Monitoring Report

1. Title of the project activity

Generation of Electricity through combustion of waste gases from Blast furnace and Corex units at JSW Steel Limited (in JPL unit 1), at Torangallu in Karnataka, India.

PDD Version: 04
Date of registration: 12th Jan 2007
Project Registration Code: 0325

Date of Monitoring Report: 9th June 2008
Version of the monitoring Report: 1

2. Executive Summary

The purpose of this monitoring report is to provide estimation of GHG emission reductions achieved by this CDM project activity for periodic verification by the DOE. The relevant details of the project activity are given below:

	Activity	Dates
1.	Start of crediting period (start of commercial operation of captive power plant)	1 April 2005
2.	Second monitoring period	1 January 2007 to 31 December 2007

The project activity consists of setting up and operation of a 1x100 MW power plant (JPL unit 1), for generation of electricity by combustion of waste gases from Blast Furnace and Corex units. The Blast Furnace in JSW Steel Limited (formerly Jindal Vijayanagar Steel Ltd.) has a capacity of 0.9 Million tons per annum, which will produce blast furnace gas of around 800 Kcal/NM³ calorific value. After in house consumption at JSW Steel, certain amount of excess BF gas is available for Power generation which otherwise would have been flared. In addition, the project activity also uses the gases generated by COREX units of JSW Steel which are in excess of internal (JSW Steel) consumption. The power generated by the project activity is supplied to JSW Steel –which otherwise would have been met by power from a captive power plant using coal as the fuel as is the common practice or from any other Independent power producer. This project activity is undertaken by the JSW Power Limited (which is recently merged with the JSW Steel Limited[1]).

In this project activity the steam generator is capable of firing BF & Corex Gases. This steam generator is a natural circulation Bi-drum type. The Steam Generator is a vertical two pass unit with a maximum continuous rating of about 390 t/hr of superheated steam at a pressure of 93 kg/sq.cm (a) and temperature of 540 deg C when supplied with feed water at a temperature of 237 deg C at the economizer inlet.

The power generated by this project activity will replace/ substitute the major quantity of electricity that could have been generated by the JSW Steel or an Independent power Producer using coal. Since the waste gas would have been flared anyway in absence of project activity, the additional emissions from generation of power by combusting waste gases, in the project activity, is zero. Hence, the project activity is effecting GHG emission reduction by displacing power generation with GHG intensive fossil fuel with that of "zero GHG emission fuel".

[1] JSW Power Ltd. was incorporated on 25/07/2003 and merged with JSW Steel on 16/11/2005

In order to estimate emission reductions, JPL unit 1 maintains the following monitored/ estimated records for parameters relevant to the project activity and its operations.

Q_1 = Daily quantity of Light Diesel Oil (LDO)
NCV_1 = Net calorific value of LDO
Q_2 = Daily quantity of High Speed Diesel (HSD)
NCV_2 = Net calorific value of HSD
EG_{GEN} =Total electricity generated and supplied through Generator transformer- GT-1 & GT-2 (MWh /yr)
EG_{AUX} =Total auxiliary Energy consumed by the project, supplied through Station aux. Transformer & 6.6 Incomer-I (MWh /yr)

The primary data monitored is as per Annex 4 and section D in the registered project design document (PDD); the details are provided under section 5 in this monitoring report. Using the data maintained for the monitoring period mentioned above, the total emission reductions being claimed during this monitoring period is **743864 tCO_{2e}**.

3. References

The approved methodology called ACM0004 (version 01, Sectoral Scope: 01, 8 July 2005)- "Consolidated baseline methodology for waste gas and/or heat for power generation", has been applied to this project activity.

4. General description of the project activity

4.1. 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)
Government of India	1. JSW Steel Limited	No.
Government of United Kingdom	2. Noble Europe Limited 3. EDF Trading Limited	No.

4.2. Physical location of the project activity

The power plant (in the project activity)is located to the West of the Blast Furnace in JSW Steel premises. The geographical location is approximately 15° 9' latitude (N) and 76° 51' longitude (E). A state high way (No. 42) connecting Bellary and Sandur is adjacent to the plant. The site is situated almost at the centre point between the two famous towns Bellary and Hospet, which are 80 km apart. The nearest railway station is Toranagallu of South Central Railway. The existing steel plant has a railway line link.

4.3. Technical description of the project

The technology employed in the project activity for using BF and COREX process generated waste gases to generate electricity is first of its kind in the world which addressed problems involved in combined firing of gases differing in relevant characteristics. The steam generator used is designed for firing either 100% COREX gas and combination of COREX

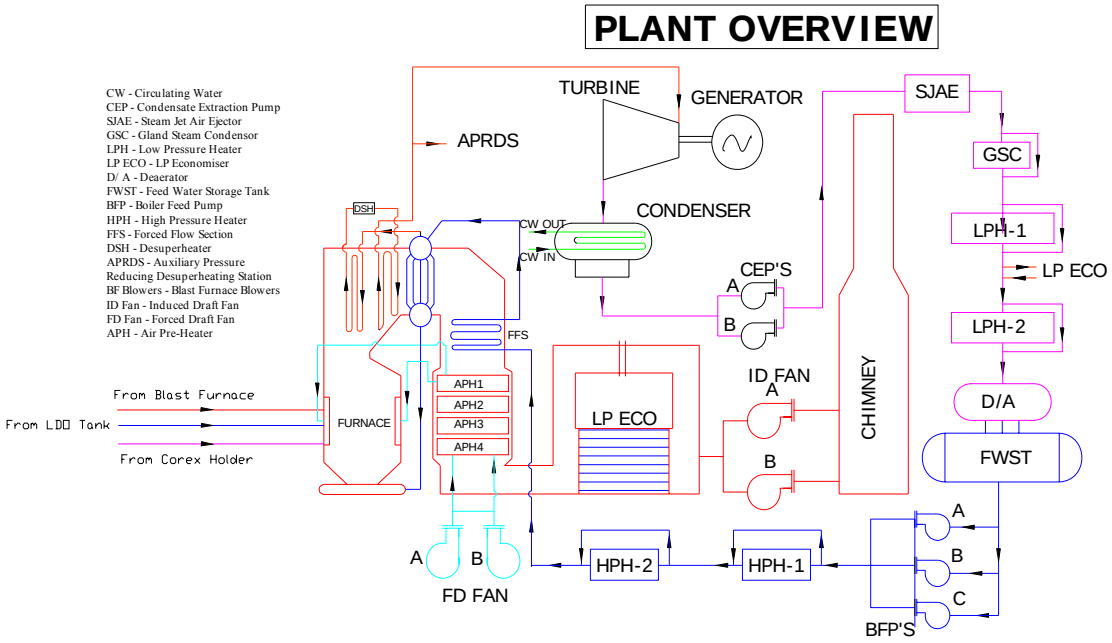
gas and BF gas and is rated to generate about 390 t/hr of superheated steam at a pressure of 93 kg/cm²(a) and temperature of 540°C. The steam generator s a natural circulation Bi-drum type, equipped with facilities for firing LDO for start-up. The steam turbine is a single cylinder machine with facility for turbine bypass, driving a turbo-generator at 3,000 rpm to produce 100 MW output [Maximum Continuous Rating (MCR)]. The steam generator is designed as semi-outdoor equipment while the turbine generator sets with all auxiliary and feed cycle equipment are located indoor.

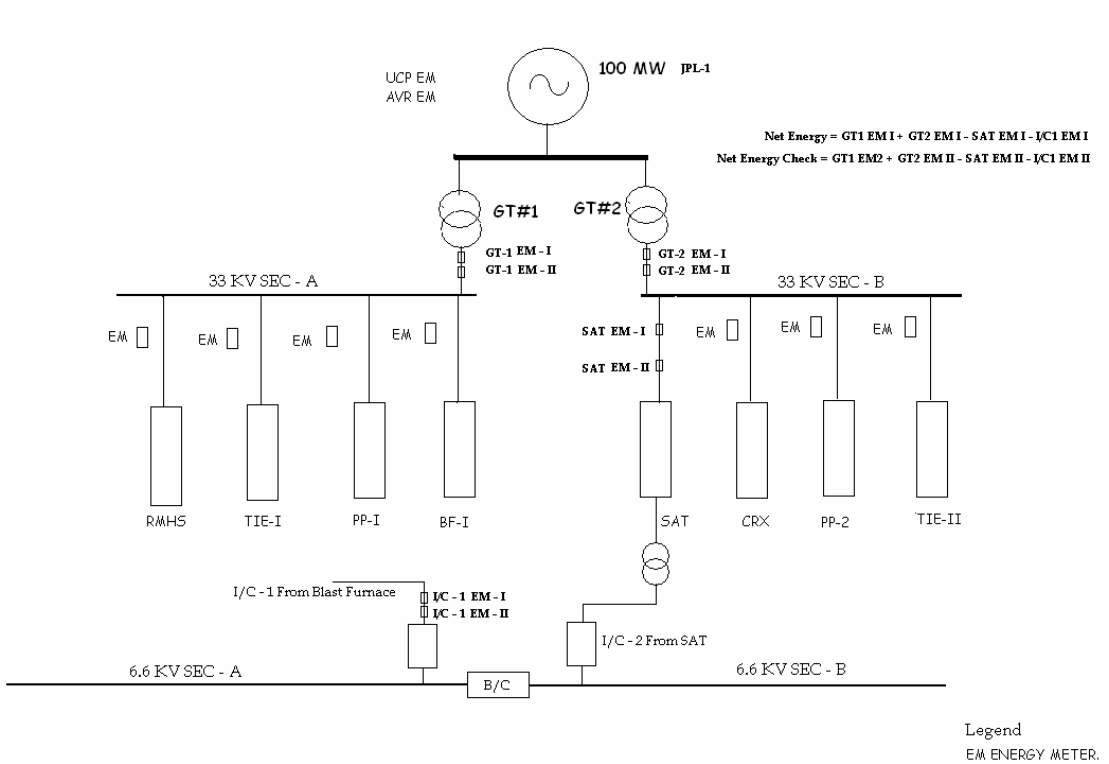
Boiler firing system consists of separate elevations for BF and COREX waste gases and start-up fuel (LDO). By combining COREX with higher calorific value and BF gases with lower calorific value, the flame stability is achieved without any conventional fuel support. The novel boiler design, come-up first time in the world, applied in this project achieves the required steam temperature with widely varying calorific value of gases. The explosive and toxic nature of these waste gases is also appropriately accounted for in the design. In this boiler, a Low Pressure (LP) Economiser is installed in waste gas path after boiler air pre heater. The condensate from the LP heater is routed through the Low Pressure Economiser water side. This helps in maintaining gas temperature at chimney inlet lesser than even for differing compositions of BF and COREX waste gases firing.

The steam from boiler is taken through main steam line and admitted to turbine. Turbine is coupled with generator capable of producing 100MW of electrical power. The steam coming out of turbine is condensed in a condenser and the condensate is fed back to boiler through regenerative feed system. In case of total power failure, 320 KVA emergency DG will come into service and provide supply for turbine lubrication oil pump.

The power generated from the generator is fed to 33 KV sections A and B through two separate generator transformers (10.5KV /33 KV). From 33 KV sections A and B, individual feeders connect to JSWSL plant loads, as well as to the station auxiliary transformer. During start-up power is drawn either from 33 KV Tie-II or 6.6 KV incomer –I. While the unit is under a shut-down, power is fed by Tie I and Tie II to JSWSL loads.

The plant overview and power evacuation diagram are provided below:





5. Monitoring Methodology and Plan

The approved monitoring methodology ACM0004 (version 01) has been applied to this project activity. The parameters monitored/ estimated and recorded in order to estimate the emission reductions from the project activity during the monitoring period is indicated in the table below (also refer section B.2 in the registered PDD). The detailed data and calculations of baseline emission, project emissions and emission reductions are provided in the attached MSExcel file (Appendix 1).

ID No.	ID Label	Data variable	Data unit	Comments
1_1.	Q_1	Volume of LDO used in the boiler	m^3	Monitored daily at '0:00' hours and recorded in the control room log-book and computer database.
2_1.	NCV_1	Net Calorific value of LDO	TJ/m^3	GCV is measured whenever procured/ once in a month from storage tank. The NCV is estimated from GCV value following equation no. 1 of ASTM procedure no. D 4809-00.
3_2.	EF_1	Carbon emission factor of LDO	tC/TJ	As per 'Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Workbook: Table 1-2', a value of 20.2 tC/TJ have been used.
1_2.	Q_2	Volume of HSD used in the DG	m^3	Monitored daily at '0:00' hours and recorded in the control room log-book and computer database.

ID No.	ID Label	Data variable	Data unit	Comments
2_2.	NCV_2	Net calorific value of HSD	TJ/m^3	GCV is measured whenever procured/ once in a month from storage tank. The NCV is estimated from GCV value following equation no. 1 of ASTM procedure no. D 4809-00 and Indian Oil Corporation Limited (IOC) test certificate for hydrogen content in HSD.
2_3.	EF_2	Emission factor of HSD	tC/TJ	As per 'Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Workbook: Table 1-2', a value of 20.2 tC/TJ have been used.
4.	EG_{GEN}	Total electricity generated and supplied through Generator transformer-GT- 1 & GT-2	MWh/yr	This is summation of electricity meter readings at '0:00' hours from generator transformers GT-1 and GT-2, and maintained in computer database. Joint meter readings are taken with JSW steel every month. 0.2 class energy meters are installed at panels Daily recording are maintained in a soft copy and monthly a printout is maintained for archiving the same .
5.	EG_{AUX}	Total auxiliary Energy consumed by the project, supplied through Station aux. Transformer & 6.6 Incomer-I	MWh/yr	This is summation of electricity meter readings at '0:00' hours from station auxiliary transformer (SAT) and 6.6 kV incomer I panel, and maintained in computer database. Joint meter readings are taken with JSW steel every month. 0.5 class energy meters are installed at panels. Daily recording are maintained in a soft copy and monthly a printout is maintained for archiving the same. 6.6 KV incomer 1 Panel.
6.	EG_Y	Net Electricity supplied to facility	MWh/yr	Calculated daily and monthly records. $EG_Y = EG_{GEN} - EG_{AUX}$
13.	$EF^2_{CO2,i}$	CO_2 emission factor for coal	tC/TJ	As per 'Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Workbook: Table 1-2', a value of 25.8 tC/TJ have been used.
14.	$Eff_{captive}$	Efficiency of captive	%	As per section B.2 in the registered

[2] The Value of $\mathbf{EF_{CO2,i\ (coal)}}$ is the Carbon Emission Factor of Coal whose value is taken as 25.8 tC/TJ from IPCC guidelines

ID No.	ID Label	Data variable	Data unit	Comments
		power generation		PDD and as per appendix 2 of this monitoring report.

Using the data variables listed above and the formula provided below, the GHG emission reductions have been estimated.

Baseline emissions are given as:
$BE_Y = BE\ electricity.y = EG_Y \cdot EF\ electricity.y$

EGy Net quantity of electricity supplied, to the manufacturing facility by the project during the year y in MWh and

EF *electricity.y* = EFy CO_2 baseline emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh)

$EG_Y = EG_{GEN} - EG_{AUX}$
EG_{GEN} = Total electricity generated and supplied through Generator transformer- GT- 1 & GT-2 (MWh /yr)
EG_{AUX} = Total auxiliary Energy consumed by the project, supplied through Station aux. Transformer & 6.6 Incomer-I (MWh /yr)

The baseline emission factor (EF_y) has been determined using the option I (Option 1. If baseline scenario is captive power generation) as mentioned in the approved methodology ACM 0004.

If the baseline scenario is determined to be captive power generation (either existing or new), the Emissions Factor for displaced electricity is calculated as follows:

$EF_{captive,y} = (EFCO_2,i(coal) / Eff_{captive}) X (44/12) X (3.6/1000)$

where:
$EF_{captive,y}$ Emissions factor for captive power generation (tCO_2/MWh)
$EF_{CO2,i}$ CO_2 emissions factor of fuel used (coal) in captive power generation (tC/TJ) (This is equal to carbon emission factor as defined in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories : Workbook Table 1-2)
$Eff_{captive}$ Efficiency of the captive power generation (%)
44/12 Carbon to Carbon Dioxide conversion factor
3.6/1000 TJ to MWh conversion factor

Project Emissions are given as :

$PEy = \sum Qi * NCVi * EFi * 44/12 * OXIDi$

where:
PEy =Project emissions in year y (tCO_2)
Qi =Mass or volume unit of fuel i consumed (t or m^3)
NCVi =Net calorific value per mass or volume unit of fuel i (TJ/t or m^3)
EFi =Carbon emissions factor per unit of energy of the fuel i (tC/TJ)
OXIDi =Oxidation factor of the fuel i (%)
As only HSD will be used in DG during emergency, hence the oxidation factor of 99% has been used as IPCC default values.
The carbon emission factor of 20.2 tC/TJ has been considered as default values from 1996 Revised IPCC Guideline

Also, LDO is used in the boiler as a start up fuel and hence will be included while calculating the project emissions.
Subscript 1: LDO
Subscript 2: HSD

Emission Reductions

The emission reduction ERy by the project activity during a given year y is the difference between the baseline emissions though substitution of electricity generation with fossil fuels(BEy) and the project emissions (PEy) as follows :

ERy= BEy – PEy

ERy are the emissions reductions of the production activity during the year y in tonnes of CO_2
BEy are baseline emissions due to displacement of electricity during the year y in tonnes of CO_2
PEy are the project emissions during the year y in tonnes of CO_2

6. Quality Control (QC) and Quality Assurance (QA)

6.1. Management Processes for Emission Reduction

JPL has leased the plant and equipment to JSW Steel and which in turn awarded the operation and maintenance responsibility to Jindal Thermal Power Generation Limited (JTPCL)[3]. JPL has also communicated to JSW Steel regarding the monitoring requirements and access to monitoring records for JPL and its nominees. Accordingly, JTPCL has constituted a management structure to monitor emission reductions and manage the CDM project.

JTPCL CEO has constituted the CDM project team, which is responsible for the project activity. The project documentation, registration and identifying project participants from Annex I countries is the responsibility of the coordinator of the project team. The monitoring and verification of the project activity is assigned to the four member team which is responsible for monitoring, verification and recording of the data, GHG emissions and emission reduction estimations. On a daily basis the monitoring reports is checked by the operation head. In case of any irregularity in the project activity it is reported to the operation head. On a monthly basis this report is forwarded to the CEO.

The site is included in ISO 14001 based Environmental Management System (EMS) in place, in which this CDM project activity is a part. Accordingly, the monitoring plan used herein is an integral part of the Environmental Management Programmes and is constituent of operational and management structure of this EMS.

6.2. Quality control (QC) and quality assurance (QA) procedures and Calibration/ Maintenance of Measuring and Analytical Instruments

The QA/QC procedures are as per applicable standards. All measuring and analytical instruments are being calibrated as per the standard procedures. The various meters used and

[3] Subsequent to merger of JSW Power and JSW Steel and rechristening of JTPCL as JSW Energy, all aspects of operation and management structure as described above will be maintained.

back-up data and calibration records are available for verification at site. The specific details regarding parameters of concern are summarized below.

Data	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	explanation why QA/QC procedures are or are not being planned
$1_1,2_1,1_2,2_2$	Low	Yes	This data is required for project emission calculation. This data is monitored using meters and standard testing equipment, which is regularly, calibrated following standard industry practices.
4,5,6	Low	Yes	This data is required for the baseline emission calculations. This data is used for the calculation of project electricity generation. This data is monitored using meters and standard testing equipment, which is regularly calibrated following standard industry practices.
13,14	Low	No	The data is directly used to calculate baseline emissions. This data is determined, so does not need QA procedure.

6.3. Environmental Impacts including Trans-boundary Impacts

Thirty-two categories of activities with a certain investment criteria are required to undertake an Environmental Impact Assessment (EIA) under the Environmental Impact Notification of Government of India. As part of the EIA study for the entire JSWSL complex, the operations of the project activity (electricity generation with waste gases) were also covered. No trans-boundary impacts are anticipated due to the electricity generation activities as project activity is located in the interior part of India. No significant environmental impacts have been identified in the EIA report. The project activity operates under valid "Consent to Operate" from the Karnataka State Pollution Control Board (KSPCB) and has not been stopped during the monitoring period (1st Jan 2007 – 31st December 2007) due to any environmental violations.

7. Calculation of GHG Emission Reductions

The steps used for calculating the emission reductions are described below.

7.1. Calculation of Project Emissions

The project emissions have been calculated using equation (4) with data inputs mentioned under section 5 in this monitoring report; the detailed data and daily project emission estimates are separately provided under Appendix 1. The project emission from 1st Jan 2007 – 31st December 2007 is **1332** tCO_{2e}.

7.2. Calculation of Baseline Emissions

The baseline emissions have been calculated using equations (1), (2) and (3) with data inputs mentioned under section 5 in this monitoring report; the detailed data and daily project emission estimates are separately provided under Appendix 1. The baseline emission from 1st Jan 2007 – 31st December 2007 is **745196** tCO_2.

7.3. Calculation of ER_y

Using equation (5), the emission reductions from 1st Jan 2007 – 31st December 2007 is **743864** tCO_2.

Appendix 1

Emission Factor for Coal	C to CO2	TJ to MWH	E^{ff} of power generation	Emission Factor
EF_{coal}	Conversion	Conversion		Efy
tC/TJ				tCO_2/MWh
25.8	3.67	0.0036	0.33375	1.02

Total Baseline emissions				
Year	Total net electricityGeneration	Total Generation	Emission Factor	Baseline Emissions
	MU	MWh	tCO2/MWh	t CO2e
Jan-07	68.0390	68039.02	1.02	69427
Feb-07	51.3361	51336.1	1.02	52383
Mar-07	47.1401	47140.1	1.02	48101
Apr-07	54.4008	54400.8	1.02	55510
May-07	70.3317	70331.7	1.02	71766
Jun-07	52.7664	52766.4	1.02	53843
Jul-07	60.1328	60132.8	1.02	61359
Aug-07	55.6351	55635.1	1.02	56770
Sep-07	64.9823	64982.3	1.02	66308
Oct-07	70.9266	70926.6	1.02	72373
Nov-07	64.87	64870	1.02	66193
Dec-07	69.7403	69740.3	1.02	71163
Jan 07- Dec 07	730.3012	730301.225	1.02	745196
Total				745196

Total project emissions					
Year	**Total Quantity of fuel Consumed**	EF of LDO	OXID for LDO	C to CO_2	Project Emissions
	TJ	**(tC/TJ)**			**t CO2e**
Jan-07	**0.04**	**20.20**	**0.99**	**3.67**	**3**
Feb-07	**3.30**	**20.20**	**0.99**	**3.67**	**242**
Mar-07	**3.81**	**20.20**	**0.99**	**3.67**	**279**
Apr-07	**1.69**	**20.20**	**0.99**	**3.67**	**124**
May-07	**0.30**	**20.20**	**0.99**	**3.67**	**22**
Jun-07	**1.27**	**20.20**	**0.99**	**3.67**	**93**
Jul-07	**5.42**	**20.20**	**0.99**	**3.67**	**397**
Aug-07	**0.27**	**20.20**	**0.99**	**3.67**	**19**
Sep-07	**0.39**	**20.20**	**0.99**	**3.67**	**28**
Oct-07	**0.45**	**20.20**	**0.99**	**3.67**	**33**
Nov-07	**0.89**	**20.20**	**0.99**	**3.67**	**64**
Dec-07	**0.40**	**20.20**	**0.99**	**3.67**	**28**
Jan 07- Dec 07					**1332**
Total					**1332**

	Project Emissions	Baseline Emissions	Emission Reductions
	tCO2e	**tCO2e**	**tCO2e**
Jan 07- Dec 07	**1332**	**745196**	**743864**
Total	**1332**	**745196**	**743864**

Appendix 2

<table>
<tr><td colspan="2">Option A, sub option 1 of the methodology</td><td colspan="2">Option A, sub option 2 of the methodology</td><td colspan="2">Option A, sub option 3 of the methodology</td></tr>
<tr><td colspan="2">Measured efficiency prior to project implementation</td><td colspan="2">Measured efficiency during monitoring</td><td colspan="2">Design Efficiency</td></tr>
<tr><td colspan="2" rowspan="2">Option B of the registered PDD (Measured efficiency during monitoring (performance Guarantee Test)</td><td colspan="2">Option B of the registered PDD (Measured efficiency during monitoring (Normal Check)</td><td colspan="2" rowspan="2">Option A of the PDD (Design)</td></tr>
<tr><td colspan="2">1st Jan 2007 – 31st December 2007</td></tr>
<tr><td>With low pressure economizer</td><td>Without low pressure economizer</td><td>With low pressure economizer</td><td>With low pressure economizer</td><td>Without low pressure economizer</td></tr>
<tr><td>31.88%</td><td>32.67%</td><td>32.68%[4]</td><td>33.375%</td><td>32.84%</td></tr>
</table>

As a conservative approach the highest value 33.375% among the option is considered for the baseline calculation. Eff=33.375%=0.33

[4] Plant Operation Data (efficiency calculation sheet)