MONITORING REPORT FORM (CDM-MR)
Version 01 - in effect as of: 28/09/2010

CONTENTS

MONITORING REPORT
Version 01 Date 10/04/2011

12 MW hydropower plant in Bhandardara in Maharashtra, India
Reference Number: UNFCCC 0430

Third Monitoring Report (Under Second Crediting Period)
Duration: 01/04/2010 to 31/03/2011
(First and last days included (01/04/2010 to 31/03/2011))

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

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The main purpose of the project activity is to generate electricity from the potential energy in the water released from Bhandardara dam and export the net electricity to the grid to meet the ever-increasing demand for energy in the state. The project activity would reduce the green house gas (GHG) emissions produced by the grid generation mix, which is mainly dominated by fossil fuel based power plants.

The Bhandardara dam is one of the oldest masonry gravity dams in Maharashtra state. The construction of the dam started in 1910 and was completed in 1926. There are two hydro power plants near Bhandardara dam. One is the project activity, which is 12 MW foot of dam hydropower plant and is known as BH-1. Another hydroelectric project of 34 MW was constructed later 10 kilometers downstream from BH-1, which is referred as BH-2. BH-1 is the small scale project activity.

The project activity involves construction and commissioning of a 12 MW hydroelectric project. The project utilises water released from Bhandardara reservoir for irrigation purposes and generates electricity. The net electricity after auxiliary consumption is connected to state electricity grid owned and operated by Maharashtra State Transmission Company Ltd (MSTCL).

The water released from the Bhandardara reservoir for irrigation purposes is conducted to a turbine in the power plant and jetted on to the turbine. This action rotates the turbine, which in turn causes the rotation of the alternator connected to the turbine, thereby producing electricity. One 12 MW Francis type turbine is installed in BH-1. The generated electricity from the project activity after auxiliary consumption is exported to MSTCL grid.

BH-1 has exported about 27.93 GWh to grid during the current monitoring period. The plant and equipment facilities have been designed to comply with the applicable stipulations / guidelines of statutory authorities such as State Pollution Control Board etc.

The project activity (BH-1) is constructed at the foot of a hill adjacent to the Bhandardara dam. BH-1 was originally built by the Government of Maharashtra Irrigation Department (GOMID) with a single hydropower generating unit of 10 MW in 1984. In Maharashtra state, all state owned hydroelectric plants are constructed by Government of Maharashtra Water Resources Department (GOMWRD) and handed over to Maharashtra State Electricity Board (MSEB) (now Maharashtra State Electricity Generation Company) for operation and maintenance. The generating unit at BH-1 was commissioned in 1986 and started commercial operation in 1987. After operating for eight years, a mishap occurred which severely damaged the entire plant and the plant ceased to operate. The rehabilitation and operation of this plant was awarded on a lease, own, operate and transfer basis to Dodson – Lindblom International Inc (DLI), an Ohio, USA, based company. DLI is part of DLZ Corporation, one of the foremost engineering and water resource companies in the Midwestern United States. An operating company by the name of Dodson – Lindblom Hydro Power Private Limited (DLHPPL) was formed to implement and operate the hydropower plants in India. The generated power from the project activity is connected to state electricity grid owned and operated by Maharashtra State Transmission Company Ltd (MSTCL). The project has been registered with UNFCCC on 30/09/2006 with renewable crediting period. The duration of the second crediting period is from 27/07/2008 to 26/07/2015. The duration of the monitoring period considered under this monitoring report is 01/04/2010 to 31/03/2011. Further, the duration of the first crediting period was from 27/07/2001 to 26/07/2008 and the amount of issued CERs from this project was 214,154 during first crediting period.

The emission reduction achieved under this monitoring period is 19,230 tCO_2

A.2. 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 (Host Party)	Dodson –Lindblom Hydro Power Private Limited (DLHPPL)	No
The State of the Netherlands	IFC-Netherlands Carbon Facility (INCaF)	Yes

A.3. Location of the project activity:

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The project activity is located at a foot of a hill adjacent to the Bhandardara dam in Lake Arthur Hill reservoir in the upper Pravara river basin. Bhandardara is in Akola Taluk in Ahmednagar district in the state of Maharashtra in India. Bhandardara is about 140 kilometers from Mumbai. The nearest town is Ghoti and closest railhead is at Igatpuri which is 40 kilometers away. The project activity is located at latitude 19° 33′ 15″ N and longitude 73° 45′ 0″ E

A.4. Technical description of the project

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The process is conversion of the potential energy, embodied in the water flowing from a higher point to a lower point, into mechanical energy and then into electrical energy. This flowing water is guided through a head race tunnel and penstock gate and jetted on to a turbine. This action rotates the turbine, which is connected to a synchronous generator. The rotation of turbine causes the rotation of the generator thereby producing electricity. The generated electricity is stepped up to 132 kV and exported to MSTCL grid, which is part of regional grid.

The technology employed is an established one. Francis turbine is employed in BH-1. The Francis turbine is the most widely used among water turbines. This is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates.

Technical specification of BH-1:

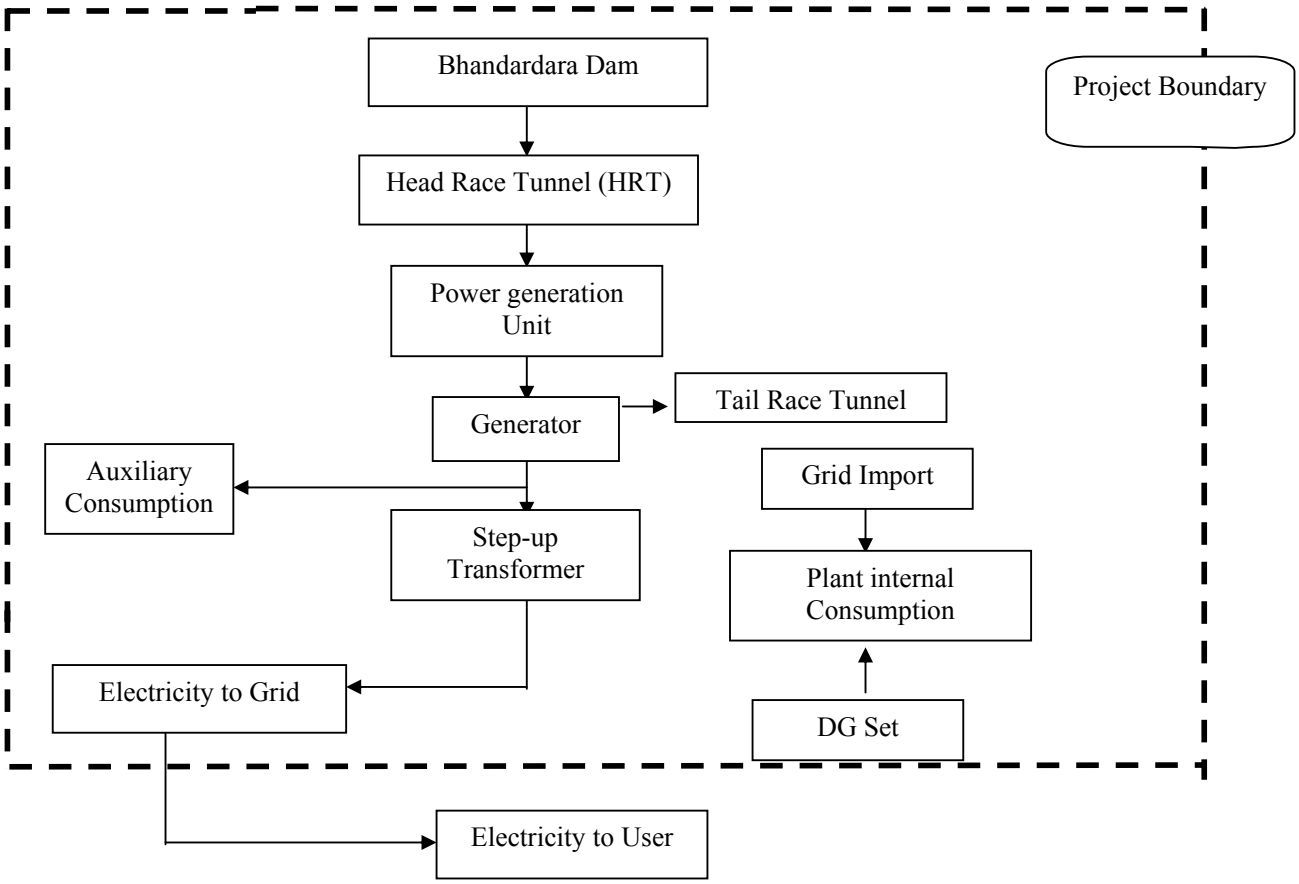
The power plant consists of water conductor, intake, power house, generation unit and a transformer.

Bhandardara reservoir	
Type of dam	Masonry gravity dam
Gross storage	318 million cubic meter (Mm^3)
Live storage for power	249 Mm^3
Top of dam	746.04 m
Water conductor	
Number	1
Type	Steel
Design discharge	24 m^3/s
Size	3.0 m dia
Length	318.8 m
Intake	
Full supply level	744.73 m
Minimum draw down level for power	720.7 m

Power house	
Type	Surface, RCC and masonry
Size	21.5 m x 29.25 m
Floor level	674.15 m
Level of CL of turbine	665.5 m
Capacity of OH crane	65/15 tonnes

Turbine unit	
Max gross head	77 m
Net design head	69 m
Design discharge	19.25 m^3/s
Type of generating unit	Vertical, Francis, top mounted thrust bearing
Number	1
Installed capacity	12.564 MW
Excitation	Static
Serial No.	V – 0037/1
Generator unit	
Guaranteed output	12 MW
Rated power factor	0.9
Efficiency at 0.9 power factor	97.62 % at 100 % load 97.38 % at 75% load 96.69 % at 50% load 94.90 % at 25% load
Rated voltage	11 kV
Serial No.	C21 /001
Connection to grid	
Transformer capacity	132kV,17.5MVA, 3 phase, OMAN
Connection point	BH-1 switchyard
Protection System	Multi functional digital relay system
Control & monitoring operation	Computer based c/w interface for remote operation

Schematic Diagram of the Project Activity:



A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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The details of the applied methodology for this project activity are listed below:

Title **:** Grid connected renewable electricity generation

Category **:** Type I, Renewable Energy Projects

Sub Category **:** I.D

Version **:** 13, dated 14th December, 2007

A.6. Registration date of the project activity:

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The project has been registered with UNFCCC on 30/09/2006.

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

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Crediting Period : Project activity is under 21 years renewable crediting period

Start date of the 1st Crediting Period : 27/07/2001

Start date of the 2nd Crediting Period : 27/07/2008

A.8. Name of responsible person(s)/entity(ies):

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Contact information of the person responsible for completing the monitoring report form

Mr. Prem P Paunikar

Director (Maharashtra Projects)

Phone : +91 22 2682 6819/ 2682 6718 / 2682 6594

E-mail: dlhppl@dlz.com

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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The project activity (BH-1) was originally built by the GOMID with a single hydropower generating unit of 10 MW in 1984. In Maharashtra state, all state owned hydroelectric plants are constructed by GOWRD and handed over to Maharashtra State Electricity Board (MSEB) (now Maharashtra State Electricity Generation Company) for operation and maintenance. The generating unit at BH-1 was commissioned in 1986 and entered commercial operation in 1987. After operating for eight years, a mishap occurred which severely damaged the entire plant and the plant ceased to operate. The rehabilitation and operation of this plant was awarded on a lease, own, operate and transfer basis to Dodson – Lindblom International Inc (DLI), an Ohio, USA, based company. The project was registered with UNFCCC on 30/09/2006 and the renewal of crediting period is approved by UNFCCC on 25/10/2008. Project proponent requested for revision in registered PDD and the same was accepted by the CDM-EB on 16/10/2010. The Plant is in operation continuously since 27th July 2001 and the project has already issued 214,154 CERs from its first crediting period (27/07/2001 to 26/07/2008).

The capacities of the project equipments are not changed during this monitoring period and no emergency incidents occurred during this period which may change the applicability of the methodology or change the emission reductions. Further, the plant was under shutdown in the month of July-10, December-10, January-11 and February-11 during the monitoring period and it was in operational mode during rest of the months of this monitoring period.

Table-1: Summary of Annual Performance Report

Month	Gross Electricity Generation (kWh)	Operational Time (Hours)	Outage Time (Hours)	Total Time (Hours)
April 2010	4,629,630	360.00	360.00	720.00
May 2010	4,623,070	437.00	307.00	744.00
June 2010	116,150	12.78	707.22	720.00
July 2010	0.00	0.00	744.00	744.00
August 2010	3,910,410	284.04	459.96	744.00

Month	Gross Electricity Generation (kWh)	Operational Time (Hours)	Outage Time (Hours)	Total Time (Hours)
September 2010	7,900,500	522.74	197.26	720.00
October 2010	1,181,080	79.79	664.21	744.00
November 2010	695,320	47.05	672.95	720.00
December 2010	0.00	0.00	744.00	744.00
January 2011	0.00	0.00	744.00	744.00
February 2011	0.00	0.00	672.00	672.00
March 2011	5,439,760	390.00	354.00	744.00
Total	**28,495,920.00**	**2,133.40**	**6,626.60**	**8,760.00**

B.2. Revision of the monitoring plan

>> NA

B.3. Request for deviation applied to this monitoring period

>> NA

B.4. Notification or request of approval of changes

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The project proponent has requested for revision in registered PDD and same was approved by the CDM-EB on 16/10/2010. (http://cdm.unfccc.int/Projects/DB/BVQI1155728784.01/view?cp=1)

SECTION C. Description of the monitoring system

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According to the registered PDD, following parameters are being monitored in the project activity:

- Electricity exported to the grid by the project activity in kWh (EG_y)
- Electricity imported from the grid by the project activity in kWh (E_{import})
- Gross electricity generated by the project activity in kWh (E_{Gen})
- Auxiliary Units consumed by the project activity in kWh
- Diesel consumed by the stand by DG Set (DC) in Ton
- Hourly electricity exported to the grid by the project activity as recorded at the main meter in kWh (HEE_{main_meter})

The electricity exported to the grid is measured continuously and a Joint meter reading statement is made which gives the electricity exported to the grid by the project activity in kWh. The Joint Meter reading is taken on the last day of every month. The measurement at 132 kV side for supply to MSETCL grid gives the energy supply reading. Monthly joint meter reading (JMR) of main and check meters installed at the substation shall be taken and signed by authorized officials of DLHPPL, MSEDCL, MSETCL and GOMWRD generally once every month. Joint meter reading of the main

meter shall be the basis for monthly invoice of energy exported to the grid. Records of the joint meter reading of energy exported to the grid shall be maintained by DLHPPL, MSEDCL, MSETCL and GOMWRD. Daily and monthly reports stating the electricity export shall be prepared by the shift in-charge and verified by the plant manager of DLHPPL.

The energy is imported at 33 kV feeder and a separate independent energy meter has installed by MSEDCL to measure the units imported by DLHPPL. The units imported are recorded monthly and bills are issued by MSEDCL. Bills of MSEDCL shall be the source of data for electricity imported. This data is used to estimate the emissions due to the electricity imported from the grid and it is considered as part of project emissions when on a monthly basis the electricity imported is equal to or more than 0.5 % of the electricity exported.

The generation meter measures the units generated by the project activity. The Monthly joint meter reading (JMR) of the generation meter shall be taken and signed by authorized officials of DLHPPL, MSEDCL, MSETCL and GOMWRD generally once every month. Records of the joint meter reading of energy generated shall be maintained by DLHPPL, MSEDCL, MSETCL and GOMWRD. Daily and monthly reports stating the electricity generated shall also be prepared by the shift in-charge and verified by the plant manager of DLHPPL which shall be used to cross check the generation. The generation is measured in plant premises at generator terminals and is monitored and recorded continuously through PLC.

The difference between the gross electricity generation (E_{Gen}) and electricity exported to the grid (EG_y) as per the JMR gives the total Auxiliary Consumption in the plant. This Auxiliary consumption includes losses in Generator step up transformer, in cables and in excitation system, which are not actually measured.

The diesel quantity available in the diesel storage tanks is recorded daily by DLHPPL in the plant log book. The diesel consumption would be recorded in the logbook in litres. However, based on the density of diesel of about 0.88 kg/litre, the diesel consumption in tons would be calculated for use in the equation to compute project emissions (PE). The quantity of diesel combusted (mass unit) for the year will be considered in the emission reduction estimation if the project emissions due to diesel consumption is equal to or more than 0.5% of the emission reductions for that period.

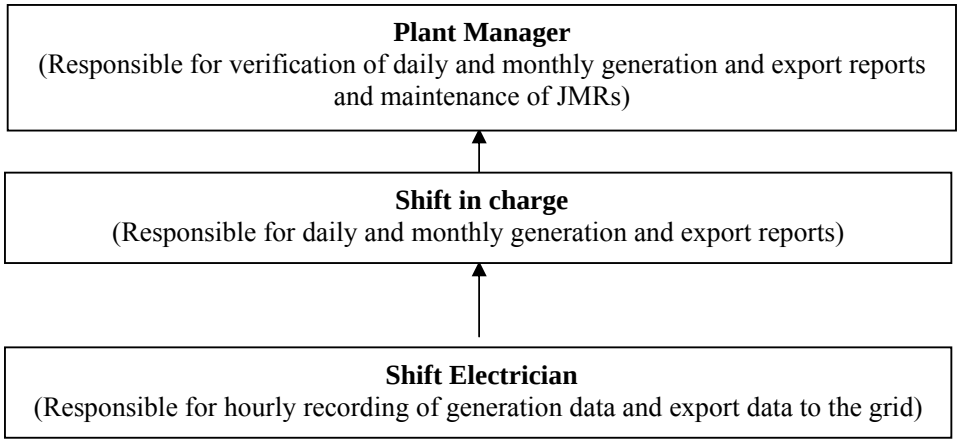
Hourly electricity exported to the grid by the project activity as recorded at the main meter and check meter. This parameter is relevant to conditions/ circumstances (those days) where the dates of Joint Meter Readings (JMRs) pertaining to the project activity do not match the individual verification periods. DLHPPL has archived and preserved all the JMRs pertaining to the energy generated and

exported by the project activity, for at least two years after end of the crediting period. DLHPPL also archived the complete metering data at generation end and export data on paper and all the data would be preserved for at least two years after end of the crediting period.

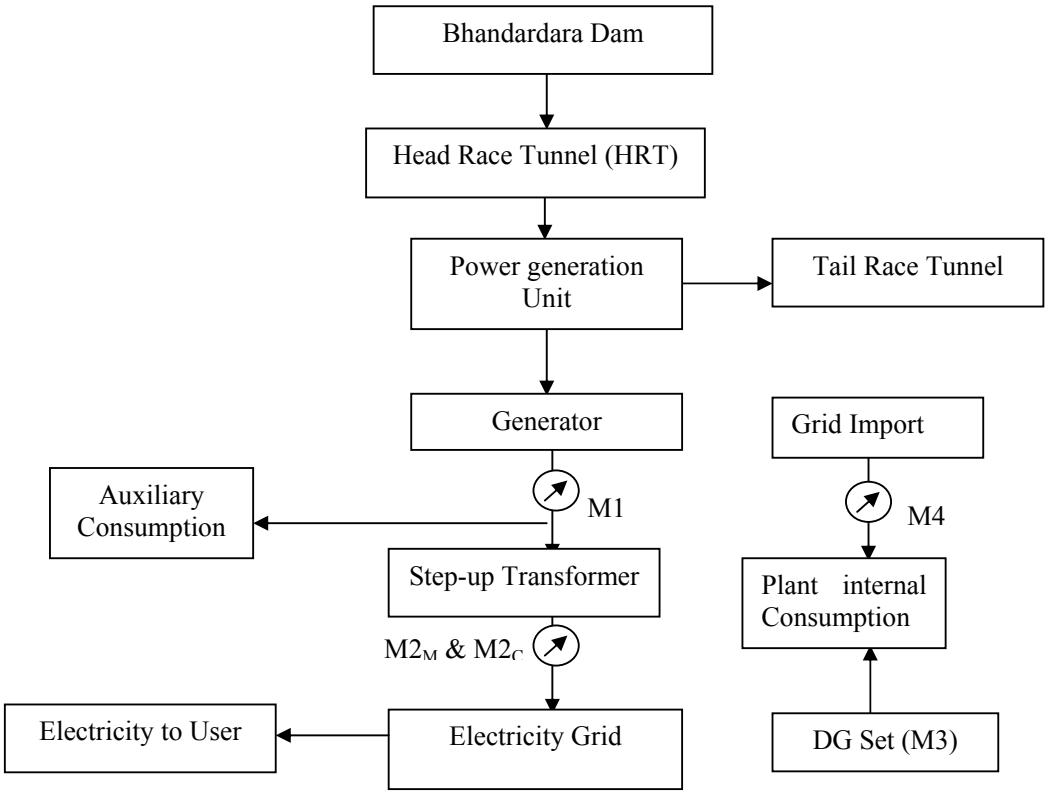
Operational and Management structure for this project activity:

Hourly data recording of the generation and export to the grid are made by the electrician of the shift and verified by the shift in charge of DLHPPL and these data are stored at generation end. Daily and monthly reports stating the generation and electricity export are prepared by the shift in-charge and verified by the plant manager of DLHPPL. Records of joint meter reading would be maintained by plant manager of DLHPPL at site. MSEDCL (MSEB) also maintains the records of joint meter readings at their office. Monthly invoices are prepared based on Joint meter readings, which are used for cross checking the energy exported to the grid. The plant manager is a qualified engineer with considerable experience in power industry. All the shift in changes are qualified engineers and have undergone related training including plant operations, data monitoring, report generation etc.

Schematic diagram for the monitoring data flow at plant



Locations of Monitoring Instruments in the Plant



M1 : Gross Energy Meter

$M2_M$: Main Export meter

$M2_C$: Check Meter

M3 : Measuring scale to monitor diesel consumption in DG set

M4 : Electricity Import Meter

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**CO_2 Emission Factor of grid (EF_y)**
Data unit:	tCO_2 / MWh
Description:	CO2 emission factor of the western regional grid
Source of data used:	Central Electricity Authority (CEA), CO2 baseline database, Version 3.0, dated 15 December 2007
Value(s) :	0.69
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for baseline emission and project emission calculation.
Additional comment:	This value is fixed for second crediting period

Data / Parameter:	**Net calorific value of diesel (NCV_{diesel})**

Data unit:	GJ per mass unit (GJ/ Ton)
Description:	Net calorific value of diesel
Source of data used:	IPCC default data
Value(s) :	43.3
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for project emission calculation.
Additional comment:	Future revision of the IPCC guidelines would be taken into account in case revisions occur during the current crediting period.

Data / Parameter:	**CO_2 Emission Factor of diesel ($EF_{CO2\ diesel}$)**
Data unit:	tCO_2 / GJ
Description:	CO2 emission factor of diesel
Source of data used:	IPCC default data
Value(s) :	0.0748
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for project emission calculation.
Additional comment:	Future revision of the IPCC guidelines would be taken into account in case revisions occur during the current crediting period.

D.2. Data and parameters monitored

Data / Parameter:	**Electricity Export (EG_y)**
Data unit:	kWh
Description:	Electricity exported to the grid by the project activity
Measured /Calculated /Default:	Measured
Source of data:	Joint Meter Readings (JMRs) taken and signed by authorized officials of MSEDCL
Value(s) of monitored parameter:	27,934,800
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is directly used for baseline estimation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Main Energy Meter and Check Energy Meters are used for net energy export Main Energy Meter Details: Make : ABB Accuracy Class : 0.2 Serial Number : 02173601 Calibration Frequency : Once in a year Date of last calibration : 01/12/2010 Validity : 30/11/2011 Check Meter Details: Make : ABB Accuracy Class : 0.2 Serial Number : 02173600 Calibration Frequency : Once in a year Date of last calibration : 01/12/2010 Validity : 30/11/2011

Measuring/ Reading/ Recording frequency:	This data is measured continually and recorded monthly
Calculation method (if applicable):	This data is directly monitored.
QA/QC procedures applied:	For measuring the energy exported to the grid, one main meter and one check meter are maintained. Joint meter reading of the main meter is the basis of billing and emission reduction calculations, so long as the meter is found to be within prescribed limits of accuracy during the periodic check. Monthly joint meter reading of main and check meters are taken and signed by authorized officials of DLHPPL, MSEDCL, MSETCL and GOMWRD generally once every month. Records of this joint meter reading are maintained by DLHPPL, MSEDCL, MSETCL and GOMWRD. The Meters are checked for accuracy and calibration by the MSETCL as per the provisions in the power purchase agreement (PPA) prevailing at the time of respective accuracy check or calibration. As per the current PPA, the meters are checked for accuracy every six months and the calibration is done once in a year.

Data / Parameter:	**Electricity Imported (E_{import})**
Data unit:	kWh
Description:	Electricity Imported from the grid by the project activity
Measured /Calculated /Default:	Measured
Source of data:	Monthly billing records of MSEDCL
Value(s) of monitored parameter:	93,743
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data used for project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The energy is imported at 33KV feeder and a separate independent energy meter is installed by MSEDCL to measure the units imported by DLHPPL. The units imported are recorded monthly and bills are issued by MSEDCL Bills of MSEDCL shall be the source of data for electricity imported.
Measuring/ Reading/ Recording frequency:	This data is measured continually and recorded once in a month.
Calculation method (if applicable):	This data is monitored directly.
QA/QC procedures applied:	Import meter is under the custody of MSEDCL, and DLHPPL has no access to meter and the calibration details pertaining to the same. Hence calibration records are not maintained by DLHPPL for the import meter.

Data / Parameter:	**Gross Electricity Generation (E_{Gen})**
Data unit:	kWh
Description:	Gross electricity generated by the project activity
Measured /Calculated /Default:	Measured
Source of data:	Joint Meter Readings (JMRs) taken and signed by authorized officials of MSEDCL.

Value(s) of monitored parameter:	28,495,920
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This value is not used for emission reduction calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Gross energy meter is used for gross energy generation by the plant Details of Gross Main Meter Make : Siemens Landis & Gyr Z.U Accuracy Class : 0.2 Serial Number : 73932341 Calibration Frequency : Once in a year Date of last calibration : 02/12/2010 Validity : 01/12/2011
Measuring/ Reading/ Recording frequency:	This data is measured continually and recorded once in a month.
Calculation method (if applicable):	This data is monitored directly.
QA/QC procedures applied:	The data are directly measured and monitored at the project site. The meters installed at the generator end shall be checked for accuracy for every six months and the calibration is done once in a year. If the accuracy of meter is found to be beyond permissible limit even after calibration then the meter shall be replaced with spare tested, calibrated meter. DLHPPL shall archive all the JMRs and the complete metering data at generation end on paper and all the data would be preserved for at least two years after end of the crediting period.

Data / Parameter:	**Auxiliary Consumption**
Data unit:	kWh
Description:	Unit consumed by the project activity
Measured /Calculated /Default:	Measured
Source of data:	Joint Meter Readings (JMRs) taken and signed by authorized officials of MSEDCL.
Value(s) of monitored parameter:	561,120
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This value is not used for emission reduction calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The difference between the gross electricity generation (E_{Gen}) and electricity exported to the grid (EGy) as per the JMR gives the total Auxiliary Consumption in the plant. The Auxiliary consumption includes losses in Generator, step up transformer, in cables and in excitation system, which are not actually measured.
Measuring/ Reading/ Recording frequency:	This data is calculated once in a month.
Calculation method (if applicable):	The data is calculated using the gross electricity generation and electricity exported as per the JMRs.
QA/QC procedures applied:	This data would be calculated based on gross electricity generation and electricity exported as per the JMRs. This data are also used in calculating electricity export in the event of simultaneous failure and /or defect in accuracy of both the main meters and check meters.

Data / Parameter:	**Diesel consumption (DC)**
Data unit:	Tons
Description:	Diesel consumed by the standby DG set
Measured /Calculated /Default:	Measured
Source of data:	Daily records of levels in the diesel storage tanks as per the plant log book.
Value(s) of monitored parameter:	0.0942
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This value is used for project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The diesel quantity available in the diesel storage tanks is recorded daily by DLHPPL in the plant log book. The diesel consumption would be recorded in the logbook in litres. However, based on the density of diesel of about 0.88 kg/litre[1], the diesel consumption in tons would be calculated.
Measuring/ Reading/ Recording frequency:	This data is measured continually and recorded monthly basis
Calculation method (if applicable):	This data is directly monitored.
QA/QC procedures applied:	No QA/QC is required.

Data / Parameter:	**Hourly Electricity Export ($HEE_{main\ meter}$)**
Data unit:	kWh
Description:	Hourly electricity exported to the grid by the project activity as recorded at the main meter and check meter. This parameter is relevant to conditions/ circumstances (those days) where the dates of Joint Meter Readings (JMRs) pertaining to the project activity do not match the individual verification periods.
Measured /Calculated /Default:	This data is recorded on an hourly basis by DLHPPL based on data recorded at the main meter.
Source of data:	Log book records for the main meter.
Value(s) of monitored parameter:	This parameter is not applicable to this monitoring period.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is directly used for baseline estimation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Main Energy Meter and Check Energy Meters are used for net energy export Main Energy Meter Details: Make : ABB Accuracy Class : 0.2 Serial Number : 02173601 Calibration Frequency : Once in a year Date of last calibration : 01/12/2010 Validity : 30/11/2011 Check Meter Details:

[1] Reference: Requirement of High Speed Diesel (HSD) fuel as per IS 1460: 1995 as specified under Motor spirit and High Speed Diesel Control Orders by the Ministry and Petroleum and Natural Gas (MoPNG) dated 28 December 1998 available at http://petroleum.nic.in/newgazette/GN%20No.511%20dtd%2029-12-98.pdf

	Make : ABB Accuracy Class : 0.2 Serial Number : 02173600 Calibration Frequency : Once in a year Date of last calibration : 01/12/2010 Validity : 3011/2011
Measuring/ Reading/ Recording frequency:	This parameter is relevant to conditions/ circumstances (those days) where the dates of Joint Meter Readings (JMRs) pertaining to the project activity do not match the individual verification periods. This data is measured continually and recorded hourly.
Calculation method (if applicable):	This data is directly monitored.
QA/QC procedures applied:	For measuring the hourly energy exported to the grid, one main meter and one check meter are maintained. The hourly meter reading of the main meter is the basis of emission reduction calculations, so long as the meter is found to be within prescribed limits of accuracy during the periodic check. Hourly meter reading of the check meters would be used for cross checking. The meters are checked for accuracy and calibration by the MSETCL as per the provisions in the power purchase agreement (PPA) prevailing at the time of respective accuracy check or calibration. As per the current PPA, the meters are checked for accuracy every six months and the calibration is done once in a year.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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The baseline emission factor has been calculated as a combined margin (CM), following the Baseline Methodology Procedure of the 'Tool to calculate the emission factor for an electricity system, version 01'. The steps as defined under the Baseline Methodology Procedure and the application to the project activity are detailed below:

Step 1: Identify the relevant electric power system

A regional grid definition is used and for the project activity, the simple operating and build margin emission factors estimated by Central Electricity Authority (CEA) for the Western Regional grid have been used to derive the combined margin emission factor for the second crediting period of the project activity.

Step 2: Select an operating margin (OM) method:

As per Step 2, the calculation of OM emission factor (EFgrid, OM,y) is based on one of the following methods:

(a) Simple OM or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM

Out of four methods mentioned defined in the Step 2, the Simple OM approach has been chosen for calculations since in the regional grid mix the low-cost/must run resources constitute less than 50% of total grid generation.

Further as per Step 2, the emission factor can be calculated using either of the two data vintages:

- Ex-ante option: A 3 year generation-weighted average based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period
- Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

For the project activity, the Ex-ante option is chosen for emission factor estimation.

The Simple OM factor is calculated as under in Step 3

STEP 3: Calculate the Operating Margin emission factor (EFgrid, OM,y) according to the selected method:

The simple OM emissions 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. Of the three options provided under Step 3 (a), Option A has been used for calculating the Simple OM

As per Option A, the simple OM emission factor is calculated as below:

$$EF_{Grid,OMsimple,y} = \frac{\sum_{i,m} FC_{i,m,y} \, x \, NCV_{i,y} \, x \, EF_{CO2,i,y}}{\sum_{m} EG_{m,y}}$$

Where,

$EF_{grid, OMsimple,y}$ =Simple operating margin CO2 emission factor in year y (tCO2/ MWh)

FCi,m,y = Amount of fossil fuel type i consumed by the power plant/ 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)

$EF_{CO2,i,y}$ = CO2 emission factor of fossil fuel type i in year y (tCO2/ GJ)

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

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

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

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

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

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

(a) The set of five power 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

The set of power units that comprise larger annual generation would be used. In terms of vintage of data, the Option 1 is chosen. As per Option 1: For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE.

STEP 5. Calculate the Build Margin emission factor

$$EF_{Grid,BM,y} = \frac{\sum_{m} EG_{m,y} \, x \, EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

$EF_{grid, BM,y}$ =Build margin CO2 emission factor in year y (tCO2/MWh)

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

$EF_{EL,m,y}$ =CO2 emission factor of power unit m in year y (tCO2/ MWh)

m =Power units included in the build margin

y =Most recent historical year for which power generation data is available

The CO2 emission factor of each power unit m, $EF_{EL,m,y}$ is determined as per the guidance in step 3 (a) for simple OM using option 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. As per Option B1, if for the power units 'm', data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) is determine as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \, x \, NCV_{i,y} \, x \, EF_{CO2,i,y}}{EG_{m,y}}$$

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 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)

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

i =All fossil fuel types combusted in power unit m in year y

y =Either 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. For the second crediting period, the ex-ante option is chosen.

Step 6: Calculation of Combined Margin Emission Factor:

The baseline emission factor of the Western regional grid ($EF_{Western\ grid,\ CM,\ y}$ in tCO_2/ MWh)) is calculated as the weighted average of the Operating Margin emission factor ($EF_{Grid,\ OM,\ y}$) and the Build Margin emission factor ($EF_{Grid,\ BM,\ y}$)

$$\mathbf{EF_{Western\ grid,\ CM,\ y} = EF_{Grid,OM,\ y} \, x \, W_{OM} + EF_{Grid,\ BM,\ y} \, x \, W_{BM}}$$

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

$EF_{grid,\ BM,\ y}$ =Build margin CO_2 emission factor in year y (tCO_2/MWh)

W_{OM} =Weighting of operating margin emission factor (%)

W_{BM}, =Weighting of build margin emission factor (%)

For hydro power projects, the default values of W_{OM} and W_{BM} are 50 % (i.e. W_{OM} =W_{BM} = 0.5) for the first crediting period only and for the second crediting period, W_{OM} and W_{BM} are 0.25 and 0.75 respectively. As per the published data of the Central Electricity Authority (CEA), Ministry of Power, Government of India (CO2 baseline database, version 03, dated 15 December 2007):

$EF_{grid, OM,, y}$ i.e. the Simple Operating Margin emission factor of the Western Grid is 0.99 tCO_2/ MWh

$EF_{grid, BM, y}$ i.e. the Build margin CO2 emission factor of the Western grid is 0.59 tCO_2/MWh

The $EF_{Western\ grid, CM, y}$ i.e. the combined margin baseline emission factor of Western grid works out to 0.69 tCO_2/ MWh based on the weights used for the second crediting period.

Table-2
Month-wise Electricity Generation, Export and Auxiliary Consumption Details

Month	Electricity Generated (kWh)	Electricity Exported (kWh)	Auxiliary Consumption (kWh)	Baseline Emission (tCO_2)
April 2010	4,629,630.00	4,536,000.00	93,630.00	3,129.84
May 2010	4,623,070.00	4,531,200.00	91,870.00	3,126.53
June 2010	116,150.00	114,000.00	2,150.00	78.66
July 2010	0.00	0.00	0.00	0.00
August 2010	3,910,410.00	3,834,000.00	76,410.00	2,645.46
September 2010	7,900,500.00	7,747,200.00	153,300.00	5,345.57
October 2010	1,181,080.00	1,158,000.00	23,080.00	799.02
November 2010	695,320.00	681,600.00	13,720.00	470.30
December 2010	0.00	0.00	0.00	0.00
January 2011	0.00	0.00	0.00	0.00
February 2011	0.00	0.00	0.00	0.00
March 2011	5,439,760.00	5,332,800.00	106,960.00	3,679.63
Total	**28,495,920.00**	**27,934,800.00**	**561,120.00**	**19,275.01**

During this monitoring period the project activity generated 28,495,920 kWh and exported 27,934,800 kWh of electricity to the grid. Hence, the baseline emissions for this monitoring period are

Therefore, BE = 27,934.80 MWh * 0.69 tCO_2 eq/ MWh
= 19,275.01 tCO_2

E.2. Project emissions calculation

>>

The project emissions for this project activity are occurred due to the following reasons:

i. Project Emissions on account of Electricity Imported

Project Emissions on account of Electricity Imported are calculated as per the equation below

$$\mathbf{PE}_{\mathbf{Import,\ y}} = \mathbf{E}_{\mathbf{Import,y}} \times EF_{Western\ grid,\ CM,\ y}$$

$PE_{Import,\ y}$ = Project emissions from import of electricity from the grid during the year y

$E_{Import,y}$ = Electricity imported from the grid by the project activity during the year y

$EF_y = EF_{Western\ grid,\ CM,\ y}$ = Baseline Emission Factor for the Western regional grid (Combined Margin Approach) whose value is fixed for the crediting period at 0.69 tCO_2e/MWh

ii. Project Emissions on account of Diesel Consumption

Project Emissions on account of Diesel consumption are calculated as per the equation below

$$PE_{DC,y} = \sum_i DC_y \times COEF$$

Where,

$PE_{DC,\ y}$ =The CO_2 emissions from fossil fuel combustion (tCO_2) during the year y

DC_y = Quantity of fuel (diesel) combusted (mass unit) for the year

COEF = CO_2 emission coefficient of fuel i.e. diesel (tCO_2/ mass unit)

The CO_2 emission coefficient COEF is calculated based on net calorific value (NCV_{diesel}) and CO_2 emission factor (EF_{CO2_diesel}) of the fuel i.e. diesel as follows:

$$COEF = NCV_{diesel} \times EF_{CO2\_diesel}$$

Where:

COEF =CO_2 emission coefficient of fuel (tCO_2/ mass unit)

NCV_{diesel} =Net calorific value of the fuel (diesel) (GJ/ mass unit)

EF_{CO2_diesel} =CO_2 emission factor of fuel i.e. diesel.

The NCV_{diesel} and EF_{CO2_diesel} have been taken from the '2006 IPCC guidelines on National GHG inventories' as 43.3 (GJ/ton) and 0.0748 (tCO_2/GJ).

Table-3

Month-wise Electricity Import and Emission details

Month	Electricity Exported (kWh)	Electricity Imported from Grid (kWh)	% share of Electricity Import vs. Net Export	Project Emission for Electricity Import (tCO2)	Considered for Emission Reductions Estimation

					(Yes/No)
April 2010	4,536,000.00	1,643.00	0.036%	1.13	No
May 2010	4,531,200.00	5,835.00	0.129%	4.03	No
June 2010	114,000.00	7,245.00	6.355%	5.00	Yes
July 2010	0.00	9,786.00	-	6.75	Yes
August 2010	3,834,000.00	8,268.00	0.216%	5.70	No
September 2010	7,747,200.00	4,566.00	0.059%	3.15	No
October 2010	1,158,000.00	8,490.00	0.733%	5.86	Yes
November 2010	681,600.00	9,435.00	1.384%	6.51	Yes
December 2010	0.00	9,744.00	-	6.72	Yes
January 2011	0.00	10,690.65	-	7.38	Yes
February 2011	0.00	8,783.25	-	6.06	Yes
March 2011	5,332,800.00	9,257.10	0.174%	6.39	No
Total	**27,934,800.00**	**93,743.00**		**64.68**	

According to the registered PDD, if the electricity import is greater or equal to 0.5% of the net electricity export then it project emissions from import need to consider. In this monitoring period, electricity import for the month of June-10, October-10 and November-10 were greater than 0.5% of net electricity export and the plant was under shutdown in the month of July-10, December-10, January-11 and February-11. Hence, project emissions due to electricity import have been considered for these months. During these months the electricity import was 64,173.90 kWh.

$PE_{Import, y}$ = 64,173 * 0.69 tCO_2

= 44.28 tCO_2

Table-4

Month-wise Diesel Consumption and Emissions Details

Month	Diesel Consumption (Ton)	% Share of Project Emission Vs Emission Reductions (%)	Project Emission for Diesel Consumption (tCO_2)	Considered for Emission Reductions Estimation (Yes/No)
April 2010	0.0018	0.0002%	0.006	No
May 2010	0.0040	0.0004%	0.013	No
June 2010	0.0378	0.1664%	0.123	No
July 2010	0.0106	-	0.034	Yes
August 2010	0.0031	0.0004%	0.010	No
September 2010	0.0026	0.0002%	0.009	No

Month	Diesel Consumption (Ton)	% Share of Project Emission Vs Emission Reductions (%)	Project Emission for Diesel Consumption (tCO_2)	Considered for Emission Reductions Estimation (Yes/No)
October 2010	0.0053	0.0022%	0.017	No
November 2010	0.0044	0.0031%	0.014	No
December 2010	0.0044	-	0.014	Yes
January 2011	0.0128	-	0.041	Yes
February 2011	0.0057	-	0.019	Yes
March 2011	0.0018	0.0002%	0.006	No
Total	**0.0942**		**0.3050**	

Similarly, according to the registered PDD, if the project emissions from the diesel use are greater or equal to 0.5% of the emission reductions then it will be considered as project emission. Considering this condition, total diesel consumption during this monitoring period was only 0.0334 Ton. Hence, project emissions due to diesel usage have been considered for July-10, December-10, January-11 and February-11 for this monitoring period.

Hence,

$PE_{DC, y} = 0.0334 * 43.3 * 0.0748\ tCO_2 = 0.108\ tCO_2$

E.3. Leakage calculation

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The leakage emissions from the project activity are considered as zero.

E.4. Emission reductions calculation / table

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Emissions reduction calculation for this project is described below:

For project activities that modify or retrofit an existing electricity generation facility, the baseline scenario is the following:

The baseline emissions and the emission reductions from the project activity are estimated based on the quantum of additional electricity exported by the project activity to the grid and the baseline emission factor (BEy) of the chosen grid calculated as a Combined Margin (CM), consisting of the combination of Operating Margin (OM) and Build Margin (BM) factors.

Following formula has been used for estimation of emission reductions for this project activity:

$ER_y = BE_y – PE - Leakage$

Where,

ER_y = CO_2 emission reduction due to project activity for the year y in tCO_2

BE_y = Baseline emissions in tCO_2

PE = Project emissions in tCO_2

Table-5
Month-wise Emission Reduction Details

Month	Baseline Emission tCO2	Project Emission tCO2	Leakage Emission tCO2	Emission Reduction tCO2
April 2010	3,129.84	0.00	0.00	3,129.84
May 2010	3,126.53	0.00	0.00	3,126.53
June 2010	78.66	5.00	0.00	73.66
July 2010	0.00	6.79	0.00	(6.79)
August 2010	2,645.46	0.00	0.00	2,645.46
September 2010	5,345.57	0.00	0.00	5,345.57
October 2010	799.02	5.86	0.00	793.16
November 2010	470.30	6.51	0.00	463.79
December 2010	0.00	6.74	0.00	(6.74)
January 2011	0.00	7.42	0.00	(7.42)
February 2011	0.00	6.08	0.00	(6.08)
March 2011	3,679.63	0.00	0.00	3,679.63
Total	**19,275.01**	**44.39**	0.00	**19,230.62**

During this monitoring period net amount of electricity exported to grid from BH-1 project is 29,265.60 MWh. At the same time the project activity has imported 92.90 MWh of electricity from grid.

Hence, BE_y = 27,934.80 MWh * 0.69 tCO_2 eq/ MWh
= 19,275.01 tCO_2

And PE = 64,173 * 0.69 + 0.0334 * 43.3 * 0.0748 tCO_2
= 44.39 tCO_2

Hence, ER_y = 19,275.01 – 44.39 – 0 t CO2
= 19,230.62 tCO_2

Emission reductions are conservatively rounded off to nearest integer. The Emission Reductions for the project activity are 19,230 tCO_2e.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>

According to the registered PDD of this said project activity, estimated emission reduction from this project for the year 2010-2011 are 35,880 t CO2e. Actual emission reduction by this project during the same period is 19,230 t CO_2e.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	35,880	19,230

E.6. Remarks on difference from estimated value in the PDD

>>

According to the registered PDD the estimated electricity export during the monitoring period was 52,000 MWh whereas, the plant has actually exported 27,934 MWh of electricity to the grid. Hence, estimated emission reductions for this project during the monitoring period are 35,880 tCO_2e whereas, actual emission reductions during the same period are 19,230 tCO_2e. This difference between the estimated and actual emission reduction is because of less rainfall during the monsoon season during year 2010-11 which was resulted in less generation from the plant. Also the plant was not operated in the month of July'10, December'10, January'11 and February'11. Therefore, net electricity exported to the grid is less than its estimation in registered PDD.

Annex-1

The energy meters used for the energy monitoring are calibrated as per the monitoring plan and the same have archived for further reference. During this monitoring period energy meters are not changed and respective energy meters have been used to monitor the electricity generation and export data.

Meter	Make	Accuracy Class	Meter Serial No.	Calibration Date	Exp. Date	Result
Gross Energy Meter at Plant	Siemens Landis & Gyr Z.U	0.2S	73932341	07/12/2009	06/12/2010	Results are satisfactory & in permissible limit by MSEDCL
			73932341	03/06/2010	02/06/2011	Results are satisfactory & in permissible limit by MSEDCL
			73932341	02/12/2010	01/12/2011	Results are satisfactory & in permissible limit by MSEDCL
Main Meter at Substation	ABB	0.2S	02173601	05/12/2009	04/12/2010	Results are satisfactory & in permissible limit by MSEDCL
			02173601	02/06/2010	01/06/2011	Results are satisfactory & in permissible limit by MSEDCL
			02173601	01/12/2010	30/11/2011	Results are satisfactory & in permissible limit by MSEDCL
Check Meter at Substation	ABB	0.2S	02173600	05/12/2009	04/12/2010	Results are satisfactory & in permissible limit by MSEDCL
			02173600	02/06/2010	01/06/2011	Results are satisfactory & in permissible limit by MSEDCL
			02173600	01/12/2010	30/11/2011	Results are satisfactory & in permissible limit by MSEDCL

Annex – 2 Abbreviations

AMS	Approved small scale methodology
BH-1	Bhandardara power house –1
BM	Built Margin
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CPCB	Central Pollution Control Board
cusec	cubic feet per second
DLHPPL	Dodson –Lindblom Hydro Power Private Limited
DLI	Dodson –Lindblom International
ERS	Environmental social review
GHG	Green house gases
GOM	Government of Maharashtra
GOMID	Government of Maharashtra Irrigation Department
GOMWRD	Government of Maharashtra Water Resources Department
GWh	Giga watt hour
HT	High tension
IPCC	Inter Governmental Panel on Climate Change
IREDA	Indian Renewable Energy Development Agency
kgC02 eq/kWh	Kilogram carbon di oxide equivalent per kilowatt hour
KV	Kilo Volt
kW	Kilo Watt
kWh	Kilo Watt hour
m	Meter
M&P	Modalities and Procedures
m3	Cubic meter
m3 /s	Cubic meter per second
MCM	Million cubic meter
MNES	Ministry of Non conventional Energy Sources, Government of India
MoEF	Ministry of Environment &Forests, Government of India
MSEDCL	Maharashtra State Electricity Distribution Company Limited
MSTCL	Maharashtra State Transmission Corporation Limited
MSEB	Maharashtra State Electricity Board
MSPGCL	Maharashtra State Power Generation Company Ltd
MU	Million kilowatt hour
MW	Megawatt
MWh	Mega Watt hour

NHPC	National Hydroelectric Power Corporation Limited
NPC	Nuclear Power Corporation Limited
NTPC	National Thermal Power Corporation Limited
OH	Overhead
OM	Operating margin
PCB	Pollution Control Board
RCC	Reinforced cement concrete
Rs.	Indian Rupees
tCO2e	tonnes carbon di oxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States Dollars