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

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 01, 20/01/2012

AMINE CIRCULATION PUMPS ENERGY EFFICIENCY AT HAZIRA WORKS OF ONGC
Reference Number: 2648
MONITORING PERIOD (23/09/2009 – 31/07/2011) (First and Last Day Included)

SECTION A. General description of the project activity

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

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Oil and Gas Corporation Limited (ONGC) is one of the leading oil & gas producers in the country. One of the major oil and gas fields owned as well as operated by it, is located off the coast of Mumbai and is collectively known as Mumbai Offshore. ONGC has a gas processing facility located at Hazira in the state of Gujarat, which carries out processing of gas received from the Mumbai offshore fields. During processing, desulphurization is one of the operations carried out to remove Sulphur (which is present in the form of H_2S) from the natural gas received. This removal of H_2S is carried out in Gas Sweetening Units (GSU's) mainly consisting of eight absorption towers. These towers use Methyl Di- Ethanol Amine (Amine) as the absorbent. The lean amine (free from H_2S) is pumped into the absorption tower using eight stage high capacity centrifugal pumps. Each absorption tower is serviced by two such pumps (one operating and another standby). The rich amine containing H_2S absorbed from the sour gas, is stripped of the H_2S in the Sulphur recovery units, and re-circulated back into the tower. The GSU facility comprising of two sets of trains (each set comprises of four trains), currently, processes approximately 41 million metric standard cubic meters of gas per day.

The amine charge pumps are critical to the operation of GSU's. They are energy intensive and constitute about 15% of the total power load of the Hazira Processing Plant. The CDM project activity comprises of improving the energy efficiency of some of the amine circulation pumps by carrying out stage blanking of the eight stage amine circulation pump. With the stage blanking the eight stage pump has been converted to a seven stage pump. Improvement in the energy efficiency of some of the amine circulation pumps has reduced to power consumption for the same level of performance. The reduction in consumption of power in turn leads to reduction in the emissions of GHG.

The project activity comprises of stage blanking of five amine circulation pumps. As mentioned in the registered PDD, the activity of stage blanking of the pumps has been completed prior to CDM registration of the project activity as under:

Pump TAG Number	Commissioning date after modifications	Status of Implementation
31P301B	July 2006	Implemented
32P301B	July 2007	Implemented
33P301B	April 2008	Implemented
34P301A	September 2008	Implemented
35P301A	August 2007	Implemented

It was planned earlier to carry out the stage blanking in additional five pumps in a phased manner. Table below gives the planned schedule to carry out the stage blanking in additional pumps and the status of implementation as on date:

Pump TAG Number	Location	Planned Commissioning date after modifications	Status of implementation
31P301A	GSU-I	Feb 2010	Not implemented
32P301A	GSU-I	Dec 2010	Not implemented
35P301B	GSU-II	June 2009	Not implemented
33P301A	GSU-I	October 2009	Not implemented
34P301B	GSU-II	August 2010	Not implemented

The stage blanking of the remaining pumps was not carried out as originally planned with the idea that these pumps will be used as standby pumps on the trains 31 to 35 and the pumps in which stage blanking has been carried out will be used for most of the time. Thus the benefit of energy efficiency would be obtained even without carrying out stage blanking on the remaining pumps.

Total emission reductions achieved during monitoring period from 23/09/2009 to 31/07/2011 are of 6036 tCO_2.

A.2. Project Participants

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Oil and Natural Gas (ONGC) Limited is the project proponent for this project activity, consequently responsible for the planning, implementation and operations of the project activity under consideration. The following table provides further details on the same;

Name of Party involved (*) ((host) indicates a host party)	**Private and/or public entity (ies) Project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/ No)**
India (host)	Oil and Natural Gas Corporation Ltd. (ONGC)	No

A.3. Location of the project activity:

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Project activity is located at Hazira in Surat district, Gujarat state of India. The location map of the project activity is given below:

Hazira is located 230km north of Mumbai, 21 km from Surat city on the right bank of river Tapi. Unimpeded passage to the Arabian Sea is just 8 km away, with the Surat-Hazira port at a distance of 10.2 km from the works. The industrial hub is well connected with the National Highway #8 passing by the town and the presence of an airport just 8 km away.

Longitude – 21° 9' 42" N
Latitude – 72° 43' 44" E

Hazira
Gujarat
India

A.4. Technical description of the project

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The project activity comprises of improving energy efficiency of some of the amine charge pumps on the absorption towers of the Gas Sweetening Units (GSU). This energy efficiency measure is affected, by way of reduction in differential pressure via technological intervention, to achieve savings in the energy consumption of the amine circulation pumps.

In the course of operation of the pumps it was observed that, the discharge pressure requirement of amine circulation pumps was reduced as compared to the design conditions. This was realized in view of reduction in sour gas (natural gas containing H2S and CO2) pressure. Thus, keeping in mind the current operating parameters, with the emphasis on energy efficiency measures, various options to optimize energy consumption were deliberated as below;

- Replacing the Pumps
- Taper Trimming of Existing Pumps
- Stage Blanking – Reduction of one Stage, Pump effectively becomes 7 stage instead of the original eight stage configuration
- A combination of Stage Blanking and Taper Trimming

After performing said various options on trial basis and making independent review and internal analysis, management planned to make combination of stage blanking and taper trimming of the impellers in one of the stages. A work order for Stage Blanking, with modified rotor assembly installation and commissioning on trial basis was placed on M/S Bharat Pumps and Compressor Ltd., Naini, Allahabad on 10/03/2006 . The pump was received on 08/07/2006, with installation and re-commissioning carried out on 28/07/2006. The pressure switch setting was changed from 75 kg/cm2 to 70 kg/cm2. The trial runs were satisfactory and fairly met all process and operational requirements.

Further to this it was observed that the current drawn by the motor of the pump reduced by 10-12 amperes resulting in savings in power consumption. Considering the fact, that the major contributing factor in power savings is stage blanking, it was decided to go ahead with only stage blanking for all the remaining pumps. Modifications in four other amine circulation pumps were carried out later. Thus the project activity comprises of stage blanking of five amine circulation pumps. As mentioned in the registered PDD, the activity of stage blanking of the pumps has been completed prior to registration of the project activity as a CDM project.

Stage Blanking, mainly deals with re-configuration of the pump, so that its optimal duty point (discharge head) is much closer to the required operating point (discharge pressure requirements), as compared to standard design conditions. Stage Blanking effectively means reduction of one stage. Effectively in a multi-stage pump, one stage is reduced by blanking. This blanking is carried out by replacing the impeller of one stage, with a blanking bush. This ensures creation of a special blank section that facilitates the smooth transfer of fluid from the previous stage diffuser outlet, directly to the impeller inlet of following stage. Post implementation of the stage blanking of the pumps the specifications of the pumps is as follows:

MAKE: POMPES GUINARD, FRANCE
TYPE: DVMX 4X6X10 C/E 8 STG
NUMBER OF STAGES:7
CAPACITY: 269 M^3/HR
HEAD: 705 METER
RPM: 2980
MOTOR RATING: 840 KW

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

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As mentioned in section B.1 of registered PDD of project activity, title and reference of the applicable methodology to project activity is as under:

- Sectoral Scope: 4-Manufacturing Industries
- Project Category: Type II: Energy Efficiency Improvement Projects
- Applicable approved small scale methodology: AMS II: D, Version 11. "Energy Efficiency and Fuel Switching Measures for Industrial Facilities"

A.6. Registration date of the project activity:

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Project activity has been registered on 23/09/2009.

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

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As mentioned in section C.2.2., of registered PDD of project activity, a fixed crediting period of 10 years has been chosen by selecting the registration date as crediting period start date for the project activity under consideration. The project activity has been registered on 23/09/2009; accordingly, the crediting period of project activity starts on 23/09/2009. The choice of crediting period in this case is the fixed time period of 10 years thus the crediting period of the project activity starts on 23/09/2009 and will end on 22/09/2019 (both days inclusive).

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

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Organization:	Oil and Natural Gas Corporation Limited (ONGC)
Street/P.O.Box:	10th Floor
Building:	SCOPE Minar, Laxmi Nagar
City:	Delhi
State/Region:	Delhi
Postfix/ZIP:	110092
Country:	India
Telephone:	+91 11 22440829/22406479
FAX:	+91 11 22011783
E-Mail:	chakraborty_ab@ongc.co.in
Title:	Executive Director
Salutation:	Mr.
Last Name:	Chakraborty
Middle Name:	
First Name:	Ashok B.
Department:	Carbon Management Group
Mobile:	+91 9868282058
Direct FAX:	+91 11 22025479
Direct tel:	+91 11 220454
Personal E-Mail:	chakraborty_ab@ongc.co.in

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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The project activity comprises of stage blanking of five amine circulation pumps. As mentioned in the registered PDD, the activity of stage blanking of the pumps has been completed prior to CDM registration of the project activity as under:

Pump TAG Number	Commissioning date after modifications	Status of Implementation
31P301B	July 2006	Implemented
32P301B	July 2007	Implemented
33P301B	April 2008	Implemented
34P301A	September 2008	Implemented
35P301A	August 2007	Implemented

It was planned earlier to carry out the stage blanking in additional five pumps in a phased manner. Table below gives the planned schedule to carry out the stage blanking in additional pumps and the status of implementation as on date:

Pump TAG Number	Location	Planned Commissioning date after modifications	Status of implementation
31P301A	GSU-I	Feb 2010	Not implemented
32P301A	GSU-I	Dec 2010	Not implemented
35P301B	GSU-II	June 2009	Not implemented
33P301A	GSU-I	October 2009	Not implemented
34P301B	GSU-II	August 2010	Not implemented

The stage blanking of the remaining pumps was not carried out as originally planned with the idea that these pumps will be used as standby pumps on the trains 31 to 35 and the pumps in which stage blanking has been carried out will be used for most of the time. Thus the benefit of energy efficiency would be obtained even without carrying out stage blanking on the remaining pumps.

B.2. Revision of the monitoring plan

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The project activity under consideration has adhered to the monitoring plan as mentioned in registered PDD. There is no revision in the monitoring plan from the plan given in the registered PDD

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

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Not Applicable

B.4. Notification or request of approval of changes

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Not Applicable

SECTION C. Description of the monitoring system

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As mentioned in section B.7.2 of registered PDD, the monitoring plan adopted for project activity under consideration includes;

- Relevant data collection, compilation and archiving, consistent with the good practices prescribed/followed.
- Data interpretation and computation techniques for monitoring and verification of GHG Emissions.

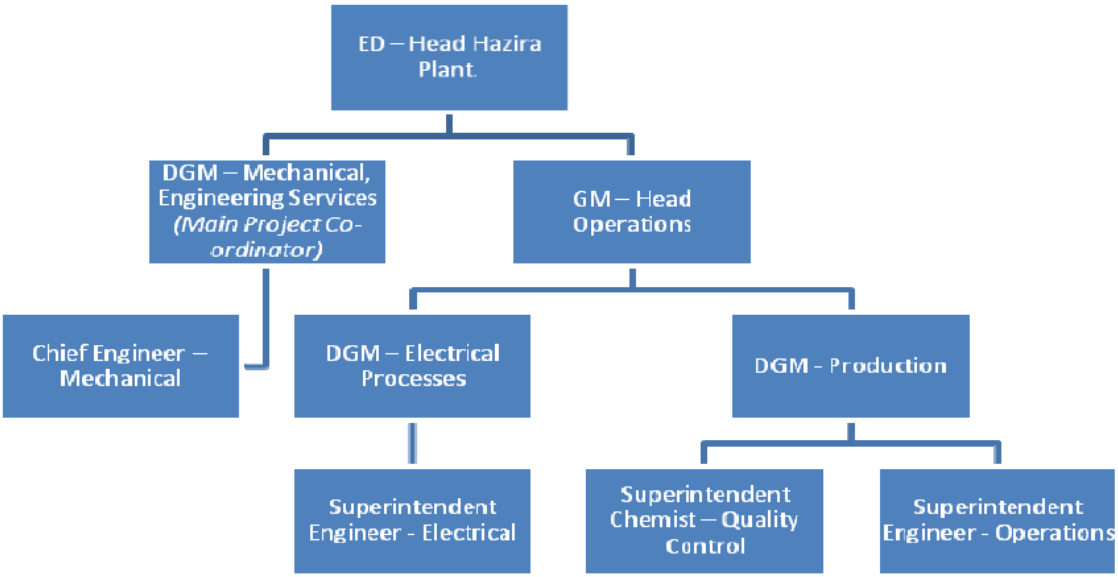
With reference to the guidelines laid down in the applicable methodology AMS II D; Energy Efficiency and Fuel Switch Measures for Industrial Facility, in the specific case of replacement, modification and retrofit measures, the monitoring consists of –

- Documenting the specifications of the equipment replaced/modified – Accordingly the technical specifications and operating parameters of the 8 stage amine circulation pump recorded, documented and archived.
- Metering the energy use of the industrial or mining and mineral production facility, processes or equipment affected by the project activity – thus the metering of the energy consumption of the stage blanked pumps was carried in real time, and values recorded daily.
- Calculating the energy savings using the metered energy consumption data obtained.

For the monitoring plan developed specifically for this project activity the following points are considered;

- Assignment of the monitoring and verification responsibilities, to the relevant in-house personnel, establishing their reporting relationships for the CDM activity, within the existing organizational structure/framework and responsibilities.
- Adaptation of existing reporting and Management Information Systems to incorporate the monitoring and verification plan of the CDM activity into ONGC's day-to-day operations.

ONGC has the following operational and management structure currently;



Monitoring Roles and Responsibilities;

- DGM – Mechanical, of the Engineering Services Department chose as the Main CDM project coordinator for the project activity under consideration. He ensures that, the monitoring plan is

strictly adhered to, relevant data collected and archived, and forwarded to the Group General Manager of ONGC's Carbon Management Group, based in New Delhi.

- The Chief Engineer – Mechanical is responsible for documenting specifications of the equipment replaced. He also, closely works with the Superintendent Engineer – Operations for the monitoring and archiving of the quantity of gas fired in the generators; and with the Superintendent Engineer – Electrical for the monitoring and archiving of the quantity of energy consumed by the lean amine circulation pumps. He carry out all the necessary computations as described in the registered project design document computation of emission reductions taken place in each year of the crediting period, and update the same to the DGM – Mechanical of Engineering Services Department. The Chief Engineer, Mechanical is responsible for overlooking the pump switch over procedures from time to time, and ensuring periodic maintenance of the pumps. The periodic review is carried out once a month, with reference to the average rate of sour gas processed and the corresponding energy consumption in the project scenario by the Chief Engineer Mechanical, and any discrepancies or deviations are duly reported.

- The Superintendent Engineer – Operations is primarily responsible for the monitoring and archiving of the quantity of the gas fired in the in-house captive generators. He is also additionally responsible for timely and prompt update of the data to the DGM – Mechanical of the Engineering Services Department, and reports discrepancies immediately if any.

- The Superintendent Engineer – Electrical is responsible for monitoring and archiving of the quantity of energy consumed by the lean amine pumps. This monitoring of data is carried out by reviewing of the daily readings reported by the in-line energy meters installed for individual pumps. The energy meters calibrated suitably as per the standard statutory requirements. Superintendent Engineer – Electrical has responsibility to ensure the accuracy class, and calibration frequency is maintained as per standard OEM guidelines.

- The Superintendent Engineer - Quality Control is responsible for obtaining the Net Calorific Value of each fuel delivery, i.e. the gas received to be fired in the generators. He also computes the annual weighted average figures for the same and update the data to DGM – Mechanical of the Engineering Services Department.

SECTION D. Data and parameters

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

Data / Parameter:	**$EF_{CO2, NG}$**
Data unit:	tCO_2/TJ
Description:	Emission factor for natural gas
Source of data used:	IPCC default values at the upper limit of uncertainty at a 95% confidence level as provided in table 1.4 of the Chapter 1 of Volume 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value(s) :	58.30
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Emission factor for Natural is used for project emission calculations.
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	**$Q_{,y}$**
Data unit:	**MMSCMD (Million Meter Standard Cubic Meter per Day)**
Description:	Average Rate of Gas Processed by the Project Activity during the monitoring period dated 23/09/2009 to 31/07/2011for each pump
Measured /Calculated /Default:	Measured
Source of data:	Online measurement (use of in-line flow meters)
Value(s) of monitored parameter:	Train 31P301 (Pump A &B) 3.89 Train 32P301 (Pump A &B) 5.25 Train 33P301 (Pump A &B) 5.21 Train 34P301 (Pump A &B) 5.83 Train 35P301 (Pump A &B) 5.28
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Average rate of gas processed by the project activity is used for baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Separate online meter for each of the pump has been used to measure the rate of gas processed by the project activity. The meter provides readings in Thousand NM3 per hour for the gas processed, which is multiplied by 0.025 to compute the rate of gas processing in MMSCMD. Readings is noted every 2 hours. Details of the online gas flow meters are as follows:

Pump	Sl of the meter	Make	Calibration Frequency	Date of last calibration	Due date for next calibration
Train-31 P301 (Pump A & B)	31FT1101	ROSEMOUNT	Annual	01/09/2011	31/08/2012
Train-32 P301 (Pump A &B)	32FT1101	ROSEMOUNT	Annual	01/09/2011	31/08/2012
Train-33 P301 (Pump A & B)	33FT1101	ROSEMOUNT	Annual	01/09/2011	31/08/2012
Train-34 P301 (Pump A & B)	34FT1101	ROSEMOUNT	Annual	02/09/2011	01/09/2011

	Train-35 P301 (Pump A & B)	35FT1101	ROSEMOUNT	Annual	02/09/2011	01/09/2011
Measuring/ Reading/ Recording frequency:	Every two hours of operation					
Calculation method (if applicable):	The average flow rate of the gas processed for the monitoring period under consideration is calculated by using weighted average of different readings of gas flow rate through a given train, as compared with the hours of operation.					
QA/QC procedures applied:	-					

Data / Parameter:	$\mathbf{NCV_{NG,y}}$
Data unit:	$Kcal/NM^3$
Description:	Weighted average net calorific value of the Natural Gas fired during the monitoring period (23/09/2009 to 31/07/2011)
Measured /Calculated /Default:	Measured and calculated
Source of data:	In-house sampling and calculations
Value(s) of monitored parameter:	7964.37
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Weighted average net calorific value of the Natural Gas fired in the gas turbines is used both for project emission calculations and the baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Use of analytical instruments in-line with national fuel standards. The NCV is obtained for each fuel delivery, from which the weighted average annual values have been calculated
Measuring/ Reading/ Recording frequency:	One sample every month
Calculation method (if applicable):	The NCV value is obtained for the fuel delivery, from which the weighted average annual value is calculated.
QA/QC procedures applied:	The measurement of the calorific value is done on sample basis using the analytical methods.

Data / Parameter:	$\mathbf{FC_{GT1,NG}}$
Data unit:	NM^3
Description:	Total quantity of Natural Gas fired in the Captive Generator GT – 1, during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using online volumetric flow meters
Value(s) of monitored parameter:	72958507
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Natural Gas fired in the Captive Generator GT – 1, is used both for project emission and baseline emission calculations.
Monitoring equipment (type, accuracy class, serial	The Hazira gas processing facility measures and monitors the volume of Natural gas fired at its in-house captive generation unit GT – 1.

number, calibration frequency, date of last calibration, validity)	Suitable QMS and reporting procedure are followed for the measurement and upkeep of this data. The details of online volumetric flow meters are provided below: Meter Make: ABB (Model: 264DS) Serial No.: 0610328 (23FT541) Calibration Frequency: Annual Date of Last Calibration: 08.03.2011 Calibration Due on: 07.03.2012
Measuring/ Reading/ Recording frequency:	Continuously online
Calculation method (if applicable):	
QA/QC procedures applied:	The flow meters has calibrated regularly as per the requirement specified by the OEM.

Data / Parameter:	**$FC_{GT2,NG}$**
Data unit:	NM^3
Description:	Total quantity of Natural Gas fired in the Captive Generator GT – 2, during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using online volumetric flow meters
Value(s) of monitored parameter:	73221423
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Natural Gas fired in the Captive Generator GT – 2, is used both project emission and baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The Hazira gas processing facility measures and monitors the volume of Natural gas fired at its in-house captive generation unit GT – 2. Suitable QMS and reporting procedure are followed for the measurement and upkeep of this data. The details of online volumetric flow meters are provided below: Meter Make: ABB (Model:264DS Serial No.: 0610334 (24FT541) Calibration Frequency: Annual Date of Last Calibration: 20/09/2011 Calibration Due on: 19/09/2012
Measuring/ Reading/ Recording frequency:	Continuously online
Calculation method (if applicable):	
QA/QC procedures applied:	The flow meters has calibrated regularly as per the requirement specified by the OEM.

Data / Parameter:	**$FC_{GT3,NG}$**
Data unit:	NM^3
Description:	Total quantity of Natural Gas fired in the Captive Generator GT – 3, during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using online volumetric flow meters
Value(s) of monitored parameter:	81517881
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Natural Gas fired in the Captive Generator GT – 3, is used both for project emission and baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The Hazira gas processing facility measures and monitors the volume of Natural gas fired at its in-house captive generation unit GT – 3. Suitable QMS and reporting procedure are followed for the measurement and upkeep of this data. The details of online volumetric flow meters are provided below: Meter Make: Instrumentation Ltd. (Model: IIFC-34WB2-500Y) Serial No.: 960032 & 960027 (96FT-FF-1 & 96FT-FF-2) Calibration Frequency: Annual Date of Last Calibration: 22/09/2011 Calibration due on: 21/09/2012
Measuring/ Reading/ Recording frequency:	Continuously online
Calculation method (if applicable):	
QA/QC procedures applied:	The flow meters has calibrated regularly as per the requirement specified by the OEM.

Data / Parameter:	**$EG_{GT1,y}$**
Data unit:	MWh
Description:	Total Quantity of Net Electricity Generated in the Captive Generator GT-1, during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using in-line energy meters
Value(s) of monitored parameter:	193317
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Net Electricity Generated in the Captive Generator GT-1, is used both for project emission and baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Hazira Gas processing facility uses in-line energy meters, to measure and monitor the net quantity of energy generated in the Captive Natural Gas based power generator. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data. The details of online volumetric flow meters are provided below: Meter Type: Secure Serial No.: GJU 04103

	Calibration Frequency: Three years Date of Last Calibration: 28.09.2011 Calibration due on: 27.09.2014
Measuring/ Reading/ Recording frequency:	Continuously online
Calculation method (if applicable):	
QA/QC procedures applied:	The parameter has monitored continuously. The energy meters were consistently checked for accuracy by periodic calibration as prescribed by the OEM of the metering equipment and the Statutory Bodies.

Data / Parameter:	$\mathbf{EG_{GT2,y}}$
Data unit:	MWh
Description:	Total Quantity of Net Electricity Generated in the Captive Generator GT-2, during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using in-line energy meters
Value(s) of monitored parameter:	194698
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Net Electricity Generated in the Captive Generator GT-2, is used both for project emission and baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Hazira Gas processing facility uses in-line energy meters, to measure and monitor the net quantity of energy generated in the Captive Natural Gas based power generator. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data. The details of online volumetric flow meters are provided below: Meter Make: Secure Serial No.: GJB 03340 Calibration Frequency: Three years Date of Last Calibration: 28.09.2011 Calibration due on: 27.09.2014
Measuring/ Reading/ Recording frequency:	Continuously online
Calculation method (if applicable):	
QA/QC procedures applied:	The parameter has monitored continuously. The energy meters were consistently checked for accuracy by periodic calibration as prescribed by the OEM of the metering equipment and the Statutory Bodies.

Data / Parameter:	$\mathbf{EG_{GT3,y}}$
Data unit:	MWh
Description:	Total Quantity of Net Electricity Generated in the Captive Generator GT-3, during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using in-line energy meters

Value(s) of monitored parameter:	207478
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Net Electricity Generated in the Captive Generator GT-3, is used both for project emission and baseline emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Hazira Gas processing facility uses in-line energy meters, to measure and monitor the net quantity of energy generated in the Captive Natural Gas based power generator. Suitable QMS and reporting procedures are followed for the measurement and upkeep of this data. The details of online volumetric flow meters are provided below: Meter Make: Secure Serial No.: GJU 04151 Calibration Frequency: Once in Three years Date of Last Calibration: 30/09/2011 Calibration due on: 29/09/2014
Measuring/ Reading/ Recording frequency:	Continuously online
Calculation method (if applicable):	
QA/QC procedures applied:	The parameter has monitored continuously. The energy meters were consistently checked for accuracy by periodic calibration as prescribed by the OEM of the metering equipment and the Statutory Bodies.

Data / Parameter:	**$EC_{PJ,y}$**
Data unit:	MWh
Description:	Quantity of Energy consumed by the project activity during the monitoring period from 23/09/2009 to 31/07/2011
Measured /Calculated /Default:	Measured
Source of data:	Onsite Measurements by using in-line energy meters
Value(s) of monitored parameter:	

Train 31P301	Pump A&B	6215.530
Train 32P301	Pump A&B	9790.110
Train 33P301	Pump A&B	8835.360
Train 34P301	Pump A&B	6285.930
Train 35P301	Pump A&B	7718.100
Total		38845.030

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Total quantity of Energy consumed by the project activity is used for project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Details of onsite integrator type meter used for measurement of energy consumed by project activity is given below:

Tag Number	Make	Calibration Frequency	Date of last calibration	Due date for next

					calibration
	08890106	L&T	Annual	20/08/2011	19/08/2012
	08890091	L&T	Annual	20/08/2011	19/08/2012
	07890523	L&T	Annual	20/08/2011	19/08/2012
	08890081	L&T	Annual	20/08/2011	19/08/2012
	08890104	L&T	Annual	20/08/2011	19/08/2012
	08890107	L&T	Annual	22/09/2011	21/09/2012
	08883505	L&T	Annual	22/09/2011	21/09/2012
	08890080	L&T	Annual	22/09/2011	21/09/2012
	08890116	L&T	Annual	22/09/2011	21/09/2012
	08890092	L&T	Annual	22/09/2011	21/09/2012
Measuring/ Reading/ Recording frequency:	Continuously				
Calculation method (if applicable):					
QA/QC procedures applied:	Separate energy meters are installed for each of the Amine circulation pumps, within the Gas Sweetening Units. The parameter has monitored continuously with the help of said energy meters and these meters has been as per standard OEM requirements.				

Data / Parameter:	$\mathbf{T_y}$	
Data unit:	Thousand hours	
Description:	Duration of operations of the pump during the monitoring period from 23/09/2009 to 31/07/2011	
Measured /Calculated /Default:	Recorded	
Source of data:	Compiled from log Books	
Value(s) of monitored parameter:	Train 31P301 (Pump A &B)	11.180
	Train 32P301 (Pump A &B)	13.364
	Train 33P301 (Pump A &B)	12.820
	Train 34P301 (Pump A &B)	13.278
	Train 35P301 (Pump A &B)	12.136
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Duration of operation of the pumps is used for computing baseline emission calculations.	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Duration of Pump operation are duly logged in the Operations Log	
Measuring/ Reading/ Recording frequency:	Two hourly	
Calculation method (if applicable):	NA	
QA/QC procedures applied:	-	

Data / Parameter:	Specifications of the Pumps Modified
Data unit:	-
Description:	Technical specifications of the modified pumps
Measured /Calculated /Default:	Measured
Source of data:	Specification sheet for the modified pump
Value(s) of monitored parameter:	MAKE: POMPES GUINARD, FRANCE TYPE: DVMX 4X6X10 C/E 8 STG NUMBER OF STAGES:7 CAPACITY: 269 M^3/HR HEAD: 705 METER RPM: 2980 MOTOR RATING: 840 KW
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	-
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The specifications are based upon the specification sheet after modification in the pump has been carried out
Measuring/ Reading/ Recording frequency:	Once, at the time of modification of each pump
Calculation method (if applicable):	Since the specifications are monitored as per the specification sheet supplied by the Pump Modifier, who is an independent agency having suitable expertise in the field, adequate QA/QC is ensured.
QA/QC procedures applied:	-

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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As mentioned in section B.6.1 of registered PDD, baseline Emissions that would have happened in the absence of the project activity, are computed by multiplication of estimated baseline energy consumption ($EC_{PJB,y}$) and the emission factor applicable for the source of power ($EF_{CP,y}$).

$$BE_{EC,y} = EC_{PJB,y} * EF_{CP,y}$$

Where;

$BE_{EC,y}$ = Baseline emissions that would have occurred in the baseline scenario, during the monitoring period 'y' (tCO_2)

$EC_{PJB,y}$ = Energy consumption that would have occurred in the baseline scenario, during the monitoring period 'y' (MWh)

$EF_{CP,y}$ = Emission factor for the captive power plant during the monitoring period y (tCO_2/MWh)

The energy consumption which would have occurred in the baseline scenario, has been determined by monitoring the actual rate of Sour Gas Processed ($FG_{PJ,y}$) and using the relationship given below to compute the corresponding values of Baseline Emissions.

$$L_{Base,y} = 8.12 * Q_y + 706.08$$

Where;

$L_{Base,y}$ = Average Load during the monitoring period 'y' (KW)

Q_y = Average Rate of Gas Processing during monitoring period 'y' in the tower connected to the pump (MMSCMD)

$$EC_{PJB,y} = T_y * L_{Base,y}$$

Where:

$EC_{PJB,y}$ = Energy consumption that would have occurred in the baseline scenario, during monitoring period 'y' (MWh)

T_y = Duration of operation of the pump during the monitoring period 'y' (Thousand Hours)

Emission factor for the captive power plant has been calculated as follows;

$$EF_{CP,y} = (\sum_k \sum_i FC_{k,i,y} * COEF_{i,y}) / (\sum_k EG_y)$$

Where;

$FC_{k,i,y}$ = Quantity of fossil fuel type *i* fired in the captive power plant *k* in the monitoring period y (mass or volume unit)

$COEF_{i,y}$ = CO_2 emission coefficient for the fuel type *i* in the monitoring period *y* (tCO_2 / mass or volume unit)

EG_y = Quantity of energy generated in the captive power plant k in the monitoring period y (MWh)

$COEF_{i,y}$, has been calculated according to the procedures provided in the latest approved version of the "tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

$$COEF_{i,y} = NCV_{i,y} * EF_{CO_2,NG}$$

Where;

$COEF_{i,y}$ = CO_2 emission coefficient of the fuel type *i* in the monitoring period *y* (tCO_2 / mass or volume unit)

$NCV_{i,y}$ = Weighted average net calorific value of the fuel type *i* in the monitoring period y. (GJ/mass or volume unit)

$EF_{CO_2,NG}$ = Weighted average CO_2 emission factor of fuel type *i* in the monitoring period *y* (tCO_2 / GJ)

Based on the values of the monitored parameters the computation of the emission factor for captive power generation for the monitoring period is tabulated below:

Parameter	Description	Value	Unit
$\sum_k FC_{k,i,y}$	Quantity of fossil fuel (natural gas) fired in the captive power	227697811	NM^3
$\sum_k EG_y$	Quantity of energy generated in the captive power plant	595493	MWh
$NCV_{i,y}$	Weighted average net calorific value of the natural gas	7964.37	$Kcal/Nm^3$
$EF_{CO_2,NG}$	Weighted average CO2 emission factor of the natural gas	58.3	tCO_2 / TJ
$COEF_{i,y}$	CO2 emission coefficient for natural gas	0.001950155	tCO_2 / Nm^3
$EF_{CP,y}$	Emission factor for the captive power plant	0.745678	tCO_2 /MWh

The calculated baseline emissions based on the monitored data for monitoring period 23/09/2009 to 31/07/2011 are tabulated below:

		Train 31P301 (Pump A &B)	Train 32P301 (Pump A &B)	Train 33P301 (Pump A &B)	Train 34P301 (Pump A &B)	Train 35P301 (Pump A &B)
Q_y	Average Rate of Gas Processing in MMSCMD	3.89	5.25	5.21	5.83	5.28
$L_{Base,y}$	Average Load during KW	737.69	748.72	748.36	753.38	748.94
T_y	Duration of operation of the pump in hrs.	11180	13364	12820	13278	12136
$EC_{PJB,y}$	Baseline Energy consumption in MWh	8247.38	10005.88	9593.96	10003.37	9089.12
$EF_{CP,y}$	Emission factor for the captive power plant (tCO2/MWh)	0.745678	0.745678	0.745678	0.745678	0.745678
$BE_{EC,y}$	Baseline emissions in ton CO2 equivalent	6150	7461	7154	7459	6778
Total Baseline Emissions for the Monitoring Period = 35002 ton CO2 equivalent						

E.2. Project emissions calculation

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Project Emissions due to the project activity are the emissions due to consumption of electricity from an off-grid captive power plant, the same are calculated as below:

$$PE_{EC,y} = EC_{PJ,y} * EF_{CP,y}$$

Where;

$PE_{EC,y}$	=	Project emissions during the monitoring period y (tCO2)
$EC_{PJ,y}$	=	Quantity of energy consumed by the project activity during the monitoring period y (MWh)
$EF_{CP,y}$	=	Emission factor for the captive power plant in the monitoring period y (tCO2/MWh)

The calculated project emissions based on the monitored data for monitoring period 23/09/2009 to 31/07/2011 are tabulated below:

Parameter		Project Emissions
$EC_{PJ,y}$	$EF_{CP,y}$	$PE_{EC,y}$
38845.03 MWH	0.745678 Ton CO2 equivalent / MWH	**28966** (tCO_2e)

E.3. Leakage calculation

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Since, no energy efficiency technology equipment is transferred from another activity and no existing equipment is transferred to another activity, therein, leakage is considered zero.

E.4. Emission reductions calculation / table

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As mentioned in section B.6.4 of registered PDD, the emission reductions due to project activity are calculated as under:

$$ER_{EC,y} = BE_{EC,y} - PE_{EC,y}$$

Monitoring Period	Baseline emissions $BE_{EC,y}$ (tCO_2)	Project Emissions $PE_{EC,y}$ (tCO_2)	Emission Reductions $ER_{EC,y}$ (tCO_2)
23/09/2009 to 31/07/2011	**35002**	**28966**	**6036**

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

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This section shall include a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**4043 (tCO_2) / Year**	**6036 (tCO_2e) for 19 months = 3812 (tCO_2e) / Year**

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

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The emission reductions actually achieved are of the same order as projected in the PDD.

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History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		