

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

CONTENTS

- A. General description of the project activity
 - A.1. Brief description of the project activity
 - A.2. Project participants
 - A.3. Location of the project activity
 - A.4. Technical description of the project
 - A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity
 - A.6. Registration date of the project activity
 - A.7. Crediting period of the project activity and related information
 - A.8. Name of responsible person(s)/entity(ies)
- B. Implementation of the project activity
 - B.1. Implementation status of the project activity
 - B.2. Revision of the monitoring plan
 - B.3. Request for deviation applied to this monitoring period
 - B.4. Notification or request of approval of changes
- C. Description of the monitoring system
- D. Data and parameters monitored
 - D.1. Data and parameters used to calculate baseline emissions
 - D.2. Data and parameters used to calculate project emissions
 - D.3. Data and parameters used to calculate leakage emissions
 - D.4. Other relevant data and parameters
- E. Emission reductions calculation
 - E.1. Baseline emissions calculation
 - E.2. Project emissions calculation
 - E.3. Leakage calculation
 - E.4. Emission reductions calculation
 - E.5. Comparison of actual emission reductions with estimates in the registered CDM-PDD
 - E.6. Remarks on difference from estimated value

Annex 1 : Calibration Details

Annex-2 : Abbreviations

MONITORING REPORT
Version 01 Date 03/12/2010

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

Second Monitoring Report (Under Second Crediting Period)
Duration: 01/04/2009 to 31/03/2010
(First and last days included (01/04/2009 to 31/03/2010))

SECTION A. General description of the project activity

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

>>

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 kilometres 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 29.266 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 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. 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 01/04/2009 to 31/03/2010. 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 20,160 tCO₂

A.2. Project Participants

>>

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:

>>

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
--

>>

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 power 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.

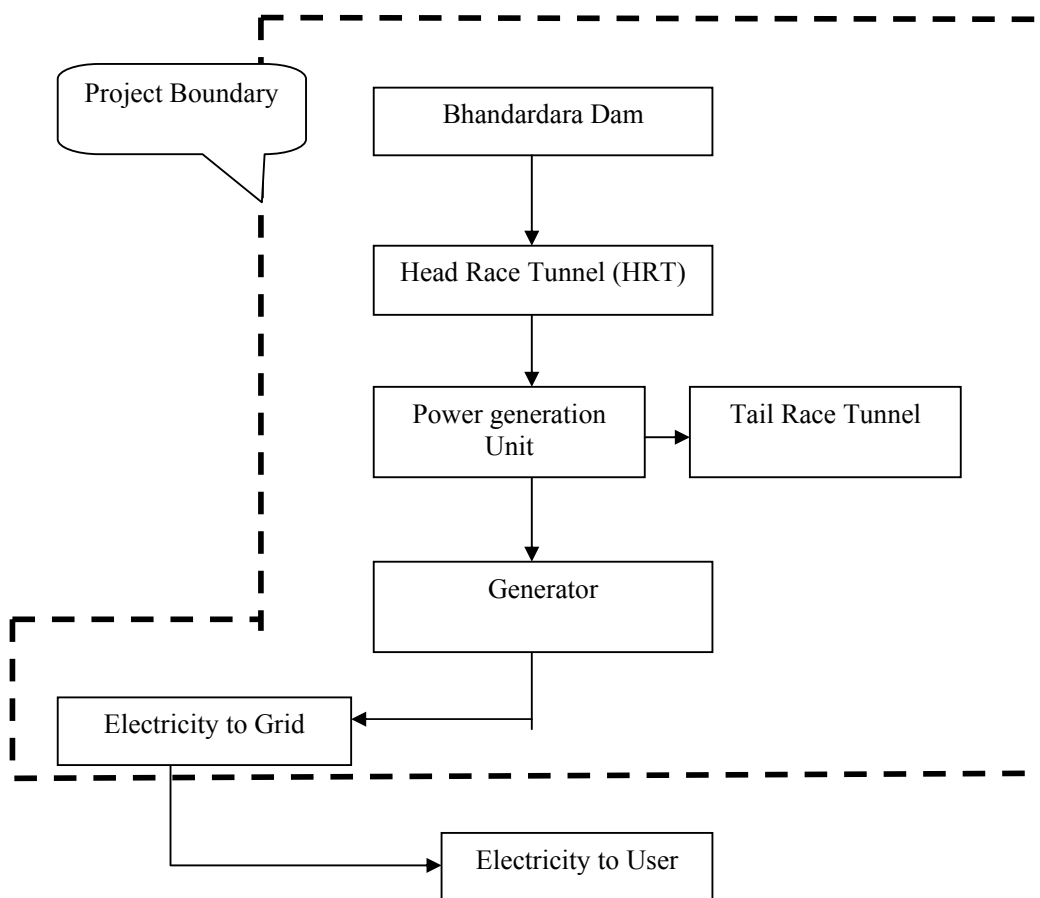
Technical specification of BH-1:

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 metre (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	
<u>Guaranteed output</u>	12 MW
<u>Rated power factor</u>	0.9
<u>Efficiency at 0.9 power factor</u>	97.62 % at 100 % load 97.38 % at 75% load 96.69 % at 50% load 94.90 % at 25% load
<u>Rated voltage</u>	11 kV
<u>Serial No.</u>	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:

>>

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:

>>

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):

>>

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):
--

>>

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**

>>

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 (27/06/2001 to 26/06/2008).

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 June-09, August-09 and September-09 during the monitoring period and it was in operational mode during rest of the months of this monitoring period.

Summary of Annual Performance Report

Month	Gross Electricity Generation (kWh)	Operational Time (Hours)	Outage Time (Hours)
April' 09	4,810,210.00	395.17	324.83
May' 09	3,469,460.00	338.00	406.00
June' 09	0.00	0.00	720.00
July' 09	2,815,770.00	231.42	512.58
August' 09	0.00	0.00	744.00
September' 09	0.00	0.00	720.00
October' 09	2,461,730.00	168.42	575.58
November' 09	1,650,710.00	113.08	606.92
December' 09	2,033,800.00	154.68	589.32
January' 10	3,064,120.00	210.60	533.40
February' 10	6,606,580.00	473.32	198.68

Month	Gross Electricity Generation (kWh)	Operational Time (Hours)	Outage Time (Hours)
March'10	2,938,250.00	228.55	515.45

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

>>

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

>>

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 power 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 power 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 (E_{G_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).

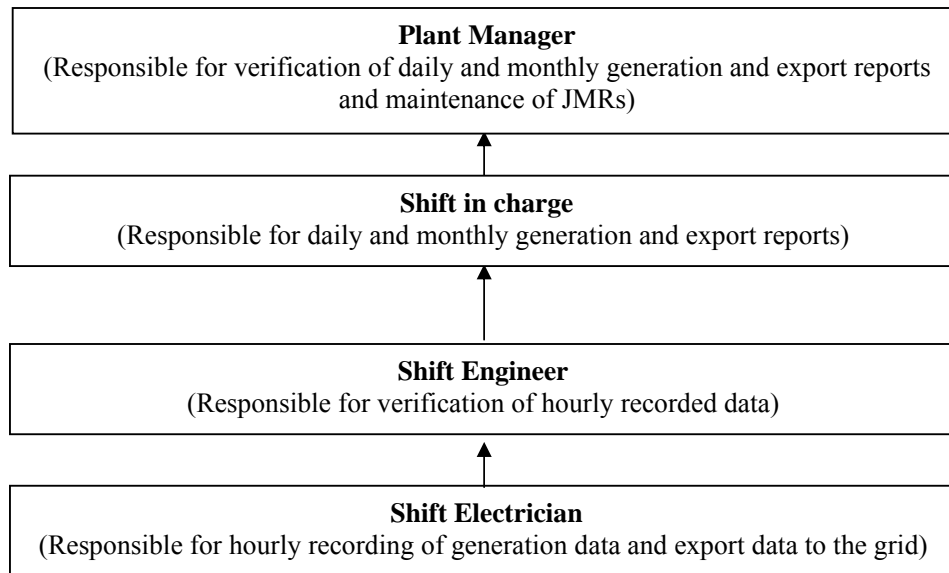
Hourly electricity exported to the grid by the project activity as recorded at the main meter and check meter. This parameter is relevant to conditions/ circumstances (those days) where the dates of Joint Meter Readings (JMRs) pertaining to the project activity do not match the individual verification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

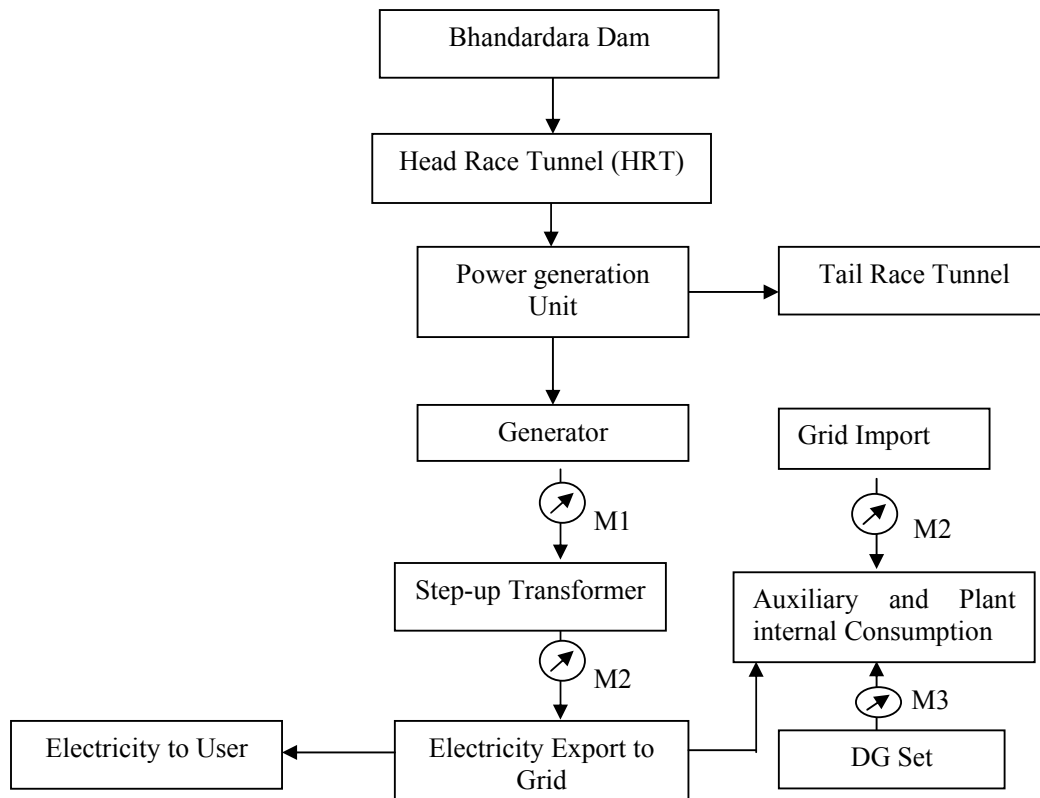
Hourly data recording of the generation and export to the grid are made by the electrician of the shift and verified by the shift engineer of DLHPPL and these data are stored at generation end. Daily and monthly reports stating the generation and power export are prepared by the shift in-charge and verified 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 engineers 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 : Energy meter to monitor electricity export and import

M3 : DG generation 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:	CO₂ Emission Factor of grid (EF_v)
Data unit:	tCO ₂ / MWh
Description:	CO ₂ emission factor of the western regional grid
Source of data used:	Central Electricity Authority (CEA), CO ₂ 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:	CO₂ Emission Factor of diesel (EF_{CO₂ diesel})
Data unit:	tCO ₂ / GJ
Description:	CO ₂ emission factor of diesel
Source of data used:	IPCC default data
Value(s) :	0.0784
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_v)
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:	29,265,600
Indicate what the data are used for (Baseline/ Project/ Leakage emission)	This data is directly used for baseline estimation

calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Main Energy Meter and Check Energy Meters are used for net energy export</p> <p><u>Main Energy Meter Details:</u></p> <p>Make : ABB</p> <p>Accuracy Class : 0.2</p> <p>Serial Number : 02173601</p> <p>Calibration Frequency : Once in a year</p> <p>Date of last calibration : 05/12/2009</p> <p>Validity : 04/12/2010</p> <p><u>Check Meter Details:</u></p> <p>Make : ABB</p> <p>Accuracy Class : 0.2</p> <p>Serial Number : 02173600</p> <p>Calibration Frequency : Once in a year</p> <p>Date of last calibration : 05/12/2009</p> <p>Validity : 04/12/2010</p>
Measuring/ Reading/ Recording frequency:	This data is measured continually and recorded hourly
Calculation method (if applicable):	This data is directly monitored.
QA/QC procedures applied:	<p>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.</p> <p>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.</p> <p>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.</p>

D.2. Data and parameters monitored	
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:	92,907
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	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

calibration, validity)	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.

D.2. Data and parameters monitored	
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:	29,850,630
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)	<p>Gross energy meter is used for gross energy generation by the plant</p> <p><u>Details of Gross Main Meter</u></p> <p>Make : Siemens Landis & Gyr Z.U</p> <p>Accuracy Class : 0.2</p> <p>Serial Number : 73932341</p> <p>Calibration Frequency : Once in a year</p> <p>Date of last calibration : 07/12/2009</p> <p>Validity : 06/12/2010</p>
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.

D.2. Data and parameters monitored	
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:	585,030

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.

D.2. Data and parameters monitored	
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:	0.081
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.

D.2. Data and parameters monitored	
Data / Parameter:	Hourly Electricity Export ($HEE_{main\ meter}$)
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.
Source of data to be used:	Log book records for the main meter.
Value of data applied for the	Not applicable to this monitoring period.

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%20td%2029-12-98.pdf>

purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	This data is recorded on an hourly basis by DLHPPL based on data recorded at the main meter.
QA/QC procedures to be applied:	<p>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.</p> <p>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.</p>
Any comment:	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

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

>>

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 (EF_{grid, OM,y}) is based on one of the following methods:

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

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 (EF_{grid, 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:

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

Where,

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

FC_{i,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

$$EF_{Grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

$EF_{grid, BM,y}$	=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:

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

Where,

$EF_{EL,m,y}$	=CO2 emission factor of power unit m in year y (tCO2/ 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)
$EF_{CO2, i,y}$	=CO2 emission factor of fossil fuel type i in year y (tCO2/ 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 ($EF_{\text{Western grid, CM, y}}$ in tCO_2/MWh) is calculated as the weighted average of the Operating Margin emission factor ($EF_{\text{Grid, OM, y}}$) and the Build Margin emission factor ($EF_{\text{Grid, BM, y}}$)

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

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

$EF_{\text{grid, BM, y}}$ =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. $W_{\text{OM}} = W_{\text{BM}} = 0.5$) 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 (CO_2 baseline database, version 03, dated 15 December 2007):

$EF_{\text{grid, OM, y}}$ i.e. the Simple Operating Margin emission factor of the Western Grid is $0.99 \text{ tCO}_2/\text{MWh}$

$EF_{\text{grid, BM, y}}$ i.e. the Build margin CO_2 emission factor of the Western grid is $0.59 \text{ tCO}_2/\text{MWh}$

The $EF_{\text{Western grid, CM, y}}$ i.e. the combined margin baseline emission factor of Western grid works out to $0.69 \text{ tCO}_2/\text{MWh}$ based on the weights used for the second crediting period.

Table-1
Monthwise Electricity Generation, Export and Auxiliary Consumption Details

Month	Electricity Generated (kWh)	Electricity Exported (kWh)	Auxiliary Consumption (kWh)	Baseline Emission (tCO_2)
April 2009	4,810,210.00	4,713,600.00	96,610.00	3,252.38
May 2009	3,469,460.00	3,398,400.00	71,060.00	2,344.90
June 2009	0.00	0.00	0.00	0.00
July 2009	2,815,770.00	2,761,200.00	54,570.00	1,905.23
August 2009	0.00	0.00	0.00	0.00

Month	Electricity Generated (kWh)	Electricity Exported (kWh)	Auxiliary Consumption (kWh)	Baseline Emission (tCO ₂)
September 2009	0.00	0.00	0.00	0.00
October 2009	2,461,730.00	2,413,200.00	48,530.00	1,665.11
November 2009	1,650,710.00	1,618,800.00	31,910.00	1,116.97
December 2009	2,033,800.00	1,993,200.00	40,600.00	1,375.31
January 2010	3,064,120.00	3,007,200.00	56,920.00	2,074.97
February 2010	6,606,580.00	6,478,800.00	127,780.00	4,470.37
March 2010	2,938,250.00	2,881,200.00	57,050.00	1,988.03
Total	29,850,630.00	29,265,600.00	585,030.00	20,193.26

During this monitoring period the project activity generated 29,850,630 kWh and exported 29,265,600 kWh of power to the grid. Hence, the baseline emissions for this monitoring period are

$$\begin{aligned}\text{Therefore, BE} &= 29,265.60 \text{ MWh} * 0.69 \text{ tCO}_2 \text{ eq/ MWh} \\ &= 20,193.26 \text{ tCO}_2\end{aligned}$$

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

$$PE_{\text{Import, y}} = E_{\text{Import, y}} \times EF_{\text{Western grid, CM, y}}$$

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

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

$EF_y = EF_{\text{Western grid, CM, y}}$ = Baseline Emission Factor for the Western regional grid (Combined Margin Approach) whose value is fixed for the crediting period at 0.69 tCO₂e/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 CO₂ emissions from fossil fuel combustion (tCO₂) during the year y

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

COEF = CO₂ emission coefficient of fuel i.e. diesel (tCO₂/ mass unit)

The CO₂ emission coefficient COEF is calculated based on net calorific value (NCV_{diesel}) and CO₂ emission factor (EF_{CO₂_diesel}) of the fuel i.e. diesel as follows:

$$COEF = NCV_{diesel} \times EF_{CO_2_diesel}$$

Where:

COEF =CO₂ emission coefficient of fuel (tCO₂/ mass unit)

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

EF_{CO₂_diesel} =CO₂ 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 (tCO₂/GJ).

Table-2
Month-wise Power Import and Emission details

Month	Electricity Exported (kWh)	Import from Grid (kWh)	% share of Power Import vs. Net Export	Project Emission for Power Import (tCO ₂)	Considered for Emission Reductions Estimation (Yes/No)
April 2009	4,713,600.00	1,620	0.03%	1.12	No
May 2009	3,398,400.00	5,235	0.15%	3.61	No
June 2009	0.00	9,384	--	6.47	Yes
July 2009	2,761,200.00	10,185	0.37%	7.03	No
August 2009	0.00	8,307	--	5.73	Yes
September 2009	0.00	9,912	--	6.84	Yes
October 2009	2,413,200.00	6,402	0.27%	4.42	No
November 2009	1,618,800.00	8,454	0.52%	5.83	Yes
December 2009	1,993,200.00	11,385	0.57%	7.86	Yes
January 2010	3,007,200.00	5,463	0.18%	3.77	No
February 2010	6,478,800.00	7,743	0.12%	5.34	No
March 2010	2,881,200.00	8,817	0.31%	6.08	No
Total	29,265,600.00	92,907	0.32%	64.11	

According to the registered PDD, if the power 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, power import for the month of November’09 and December’09 were greater than 0.5% of net electricity export and the plant was under shutdown in the month of June’09, August’09, September’09. Hence, project

emissions due to power import have been considered for these months. During these months the electricity import was 47,442 kWh.

$$\begin{aligned} PE_{\text{Import, y}} &= 47,442 * 0.69 \text{ tCO}_2 \\ &= 32.73 \text{ tCO}_2 \end{aligned}$$

Table-3
Month-wise Diesel Consumption and Emissions Details

Month	Consumption (Ton)	% Share of Project Emission Vs Baseline Emission Reductions (%)	Project Emission for Diesel Consumption (tCO ₂)	Considered for Emission Reductions Estimation (Yes/No)
April 2009	0.0018	0.0002%	0.006	No
May 2009	0.0044	0.0006%	0.014	No
June 2009	0.0141	--	0.046	Yes
July 2009	0.0044	0.0007%	0.014	No
August 2009	0.0220	--	0.071	Yes
September 2009	0.0097	--	0.031	Yes
October 2009	0.0062	0.0012%	0.020	No
November 2009	0.0053	0.0015%	0.017	No
December 2009	0.0018	0.0004%	0.006	No
January 2010	0.0062	0.0010%	0.020	No
February 2010	0.0018	0.0001%	0.006	No
March 2010	0.0035	0.0006%	0.011	No
Total	0.0810		0.262	

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. Total diesel consumption during this monitoring period was only 0.0810 Ton and in the month of June'09, August'09 and September'09 emissions from diesel usage were greater than 0.5% of the emission reductions. Hence, project emissions due to diesel usage have been considered only for these months. During these periods, total diesel usage was 0.0458 Ton.

Hence,

$$\begin{aligned} PE_{\text{DC, y}} &= 0.0458 * 43.3 * 0.0748 \text{ tCO}_2 \\ &= 0.148 \text{ tCO}_2 \end{aligned}$$

E.3. Leakage calculation

>>

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

E.4. Emission reductions calculation / table

>>

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 (BE_y) 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 = CO₂ emission reduction due to project activity for the year y in tCO₂

BE_y = Baseline emissions in tCO₂

PE = Project emissions in tCO₂

Table-4
Month-wise Emission Reduction Details

Month	Baseline Emission tCO ₂	Project Emission tCO ₂	Leakage Emission tCO ₂	Emission Reduction tCO ₂
April, 09	3,252.38	0.00	0	3,252.38
May, 09	2,344.90	0.00	0	2,344.90
June' 09	0.00	6.52	0	(6.52)
July' 09	1,905.23	0.00	0	1,905.23
August' 09	0.00	5.80	0	(5.80)
September' 09	0.00	6.87	0	(6.87)
October' 09	1,665.11	0.00	0	1,665.11
November' 09	1,116.97	5.83	0	1,111.14
December' 09	1,375.31	7.86	0	1,367.45
January' 10	2,074.97	0.00	0	2,074.97
February' 10	4,470.37	0.00	0	4,470.37
March' 10	1,988.03	0.00	0	1,988.03

Month	Baseline Emission tCO ₂	Project Emission tCO ₂	Leakage Emission tCO ₂	Emission Reduction tCO ₂
Total	20,193.26	32.88	0	20,160.38

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.

$$\begin{aligned}\text{Hence, BE}_y &= 29,265.60 \text{ MWh} * 0.69 \text{ tCO}_2 \text{ eq/ MWh} \\ &= 20,193.26 \text{ tCO}_2\end{aligned}$$

$$\begin{aligned}\text{And PE} &= 47.442 * 0.69 + 0.0458 * 43.3 * 0.0748 \text{ tCO}_2 \\ &= 32.88 \text{ tCO}_2\end{aligned}$$

$$\begin{aligned}\text{Hence, ER}_y &= 20,193.26 - 32.88 - 0 \text{ t CO}_2 \\ &= 20,160.38 \text{ tCO}_2\end{aligned}$$

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 2009-2010 are 35,880 t CO₂e. Actual emission reduction by this project during the same period is 20,160.38 t CO₂e.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO₂e)	35,880	20,160.38

Emission reductions were conservatively rounded off to nearest integer. The Emission Reductions for the project activity are 20,160 tCO₂e

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 29,266 MWh of electricity to the grid. Hence, estimated emission reductions for this project during the monitoring period are 35,880 tCO₂e whereas, actual emission reductions during the same period are 20,160 tCO₂e. This difference between the estimated and actual emission reduction is because of less rainfall during the monsoon season during year 2009-10 which was resulted in less generation from the plant. Also the plant was not operated in the month of June'09, August'09, and September'09. 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	Result
Gross Energy Meter at Plant	Siemens Landis & Gyr Z.U	0.2S	73932341	24/12/2008	Results are satisfactory & in permissible limit by MSEDCL
Gross Energy Meter at Plant	Siemens Landis & Gyr Z.U	0.2S	73932341	02/06/2009	Results are satisfactory & in permissible limit by MSEDCL
Gross Energy Meter at Plant	Siemens Landis & Gyr Z.U	0.2S	73932341	07/12/2009	Results are satisfactory & in permissible limit by MSEDCL
Main Meter at Substation	ABB	0.2S	02173601	23/12/2008	Results are satisfactory & in permissible limit by MSEDCL
Main Meter at Substation	ABB	0.2S	02173601	02/06/2009	Results are satisfactory & in permissible limit by MSEDCL
Main Meter at Substation	ABB	0.2S	02173601	05/12/2009	Results are satisfactory & in permissible limit by MSEDCL
Check Meter at Substation	ABB	0.2S	02173600	23/12/2008	Results are satisfactory & in permissible limit by MSEDCL
Check Meter at Substation	ABB	0.2S	02173600	02/06/2009	Results are satisfactory & in permissible limit by MSEDCL
Check Meter at Substation	ABB	0.2S	02173600	05/12/2009	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
kgCO ₂ 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
m ³	Cubic meter
m ³ /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
tCO ₂ e	tonnes carbon di oxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
US\$	United States Dollars