grid as published in the CEA database version 5 are as follows:

Simple Operating Margin

	NEWNE Grid (tCO_2 e/MWh)
Simple Operating Margin – 2006-07	1.0085
Simple Operating Margin – 2007-08	.9999
Simple Operating Margin – 2008-09	1.0066
Weighted average Operating Margin of last three years	1.0049

Build Margin

	NEWNE Grid (tCO_2 e/MWh)
Build Margin	0.6752

Weighted Combined Margin Calculations

	Weights	**NEWNE Grid (tCO_2 e/MWh)**
Operating Margin	0.50	0.5024
Build Margin	0.50	0.3375
Combined Margin		**0.8401**

[10] Baseline Carbon Dioxide Emissions from Power Sector, Baseline Carbon Dioxide Emission Database Version 5.0 dated November 2009 on http://www.cea.nic.in/reports/planning/cdm_co2/database_publishing_ver5.zip

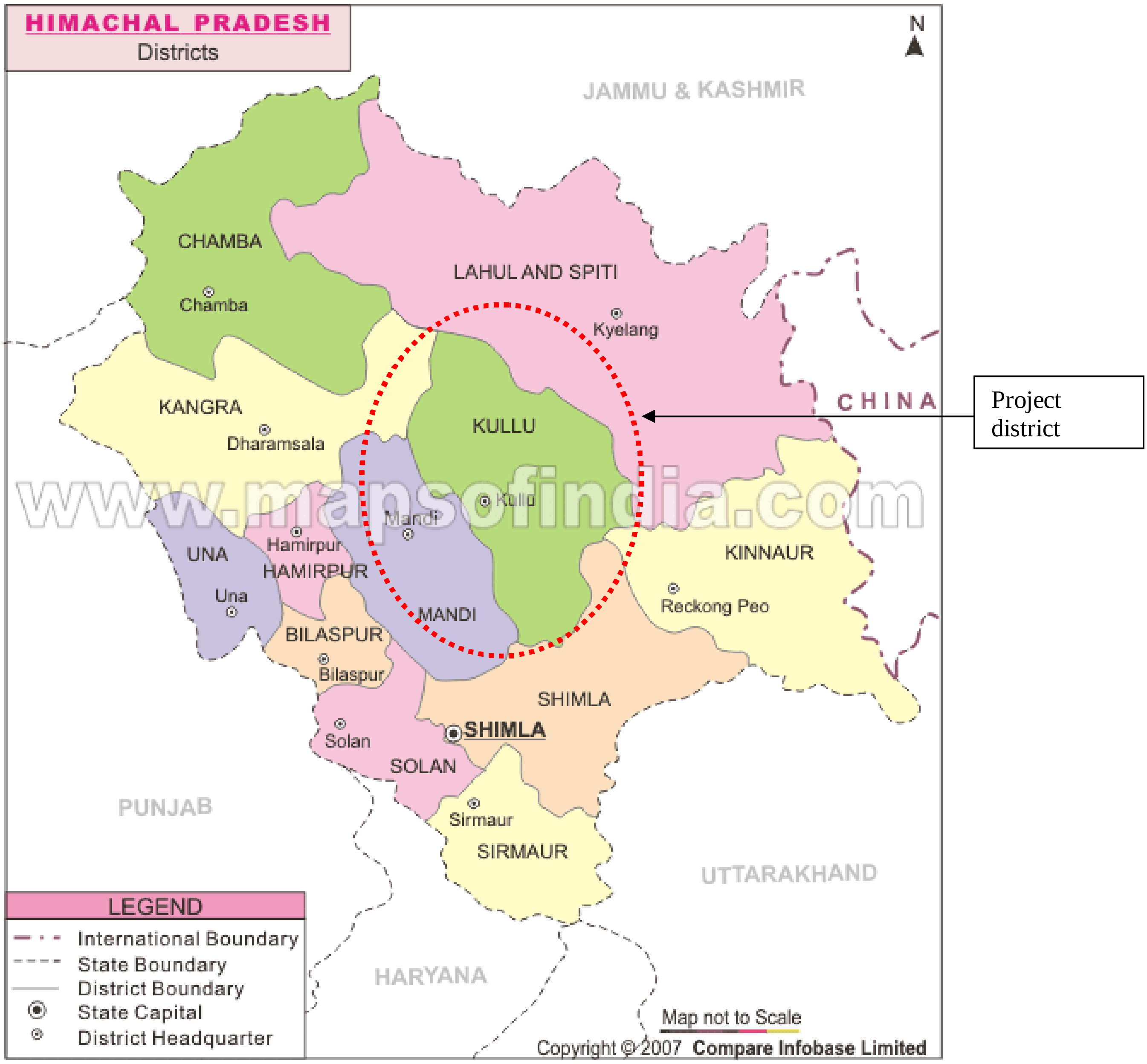
Annex 4

MONITORING INFORMATION

Please refer to Section B.7.2

APPENDIX 1

DISTRICT MAP OF HIMACHAL PRADESH



DISTRICT MAP OF KULLU

Appendix 2: BENCHMARK APPROACH

Selection of Appropriate Benchmark:

In choosing an appropriate benchmark we have based our approach on the principles of financing and investment decision making that are well found in theory and practice of corporate financing world wide. We have derived from text book on “Corporate Finance Theory and Practice” by Dr. Aswath Damodaran of Stern School of Business, New York University.

The guidance to investment analysis issued in EB 62, Annex 5 (Para 11) states that in cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Required/expected returns on equity are appropriate benchmarks for equity IRR.

It is also worthwhile to note that the captioned project is a Greenfield hydro power generation project that generates and supplies electricity to the state grid, therefore the project can not have only one possible project developer. Accordingly, the cost of equity applicable to the project type has been considered.

Cost of Equity:

The expected return on equity has been determined using the Capital Asset Pricing Model (CAPM)[11]. The CAPM economic model is used worldwide to determine the required/expected return on equity based on potential risk of an investment. The CAPM framework is the Nobel award winning work of financial economist Dr. William Sharpe.

Ke = Rf + B x (Rm - Rf)
where:
Ke = Rate of return on equity capital;
Rf = Risk-free rate of return;
B = Beta;
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 rate of interest on government bonds are considered as risk free rates. Page 188 of text book on “Corporate Finance Theory and Practice” by Dr. Aswath Damodaran[12], Stern School of Business, New York University, describes that the long term government bond rates are suitable indicators of risk free rates when the time horizon for the investment is long term.

Accordingly the risk free rate has been taken from Indian government bond rates available. This has been considered as it was in the year of investment (i.e in that year, the company had the alternative of this

[11] The Capital Asset Pricing Model (CAPM) was published in 1964 by William Sharpe, for his work on CAPM Sharpe received the Nobel Prize in 1990. http://www.investopedia.com/articles/06/CAPM.asp

[12] Dr. Damodaran, one of the foremost authorities in the world in the field of Investment Analysis

long term risk free investment). The data on government bond rates is published by Reserve Bank of India. (Web-link: http://www.rbi.org.in/scripts/BS_ViewBulletin.aspx?Id=11317)

The average risk free return has been taken from the yield rate on GOI securities.

Risk Premium:

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 average return on government securities over an extended period of history [page 190, Corporate Finance Theory and Practice, Dr. Aswath Damodaran]. It is preferred to use long term premimums, i.e over a period of 25 years, since considering shorter time periods can lead to large standard errors because volatility in stock returns [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran]. It is also preferred to calculate the risk premium based on geometric mean of the returns since arithmetic mean overstates the risk premium. Geometric mean is defined as the compounded annual return over the same period [page 191, Corporate Finance Theory and Practice, Dr. Aswath Damodaran].

Therefore the risk premium has been calculated as the difference in compounded annual return bewteen the BSE-Sensex and the Government bond rates since the year of inception of BSE Sensex, i.e. 1979 – 80. The detailed calculations are presented in the attached excel sheet. BSE Sensex is the oldest index in the Indian Stock Market[13] and thus has the largest quantum of data. The Sensex represents 30 component stocks representing large, well-established and financially sound companies across key sectors. It also features the most frequently traded stocks. The entire data range of BSE Sensex, since its inception, has been considered.

Beta:

Beta (B) indicates the sensitivity of the company to market risk factors. Beta represents the market risk for an asset and is calculated as the statistical measure of volatility of a specific asset/investment relative to the movement of a market group. The conventional approach for estimating beta of an investment is a regression of returns on investment against returns on a market index. 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 power generation companies in India. Three such companies which have been involved in hydro power generation have also been included in the benchmark calculation.

Therefore, we have considered beta values of electricity generating companies in India. The group of companies considered includes renewable as well as conventional power generating companies. It is understood that risky businesses are likely to have higher cost of equity than safer businesses; projects in riskier businesses will have to cover these higher costs. Hence, 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. hydro), 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 the Beta values of all power generating companies in India which were listed on the stock exchange at the time of this investment. Beta values of individual companies have been sourced from Bloomberg values of which are available at

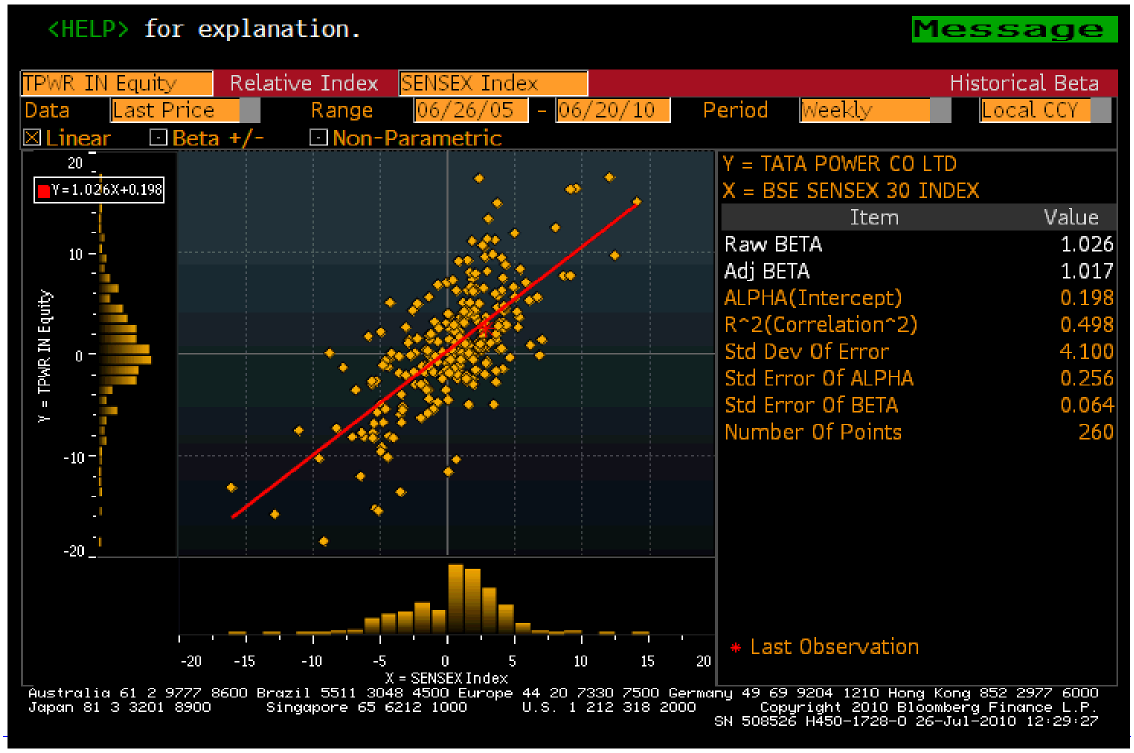
[13] http://www.bseindia.com/about/abindices/preface.asp

http://www.bloomberg.com. 2. Beta in the benchmark computation has been taken as the average of beta of 5 years. As per Dr. Aswath Damodaran (Estimating Risk Parameters[14]), 2-5 years of data is generally used to estimate beta. Thus a 5 year period has been chosen to cover a greater spread of market variations.

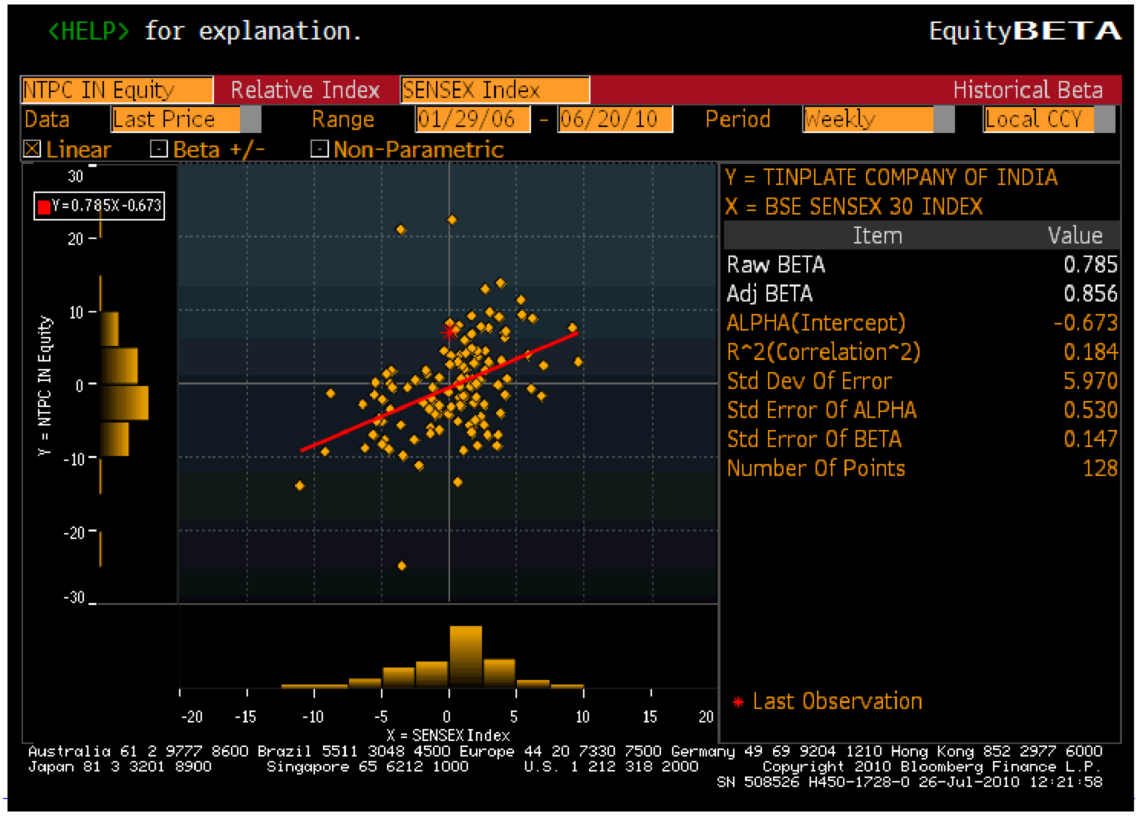
Company Name	5 year Beta
BF UTILITIES LTD	1.170
CESC	1.062
GUJARAT INDS	1.009
NEYVELI LIGNITE	1.191
TATA POWER CO	1.017
JPVL	1.204
IHPML	1.048
NTPC	0.856
NHPC	0.866
Average Beta	**1.036**

The cost of equity therefore works out to 18.36%

The screenshots from Bloomberg for Beta are shown below



[14] http://www.ba.metu.edu.tr/~adil/ba4829/Damodaran-beta.pdf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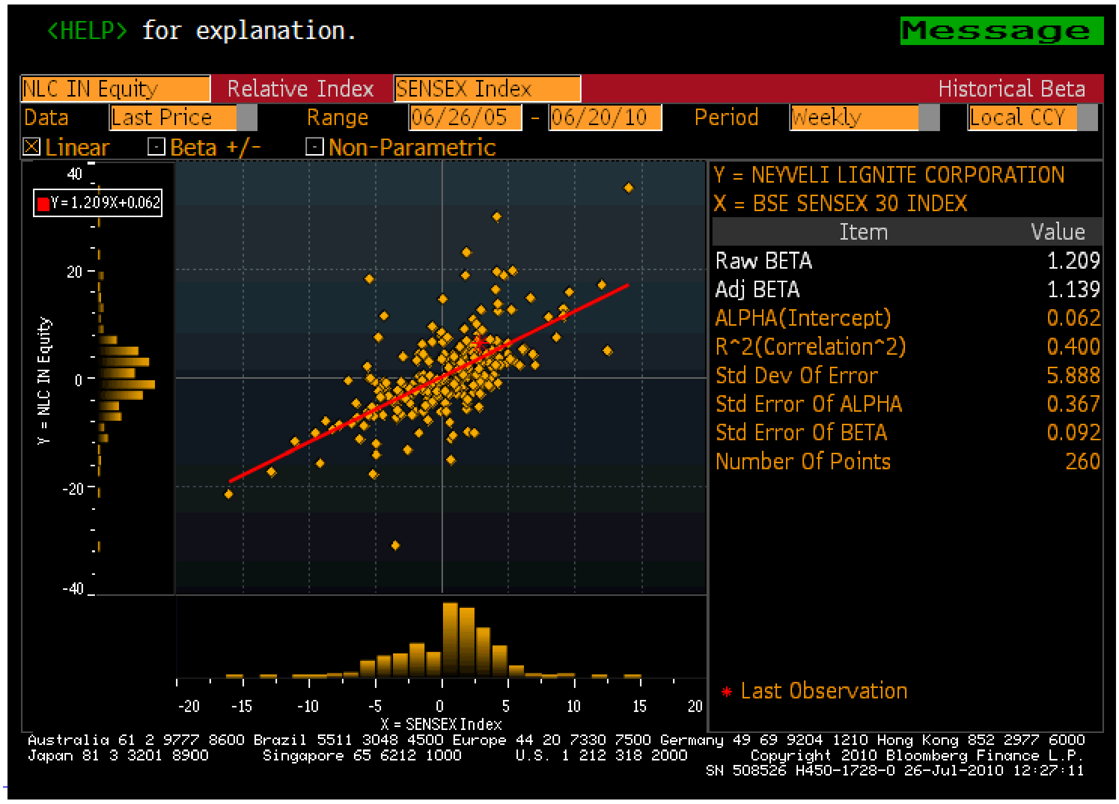
EquityBETA
NTPC IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
01/29/06
-
06/20/10
Period
Weekly
Local CCY
Linear
Beta +/-
Non-Parametric
Y=0.785X-0.673
Y = NTPC IN Equity
Y = TINPLATE COMPANY OF INDIA
X = BSE SENSEX 30 INDEX
Item Value
Raw BETA 0.785
Adj BETA 0.856
ALPHA(Intercept) -0.673
R^2(Correlation^2) 0.184
Std Dev Of Error 5.970
Std Error Of ALPHA 0.530
Std Error Of BETA 0.147
Number Of Points 128
Last Observation
X = SENSEX Index
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2010 Bloomberg Finance L.P.
SN 508526 H450-1728-0 26-Jul-2010 12:21:58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NLC IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
06/26/05
-
06/20/10
Period
Weekly
Local CCY
Linear
Beta +/-
Non-Parametric
Y=1.209X+0.062
Y = NLC IN Equity
Y = NEYVELI LIGNITE CORPORATION
X = BSE SENSEX 30 INDEX
Item Value
Raw BETA 1.209
Adj BETA 1.139
ALPHA(Intercept) 0.062
R^2(Correlation^2) 0.400
Std Dev Of Error 5.888
Std Error Of ALPHA 0.367
Std Error Of BETA 0.092
Number Of Points 260
Last Observation
X = SENSEX Index
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2010 Bloomberg Finance L.P.
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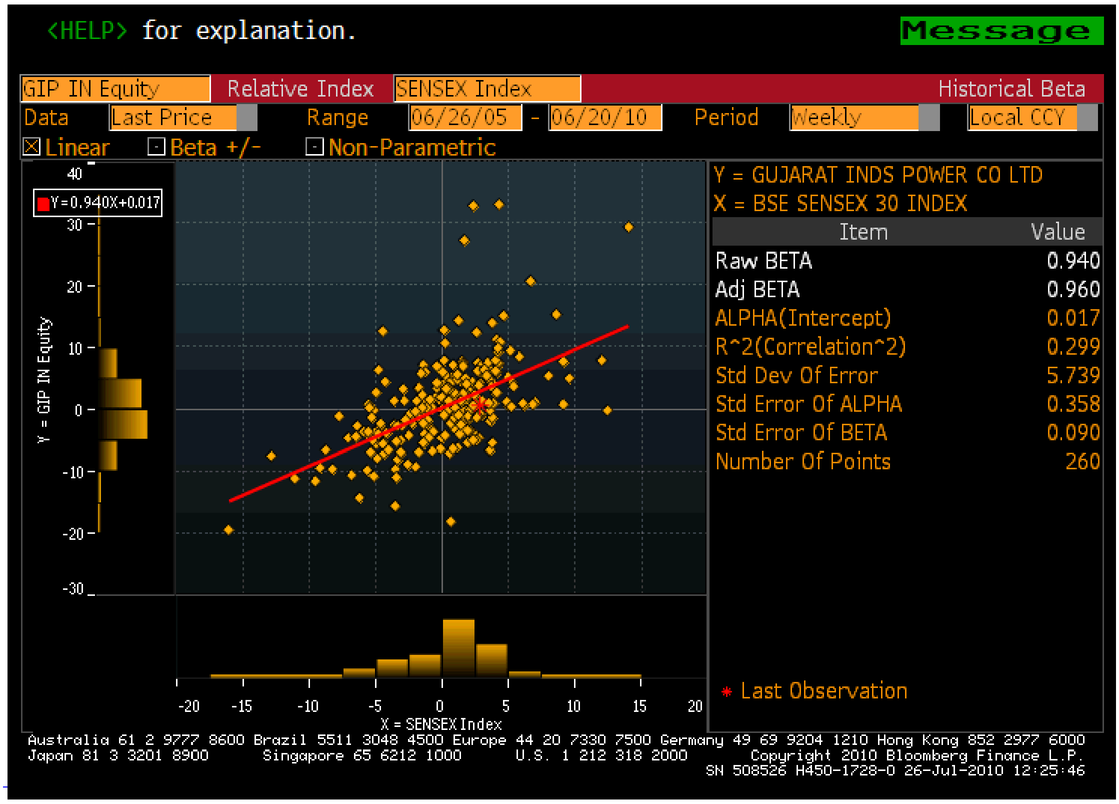
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GIP IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
06/26/05 - 06/20/10
Period
Weekly
Local CCY
Linear
Beta +/-
Non-Parametric
Y=0.940X+0.017
Y = GIP IN Equity
X = SENSEX Index
Y = GUJARAT INDS POWER CO LTD
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 0.940
Adj BETA 0.960
ALPHA(Intercept) 0.017
R^2(Correlation^2) 0.299
Std Dev Of Error 5.739
Std Error Of ALPHA 0.358
Std Error Of BETA 0.090
Number Of Points 260
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2010 Bloomberg Finance L.P.
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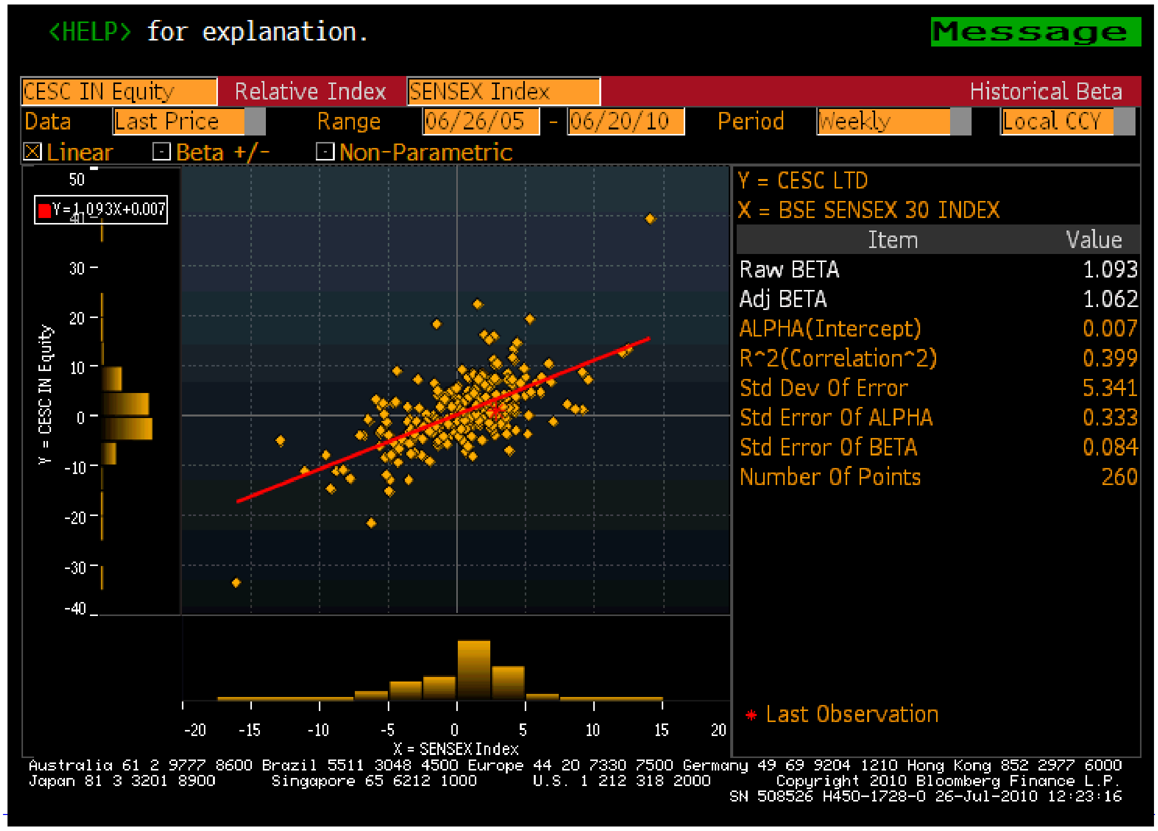
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CESC IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
06/26/05 - 06/20/10
Period
Weekly
Local CCY
Linear
Beta +/-
Non-Parametric
Y=1.093X+0.007
Y = CESC IN Equity
X = SENSEX Index
Y = CESC LTD
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 1.093
Adj BETA 1.062
ALPHA(Intercept) 0.007
R^2(Correlation^2) 0.399
Std Dev Of Error 5.341
Std Error Of ALPHA 0.333
Std Error Of BETA 0.084
Number Of Points 260
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
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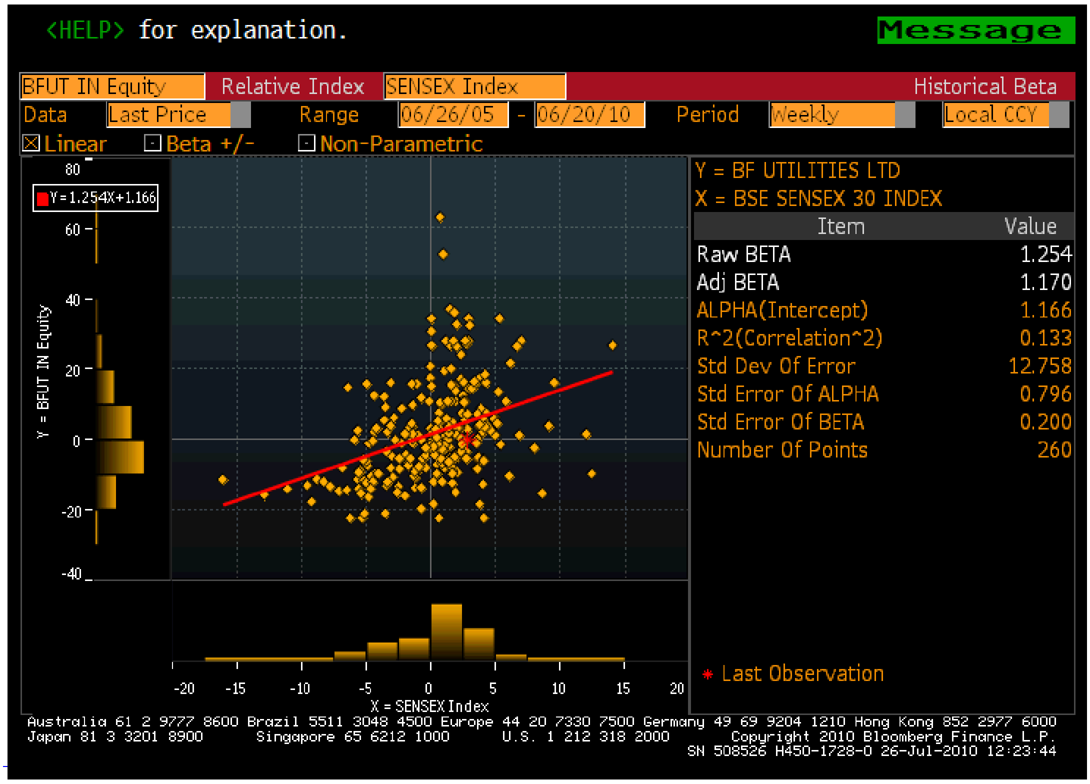
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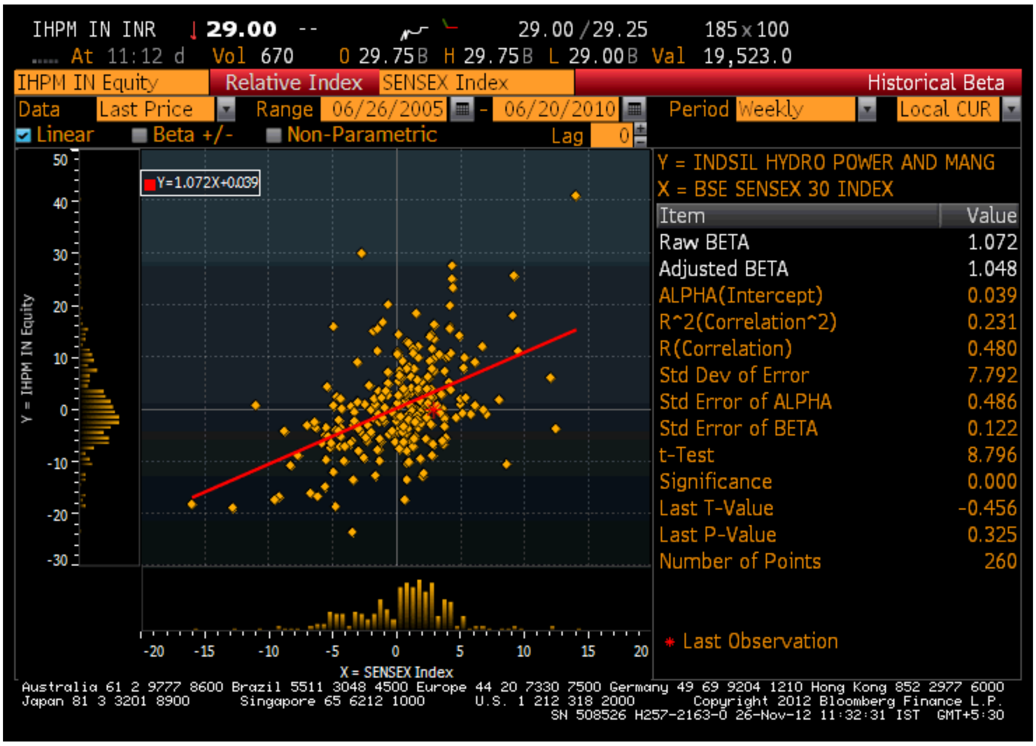
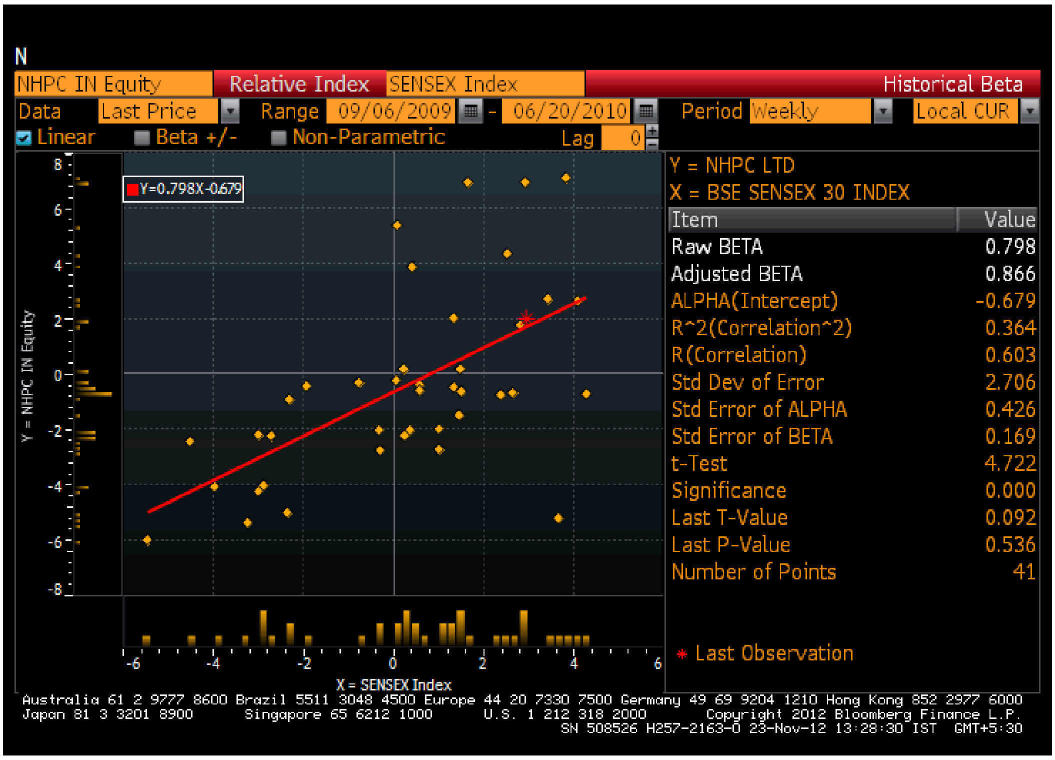
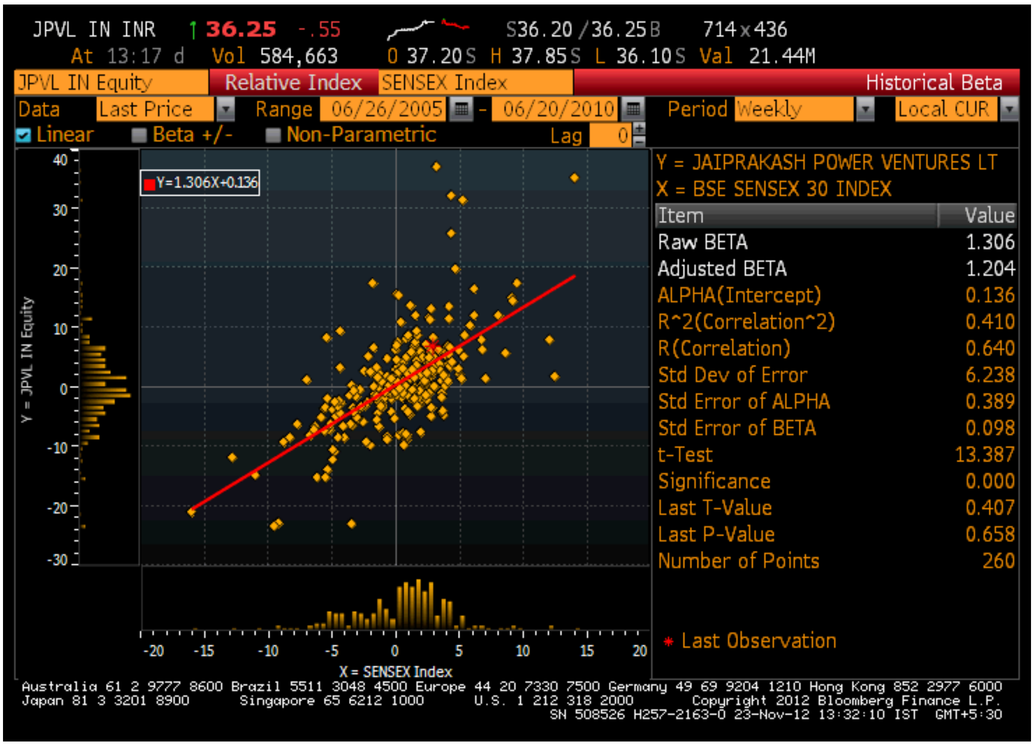
Message
BFUT IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
06/26/05 - 06/20/10
Period
Weekly
Local CCY
Linear
Beta +/-
Non-Parametric
Y=1.254X+1.166
Y = BFUT IN Equity
Y = BF UTILITIES LTD
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 1.254
Adj BETA 1.170
ALPHA(Intercept) 1.166
R^2(Correlation^2) 0.133
Std Dev Of Error 12.758
Std Error Of ALPHA 0.796
Std Error Of BETA 0.200
Number Of Points 260
Last Observation
X = SENSEX Index
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2010 Bloomberg Finance L.P.
SN 508526 H450-1728-0 26-Jul-2010 12:23:44


IHPM IN INR 29.00 --
29.00 / 29.25 185 x 100
At 11:12 d Vol 670 O 29.75B H 29.75B L 29.00B Val 19,523.0
IHPM IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
06/26/2005 - 06/20/2010
Period
Weekly
Local CUR
Linear
Beta +/-
Non-Parametric
Lag
Y=1.072X+0.039
Y = IHPM IN Equity
Y = INDSIL HYDRO POWER AND MANG
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA 1.072
Adjusted BETA 1.048
ALPHA(Intercept) 0.039
R^2(Correlation^2) 0.231
R(Correlation) 0.480
Std Dev of Error 7.792
Std Error of ALPHA 0.486
Std Error of BETA 0.122
t-Test 8.796
Significance 0.000
Last T-Value -0.456
Last P-Value 0.325
Number of Points 260
Last Observation
X = SENSEX Index
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2012 Bloomberg Finance L.P.
SN 508526 H257-2163-0 26-Nov-12 11:32:31 IST GMT+5:30


N
NHPC IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
09/06/2009
06/20/2010
Period
Weekly
Local CUR
Linear
Beta +/-
Non-Parametric
Lag
0
Y=0.798X-0.679
Y = NHPC IN Equity
X = SENSEX Index
Y = NHPC LTD
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA
0.798
Adjusted BETA
0.866
ALPHA(Intercept)
-0.679
R^2(Correlation^2)
0.364
R(Correlation)
0.603
Std Dev of Error
2.706
Std Error of ALPHA
0.426
Std Error of BETA
0.169
t-Test
4.722
Significance
0.000
Last T-Value
0.092
Last P-Value
0.536
Number of Points
41
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2012 Bloomberg Finance L.P.
SN 508526 H257-2163-0 23-Nov-12 13:28:30 IST GMT+5:30


JPVL IN INR
36.25
-.55
S36.20 / 36.25B
714 x 436
At 13:17 d
Vol 584,663
O 37.20S
H 37.85S
L 36.10S
Val 21.44M
JPVL IN Equity
Relative Index
SENSEX Index
Historical Beta
Data
Last Price
Range
06/26/2005
06/20/2010
Period
Weekly
Local CUR
Linear
Beta +/-
Non-Parametric
Lag
0
Y=1.306X+0.136
Y = JPVL IN Equity
X = SENSEX Index
Y = JAIPRAKASH POWER VENTURES LT
X = BSE SENSEX 30 INDEX
Item
Value
Raw BETA
1.306
Adjusted BETA
1.204
ALPHA(Intercept)
0.136
R^2(Correlation^2)
0.410
R(Correlation)
0.640
Std Dev of Error
6.238
Std Error of ALPHA
0.389
Std Error of BETA
0.098
t-Test
13.387
Significance
0.000
Last T-Value
0.407
Last P-Value
0.658
Number of Points
260
Last Observation
Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2012 Bloomberg Finance L.P.
SN 508526 H257-2163-0 23-Nov-12 13:32:10 IST GMT+5:30