

# MONITORING REPORT

## Hanuman Ganga Hydro (4.95 MW) Plant at Uttarakhand

By

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Project site  
Hanuman Ganga Nallah;  
Near Hanuman Chatti village, Uttarkashi District.

<b>Project Title</b>	Hanuman Ganga Hydro (4.95 MW) Plant at Uttarakhand
<b>Version</b>	03.2 (1 <sup>st</sup> Periodic Verification)
<b>Report ID</b>	VCS_MR_HG_Ver3.2
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<b>Monitoring Period</b>	28-March-2006 to 31-March-2010
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## 1 PROJECT DETAILS

### 1.1 Summary Description of Project

**Title:** Hanuman Ganga Hydro (4.95 MW) Plant at Uttarakhand

**VCS Registration Details:**

VCS PD Completion date: – 15/11/2009  
 Validation Deed Representation date: - 18/11/2009  
 Final Validation Report No.:- 53707108-08/461  
 Final Validation Report Issued on: - 18/11/2009

**VCS Monitoring Details:**

Version: 03.2 (1<sup>st</sup> Periodic Verification)  
 Monitoring Period: 28/03/2006 to 31/03/2010  
**Total Emission Reductions Claimed:** 51,894 VCUs

**Project Activity:**

The project activity consists of a small hydro project, the total installed capacity being 4.95 MW to generate clean electricity using the energy of the flowing stream. The project is a run-of- the- river type with minimum environmental impacts. The technology or electricity generation process using hydro resources is converting the potential energy available in the stream flowing from higher altitudes into mechanical energy using hydro turbines and then to electrical energy using alternators. The project activity will provide and sell electricity to the state electricity utility (Uttarakhand Power Corporation Limited (UPCL)) through NEWNE grid, and thus will reduce dependence on fossil fuels and thereby reducing CO2 emissions.

The Hanuman Ganga project with its total capacity of 4.95 MW has got commissioned in two phases. The first phase with capacity of 3 MW was commissioned in March 2005 and the second phase with capacity of 1.95 MW was commissioned in April 2008.)

Commissioning of Phase I (3 MW)	:	24/03/2005
Commissioning of Phase II (1.95 MW)	:	19/04/2008

The site is located on Hanuman Ganga Nallah near Hanuman Chatti village in Uttarkashi District, Uttarakhand State of India.

It was estimated that project would be able to export around **26.017 GWH** of electricity (in total) per year to the Uttarakhand State Electricity Board. It was also estimated that this project will help to mitigate climate change and lead to green house gas emission reductions of **184228 tCO<sub>2e</sub>** for the crediting period of 10 years.

### 1.2 Sectoral Scope and Project Type

**Sectoral Scope:** Energy (renewable/non-renewable)

**Project Type:** According to small-scale CDM modalities the project activity falls under:

Type I – Renewable Energy Projects

Category ID – Grid connected renewable electricity generation, (Version 13, EB 36).

The project activity is not a grouped project.

### 1.3 Project Proponent

Regency Aquaelectro & Motelresorts Ltd. who is the Project Proponent of the project activity and also the sole owner of all the GHG emission reductions credits generated. The contact details of the Project Proponent are given in the below table:

Organization:	M/s Regency Aquaelectro & Motelresorts Ltd.
Street/P.O.Box:	River View Lane,
Building:	Regency Complex
City:	Paonta Sahib.
State/Region:	Himachal Pradesh
Postfix/ZIP:	173 025
Country:	India
Telephone:	01704-223431, 01704-224431
FAX:	01704-222645
E-Mail:	<a href="mailto:aphregency@yahoo.co.in">aphregency@yahoo.co.in</a>
Title:	Managing Director
Salutation:	Mr.
Last Name:	Sharma
Middle Name:	
First Name:	Arun
Mobile:	094180-26677
Direct FAX:	01704-222645
Direct tel:	01704-223778
Personal E-Mail:	<a href="mailto:aphregency@yahoo.co.in">aphregency@yahoo.co.in</a>

The roles and responsibilities of the project proponent and the concerned staff are explained in detail in section 3.3 below.

### 1.4 Other Entities Involved in the Project

No other entity is involved in the project.

### 1.5 Project Start Date

24/03/2005<sup>1</sup> which is the date of commissioning of the Phase I (3 MW) of the Project..

### 1.6 Project Crediting Period

Project Crediting Period is 10 Years.

28/03/2006 is the start date and 27/03/2016 will be the end date of the crediting period.

### 1.7 Project Location

Host Party : India  
 Region : Northern Region of India  
 State : Uttarakhand.

<sup>1</sup> Commissioning Certificate by UPCL dated 24/03/2005

City (District) : Uttarkashi  
 Town : Hanuman Ganga Nallah  
 Community (Village) : Hanuman Chatti village

**Access to project site:**

Hanuman Chatti is 165 km from Dehradun via Mussoorie. The distance from the National Capital, New Delhi is 420 KM. The nearest Railway Station and Airport is at Dehradun.

**Geographical Coordinates:**

<b>Latitude</b>	N 30 <sup>0</sup> 55' 50"
<b>Longitude</b>	E 78 <sup>0</sup> 24' 20"

**Project Boundary:**

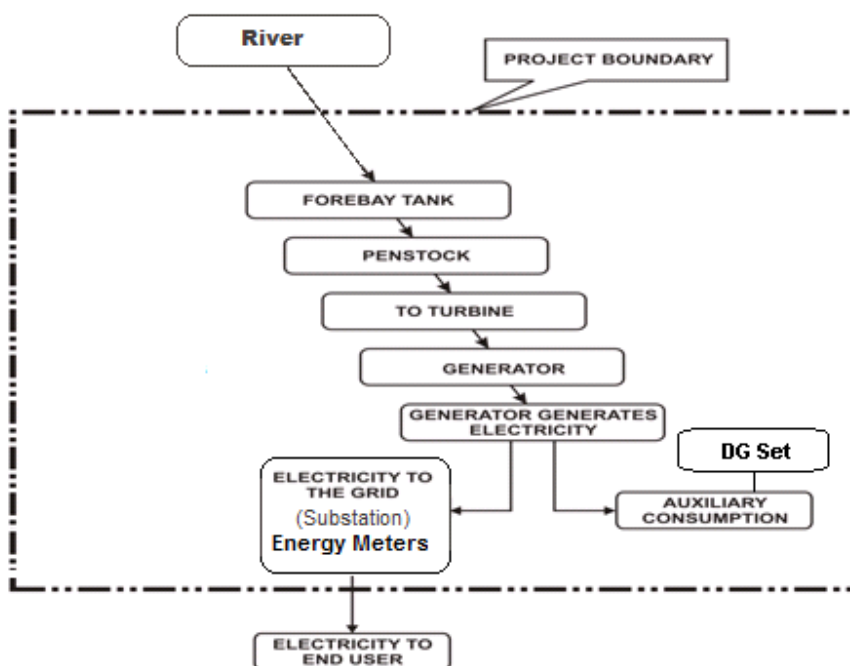
As per paragraph 6 of AMS I.D, Version 13,

*The Project Boundary encompasses the physical, geographical site of the renewable energy generation source.*

As already described in the registered VCS PD, section 2.3, the project boundary includes the power house, water inlet and outlet, transmission set up. The Project boundary is shown by dotted line box in diagram below:

Hence the project boundary is from the point of river water intake in the Forebay tank to the point of interconnection at the substation where electricity is exported to the grid. The auxiliary consumption of power used to generate the electricity is within the project boundary.

One DG set of 160 kVA capacity was being used as a emergency lighting source.



### 1.8 Title and Reference of Methodology

As defined under Appendix B of the simplified modalities and procedures for small-scale CDM project activities, the project activity falls under following project types and categories:

Type : I – Renewable Energy Projects  
 Project Category : I.D – Grid connected renewable electricity generation  
 Version 13(EB 36, 14/12/2007)

The monitoring of Emission Reductions generated by the project follows the same principles that have been adopted for the monitoring of emission reductions under the Clean Development Mechanism.

In accordance with the AMS I.D methodology, the Monitoring shall consist of the metering of electricity generated by renewable technology. As per monitoring report in the PDD, the data to be monitored is net electricity exported to the grid.

**2 IMPLEMENTATION STATUS**
**2.1 Implementation Status of the Project Activity**

The project activity is in operation since 19.04.2008 for full capacity of the plant i.e. 4.95 MW. However, it was completed in 2 phases; 3 MW since 24.03.2005 and additional 1.95 MW since 19.04.2008.

No changes / modifications in the plant equipment take placed as of date.

**Downtime / Running Hours**

The project is operating in successful manner, except some instances of shutdown due to various reasons. The downtime and running hours for the project activity during the monitoring period, alongwith the dominant causes of shutdown, have been shown below:

Period	Downtime Hours	Dominant Reasons for downtimes	Running Hours
<b>2006</b>			
01.04.2006 - 30.04.2006	107.07	Rostering	612.53
01.05.2006 - 31.05.2006	85.03	Earth fault	634.57
01.06.2006 - 30.06.2006	34.36	Earth fault	685.24
01.07.2006 - 31.07.2006	111.31	Earth fault	608.29
01.08.2006 - 31.08.2006	83.2	Earth fault	636.58
01.09.2006 - 30.09.2006	19.11	Earth fault	700.49
01.10.2006 - 31.10.2006	26.57	Under Voltage	693.03
01.11.2006 - 30.06.2006	81.58	Rostering	638.02
01.12.2006 -	40.18	Earth fault and	679.42

31.12.2006		Rostering	
<b>2007</b>			
01.01.2007 - 31.01.2007	117.25	Due to breaking of 33KV transmission line	602.35
01.02.2007 - 28.02.2007	113.12	breaking of transmission line and Rostering	606.48
01.03.2007 - 31.03.2007	51.55	Earth fault and Grid failure	668.05
01.04.2007 - 30.04.2007	92.11	Earth fault	623.49
01.05.2007 - 31.05.2007	306.4	Earth fault	414.56
01.06.2007 - 30.06.2007	84.28	Earth fault	636.32
01.07.2007 - 31.07.2007	21.03	Rostering	698.57
01.08.2007 - 31.08.2007	42.51	Earth fault	677.09
01.09.2007 - 30.09.2007	41.51	Earth fault	678.09
01.10.2007 - 31.10.2007	16.05	Under Voltage	703.55
01.11.2007 - 30.11.2007	10.59	Earth fault and Under Voltage	709.01
01.12.2007 - 31.12.2007	34.55	Under Voltage	709.05
<b>2008</b>			

01.01.2008 - 31.01.2008	22.26	Under Voltage	697.34
01.02.2008 - 29.02.2008	28.55	Under Voltage	691.05
01.03.2008 - 31.03.2008	76.55	Under Voltage	643.05
01.04.2008 - 30.04.2008	101.44	Earth fault	618.16
01.05.2008 - 31.05.2008	75.29	Earth fault	644.31
01.06.2008 - 30.06.2008	73.07	Breaking of transmission line and Under Voltage	646.53
01.07.2008 - 31.07.2008	63.56	Under Voltage	656.04
01.08.2008 - 31.08.2008	186.13	Breaking of 33 KVtransmissio n line	533.57
01.09.2008 - 30.09.2008	29.58	Earth fault	690.02
01.10.2008 - 31.10.2008	50.18	Earth fault	669.42
01.11.2008 - 30.11.2008	34.32	Earth fault	685.28
01.12.2008 - 31.12.2008	17.30	Earth fault and Under Voltage	702.57
<b>2009</b>			
01.01.2009 - 31.01.2009	36.08	Earth fault	683.52
01.02.2009 - 28.02.2009	27.00	Earth fault	693.00

01.03.2009 - 31.03.2009	40.35	Earth fault	679.25
01.04.2009 - 30.04.2009	93.58	Earth fault	627.02
01.05.2009 - 31.05.2009	90.33	Earth fault	629.27
01.06.2009 - 30.06.2009	121.46	Under Voltage	598.14
01.07.2009 - 31.07.2009	99.25	33 KV shutdown by UPCL	620.35
01.08.2009 - 31.08.2009	53.06	Breaking of 33KV transmission line	666.54
01.09.2009 - 30.09.2009	14.12	Earth fault	705.48
01.10.2009 - 31.10.2009	41.47	Under Voltage	678.13
01.11.2009 - 30.11.2009	17.16	Under Voltage	702.14
01.12.2009 - 31.12.2009	20.58	Earth fault	699.02
<b>2010</b>			
01.01.2010 - 31.01.2010	93.54	Earth fault	626.06
01.02.2010 - 28.02.2010	17.48	Earth fault	702.02
01.03.2010 - 31.03.2010	7.41	Under Voltage	712.19
01.04.2010 - 30.04.2010	112.45	Earth fault	607.15

01.05.2010 - 31.05.2010	-----	Shut down due to maintenance in desilting tank's wall	-----
01.06.2010 - 30.06.2010	-----	Shut down due to maintenance in desilting tank's wall	-----
01.07.2010 - 31.07.2010	10.50	Earth fault	181.50
01.08.2010 - 31.08.2010	86.43	Earth fault	634.17
01.09.2010 - 30.09.2010	422.09	Earth fault	297.51
01.10.2010 - 31.10.2010	74.39	Earth fault	645.21
01.11.2010 - 30.11.2010	33.20	Earth fault	688.58
01.12.2010 - 31.12.2010	26.30	Under Voltage	693.57

The project activity is situated in the hilly region of Uttarkashi District. Land sliding, Breakdown, any failure in the line are also the reasons for Downtime Hours.

## 2.2 Deviations from the Monitoring Plan

No deviations from the Monitoring Plan.

## 2.3 Grouped Project

This is not a grouped project

**3 DATA AND PARAMETERS**
**3.1 Data and Parameters Available at Validation**

Data Unit / Parameter:	<b>EF<sub>OM,y</sub></b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Operating Margin Grid Emission factor of the regional grid (NEWNE grid in India)
Source of data:	Calculated from CO <sub>2</sub> baseline database for the Indian Power Sector –Central Electricity Authority (CEA), Ministry of Power, Version 4.0, September 2008.
Value applied:	1.0086
Purpose of the data:	The parameter is used in calculating the emission reductions that are taking place due to the project activity in a conservative and transparent manner.
Any comment:	The CEA databases are maintained and made publicly available by CEA

Data Unit / Parameter:	<b>EF<sub>BM,y</sub></b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Build Margin Grid Emission factor of the regional grid (NEWNE grid in India)
Source of data:	CO <sub>2</sub> baseline database for the Indian Power Sector –Central Electricity Authority (CEA), Ministry of Power, Version 4.0, September 2008.
Value applied:	0.5977
Purpose of the data:	The parameter is used in calculating the emission reductions that are taking place due to the project activity in a conservative and transparent manner. The data has been published by CEA, which is the nodal agency for all power related activities in the country.
Any comment:	The CEA databases are maintained and made publicly available by CEA

Data Unit / Parameter:	<b>EF<sub>y</sub></b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Combined Margin CO <sub>2</sub> emission factor of the regional grid (NEWNE grid in India)

Source of data:	Calculated from Operating Margin and Build Margin
Value applied:	0.803
Purpose of the data:	The parameter is used in calculating the emission reductions that are taking place due to the project activity in a conservative and transparent manner. The data has been published by CEA, which is the nodal agency for all power related activities in the country.
Any comment:	This value is fixed <i>ex-ante</i>

Data Unit / Parameter:	NCV <sub>diesel</sub>
Data unit:	TJ/Tonne
Description:	Net Calorific value of diesel
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.043033
Purpose of the data:	For calculation of project emissions
Any comment:	Fixed value has been taken

Data Unit / Parameter:	EF <sub>diesel</sub>
Data unit:	tCO <sub>2</sub> /TJ
Description:	Emission factor of diesel (EF <sub>diesel</sub> )
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	74.1
Purpose of the data:	For calculation of project emissions
Any comment:	Fixed value has been taken

### 3.2 Data and Parameters Monitored

Data and parameters monitored / selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

Data Unit / Parameter:	EG <sub>y</sub>
Data unit:	MWh
Description:	<b>Net electricity exported to the grid</b> (electricity exported by hydro power plant (electricity generated minus auxiliary electricity) minus electricity imported from the NEWNE grid,)

Source of data:	Data type : Measured The data is measured using the trivector energy meters installed at the substation next to the plant and recorded in JMR reports issued by UPCL
Description of measurement methods and procedures to be applied:	For measuring the net electricity exported to the grid by the project activity at the interconnection point, one set of Main meter (part of interconnection facility) and check meter are provided at the substation of the State Electricity Board which is placed next to the plant. The meters are in sealed condition and in the jurisdiction of the UPCL.  Monthly joint meter reading of the meter at the interconnection point is taken by the designated officials of the company and UPCL. The joint meter readings are recorded and signed by the authorized representatives of both parties on each of the above instances. UPCL will be the responsible authority for this measurement.
Frequency of monitoring/recording:	Daily
Value monitored:	Year 2006 = 13723 Year 2007 = 15016 Year 2008 = 16206 Year 2009 = 17091 Year 2010 = 2592
Monitoring equipment:	Monitoring: Data is monitored by main energy gross meter Manufacturing No.: upc00095 Make: Secure Accuracy: +/- 0.5% Archiving policy: Paper & Electronic Responsibility: Manager (Power Plant) Calibration: Once in 3 years
QA/QC procedures to be applied:	The meter installed is of 0.5% accuracy class. The main meter and check meter will be test checked for accuracy at site. The Meters will be calibrated regularly and at least once in 3 years as per the requirements of Annex 20 of EB 41. The test for the main meter and the check meter will be done with reference to a portable Sub Standard meter, which will be of accuracy class compatible with the class of meter under test. The calibration of the energy meters is done at

	the discretion of UPCL. Electricity sales bills / receipts may be used for cross-checking the net amount of electricity exported to the grid.
Calculation method:	<i>If applicable</i>
Any comment:	Data will be archived on paper and also electronically. Archived data will be kept during the crediting period plus 2 years or the last issuance of VERs for this project activity, whichever occurs later.

Data Unit / Parameter:	FC <sub>Diesel</sub>
Data unit:	Kg
Description:	Fuel Consumption of DG set
Source of data:	Plant log book
Description of measurement methods and procedures to be applied:	The actual diesel consumption were maintained in the plant log books. Method: The quantity of fuel has been measured using level gauge of the DG set and noted in the log book. Total operational time and consumption of diesel have been recorded and used in the calculation of project emissions.
Frequency of monitoring/recording:	Consumption is recorded whenever DG is put into use in case of grid failures coupled with plant shutdowns
Value monitored:	Year 2006 = 369.89 Year 2007 = 417.79 Year 2008 = 461.17 Year 2009 = 449.75 Year 2010 = 73.06 Total (2006-2010) = 1772.2
Monitoring equipment:	Monitoring: Level gauge of the DG set
QA/QC procedures to be applied:	NA
Calculation method:	NA
Any comment:	Data will be archived on paper and also electronically. Archived data will be kept during the crediting period plus 2 years or the last issuance of VERs for this project activity, whichever occurs later.

### 3.3 Description of the Monitoring Plan

As described in the Section 3.4 of the Registered VCS PD for this project, the description of the monitoring plan is as follows:

The authority and responsibility for monitoring, measurement, reporting and reviewing of the data rests with the Chief Project Officer. The identified person will be in charge of the GHG monitoring activities within project's functioning. The Chief Project Officer will be assisted by a team of experienced personnel for the project. The primary responsibility of the team is to measure, monitor, and record and report the information on various data items to the Chief Project Officer. Periodic calibration of various instruments used in the monitoring of GHG related data and record keeping of the same also will be the responsibility of the team.

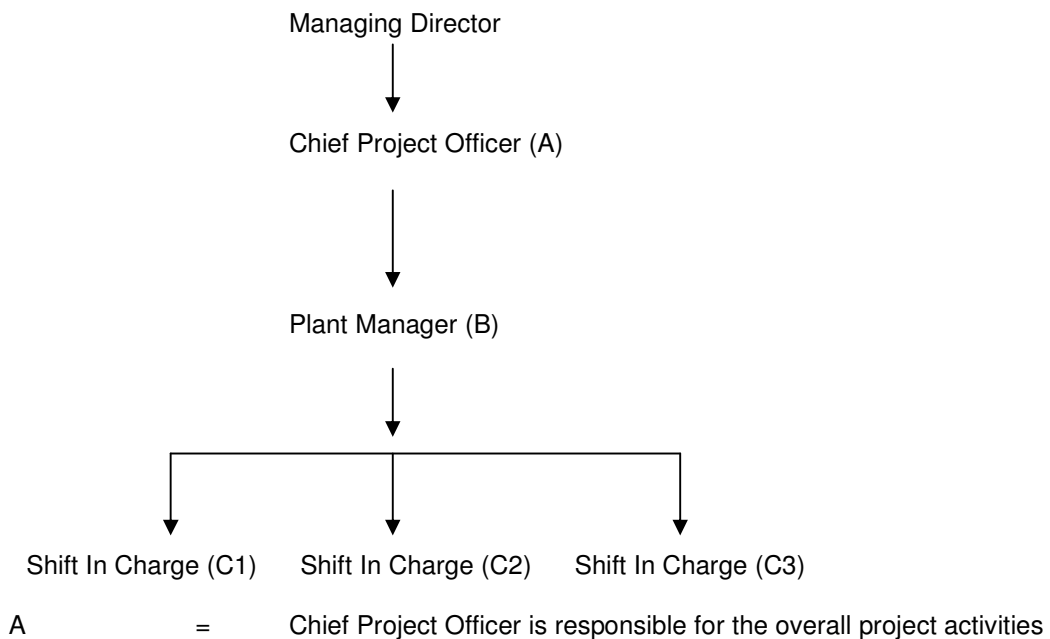
The responsibility of review, storage and archiving of information in good condition lies with the Chief Project Officer. The Chief project Officer will undertake periodic verifications and onsite inspections to ensure the quality of the data collected by the team and initiate steps in case of any abnormal conditions. The Chief Project Officer will review the data collected by the team and suggest corrective actions wherever required.

The total electricity generated by the project activity (both phases) will be monitored through state-of-the-art sealed and tested meters at a common metering point. The metering system will comprise of one main meter and one check meter in the sub-station, recording net electricity exported. The net metered electricity export data will be used to calculate and monitor the greenhouse gas emission reductions from the project. All meter data will be stored in electronic and paper formats.

Calibration of the energy meters are done as per the standard industry practice and minimum once in every three years by some reputed third party. The calibration certificates of the meters will be stored.

Invoices for the quantity of electricity exported and sold will be archived for two years beyond the crediting period.

The organization structure of the project activity is as given below:



B = Plant Manger is responsible for the technical aspects of the project.  
 C1, C2, C3, = 3 Shift In Charge will be there who will be placed in 3 shifts and also take care of the technical faults occurring in the plant.

Personnel /authority	Responsibility
Shift In charge	<i>Generation/electricity</i> - Collection of meter reading for electricity generation, export by the project activity. Report is sent to the Plant Manager on daily basis.
Plant Manager	Review of the monitored parameters for correctness, corrective measures in case of minor errors in the monitored data and preparation of a daily summary on project operation and electricity generation to the Chief Project Officer on monthly basis. The Plant Manager will be responsible for calibration of the energy meters in due time and keep its records.
Chief Project Officer	Review of the monthly reports submitted by Plant Manager and also compilation of the data on electricity export to the grid system on a monthly basis for submission to the board of directors. The responsibility of Chief Project Officer also include modification of the structure of monitoring reports and data recording formats as and when required
Managing Director	Review of the reports submitted by Chief Project Officer and preparing the brief summary of information on important aspects, such as, plant operational conditions, total power export, etc.

- Retention period:

All these data will be retained up to 2 years after the end crediting period.

The meter installed at the project activity show readings of electricity exported and electricity imported. The generated electricity is exported into the grid after meeting the in-house auxiliary consumption of the plant. Hence, Electricity exported, therefore, takes into account auxiliary consumption .

In case of main meter failure, check meter is used to calculate the electricity exported to the grid. In case the check meter is faulty it is immediately replaced by a new meter and meter reading from the replaced meter will be used thereafter. The faulty meters are sent to Electricity Board for calibration and accuracy and are duly replaced by a new meter. In case error is identified during annual accuracy testing which is beyond the permissible limits of error, the meter shall be immediately calibrated and replaced, if necessary. The error that is identified in the 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. JMR for the period thereafter shall be as per the calibrated meter.

According to paragraph 4 & 6 of Annex 60 of EB 52 “GUIDELINES FOR ASSESSING COMPLIANCE WITH THE CALIBRATION FREQUENCY REQUIREMENTS”, the calibration certificates for the meter installed at the project site for the said monitoring period was not available, hence according to paragraph 6 of Annex 60, EB 52 the delayed calibration for the meters (main meter & check meter) were successfully completed on 14.02.2011

Emission reductions have been calculated conservatively as per the paragraph 4 of the said guidelines through following steps:

- The results of delayed calibration shows that the error is smaller than the maximum permissible error (+/-0.5%)
- Therefore 0.5% error has been considered in the measured values for the calculation of emission reductions. Conservatively 0.5% of the electricity exported is deducted from the electricity exported and 0.5% of the electricity imported is included in the electricity imported.

Hence, the net export to the grid for the calculation of emission reduction would be:

$$\text{Net Export to the grid (EG}_y\text{)} = \text{Total Export} \times (1 - 0.5\%) - \text{Total Import} \times (1 + 0.5\%)$$

Details of the delayed calibration have been provided in the table below:

Meter	Make	Accuracy Class	Serial Number	Calibration Date	Calibrating Entity
Main Meter	L&T	0.5%	06763268	15/02/11	UPCL
Check Meter	Secure	0.5%	UPC00095	15/02/11	UPCL

#### 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

##### 4.1 Baseline Emissions

**Baseline Emissions:** Baseline emissions due to the project activity are calculated as follow:

Baseline Emissions (BE<sub>y</sub>) = Combined Margin CO<sub>2</sub> emission factor of the regional grid (EF<sub>y</sub>) X Net electricity exported to the grid (EG<sub>y</sub>)

The month wise Baseline Emission reductions from the project are tabulated below:

**Table: for the Year 2006 (April<sup>2</sup> 2006 – December 2006):**

Month (As per the dates of billing in the invoices)	Electricity generated at metering point	Electricity after deduction of 0.5%	Electricity imported	Electricity imported considering 0.5% extra	Net Electricity exported to the Grid	Baseline Emission Factor	Baseline Emissions
					EG <sub>y</sub>	EF <sub>y</sub>	BE <sub>y</sub>
	kWh		kWh		MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub>
April	1686200	1677769	0	0	1678	0.803	1347
May	1934800	1925126	0	0	1925	0.803	1546
June	2110600	2100047	0	0	2100	0.803	1686
July	1050000	1044750	1400	1407	1043	0.803	838
August	1466600	1459267	100	101	1459	0.803	1172
September	1945300	1935574	100	101	1935	0.803	1554
October	1590700	1582747	0	0	1583	0.803	1271
November	1006000	1000970	0	0	1001	0.803	804
December	1003800	998781	0	0	999	0.803	802
<b>Total</b>	<b>13794000</b>	<b>13725030</b>	<b>1600</b>	<b>1608</b>	<b>13723</b>		<b>11019</b>

**Table: for the Year 2007:-**

Month (As per the dates of billing in the invoices)	Electricity generated at metering point	Electricity after deduction of 0.5%	Electricity imported	Electricity imported considering 0.5% extra	Net Electricity exported to the Grid	Baseline Emission Factor	Baseline Emissions
					EG <sub>y</sub>	EF <sub>y</sub>	BE <sub>y</sub>
	kWh		kWh		MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub>

<sup>2</sup> Although the monitoring period begins from March 28, 2006, generation data has been accounted from 1st April 2006 onwards, as the data was not available for the baseline period 28 - 31 March 2006. Consequently, we are not claiming any emission reductions for these last four days of March 2006.

January	1004000	998980	0	0	999	0.803	802
February	800100	796100	0	0	796	0.803	639
March	1004700	999677	0	0	1000	0.803	803
April	1554200	1546429	400	402	1546	0.803	1241
May	1134100	1128430	0	0	1128	0.803	906
June	1377300	1370414	200	201	1370	0.803	1100
July	1318400	1311808	1000	1005	1311	0.803	1053
August	1010800	1005746	1700	1709	1004	0.803	806
September	1865900	1856571	100	101	1856	0.803	1491
October	1613800	1605731	600	603	1605	0.803	1289
November	1368000	1361160	0	0	1361	0.803	1093
December	1044200	1038979	0	0	1039	0.803	834
<b>Total</b>	<b>15095500</b>	<b>15020023</b>	<b>4000</b>	<b>4020</b>	<b>15016</b>		<b>12057</b>

Table: for the Year 2008:-

Month (As per the dates of billing in the invoices)	Electricity generated at metering point	Electricity after deduction of 0.5%	Electricity imported	Electricity imported considering 0.5% extra	Net Electricity exported to the Grid	Baseline Emission Factor	Baseline Emissions
	kWh		kWh		EGy MWh	EFy tCO2/MWh	BEy tCO2
January	1010900	1005846	100	101	1006	0.803	808
February	718000	714410	0	0	714	0.803	574
March	1154700	1148927	300	302	1149	0.803	922
April	1407400	1400363	0	0	1400	0.803	1124
May	1818800	1809706	100	101	1810	0.803	1453
June	1541000	1533295	200	201	1533	0.803	1231
July	1299000	1292505	400	402	1292	0.803	1038
August	1260400	1254098	500	503	1254	0.803	1007
September	1173600	1167732	1400	1407	1166	0.803	937
October	1853100	1843835	100	101	1844	0.803	1481
November	1800100	1791100	0	0	1791	0.803	1438
December	1253800	1247531	0	0	1248	0.803	1002
<b>Total</b>	<b>16290800</b>	<b>16209346</b>	<b>3100</b>	<b>3116</b>	<b>16206</b>		<b>13013</b>

Table: for the Year 2009:-

Month (As per the dates of billing in the invoices)	Electricity generated at metering point	Electricity after deduction of 0.5%	Electricity imported	Electricity imported considering 0.5% extra	Net Electricity exported to the Grid	Baseline Emission Factor	Baseline Emissions
	kWh		kWh		EGy MWh	EFy tCO2/MWh	BEy tCO2

January	1011700	1006642	0	0	1007	0.803	808
February	803400	799383	100	101	799	0.803	642
March	802400	798388	100	101	798	0.803	641
April	1226200	1220069	0	0	1220	0.803	980
May	1682000	1673590	0	0	1674	0.803	1344
June	1678700	1670307	0	0	1670	0.803	1341
July	1828500	1819358	0	0	1819	0.803	1461
August	2061000	2050695	0	0	2051	0.803	1647
September	1765400	1756573	0	0	1757	0.803	1411
October	2022000	2011890	0	0	2012	0.803	1616
November	1302400	1295888	0	0	1296	0.803	1041
December	993500	988533	0	0	989	0.803	794
<b>Total</b>	<b>17177200</b>	<b>17091314</b>	<b>200</b>	<b>201</b>	<b>17091</b>		<b>13724</b>

**Table: for the Year 2010**

Month (As per the dates of billing in the invoices)	Electricity generated at metering point	Electricity after deduction of 0.5%	Electricity imported	Electricity imported considering 0.5% extra	Net Electricity exported to the Grid	Baseline Emission Factor	Baseline Emissions
	kWh		kWh		EGy MWh	EFy tCO <sub>2</sub> /MWh	BEy tCO <sub>2</sub>
January	667900	664561	0	0	665	0.803	534
February	727800	724161	100	101	724	0.803	581
March	1209800	1203751	100	101	1204	0.803	967
<b>Total</b>	<b>2605500</b>	<b>2592473</b>	<b>200</b>	<b>201</b>	<b>2592</b>		<b>2081</b>

Therefore, the total Baseline Emission achieved by the project activity during the monitoring period of 28 March 2006 to 31 March 2010 are = **51,894tCO<sub>2</sub>e**.

## 4.2 Project Emissions

The project activity is a run-of-river hydroelectric project. There are no anthropogenic emissions by sources of GHGs in the equipments/ technology involved as a whole as a result of the project activity.

Thus, PE<sub>y</sub> = 0

The use of DG set is done in case of emergency grid failure only for the purpose of lighting for the control room as well as the living rooms for the power plant personnel. Therefore, as per the Para 21 of the methodology the emission due to diesel usage will be accounted as a project emission and shall be calculated as per the latest version of "Tool to calculate project or leakage CO<sub>2</sub> emission from fossil fuel combustion, Version 02". For proper monitoring separate log book has been maintained at the site for recording annual diesel consumption by the DG set (monitoring parameters are tabulated in the section 3.2 of the PD) and the project emissions calculation on actual basis, as follows.

Capacity of DG Set = 160 kVA

Fuel Consumption ( $FC_{\text{Diesel}}$ ) = 1772.2 Kg = 1.772 Tonne

Net Calorific value of diesel ( $NCV_{i,y}$ ) = 0.043033 TJ/Tonne (Reference: 2006 IPCC Guidelines for National Greenhouse Gas Inventories)

Emission factor of diesel ( $EFCO_{2,i,y}$ ) = 74.1 tCO<sub>2</sub>/TJ (Reference: 2006 IPCC Guidelines for National Greenhouse Gas Inventories)

Project Emission ( $PE_y$ ) = 1.772 \* 0.043033 \* 74.1 tCO<sub>2</sub> = 5.651 tCO<sub>2</sub>

Project emissions account for only 0.01% of the total emission reductions, which is substantially less than 1% of the total emission reductions. Thus, the HSD usage is not significant and hence not a part of ER calculations.

Therefore,  $PE_y = 0$ .

#### 4.3 Leakage

Emissions related to the manufacture and transport of equipment, and other transportation based emissions are not included as they do not occur at the physical or geographic site of the project. Emissions associated with the construction of the project have been excluded as the construction of a fossil fuel fired plant would generate a similar quantity of emissions. Thus,  $LE_y = 0$

#### 4.4 Summary of GHG Emission Reductions and Removals

$$\begin{aligned} \text{Emission reductions (ER}_y) &= BE_y - PE_y - LE_y \\ &= BE_y \text{ (because } PE_y \text{ \& } LE_y \text{ is 0)} \end{aligned}$$

The month wise Emission reductions from the project are tabulated below:

S. No.	Year	Emission Reductions ( tCO <sub>2</sub> )
1	2006	11019
2	2007	12057
3	2008	13013
4	2009	13724
5	2010	2081
6	<b>Total Emission Reductions</b>	<b>51894</b>

It is evident that the number of achieved ERs (51894 tCO<sub>2</sub>) during the monitoring period (28/03/2006 – 31/03/2010) are less than the projected ERs (58877 tCO<sub>2</sub>) for the same period. The projected ERs are calculated to present the most favourable scenario for ER generation and reports the maximum number of ERs that can be generated by the project activity under most suitable conditions. There are a number of factors like PLF, Plant shutdown, Grid unavailability

and other unforeseen events which adversely affect the electricity generation and thus, results in lesser ERs as compared to the projected scenario.

5 ADDITIONAL INFORMATION

**Equation to calculate Emission Reductions:**

The estimated emission reductions have been calculated in accordance to paragraph 9 of AMS I. D. version 13 methodology which states that

*For all other systems, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kgCO<sub>2</sub>e/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 kgCO<sub>2</sub>e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.*

Baseline emission factor is estimated using the *option (a)* from the above and the following formula and directly taken from the data published by CEA, version 4.

The baseline is calculated using the combined margin approach. For details of the calculation of the combined margin emission factor please refer to the Grid Emission factor calculation excel sheet which is a part of the PD.

**Step 1: Calculation of Operating Margin Emission Factor**

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

**The  $EF_{OM, Y}$  is estimated to be:**

The Simple Operating margin is obtained as the weighted average margin from the three year vintage data of Simple Operating margin and the net generations in the Operating Margin in the respective years.

Thus the final  $EF_{OM, Y}$  based on three years average is estimated to be **1.0086 tCO<sub>2</sub>/MWh**.

**Step 2: Calculation of the Build Margin Emission Factor  $EF_{BM, Y}$**

**The  $EF_{BM, y}$  is estimated as 0.5977 tCO<sub>2</sub>/MWh**

(with sample group constituting most recent capacity additions to the grid comprising 20% of the system generation).

**Step 3: Calculation of Baseline Emission Factor  $EF_y$**

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

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$$

Where the weights  $w_{OM}$  and  $w_{BM}$ , are 50% and 50% respectively (by default), and  $EF_{OM,y}$  and  $EF_{BM,y}$  are calculated as described in Steps 1 and 2 above and are expressed in tCO<sub>2</sub>/MWh.

Baseline Emission factor: **0.803 tCO<sub>2</sub>/MWh**.

**Details of Baseline data:**

*Operating margin emission factor and Build Margin emission factor calculations:*

Data of Operating and Build Margin for the three financial years from 2005 to 2008 has been obtained from – ‘**The CO<sub>2</sub> Baseline Database for the Indian Power Sector**’ Ministry of Power: Central Electricity Authority (CEA) Version 4.0, Dated: 01/09/2008.

This database is prepared as per “**Tool to calculate the emission factor for an electricity system**” **Version 1.1**.

The above value of Baseline Emission factor 0.803 tCO<sub>2</sub>/MWh will be used as ex-ante for the calculation of GHG emission reductions during the crediting period of the project activity.

Baseline emissions or emissions avoided by the project activity are estimated using the *Option (a)*

$$BE_y = EF_y \times EG_y$$

Where,

BE<sub>y</sub> = Baseline Emissions in the year y (tCO<sub>2</sub>),

EF<sub>y</sub> = Baseline Emission Factor (tCO<sub>2</sub>/MWh)

EG<sub>y</sub> = Net electricity exported to the grid from project activity in the year y (MWh)

The detailed excel sheet for emission reduction calculations has been submitted to the DOE.

**ANNEX 1**
**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

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