

MONITORING REPORT

Ver. 01, November 2009

[The Monitoring period is chosen from 2008.10.09 to 2009.10.31 both days are included]

UNFCCC Project Activity Ref. No: 1549
9 MW Neria Hydroelectric Project,
Karnataka, India

Net Emission Reductions: 17785 tCO₂ e

Registered Office	Project Site
Bhoruka Power Corporation Limited, 48, Lavelle Road, Bangalore – 560001, Karnataka, India Ph: 91+80-2227 2271	9 MW Neria Hydroelectric Project, Dharmastala Village, Dakshina Kannada District, Karnataka, India.

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1. Introduction

The purpose of this monitoring report is to calculate the Greenhouse Gas Emission reduction achieved by the project activity for the periodic verification.

The first monitoring report covers the activity from 09.10.2008 to 31.10.2009 (both days included). The plant net exported 20.754 GWh to the grid during the reported period.

The project has been completed and the Units were synchronized with KPTCL grid as follows:

- Unit – I : 27.07.2006
- Unit – II : 27.07.2006

2. Reference

As per UNFCCC methodologies are mentioned in <http://cdm.unfccc.int/methodologies/index.html>, the project is categorized in sectoral scope 1: “**Energy Industries (renewable / non-renewable sources)**” and applied **Approved Baseline methodology (AMS I.D, Version 10)**.

Registered documents are available at

<http://cdm.unfccc.int/Projects/DB/DNV-CUK1200571481.71/view>

3. Abbreviations in the Report

BPCL	:	Bhoruka Power Corporation Limited
CEA	:	Central Electricity Authority, Government of India.
KPTCL	:	Karnataka Power Transmission Corporation Limited
MESCOM	:	Mangalore Electric Supply Company Limited
GHG	:	Greenhouse Gases
PDD	:	Project Development Document
PPA	:	Power Purchase Agreement

4. General Description of the Project

The 9 MW (2x4.5 MW) Neria Mini Hydel Power Project developed by Bhoruka Power Corporation Limited is a mini hydroelectric project in Dhakshina kannada district of Karnataka State, India. It is a Run-off the river scheme on Neria river, which is a west flowing river. Major components of the project are a diversion weir was constructed across the river to divert the stream to a power canal upto fore bay cum intake structure, individual steel penstock to convey water each hydro generating unit and an open tail race channel to release water back into the river.

Neria Mini Hydel Power Project utilizes the water releases in the River during monsoon and the natural head is available in at site for power generation. The maximum flow through the units is 59.7 cumecs and a gross head of about 17.5 m is available for power generation.

The project also uses a 80 KVA DG set for catering essential station auxiliaries in the event of 33 KV supply mains failure.

The generated electricity is evacuated to 33 kV Sub-station, Pilakala owned by KPTCL, which is 15 km away from the project site through double circuit 33 KV transmission line and fed into the state grid. The electricity is sold to Mangalore Electric Supply Company Limited (MESCOM) as per Power Purchase Agreement (PPA).

The plant site is located at Latitude 12°56' 07.20" N and Longitude 75°22' 53.87" E. Project boundary specified in the Appendix B of simplified modalities and procedures is that encompasses the physical, geographical site of the renewable generation source and all power plants connected physically to the electricity system that the CDM project power plant is connected to (the state grid and collection of grids of states in the Southern region. For the project activity under consideration, the project site considered encompasses the diversion structure, water conducting system, penstocks, powerhouse with 2 TG units, tailrace canal and power evacuation system.

5. Details of Major Equipment of the Project

The details of major equipment of the project and suppliers are presented below:

Table 1 – Details of Major Equipment of the Project and Suppliers

S.No	Equipment details
1	<p>Turbine: 2 sets of Horizontal S type Full Kaplan type Turbine, Adjustable runner & guide vanes controlled by servomotors along with indicating and recording instruments, etc. Rated output; 4808 KW, Rated discharge: 29.855 cu.m/sec, Net head: 17.50 m and 260 rpm.</p> <p>Supplier: M/s Boving Fouress Ltd, Bangalore, India.</p>
2	<p>Generator: Horizontal synchronous type, capacity: 5294 KVA, 3 Phase, 11 kV, 5% over load, 50 c/s, 750 RPM and 0.85 PF Lag.</p> <p>Supplier: M/s Toyo Denki Power system Pvt Ltd, Bangalore, India.</p>

6. Statement to what extent the Project has been implemented as planned

The Project has been completed and the monitoring equipments were installed to monitor the parameters as described in the registered Project Design Document (PDD). The Plant is in operation continuously (with outages – forced & planned) since 27.07.2006.

The values mentioned in the below table 2.1 & 2.2 are taken from the Logbook of power plant. It is checked by site incharge everyday. Such log readings are considered valid for plant activities.

The details of plant outages are presented in below tables.

Table –2.1: Outage Details for Unit - I during the Reported Period

Period (2008-09)	Total available hours during monitored period	Non- availability of water (Off season) (Hours)	Planned Shut down (Hours)	Forced Shut down (Hours)	Total shut down hours	Total No. of hours plant operated
1	2	3	4	5	6 = 4 + 5	7 = 2 - 3 - 6
October	552:00	0:00	0:00	29:13	29:13	522:47
November	720:00	483:13	0:00	10:33	10:33	226:14
December	744:00	716:05	0:00	0:00	0:00	27:55
January	744:00	744:00	0:00	0:00	0:00	0:00
February	672:00	672:00	0:00	0:00	0:00	0:00
March	744:00	744:00	0:00	0:00	0:00	0:00
April	720:00	720:00	0:00	0:00	0:00	0:00
May	744:00	744:00	0:00	0:00	0:00	0:00
June	720:00	517:33	0:00	11:08	11:08	191:19
July	744:00	0:00	0:00	39:24	39:24	704:36
August	744:00	8:23	79:24	18:17	97:41	637:56
September	720:00	1:30	0:00	14:40	14:40	703:50
October	744:00	341:47	0:55	9:02	9:57	392:16

Table –2.2: Outage Details for Unit – II during the Reported Period

Period (2008-09)	Total available hours during monitored period	Non- availability of water (Off season) (Hours)	Planned Shut down (Hours)	Forced Shut down (Hours)	Total shut down hours	Total No. of hours plant operated
1	2	3	4	5	6 = 4 + 5	7 = 2 - 3 - 6
October	552:00	520:44	0:00	0:45	0:45	30:31
November	720:00	459:15	0:00	7:28	7:28	253:17
December	744:00	578:35	0:00	0:00	0:00	165:25

January	744:00	695:38	0:00	1:30	1:30	46:52
February	672:00	663:18	0:00	0:00	0:00	8:42
March	744:00	740:42	0:00	0:00	0:00	3:18
April	720:00	720:00	0:00	0:00	0:00	0:00
May	744:00	744:00	0:00	0:00	0:00	0:00
June	720:00	571:22	0:00	2:18	2:18	146:20
July	744:00	20:05	0:55	42:34	43:29	680:26
August	744:00	0:00	0:05	21:13	21:18	722:42
September	720:00	0:00	1:10	18:46	19:56	700:04
October	744:00	0:00	0:49	24:32	25:21	718:39

7. Parameters being monitored according to monitoring plan

The following parameters were monitored on continuous basis

a) Energy

- Electronic energy meters were installed for the energy exported to the State grid and the energy imported from the State grid. Monthly energy meter readings have recorded and jointly certified by the representatives of MESCOM, KPTCL & Bhorka Power Corporation Limited.
- b) CEA's CO₂ Baseline Database for emission factor for Southern regional grid is considered.

Data being collected to monitor the GHG reduction is given in the below table(as per section B.7 of Registered PDD) :

Data / Parameter:	EG _y
Data unit:	GWh
Description:	Electricity supplied to the grid by the project
Source of data to be used:	On-site measurements
Value of data	20.754GWh during the year of 2008-09
Description of measurement methods and procedures to be applied:	Measured monthly using calibrated meters and aggregated annually.
QA/QC procedures to be applied:	Meters will be calibrated as per industry standards. Sales records to the grid and other records are used to ensure consistency.
Any comment:	Electric power sold to the grid will be measured by main meter and check meter by both BPCL and KPTCL as specified in the PPA and records maintained. To be cross-checked with monthly invoices or receipts of payments.

Data / Parameter:	EG _{grossy}
Data unit:	GWh

Description:	Total electricity generated by the project during the year y
Source of data to be used:	On-site measurements
Value of data	21.082 GWh during the year of 2008-09
Description of measurement methods and procedures to be applied:	Measured monthly using calibrated meters and aggregated annually.
QA/QC procedures to be applied:	Meters will be calibrated as per industry standards.
Any comment:	

Data / Parameter:	$EG_{\text{Auxiliary}}$
Data unit:	GWh
Description:	Auxiliary electricity consumption of the project
Source of data to be used:	On-site measurements
Value of data	0.226 GWh during the year of 2008-09
Description of measurement methods and procedures to be applied:	Measured monthly using calibrated meters and aggregated annually or the difference between the gross energy generation and the net electricity export to the grid system, can be arrived as auxiliary consumption of the project activity.
QA/QC procedures to be applied:	Meters will be calibrated as per industry standards. Sales records to the grid and other records are used to ensure consistency. If the data is calculated as the difference between gross and net power export, no QA/ QC procedures are applicable, since, both parameters are already underwent the QA/QC procedures.
Any comment:	

Data / Parameter:	$EG_{\text{Import},y}$
Data unit:	GWh
Description:	Grid electricity import to the project activity during the year y
Source of data to be used:	On-site measurements
Value of data	0.102 GWh during the year of 2008-09
Description of measurement methods and procedures to be applied:	Measured monthly using calibrated meters and aggregated annually.
QA/QC procedures to be applied:	Meters will be calibrated as per the industry standards. Project proponent will pay to the KPTCL based on the meter reading recorded in the import meter. The maintenance and/or other quality control measures are taken by KPTCL, since any false reading in the meter is a financial loss to KPTCL. Hence, KPTCL give high priority in quality control of the import meter. Since, the data item is not under the control of project

	proponents, no QA/QC procedures are provided here.
Any comment:	

Data / Parameter:	$F_{i,y}$
Data unit:	Tonnes/kilo liters
Description:	Quantity of fossil fuel type i combusted in the project plant during year y
Source of data to be used:	On-site measurements
Value of data	0 (assumed value for ex-ante calculation of emission reductions)
Description of measurement methods and procedures to be applied:	The total number of operating hours of DG set and the corresponding quantity of diesel consumed for the purpose will be recorded in the log book maintained at the DG set room. The operating hours and the quantity of diesel consumption will be recorded.
QA/QC procedures to be applied:	The weigh bridge meter will under go calibration/maintenance subject to appropriate industrial standards. The data recorded can be cross checked against the fuel purchase receipts.
Any comment:	

- **Methods of data transfer and archiving policy –**

The data have been recorded both at the project site as well as at the grid sub-station, which is under the control of KPTCL. The electricity export / import readings have been measured using calibrated tri-vector meters and recorded manually by the representatives of MESCOM or KPTCL and BPCL as a proof of export and import of electricity by the project activity. Those meter readings are the basis for the invoices raised by BPCL. These readings are also considered for emission estimations. Sales bills / receipts may be compared as an alternative proof of the electricity exported to the grid. And the data will be stored for a period of 2 years after the crediting period.

- **Technical details of monitoring instruments like make, type, class, current, voltage range, year of manufacturing, serial no, etc.**

The following table “A” contains the specifications of earlier installed Tri vector meters, which were later has been replaced as per KPTCL representative insists. The details of the existing Tri vector meters specifications mentioned in “Table B”

Table "A"

	LINE -1		LINE - 2	
	Main meter	Check meter	Main meter	Check meter
Type	ER300P	ER300P	ER300P	ER300P
Make	L & T	L & T	L & T	L & T
Class	0.2 S	0.2 S	0.2 S	0.2 S
Current	1A	1A	1A	1A
Voltage	-/110V (L-L)	-/110V (L-L)	-/110V (L-L)	-/110V (L-L)
Year of manf.	2005	2005	2005	2005
Serial No.	05341379	05341375	05341378	05271163

Table "B"

	LINE -1		LINE - 2	
	Main meter	Check meter	Main meter	Check meter
Type	ER300P	ER300P	ER300P	ER300P
Make	L & T	L & T	L & T	L & T
Class	0.2S FOR Active & 0.5S for Reactive	0.2S FOR Active & 0.5S for Reactive	0.2S FOR Active & 0.5S for Reactive	0.2S FOR Active & 0.5S for Reactive
Current	250/1A	250/1A	250/1A	250/1A
Voltage	33KV/110V	33KV/110V	33KV/110V	33KV/110V
Year of manf.	2007	2007	2007	2007
Serial No.	07361082	07361086	07361061	07361037

- Calibration of monitoring instruments with due date of calibration, calibration procedure, And traceability of calibration meters with national and international standards

	LINE -1		LINE - 2	
	Main meter	Check meter	Main meter	Check meter
Date of calibration	11.02.2009	11.02.2009	11.02.2009	11.02.2009
Calibration Procedure & Standards	Calibration procedure for energy meters is as per Article 7 of PPA signed between BPCL & KPTCL			

Management system and quality assurance:

Electricity: (Quality check & assurance is as per Article 7 of PPA signed between BPCL & KPTCL). Both Main and Check meters (export & import) installed by BPCL are of 0.2% accuracy class. Each meter is jointly inspected and sealed on behalf of the parties.

Both Main and Check meters are tested and certified at least once every year against an accepted laboratory standard meter in accordance with electricity standards. The meters are deemed to be working satisfactorily if the errors are within specifications for meters of 0.2% accuracy class.

Information Used for Emission Reduction Calculations

Sr. No.	Key information/data used for baseline	Source of data/information
1.	Electricity Generated	Monthly Energy Meter Readings
2.	Southern Regional Grid	CO ₂ Baseline Database for the Indian Power Sector User Guide, Draft, Version 2.0 (June 2007) Central Electricity Authority, Government of India.

As per the billing period, The Month wise data on electricity generation, auxiliary power consumption, electricity exported to grid and electricity imported from grid are presented in the tables given below:

Table - 3: Details of Electricity exported to grid, Electricity imported from grid and Net electricity displaced

Monitoring period	Electricity Exported to grid	Electricity imported from grid	Net electricity displaced	
	kWh	kWh	kWh	MWh
09.10.08 to 01.11.08	1492403	0	1492403	1492.40
01.11.08 to 01.12.08	765750	4500	761250	761.25
01.12.08 to 01.01.09	290250	12000	278250	278.25
01.01.09 to 01.02.09	73500	14250	59250	59.25
01.02.09 to 01.03.09	12000	13500	-1500	-1.50
01.03.09 to 01.4.09	5250	15750	-10500	-10.50
01.04.09 to 01.05.09	2250	14500	-12250	-12.25
01.05.09 to 01.06.09	0	17900	-17900	-17.90
01.06.09 to 01.07.09	660100	8900	651200	651.20
01.07.09 to 01.08.09	5750400	1000	5749400	5749.40
01.08.09 to 01.09.09	4630700	200	4630500	4630.50
01.09.09 to 01.10.08	4030300	200	4030100	4030.10
01.10.09 to 01.11.09	3144700	200	3144500	3144.70
Total	20857603	102900	20754703	20754.90

8. GHG Calculations

The following formula is adopted for calculating emission reductions generated by the project activity:

$$ER_y = BE_y - PE_y - L_y$$

Where ER_y is emission reductions in a given year

BE_y is baseline emissions in a given year

PE_y is project emissions in a given year

L_y is leakage in a given year

Since the project emissions (PE_y) as well as the leakage (L_y) are zero, the emission reductions are equal to baseline emissions.

Baseline Emissions

The baseline emissions are calculated as follows:

$$BE_y = EG_y \cdot EF_y$$

Where EG_y is the net electricity export to grid in a given year (GWh)

EF_y is the emission factor for a given year (tCO₂/GWh)

The combined emission factor is 857 tCO₂/GWh for Southern regional grid, which is calculated based on Simple OM on ex-ante and Build margin on ex- ante determination as per registered PDD and the data was taken from Table B of CO₂ Baseline Database Version 2, dated June 2007 published by CEA, India². The detailed calculations are furnished in Enclosure –I of this report.

<http://cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>

Leakage

As per sec. 12 of AMS ID, project participants do not need to consider these emission sources as leakage in applying this methodology. Hence the leakage emissions are considered zero.

Using the above formulas, the Emission reductions from the project activity are shown

9. Net Emission Reductions

The emission reductions for the chosen monitored period

Table - 4: Net Emission Reductions for Billing period i.e. Calendar month

Monitoring period (2008-09)	Electricity Exported to grid	Electricity imported from grid	Net electricity displaced		Baseline Emission factor	Baseline Emissions	Project Emissions	Net Voluntary Emission reductions
	kWh	kWh	kWh	MWh	tco2/MWh	tco2e	tco2e	tco2e
09.10.08 to 01.11.08	1492403	0	1492403	1492.40	0.857	1278	0	1278
01.11.08 to 01.12.08	765750	4500	761250	761.25	0.857	652	0	652
01.12.08 to 01.01.09	290250	12000	278250	278.25	0.857	238	0	238
01.01.09 to 01.02.09	73500	14250	59250	59.25	0.857	50	0	50
01.02.09 to 01.03.09	12000	13500	-1500	-1.50	0.857	-1	0	-1
01.03.09 to 01.04.09	5250	15750	-10500	-10.50	0.857	-8	0	-8
01.04.09 to 01.05.09	2250	14500	-12250	-12.25	0.857	-10	0	-10
01.05.09 to 01.06.09	0	17900	-17900	-17.90	0.857	-15	0	-15
01.06.09 to 01.07.09	660100	8900	651200	651.20	0.857	558	0	558
01.07.09 to 01.08.09	5750400	1000	5749400	5749.40	0.857	4927	0	4927
01.08.09 to 01.09.09	4630700	200	4630500	4630.50	0.857	3968	0	3968
01.09.09 to 01.10.08	4030300	200	4030100	4030.10	0.857	3453	0	3453
01.10.09 to 01.11.09	3144700	200	3144500	3144.70	0.857	2695	0	2695
Total	20857603	102900	20754703	20754.90		17785		17785

The details of calculation of emission reductions month wise is presented in Excel spread sheet

10.Measures to ensure the results/uncertainty analysis

The energy exported by Boruka Power is recorded from independent Main meter installed at Pilakala substation. In the event, the Main meter is not in operation, and the reading from Check meter is used for billing.

The calibration of monitoring equipment is being maintained as per the requirement of KPTCL and the same is being done regularly. Electricity export to grid & electricity import from grid is being recorded daily and the same is being verified by the plant incharge.

11.Details of Monitoring team and Responsibilities

A CDM team has been formed in Bhoruka Power for monitoring and verification of all the monitoring parameters as per the guidelines formulated by the management of BPCL. Qualified and trained people monitor the parameters and emission reduction calculations. In the complete implementation and monitoring Plan, BPCL is the sole agency responsible for implementation and monitoring of project activity. The details of monitoring team are detailed below:

1. Managing Director
2. Head- O & M
3. Shift Incharge

Rules and responsibilities of Team

Managing Director

Managing Director is responsible for the total monitoring plan. The Managing Director will examine the reports generated by Head- O & M w.r.t; the monthly electricity exported to grid, electricity imported from grid and annual emission reduction calculations as per the monitoring plan. He also examines the internal audit reports prepared by Internal auditor / Head- O & M and will in particular take note of any deviations in data over the norms and monitor that the corrective actions have resulted in adherence to standards.

Head- O & M

Head- O & M is assisting and reporting to Managing Director for completing the task discussed above. The Head- O & M is responsible for the electricity generations at their individual locations. They will cross check, sign the log book regularly and report to Managing director for any abnormality. The calibrations of the meters installed are taken care by him as per the monitoring plan. The responsibility of storage and archiving of information in good condition also lies with the Head O & M. He also generate internal audit repots as per the monitoring plan and when ever necessary and will be submitted to Managing Director.

Shift Incharge

Shift Incharge is responsible for recording the electricity meter readings at project site on daily basis. He will also responsible to take note of net export power to grid, plant shut down times, if any etc. The monthly reports will be generated and submitted to the Head- O & M for verification and emission reduction calculations.

Enclosure I

BASELINE INFORMATION

According to the ACM 0002, grid emission factor is calculated as Combined Margin (CM), comprising the Operating Margin (OM) emission factor and the Build Margin (BM) emission factor. The following procedure was adopted for estimating the grid electricity emission factor:

Step 1 – Calculation of the Operating Margin

As per registered PDD and validation report, the Operating Margin (OM) emission factor was ex-ante determination and the same fixed for crediting period and the relevant information is presented below:

As mentioned under section B.6 of registered PDD, the Simple OM emission factor has been calculated using a three-year average, based on the most recent statistics available at the time of PDD submission i.e. 2003-04, 2004-05 and 2005-06. Data for this period for all the states in the southern power grid viz. Andhra Pradesh, Karnataka, Tamil Nadu, Kerala and Pondicherry compiled by CEA (<http://cea.nic.in>) was analyzed and the Emission factor as per Simple OM method is estimated at 1003.79 tCO₂/GWh.

Operating Margin for the most recent three years:

Most recent three years	2003--04	2004-05	2005-06
Operating Margin* (OM) in t CO2 / GWh	1004.11	999.94	1007.33
Average of 3 years	1003.79 t CO ₂ / GWh		
<ul style="list-style-type: none">• including imports- For details please refer Annex. 3 of registered PDD			

Step 2 – Calculation of the Build Margin

As per registered PDD, the build margin has been calculated on ex ante and data available from host party authority (CEA) are used.

The average emissions intensity of the 20% most recent capacity additions in the grid based on net generation and taken from Table B of Carbon Dioxide Baseline Data base, Version 02, June 2007 published by Central Electricity Authority, Government of India, and Ministry of Power Central Electricity Authority.

<http://cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm>

Build Margin (BM) for the year 2005-06	711.34	tCO ₂ / GWh
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Step 3 – Calculation of the baseline emission factor (Combined Margin)

The baseline emission factor in year y is calculated as the simple average of the OM and BM emission factors, i.e. OM and BM are each weighted with 50%. The combined emission factor is 857 tCO₂ / GWh for southern regional grid, which is calculated based on simple OM and Build margin on ex post determination as per registered PDD.

Combined Margin (CM) Simple average of OM and BM	857	tCO ₂ / GWh
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Appendix A Assumptions for CO₂ Emission Calculations

Fuel Emission Factors (EF) (Source: Coal/Lignite - Initial National Communication, Gas/Oil/Diesel/Naphta - IPCC 2006, Corex - own assumption)

	Unit	Coal	Lignite	Gas	Oil	Diesel	Naphta	Corex
EF based on NCV	gCO ₂ /MJ	95.8	106.2	56.1	77.4	74.1	73.3	0.0
Delta GCV NCV	%	3.6%	3.6%	10%	5%	5%	n/a	n/a
EF based on GCV	gCO ₂ /MJ	92.5	102.5	51.0	73.7	70.6	69.8	0.0
Oxidation Factor	-	0.98	0.98	1.00	1.00	1.00	1.00	n/a
Fuel Emission Factor	gCO ₂ /MJ	90.6	100.5	51.0	73.7	70.6	69.8	0.0

n/a = not applicable (i.e. no assumptions were needed)

Assumptions at Station Level (only where data was not provided by station)

	Unit	Coal	Lignite	Gas-OC	Gas-OC	Oil	Diesel-Eng	Diesel-OC	Naphta	Hydro	Nuclear
Auxiliary Power Consumption	%	8.0	10.0	3.0	1.0	3.5	3.5	1.0	3.5	0.5	10.5
Gross Heat Rate	kcal /kWh (gross)	2'500	2'713	2'013	3'150	2'117	1'975	3'213	2'117	n/a	n/a
Net Heat Rate	kcal /kWh (net)	2'717	3'014	2'075	3'182	2'193	2'047	3'330	2'193	n/a	n/a
Specific Oil Consumption	ml /kWh (gross)	2.0	3.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
GCV	kcal /kg (or m3)	3'755	n/a	8'800	n/a	10'100	10'500	10'500	11'300	n/a	n/a
Density	t /1,000 lt	n/a	n/a	n/a	n/a	0.95	0.83	0.83	0.70	n/a	n/a
Specific CO ₂ emissions	tCO ₂ /MWh	1.04	1.28	0.44	0.68	0.68	0.60	0.98	0.64	n/a	n/a

n/a = not applicable (i.e. no assumptions were needed)

Assumptions at Unit Level (by capacity; only for units in the BM, where data was not provided by station)

Coal	Unit	67.5 MW	120 MW	200-250 MW	500 MW
Gross Heat Rate	kcal /kWh	2'750	2'500	2'500	2'425
Auxiliary Power Consumption	%	12.0	9.0	9.0	7.5
Net Heat Rate	kcal /kWh	3'125	2'747	2'747	2'622
Specific Oil Consumption	ml /kWh	2.0	2.0	2.0	2.0
Specific CO ₂ Emissions	tCO ₂ /MWh	1.19	1.05	1.05	1.00
Lignite	Unit	75 MW	125 MW	210/250 MW	
Gross Heat Rate	kcal /kWh	2'750	2'500	2'713	
Auxiliary Power Consumption	%	12.0	12.0	10.0	
Net Heat Rate	kcal /kWh	3'125	2'909	3'014	
Specific Oil Consumption	ml /kWh	3.0	3.0	3.0	
Specific CO ₂ Emissions	tCO ₂ /MWh	1.32	1.23	1.28	
Gas	Unit	0-49.9 MW	50-99.9 MW	>100 MW	
Gross Heat Rate	kcal /kWh	1'960	1'910	1'970	
Auxiliary Power Consumption	%	3.0	3.0	3.0	
Net Heat Rate	kcal /kWh	2'010	1'969	2'031	
Specific CO ₂ Emissions	tCO ₂ /MWh	0.43	0.42	0.43	
Diesel	Unit	0.1-1 MW	1-3 MW	3-10 MW	>10 MW
Gross Heat Rate	kcal /kWh	2'350	2'250	2'100	1'975
Auxiliary Power Consumption	%	3.5	3.5	3.5	3.5
Net Heat Rate	kcal /kWh	2'435	2'332	2'176	2'047
Specific CO ₂ Emissions	tCO ₂ /MWh	0.72	0.69	0.64	0.60
Naphta	Unit	All sizes			
Increment to Gas Heat Rate	%	2%			
Gross Heat Rate	kcal /kWh	2'117			
Auxiliary Power Consumption	%	3.5			
Net Heat Rate	kcal /kWh	2'193			
Specific CO ₂ Emissions	tCO ₂ /MWh	0.64			

Combined Margin	Unit	
Weight OM	%	60%
Weight BM	%	60%

Conversion Factors	Unit	
Energy	kJ /kcal	4.1868
	MJ /kWh	3.6

Oil		
Specific Emission	gCO ₂ /ml	2.98

Appendix B Grid Emission Factors

Table A: Values for all grids for FY 2005-06 to 2007-08, excluding Inter-grid and cross-border electricity transfers.

Note: Values are rounded off at two decimals here. See Database(Excel file, Worksheet “Results”) for additional decimals.

Weighted Average Emission Rate (tCO₂/MWh) (excl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	0.72	0.73	0.74	0.71	0.71	0.71
East	1.09	1.06	1.11	1.10	1.08	1.08
South	0.73	0.75	0.82	0.84	0.78	0.74
West	0.90	0.92	0.90	0.90	0.92	0.87
North-East	0.42	0.41	0.40	0.43	0.32	0.33
India	0.82	0.83	0.85	0.85	0.84	0.82

Simple Operating Margin (tCO₂/MWh) (excl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	0.98	0.98	1.00	0.99	0.97	0.99
East	1.22	1.22	1.20	1.23	1.20	1.16
South	1.02	1.00	1.01	1.00	1.00	1.01
West	0.98	1.01	0.98	0.99	1.01	0.99
North-East	0.73	0.71	0.74	0.74	0.71	0.70
India	1.02	1.02	1.02	1.03	1.03	1.02

Build Margin (tCO₂/MWh) (excl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North					0.53	0.60
East					0.90	0.97
South					0.71	0.71
West					0.77	0.63
North-East					0.15	0.15
India					0.70	0.68

Combined Margin (tCO₂/MWh) (excl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	0.76	0.76	0.77	0.76	0.75	0.80
East	1.06	1.06	1.05	1.07	1.05	1.06
South	0.87	0.85	0.86	0.86	0.85	0.86
West	0.87	0.89	0.88	0.88	0.89	0.81
North-East	0.44	0.43	0.44	0.44	0.43	0.42
India	0.86	0.86	0.86	0.86	0.86	0.85

Table B: Values for all grids for FY 2007-08, including inter-grid and cross-border electricity transfers.

Weighted Average Emission Rate (tCO₂/MWh) (incl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	0.72	0.73	0.74	0.71	0.72	0.72
East	1.09	1.03	1.09	1.08	1.05	1.05
South	0.74	0.75	0.82	0.84	0.78	0.74
West	0.90	0.92	0.90	0.90	0.92	0.88
North-East	0.42	0.41	0.40	0.43	0.48	0.33
India	0.82	0.83	0.85	0.85	0.84	0.81

Simple Operating Margin (tCO₂/MWh) (incl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	0.98	0.98	1.00	0.99	0.98	0.99
East	1.22	1.19	1.17	1.20	1.17	1.13
South	1.03	1.00	1.01	1.00	1.00	1.01
West	0.98	1.01	0.98	0.99	1.01	0.99
North-East	0.73	0.71	0.74	0.74	0.84	0.70
India	1.01	1.02	1.02	1.02	1.02	1.02

Build Margin (tCO₂/MWh) (not adjusted for imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North					0.53	0.60
East					0.90	0.97
South					0.71	0.71
West					0.77	0.63
North-East					0.15	0.15
India					0.70	0.68

Combined Margin in tCO₂/MWh (incl. Imports)						
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	0.76	0.76	0.77	0.76	0.75	0.80
East	1.06	1.05	1.04	1.05	1.04	1.05
South	0.87	0.85	0.86	0.86	0.85	0.86
West	0.87	0.89	0.88	0.88	0.89	0.81
North-East	0.44	0.43	0.44	0.44	0.49	0.42
India	0.85	0.86	0.86	0.86	0.86	0.85

Enclosure 2:

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