MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	12 MW hydropower plant in Bhandardara in Maharashtra, India
Reference number of the project activity	0430
Version number of the monitoring report	02
Completion date of the monitoring report	26/07/2012
Registration date of the project activity	30/09/2006
Monitoring period number and duration of this monitoring period	Monitoring period number : 04 (2nd crediting period) Duration: 01/04/2011 – 31/03/2012 (First and last days included)
Project participant(s)	1.Dodson –Lindblom Hydro Power Private Limited (DLHPPL) 2. IFC-Netherlands Carbon Facility (INCaF)
Host Party(ies)	India
Sectoral scope(s) and applied methodology(ies)	Sectoral scope: 01 , Renewable energy project AMS.I.D. "Grid connected renewable electricity generation"---- Version 13
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	35,880 tCO_2/ year
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	41,409 tCO_2

SECTION A. Description of project activity

A.1. Purpose description of and general project activity

Purpose of the project activity and the measures taken to reduce greenhouse gas emissions:

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 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 exported to state electricity grid owned and operated by Maharashtra State Transmission Company Ltd (MSTCL).

Brief description of the installed technology and equipments:

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 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 60.02 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).

Relevant dates for the project activity:

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 and the renewal date is 25/10/2008. The duration of the monitoring period considered under this monitoring report is 01/04/2011 to 31/03/2012. 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.

Total emission reductions achieved in this monitoring period:

The emission reductions as calculated are mentioned in Table 1 below.

Table 1: Emission reduction over the monitoring period

Month and Year	Total emission reductions achieved in this monitoring period in tonnes of CO_2 eq
April 2011	2,718
May 2011	6,213
June 2011	3,242
July 2011	5,176
August 2011	5,123
September 2011	5,982
October 2011	492
November 2011	(5)
December 2011	1,861
January 2012	3,896
February 2012	3,150
March 2012	3,561
Total	**41,409**

A.2. Location of 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 about 140 kilometres from Mumbai. The nearest town is Ghoti and closest railhead is at Igatpuri which is 40 kilometres away.

(a) Host Part(ies): India
(b) Region /State/Province: Maharashtra
(c) City/Town/Community: Bhandardara
(d) Physical/ Geographical location: Latitude 19° 33′ 15″ N and longitude 73° 45′ 0″ E.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A (host) - India	Private entity A: Dodson – Lindblom Hydro Power Private Limited (DLHPPL) Public entity A: Not applicable	No
Party B - The State of the Netherlands	Private entity B: IFC-Netherlands Carbon Facility (INCaF) Public entity B: Not applicable	Yes

A.4. Reference of applied methodology

Title, reference and version of the baseline and monitoring methodology applied to the project activity is furnished in Table 2 below.

Table 2: Methodological details

Applicable Methodology	AMS. I.D.
Project Type	Renewable energy projects
Project Category	Grid connected renewable electricity generation
Version	13
Sectoral Scope	01
Reference	http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X
Tool	'Tool to calculate the emission factor for an electricity system (Version 01)

A.5. Crediting period of project activity

Type	:	Renewable crediting period
Crediting period	:	21 years
Start date of the 1st Crediting Period	:	27/07/2001
End date	:	26/07/2008
Start date of 2nd Crediting period	:	27 /07/2008
End date	:	26 /07/2015

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

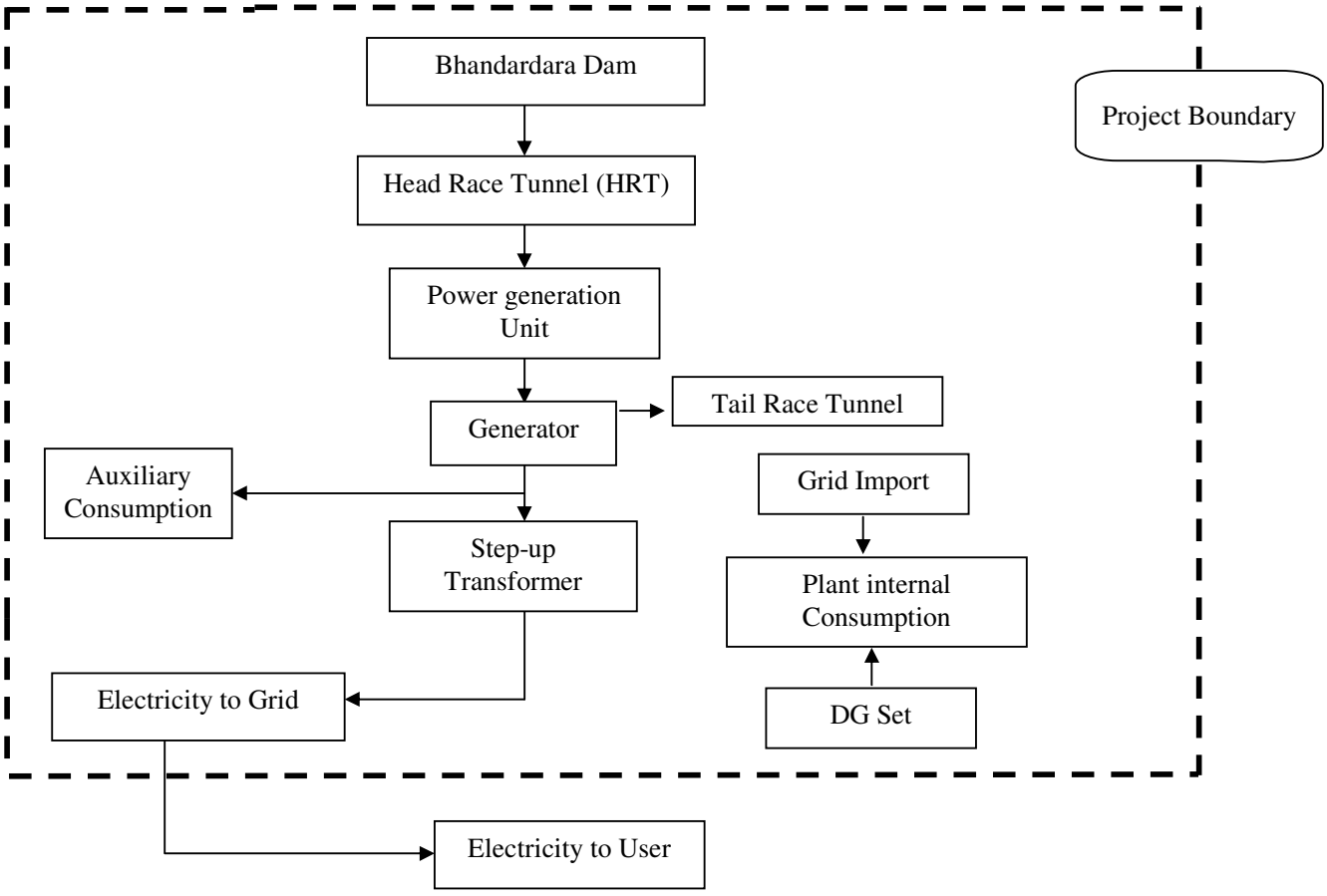
The project activity (BH-1) was originally built by the GOMID with a single hydropower generating unit of 10 MW in 1984. In Maharashtra state, all state owned hydroelectric plants are constructed by GOMWRD and handed over to Maharashtra State Electricity Board (MSEB) (now Maharashtra State Electricity Generation Company) for operation and maintenance. The generating unit at BH-1 was commissioned in 1986 and 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 rated turbine capacity mentioned in the initial version of the PDD was 12 MW. However, the revised PDD which got accepted by the UNFCCC on a date of 16/10/2010 mentions the total capacity of the turbine as 14.84 MW in order to incorporate the maximum overload capacity up and above the nominal rated capacity of the corresponding turbine. 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).

There is one Francis turbine is employed in the project activity. The 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 technical specifications of the employed technology are provided in Annex 1.

Schematic Diagram of the Project Activity:



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 Nov-11 during the monitoring period and it was in operational mode during rest of the months of this monitoring period.

Table 3: Summary of Annual Performance Report

Month	Gross Electricity Generation (kWh)	Operational Time (Hours)	Outage Time (Hours)	Total Time (Hours)
April 2011	4019120	291.43	429.00	720.43
May 2011	9186320	743.57	1.03	744.60
June 2011	4795880	473.32	246.61	719.93
July 2011	7652020	614.38	129.47	743.85
August 2011	7572560	522.80	221.17	743.97
September 2011	8844280	601.60	118.60	720.20
October 2011	732370	50.00	693.98	743.98
November 2011	0	0	720.87	720.87
December 2011	2748730	188.90	554.15	743.05
January 2012	5752390	401.77	343.05	744.82
February 2012	4653190	340.31	330.61	670.92
March 2012	5263610	416.90	326.95	742.85
Total				

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

No deviations from registered monitoring plan or applied methodology is applied for this monitoring period.

B.2.2. Corrections

Not applicable since no corrections to project information or parameters fixed at validation have been applied for this monitoring period.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

There are no changes from the registered monitoring plan or applied methodology.

B.2.4. Changes to project design of registered project activity

The project proponent had requested for revision in registered PDD and same was approved by the CDM-EB.

Approval date: 16/10/2010
Reference number: 0430
Reference link: http://cdm.unfccc.int/Projects/DB/BVQI1155728784.01/view?cp=1

B.2.5. Changes to start date of crediting period

No changes to start date of crediting period is applied for this monitoring period.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable as this is not an afforestation or reforestation project activity.

SECTION C. Description of 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 and check 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 been 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.

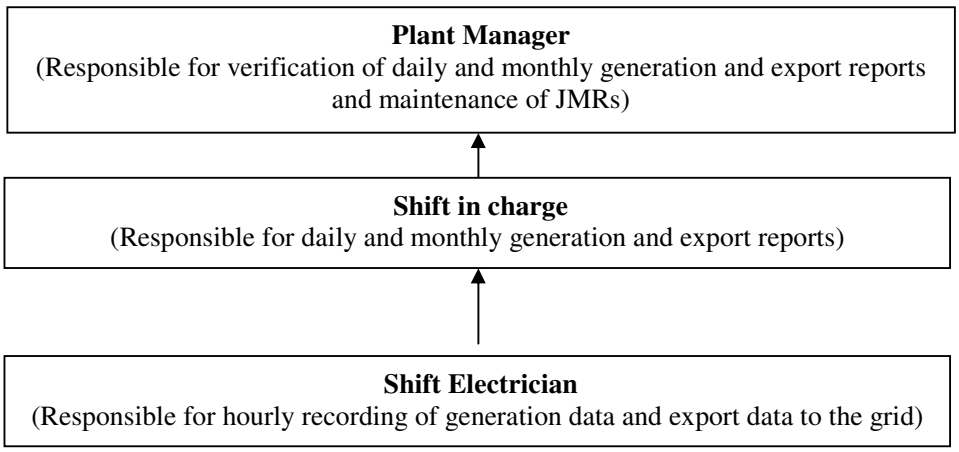
The diesel quantity available in the diesel storage tanks is recorded daily by DLHPPL in the plant log book. The diesel consumption would be recorded in the logbook in litres. However, based on the density of diesel of about 0.88 kg/litre, the diesel consumption in tons would be calculated for use in 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:

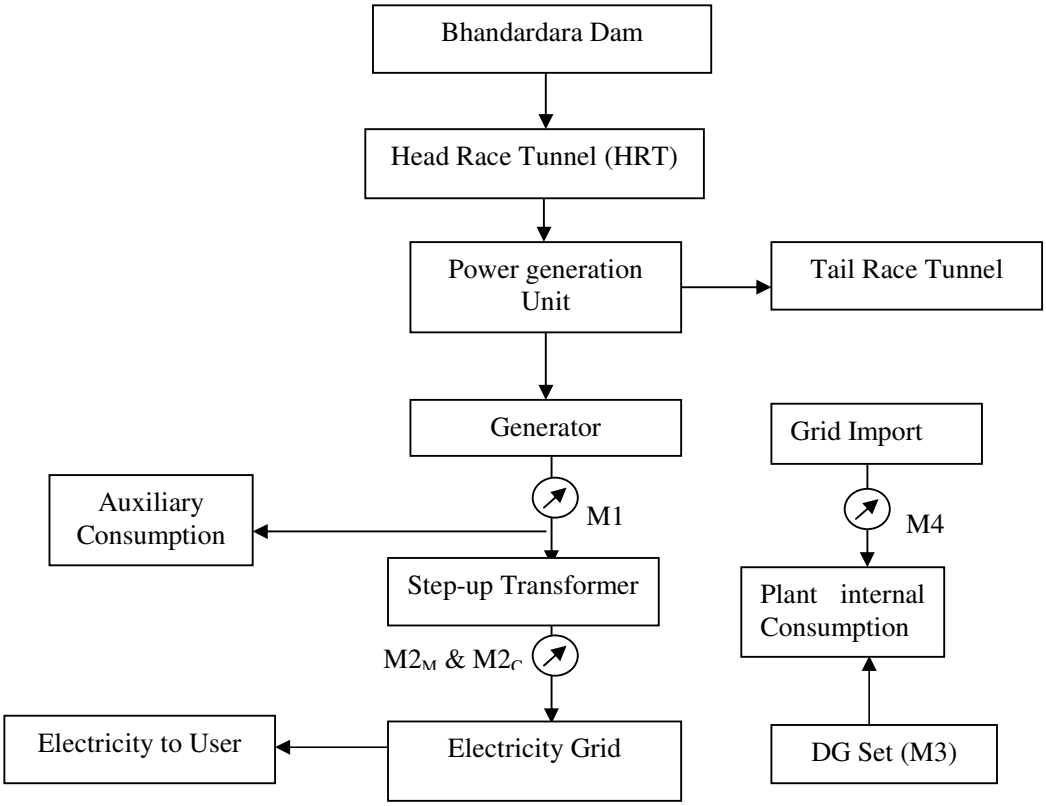
Hourly data recording of the generation and export to the grid are made by the electrician of the shift and verified by the shift in charge of DLHPPL and these data are stored at generation end. Daily and monthly reports stating the generation and electricity export are prepared by the shift in-charge 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-charges 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



Schematic diagram for monitoring system involved in the project activity is provided below-

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 fixed ex ante or at renewal of crediting period

(Copy this table for each piece of data and parameter.)

Data/Parameter	**CO_2 Emission Factor of grid (EF_y)**
Unit	tCO_2 / MWh
Description	CO_2 emission factor of the western regional grid
Source of data	Central Electricity Authority (CEA), CO_2 baseline database, Version 3.0, dated 15 December 2007
Value(s) applied	0.6900
Purpose of data	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})**
Unit	GJ per mass unit (GJ/ Ton)
Description	Net calorific value of diesel
Source of data	IPCC default data
Value(s) applied	43.3000
Purpose of data	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 ($EF_{CO2\ diesel}$)**
Unit	tCO_2 / GJ
Description	CO_2 emission factor of diesel
Source of data	IPCC default data
Value(s) applied	0.0748
Purpose of data	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

(Copy this table for each piece of data and parameter.)

Data/Parameter	**Electricity Export (EG_y)**
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	60,026,400
Monitoring equipment	Main Energy Meter and Check Energy Meters are used for net energy export <u>Main Energy Meter Details:</u> Make : ABB Accuracy Class : 0.2 Serial Number : 02173601 Calibration Frequency : Once in a year Date of 3rd calibration : 08/12/2011 Date of 2nd calibration : 22/06/2011 Date of 1st calibration : 01/12/2010 <u>Check Meter Details:</u> Make : ABB Accuracy Class : 0.2 Serial Number : 02173600 Calibration Frequency : Once in a year Date of 3rd calibration : 08/12/2011 Date of 2nd calibration : 22/06/2011 Date of 1st calibration : 01/12/2010
Measuring/Reading/ Recording frequency	This data is measured continually and recorded monthly
Calculation method (if applicable)	This data is directly monitored.

QA/QC procedures	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.
Purpose of data	This data is directly used for baseline estimation
Additional comment	-

Data/Parameter	**Electricity Imported (E_{import})**
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	47,281
Monitoring equipment	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. Make-Genus Meter Sl. No. 03003064 Class-0.5 However, it may be noted that the import meter reading for billing purpose is taken with the display shown on the meter and recorded manually. The com port is an additional facility provided on the meter, only to download the stored data of the meter in the form of soft copy so that MSEDCL can view this data if required. 'Com port' is used for communication between the meter and the computer. The reading display on the meter is not affected by failure of 'com port', only data can not be retrieved. Hence, even during the period of 'com port' failure, there were no problems in monitoring and subsequent recording of the 'electricity import' parameter.
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	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.
Purpose of data	This data used for project emission calculation
Additional comment	-

Data/Parameter	**Gross Electricity Generation (E_{Gen})**
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	61,220,470
Monitoring equipment	Gross energy meter is used for gross energy generation by the plant <u>Details of Gross Main Meter</u> Make : Siemens Landis & Gyr Z.U Accuracy Class : 0.2s Serial Number : 73932341 Calibration Frequency : Once in a year Date of 3rd calibration : 08/12/2011 Date of 2nd calibration : 22/06/2011 Date of 1st calibration : 01/12/2010
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	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.
Purpose of data	This value is not used for emission reduction calculation.
Additional comment	-

Data/Parameter	Auxiliary Consumption
Unit	kWh
Description	Unit consumed by the project activity
Measured/Calculated /Default	Calculated
Source of data	Joint Meter Readings (JMRs) taken and signed by authorized officials of MSEDCL and the Gross Electricity Generation readings
Value(s) of monitored parameter	1,194,070
Monitoring equipment	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	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.
Purpose of data	This value is not used for emission reduction calculation.
Additional comment	-

Data/Parameter	Diesel consumption (DC)
Unit	Litres
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	65
Monitoring equipment	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 continuously and recorded monthly basis
Calculation method (if applicable)	This data is directly monitored.
QA/QC procedures	Not required
Purpose of data	This value is used for project emission calculation.
Additional comment	-

[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

Data/Parameter	**Hourly Electricity Export (HEE_{main_meter})**
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.
Monitoring equipment	Main Energy Meter and Check Energy Meters are used for net energy export <u>Main Energy Meter Details:</u> Make : ABB Accuracy Class : 0.2s Serial Number : 02173601 Calibration Frequency : Once in a year Date of 3rd calibration : 08/12/2011 Date of 2nd calibration : 22/06/2011 Date of 1st calibration : 01/12/2010 <u>Check Meter Details:</u> Make : ABB Accuracy Class : 0.2s Serial Number : 02173600 Calibration Frequency : Once in a year Date of 3rd calibration : 08/12/2011 Date of 2nd calibration : 22/06/2011 Date of 1st calibration : 01/12/2010
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	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.
Purpose of data	This data is directly used for baseline estimation.
Additional comment	-

D.3. Implementation of sampling plan

Not applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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 (EFgrid, OM,y) according to the selected method:

The simple OM emissions factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/ MWh) of all generating power plants serving the system, not including low-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 CO_2 emission factor in year y (tCO_2/ 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)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/ 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 CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/ MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

The CO_2 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 ($EF_{Grid,\ BM,\ y}$)

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

$EF_{grid,\ OM,,\ y}$	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 (CO_2 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 CO_2 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 4: Month-wise Electricity Generation, Export and Auxiliary Consumption Details

Month	Electricity Generated (kWh)	Electricity Exported (kWh)	Auxiliary Consumption (kWh)	Baseline Emission (tCO_2)
April 2011	4,019,120.00	3,939,600.00	79,520.00	2,718
May 2011	9,186,320.00	9,004,800.00	181,520.00	6,213
June 2011	4,795,880.00	4,699,200.00	96,680.00	3,242
July 2011	7,652,020.00	7,501,200.00	150,820.00	5,176
August 2011	7,572,560.00	7,424,400.00	148,160.00	5,123
September 2011	8,844,280.00	8,670,000.00	174,280.00	5,982
October 2011	732,370.00	717,600.00	14,770.00	495
November 2011	0.00	0.00	0.00	0
December 2011	2,748,730.00	2,697,600.00	51,130.00	1,861
January 2012	5,752,390.00	5,646,000.00	106,390.00	3,896
February 2012	4,653,190.00	4,564,800.00	88,390.00	3,150
March 2012	5,263,610.00	5,161,200.00	102,410.00	3,561
Total	**61,220,470.00**	**60,026,400.00**	**1,194,070.00**	**41,418**

During this monitoring period the project activity generated 61,220,470 kWh and exported 60,026,400 kWh of electricity to the grid. Hence, the baseline emissions for this monitoring period are

Therefore, BE = 60,026 MWh * 0.69 tCO_2 eq/ MWh

= 41,418 tCO_2

E.2. Calculation of project emissions or actual net GHG removals by sinks

The project emissions for this project activity have 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

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

$PE_{Import,\,y}$	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 5: 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 (tCO_2)	Considered for Emission Reductions Estimation (Yes/No)
April 2011	3,939,600.00	3,564.00	0.090%	0	No
May 2011	9,004,800.00	2,640.00	0.029%	0	No
June 2011	4,699,200.00	494.00	0.011%	0	No
July 2011	7,501,200.00	4,847.00	0.065%	0	No
August 2011	7,424,400.00	2,341.00	0.032%	0	No
September 2011	8,670,000.00	1,015.00	0.012%	0	No
October 2011	717,600.00	4,149.00	0.578%	2.86	Yes
November 2011	0.00	8,030.00	-	5.54	Yes
December 2011	2,697,600.00	6,862.00	0.254%	0	No
January 2012	5,646,000.00	5,282.00	0.094%	0	No
February 2012	4,564,800.00	1,034.00	0.023%	0	No

March 2012	5,161,200.00	7,023.00	0.136%	0	No
Total	**60,026,400.00**	**47,281.00**			

According to the registered PDD, if the electricity import is greater or equal to 0.5% of the net electricity export then project emissions from import of electricity need to consider. In this monitoring period, electricity import for the month of October-11 and November-11 were greater than 0.5% of net electricity export and the plant was under shutdown in the month of November-11. Hence, project emissions due to electricity import have been considered for these months. During these months the electricity import was 47,281kWh.

$PE_{Import, y}$ = 12,179 kWh * 0.69 tCO_2 / MWh
= 12.18 MWh * 0.69 tCO_2 / MWh
= 8.40 tCO_2

Table 6: Month-wise Diesel Consumption and Emissions Details

Month	Diesel Consumption (Litres)	% Share of Project Emission Vs Emission Reductions (%)	Project Emission for Diesel Consumption (tCO_2)	Considered for Emission Reductions Estimation (Yes/No)
April 2011	3.50	0.0004%	0	No
May 2011	2.50	0.0001%	0	No
June 2011	9.00	0.0008%	0	No
July 2011	7.00	0.0004%	0	No
August 2011	5.00	0.0003%	0	No
September 2011	5.00	0.0002%	0	No
October 2011	13.00	0.0075%	0	No
November 2011	2.00	-	0.006	Yes
December 2011	6.50	0.0010%	0	No
January 2012	4.00	0.0003%	0	No
February 2012	2.50	0.0002%	0	No
March 2012	5.00	0.0004%	0	No
Total	**65.00**			

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 65 liters. Hence, project emissions due to diesel usage have been considered for Novemeber-11 for this monitoring period.
Hence,

$PE_{DC, y} = 0.0018^{2} * 43.3 * 0.0748\ tCO_2 = 0.006\ tCO_2$

[2] This value is converted to tons as per the registered PDD, for more details refer to section D.2.

E.3. Calculation of leakage

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

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
Total	41,418	8.41	0	41,409

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	35,880	41, 409

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

According to the registered PDD the estimated electricity export during the monitoring period was 52,000 MWh whereas, the plant has actually exported 60,026 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 41,409 tCO_2e.

This difference between the estimated and actual emission reduction is because of high amount of precipitation during the monsoon season in the year 2011-12[3] which resulted in high generation from the plant. Further, the plant was not operational in the month of Novmeber-11 only. Therefore, net electricity exported to the grid is higher than its estimation in registered PDD.

[3] The details of precipitation data and useful water availability for generation will be provided to the DOE.

Annex 1

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 / sec
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

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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