MONITORING REPORT
Version 2, 21 June 2010

Project activity: Pakarab Fertiliser Co-generation Power Project
Reference number: 2687
Monitoring Period: 21/12/2009 – 31/05/2010

CONTENTS

Section A. General description of the project activity

A.1. Brief description of the project activity:

The purpose of this monitoring report is to calculate and clarify GHG emission reduction quantity achieved by this CDM project activity for verification. The Pakarab Fertilizer Limited (PFL) is a major fertilizer complex producing both Nitrogenous and Phosphatic fertilizers. Power and steam for the fertilizer processes as well as for common consumers within the Pakarab Fertilizer area were before the implementation of project activity supplied by the captive power plant on-site, without any cogeneration. Power was generated by condensing steam turbines with low steam parameters and process steam for the factory in a heat-only process resulting in a high fuel consumption and high CO_2 emissions.

Therefore PFL was considering as CDM project activity to replace the existing captive condensing power plant with a new highly energy efficient co-generation plant. Primarily the new cogeneration plant (project activity) completely covers the power and steam demand of the fertiliser complex and the replaced captive power house is further used as backup and for standby purposes. The project activity comprises the co-generation of electricity and heat (steam): the waste heat of the gas turbines is used by heat recovery steam generators (HRSGs) to produce the steam that would have produced in heat-only mode in the replaced power house..

The construction period of the project activity was from January 2008 to July 2009. Commissioning and start of operation of GTG No. 1 was in April 2009, of GTG No. 2 in June 2009and of GTG No. 3 in July 2009.

The total emission reductions achieved in this monitoring period are 22,590 tCO_2

A.2 Project Participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Pakistan	Pakarab Fertiliser Limited	No
Germany	Fichtner GmbH & Co. KG (Consultant)	No

A.3. Location of the project activity:

Host party: Islamic Republic of Pakistan
Province: Punjab, which is Pakistan's second largest province at 205,344 km.

City/Town/community:
Multan which is Multan; Multan is a city in the Punjab Province of Pakistan and the capital of Multan District. It is located in the southern part of the province. Relevant meteorological data for Multan for the years 1991 to 2005 have been summarised and are shown below:

- Mean annual air temperature 25.4 °C
- Mean relative humidity 57%
- Extreme maximum air temperature 50 °C
- Extreme minimum air temperature 0 °C

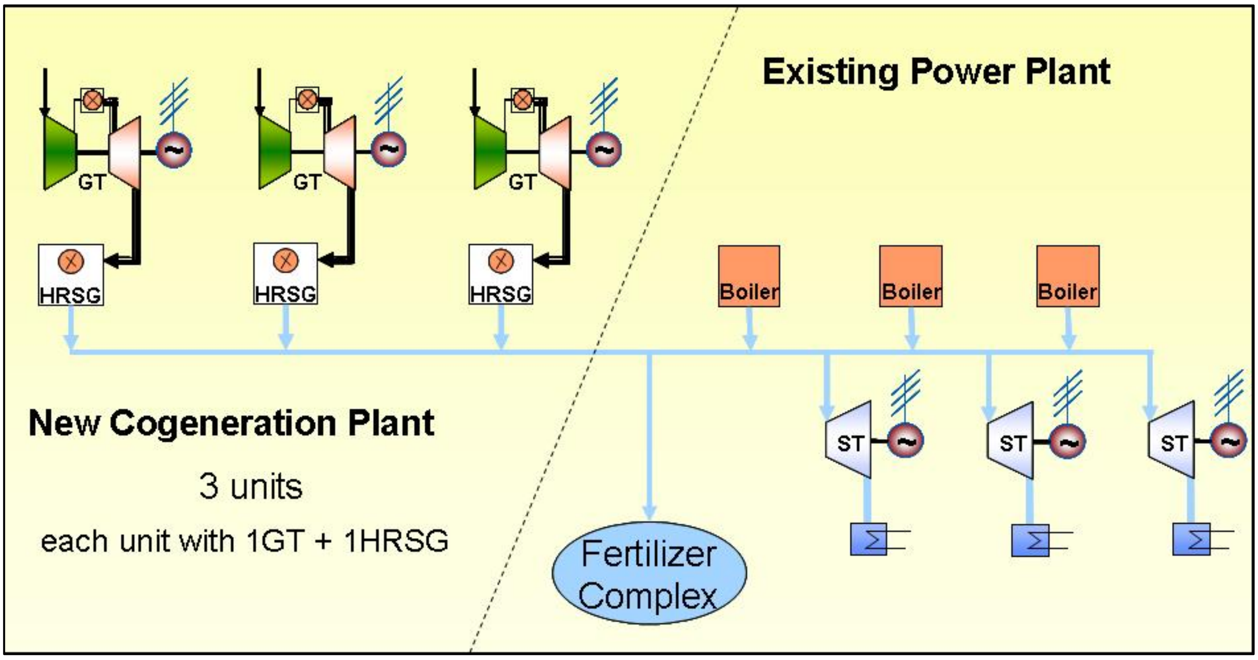
Detail of physical location:
Pakarab Fertilizer factory is situated about 10 km north-east to the centre of Multan city, Pakistan, on the highway leading to Lahore.
The geographical coordinates of the project activity are as follows:
Latitude: 30°12′00″N
Longitude: 71°27′00″E

A.4. Technical description of the project:

Description of the activities/measures being implemented within the project activity

As CDM project activity a highly energy efficient **cogeneration plant** is implemented. The new power plant shall almost completely cover the power and process steam demand of the fertiliser complex and the existing power plant will be used as backup and standby unit in case of forced or planned outages of units of the cogeneration plant (see figure below).

Figure 1: Overview of new cogen plant and existing power plant



For cogeneration of power and steam with the required parameter of 40 bar/405 °C, a **new gas-turbine cogeneration plant** with three gas turbines and three upstream heat recovery steam generators (HRSG) is implemented as project activity. Several units are chosen for redundancy purposes. The power output and efficiency of gas turbines depend on the site conditions with regard to elevation and ambient temperature. From several gas turbine types which are offered in the market, the one according to Table 1 has been selected for implementation for the project activity.

Table 1: Output of selected gas turbine type GE10-1 for cogeneration plant

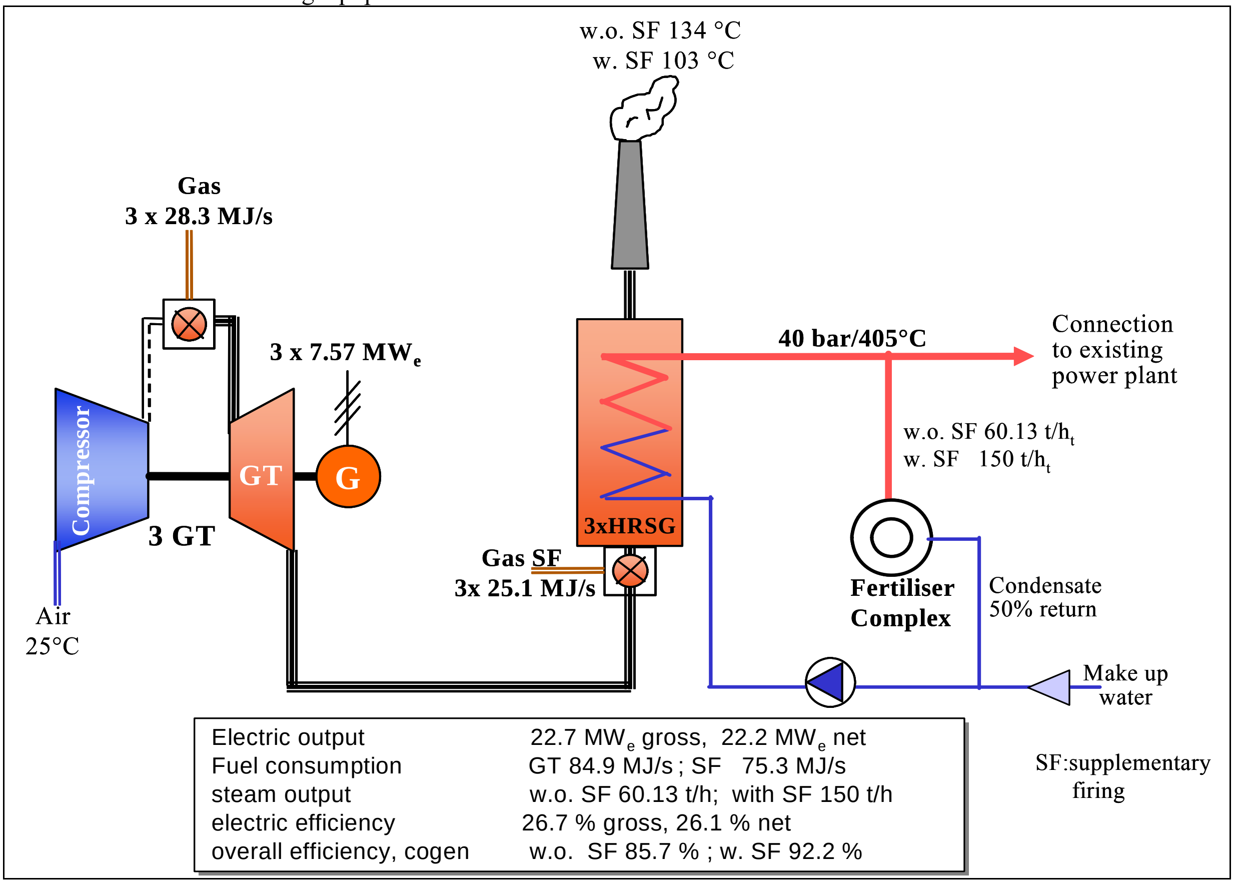
Ambient conditions and load	Output (gross) [MW]	Efficiency ***) [%]
ISO- rating *) and 100% load	10.70	30.36
Average site conditions **) and 100% load	9.70	29.25
Average site conditions **) and annual average load of 78%	7.57	26.70

*) atmospheric pressure 1.013 bar, temperature 15 °C, relative humidity 60 %
**) according to data sheet GT manufacturer for reference site conditions
***) gross electric output to firing duty as net calorific value (NCV)

At the annual average temperature of 25 °C the selected gas turbines can meet also the expected maximum power demand of 25 MW (3 x 9.7 MW = 29.1 MW). As the average power demand of the fertiliser complex is about 22 MW the gas turbines will have to be operated at part load during most of the time; the consequence will be a lower efficiency.

A simplified heat flow diagram of the cogeneration plant for operation at annual average conditions (25°C) and net power output (22.2 MW) is shown in the figure below. The in-house (own) power demand of 0.5 MW is derived from similar plants. In pure cogeneration mode, the plant can generate 55.8 t/h process steam. In order to meet the average demand of 150 t/h, the HRSGs are equipped with supplementary firing (SF). At average annual load conditions the electric efficiency declines due to the part load operation as it is typical for gas turbines. The overall efficiency, however, with supplementary firing obtains according to the cycle simulations a remarkable level of 92.2 %. The manufacturer of the plant guarantees 91.5% overall efficiency; this may contain some security margin to avoid penalties.

Figure 2: Simplified heat flow diagram of the cogeneration plant at annual average load conditions. Refer to Annex 2 to Annex 5 for exact locations of metering equipment.



Note: The calculation of the emission reductions is based on 91.5% overall efficiency that is guaranteed by the manufacturer of the plant.

The manufacturers of the major equipment are as follows:

1. HRSGs: UMAG Technologie GmbH
2. Gas turbines: GE Oil & Gas Nuovo Pignone
3. Generators: Ansaldo Italy

Also, for monitoring locations/positions, please refer to the attached annexures 02,03,04 and 05.

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

- AM0014/Version 04 (EB33 decision)
- “Natural gas-based package cogeneration”.

A.6. Registration Date of the project activity:

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

Start date of CDM project activity: 13 July 2007
Start date of crediting period: 21 December 2009
Crediting period: 3 x 7 years

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

Pakarab Fertiliser Limited:

Name of person	Role & Responsibilities	Phone Number	E-mail
Unit Manager (Instrument) Mr. Tariq Qasim Khan	Provide first end help for fixing technology, metering equipment, verify data gaps and calibrate metering equipment, undertake regular on-site checks	+92- 61- 9220022	pafl.uminst@fatima-group.com
Unit Manager (Utilities) 1) Mr. Abdul Rauf / 2) Mr. Mat-ur-Rab	Oversee collected data regularly, analyse data, write up monitoring report, issue report to DOE, archive data, discuss proposed changes of the Monitoring plan with DOE	1) +92- 61- 9220022 Extension 3141 2) +92- 61- 9220022 Extension 3142	1)pafl.umutw@fatima-group.com 2) mati@fatima-group.com
Process Engineer (Utilities) Hamza Mahmood	Provide internal Quality Control and audit of the data and monitoring plan	+92- 61- 9220022 Extension 3169	hamza.manj@fatima-group.com

Fichtner GmbH & Co. KG (Consultant):
Dr. Ole Langniss, ole.langniss@fichtner.de, +49 711 8995 584
Ursula Baumgartner, ursula.baumgartner@fichtner.de, +49 711 8995 578

SECTION B. Implementation status of the project activity

B.1. Implementation status of the project activity:

Starting date of operation of the project activity:

a) April 17, 2009: GTG No.1 commissioned
b) April 29, 2009: GTG No. 1 has been started and is connected on distribution network through busbar
c) May 20, 2009: GTG No.2 commissioned
d) June 19, 2009: GTG No. 2 has been started and is connected on distribution network through busbar
e) July 7, 2009: GTG No.3 commissioned
f) July 20, 2009: GTG No. 3 has been started and is connected on distribution network through busbar

The following table indicates information regarding trippings and normal stoppages.

Table 2: Trippings and normal stoppages

Start/Stop & Tripping record From Dec 21, 2009 to May 31,2010					
S. #	**DATE**	**EQUIPMENT**	**TIME**	**START/NORMAL STOP/TRIP**	**REMARKS**
GTG's					
1	Jan 3,2010	GTG # 3	0800	Normal stopped	Annual Turn around
2	Jan 9,2010	GTG # 1	0350	Tripped	due to inlet filters high Diff pressure (PDT-263)
3	Jan 10,2010	GTG # 1	1135	Started	
4	Jan 11,2010	GTG # 1	0900	Normal stopped	To attend high diff pressure (PDT-263)
5	Jan 11,2010	GTG # 2	0840	Started	
6	Jan 13,2010	GTG # 2	2000	Tripped	Under frequency
7	Jan 13,2010	GTG # 1	2008	Started	
8	Jan 14,2010	GTG # 2	0010	Started	
9	Jan 14,2010	GTG # 1	0330	Normal stopped	Desynchronized at 0036 hrs(FSNL)
10	Jan 17,2010	GTG # 2	1650	Tripped	By tripping of Transformers T-1& T-2
11	Jan 17,2010	GTG # 2	1740	Started	
12	Jan 18,2010	GTG # 2	0800	Emergency Push button	To check Emergency push button in ATA-2010
13	Jan 18,2010	GTG # 3	1910	Started	
14	Jan19,2010	GTG # 3	1326	Tripped	To check Emergenct Diesel Generator Auto test
15	Jan 19,2010	GTG # 2	1443	Started	
16	Jan 22,2010	GTG # 2	1302	Normal stopped	
17	Jan 22,2010	GTG # 3	1240	Started	
18	Feb 1,2010	GTG # 2	0920	Started	
19	March 4,2010	GTG # 3	1322	Normal stopped	Compressor suction filter change over
20	March 4,2010	GTG # 3	1930	Started	
21	April20,2010	GTG # 3	0840		Desynchronized at 0840 hrs (FSNL)
22	April20,2010	GTG # 1	0733	Started	
23	April20,2010	GTG # 3	1100		Synchronized at 1100 hrs
24	April23,2010	GTG # 2	1705	Tripped	Pepper mill actuator failure
25	May 9,2010	GTG # 2	1555	Started	
26	May 14,2010	GTG # 1	1400	Tripped	Low lube oil pressure
27	May 17,2010	GTG # 1	1440	Started	

HRSG's					
S. #	DATE	EQUIPMENT	TIME	START/NORMAL STOP/TRIP	REMARKS
1	Jan 4,2010	HRSG# 1	1620	Tripped	During change over to FA mode
2	Jan 4,2010	HRSG# 1	1645	Started	
3	Jan 17,2010	HRSG#2	1650	Tripped	due to GTG #2 trip
4	Jan 17,2010	HRSG#2	1750	Started	
5	Jan 30,2010	HRSG#3	0845	Tripped	due to low pressure of NG
6	Jan 30,2010	HRSG#3	0915	Started	
7	March 3,2010	HRSG#3	1215	Tripped	during start up on TEG mode
8	March 3,2010	HRSG#3	1255	Started	
9	April 19,2010	HRSG#3	0915	Tripped	During change over to FA mode
10	April 19,2010	HRSG#3	0920	Started	
11	Jan 2,2010	HRSG#3	0000	Normal stopped	Annual Turn around
12	Jan 21,2010	HRSG#3	0845	Started	
13	Jan 8,2010	HRSG#1	1145	Normal stopped	Annual Turn around
14	Feb 4,2010	HRSG#1	1450	Started	
15	Jan 18,2010	HRSG#2	0755	Normal stopped	Annual Turn around
16	Jan 30,2010	HRSG#2	1355	Started	
17	Jan 22,2010	HRSG#3	0545	Normal stopped	Annual Turn around
18	Jan 26,2010	HRSG#3	1140	Started	
19	April 24,2010	HRSG#2	1130	Normal stopped	Fresh Air fan filter cleaning
20	April 24,2010	HRSG#2	1510	Started	
21	Feb 5,2010	HRSG#1	2150	Normal stopped	
22	Feb 13,2010	HRSG#1	1735	Started	

B.2. Revision of the monitoring plan:

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

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B.4. Notification or request of approval of changes:

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SECTION C. Description of the monitoring system

Operational data relevant for emission accounting are logged by operator on daily basis using a Pre-prepared log-sheet form, as part of the data logging system. The log book will be signed and checked by the Unit Manager (Utilities) who is compile the report on weekly basis to determine:

- Cogeneration system heat output (CAHO) to the fertiliser complex.
- Cogeneration system electricity output (CEO) to the fertiliser complex.
- The natural gas consumption V_{NG}/AEC_{NG} at the cogeneration system

The Unit Manager (Utilities) consolidates the above data on monthly basis, and cross-checks them against sales invoices from gas suppliers. The consolidated information will be summarized into a monthly report, checked and signed by the Site General Manager.

Calibration Procedure

The instrumentations installed are new and have been calibrated to international standard before commissioning. Regular calibration will be performed on regular basis during the annual maintenance shut-down at the end of first year and subsequent years to all identified instrumentations up to error level of 4% or less for critical devices such as gas meter, electricity meter and heat measurement instruments. Every end of maintenance shut-down, the Unit Manager (Instruments) composes a Calibration Status Report listing all CDM-related instruments, their details, calibration status and expected error. The calibration reports can be found in Annex 1.

Archiving of Data

Field data will be stored on computer software, but daily log-sheet will serve as back-up purpose and archived at Project site. All the metered and the calculated parameters and data will be kept on paper for two years and in electronic form until 2 years after end of the crediting period (data on 1st creditin period will be kept until end of 2017 or beyond).

Role and Responsibilities:

Name of person	Role & Responsibilities	Phone Number	E-mail
Unit Manager (Instrument) Mr. Tariq Qasim Khan	Provide first end help for fixing technology, metering equipment, verify data gaps and calibrate metering equipment, undertake regular on-site checks	+92- 61- 9220022	pafl.uminst@fatima-group.com
Unit Manager (Utilities) 1) Mr. Abdul Rauf / 2) Mr. Mat-ur-Rab	Oversee collected data regularly, analyse data, write up monitoring report, issue report to DOE, archive data, discuss proposed changes of the Monitoring plan with DOE	1) +92- 61- 9220022 Extension 3141 2) +92- 61- 9220022 Extension 3142	1)pafl.umutw@fatima-group.com 2) mati@fatima-group.com
Process Engineer (Utilities) Hamza Mahmood	Provide internal Quality Control and audit of the data and monitoring plan	+92- 61- 9220022 Extension 3169	hamza.manj@fatima-group.com

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:	**CO_2 emission factor for natural gas (EF_{NG})**
Data unit:	t CO_2 /TJ
Description:	CO_2 emission factor
Source of data used:	Default emission factor of 2006 IPCC guidelines, Chapter 2 Stationary Combustion, Table 2-2 (energy industries) and Table 2-3 (manufacturing industries and construction)
Value applied:	56.1 t CO_2 /TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Methodology AM0014 sets the following hierarchy for the natural gas emission factor to be chosen: 1. National GHG inventory 2. IPCC, fuel type and technology specific 3. IPCC, near fuel type and technology It has been verified that no specific emission factor other than the IPCC default value is used. Therefore, option "2. IPCC, fuel type and technology specific" has been applied.
Any comment:	-

Data / Parameter:	**Thermal efficiency or heat rate for steam generation in heat-only mode (baseline)**
Data unit:	% (thermal efficiency boiler e_b), GJ_{NCV}/GJ_{th} (heat rate boiler FR_{th})
Description:	The thermal efficiency for steam generation in heat-only mode, or the heat rate as its inverse value, characterize the efficiency of the current system.
Source of data used:	Default value according to AM0014
Value applied:	91.0 % or 1.10 GJ_{NCV}/GJ_{th}
Justification of the choice of data or description of measurement methods and procedures actually applied :	Selection according to the selected baseline scenario: 3. Industrial plant upgrades the thermal energy generating equipment and therefore increases the efficiency of boiler(s) immediately. (see Section B.3 of PDD)
Any comment:	-

Data / Parameter:	**Net electric efficiency or net heat rate for electricity generation in condensing mode with existing steam turbines (baseline)**
Data unit:	% (electric efficiency e_{ST}), GJ_{NCV}/MWh_{elec} (heat rate FR_{elec})
Description:	The efficiency for electricity generation in condensing mode, or the heat rate as its inverse value, characterize the efficiency of the current system.
Source of data used:	Calculation with Fichtner's thermodynamic cycle simulation software KPRO® (see PDD, Annex 3e)
Value applied:	23.4 % or 15.38 GJ_{NCV}/MWh_{elec}
Justification of the choice of data or description of measurement methods and procedures actually applied :	The electric efficiency / heat rate were calculated with the use of Fichtner's thermodynamic cycle simulation software KPRO® (see PDD, Annex 3e), applying number-plate thermodynamic parameters of the steam turbines etc. (see PDD, Section B.3). Historic values couldn't be applied because steam generated for steam turbine supply and heat supply is not measured separately.
Any comment:	-

D.2. Data and parameters monitored:

According to the monitoring methodology, monitoring involves the following:

- The fuel consumption (natural gas) at the cogeneration system
- Heat production at the cogeneration system
- Electricity production at the cogeneration system
- Fate of the electricity displaced by the project activity since the project activity displaces electricity from a fossil fuel based dedicated power plant

Data / Parameter:	**Cogeneration system heat output (CAHO)**
Data unit:	TJ
Description:	The cogen plant produces steam for the supply of the fertilizer complex in the heat recovery steam generators (HRSG), with use of the gas turbine waste heat and additional supplementary firing. This cogeneration system heat output (CAHO) is needed to calculate *ex-post* the baseline fuel consumption for heat supply $ABEC_{BF, th}$, and the Baseline CO_2 emissions from combustion of baseline fuel for heat supply, BE_{th}.
Measured /Calcuated / Default:	Calculated
Source of data:	The cogeneration system heat output (CAHO) to the fertiliser complex is determined by an appropriate metering device as the difference of the heat content of the steam minus the heat content of the returned condensate and minus the heat content of the make up water to balance the condensate losses. The steam amount (in t) and its pressure (in Pa) and temperature (in °C), as well as the returned condensate (in t) will be continuously metered. The heat supplied in form of steam to the fertilizer complex will be calculated by use of the metered values on average daily basis.
Value of monitored parameter:	Steam Equivalent to heat: 752.84 TJ
Indicate what the data re used for (Baseline/Project/Leakage emission calcualtion)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(For point of installation of the following see Annex 3) Type: Steam flow sensor (FT-08): Measuring Method : Orifice Plate d/p cell Transmitter Model No : IDP10-T22B21F-M1 Serial number: 8470121 Instrument Range: 0 ~ 5000 mmH2O Instrument Vendor Defined Accuracy: ± 0.13 % Make : FOXBORO ,USA. Calibration frequency: monthly Date of last calibration: 5 May, 2010 Validity: 4 June ,2010 Type: Steam pressure sensor (PT-05): Measuring Method : Gauge Pressure Transmitter Model No : IDP10-T22E1F-M1L1V3 Serial number: 8470110 Instrument Range: 0 ~ 60 Barg Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA. Calibration frequency: monthly Date of last calibration: 5 May, 2010 Validity: 4 June,2010 Type: Steam temperature sensor (TT-05): Measuring Method : RTD , 4-Wire PT-100 Temperature Transmitter Model No : RTT15-T1EX4TXF Serial number: 8470033 Instrument Range: 0 ~ 450 DegC Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 5 May, 2010 Validity: 4 June,2010 Type: condensate flow meter (FT-09): Measuring Method : Orifice Plate d/p cell Transmitter Model No : IDP10-T22B21F-M1 Serial number: 8470122 Instrument Range: 0 ~ 2500 mmH2O Instrument Vendor Defined Accuracy: ± 0.13 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 7 May, 2010 Validity: 6 June,2010 Type: condensate temperature sensor (TT-06): Measuring Method : RTD , 4-Wire PT-100 Temperature Transmitter Model No : RTT15-T1ER4TXF Serial number: 8470022

	Instrument Range: 0 ~ 200 DegC Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 3 May, 2010 Validity: 2 June,2010 Type: condensate pressure sensor (PT-06): Measuring Method : Gauge Pressure Transmitter Model No : IDP10-T22E1F-M1L1V3 Serial number: 8470111 Instrument Range: 0 ~ 10 Barg Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 5 May, 2010 Validity: 4 June,2010 (For point of installation of the following see Annex 4) Type: Demin/make-up water flow meter (FT-05) Measuring Method : Orifice Plate d/p cell Transmitter Model No : IDP10-T22B21F-M1 Serial number: 8470119 Instrument Range: 0 ~ 2500 mmH2O Instrument Vendor Defined Accuracy: ± 0.13 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 7 May, 2010 Validity: 6 June,2010 Type: Demin/make-up water temperature sensor (TT-02) Measuring Method :Orifice Plate d/p cell Transmitter Model No : RTT15-T1EP4TXF Serial number: 8470017 Calibration Range: 0 ~ 100 DegC Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 3 May, 2010 Validity: 2 June,2010 Heat energy content will be permanently determined by Supervisory Control System Standards used: ISO-5167 (for steam flow) Responsible person: plant manager Calibration procedures: Metering devices are flow calibrated as part of the manufacturing process. The purpose of this calibration is to determine a calibration factor which is applied to the flow calculations as an adjustment to correct for bias error from the ISO-5167 discharge coefficient equations. Accuracy of measurement: +/- 2.5%
Measuring/Recording frequency:	Measurement interval: continuously, Values are recorded every two hours
Calculation method	Formula: **Heat content of steam:** Produced steam (at T_1, P_1) in t/day × Enthalpy (at T_1, P_1) in MJ/t /1000 = heat content of delivered steam (at T_1, P_1) in GJ/day **Heat content of feed water (condensate + make up water):** Condensate returned from Plants in t/day / Produced steam in t/day = condensate return rate in % Condensate return rate in % x Condensate Enthalpy (at T2) in MJ/ton + (1-condensate return rate in %) x Make up Water Enthalpy (at T3) in MJ/t = Average Enthalpy of feed water in MJ/t Mass balance: Feed water in t/day = Delivered steam in t/day Average Enthalpy of feed water in MJ/t x Feed water in t/day / 1000 = Heat content of feed water in GJ/day **cogeneration system heat output (CAHO):** content of delivered steam (at T_1, P_1) in GJ/day - Heat content of feed water in GJ/day = cogeneration system heat output (CAHO) in GJ/day The cogeneration system heat output CAHO is calculated for each day. These daily results are aggregated for each month.

	Please refer also to log sheets. <u>Calculation of Enthalpy:</u> The calculation of the enthalpy which is necessary to determine the CAHO is based on WADA. WADA is a program for the exact calculation of thermic and calorific data on chemical media of water and steam in excel or as an independent application, which also allows graphical evaluations. Thereby resulting on the inputs following data are calculated: • Compression, temperature, steam mass fraction • Enthalpy, entropy, specific volume • Dynamic and kinematic viscosity • Specific heat capacity and heat conductivity For calculating in a high temperature region, pressures up to 50 MPa are covering a temperature range from 1073.15 K to 2273.15 K. Therefore this program is calculating with following data for water and steam: • h-s Diagram for Water and Steam, Kretzschmar, H.-J. and Stöcker, I., 2nd ed., 2008, Springer-Verlag, Berling (ISBN: 978-3-540-7487-8) • T-s Diagramm for Water and Steam, Kretzschmar, H.-J. and Stöcker, I., Springer-Verlag, Berlin (ISBN: 3-540-29484-9) WADA was developed in 1989 at the University of Applied Sciences Zittau/Görlitz under the direction of H.-J. Kretzschmar, whose area of expertise is technical thermodynamics. The licence of this program was sold to FICHTNER Consulting AG, who is the distribution partner of the University of Applied Siences Zittau/Görlitz. The Software is with costs and purchasable at the software operator FICHTNER Consulting AG at a price of 1,025,86 €. The precondition for operating this system software is the operating system of Win 7, Win Vista, Win XP, Win 2000, Win NT or Win ME.
QA/QC procedures applied:	Regular monthly sensor and meter checks and signed off records by plant manager; monthly data will be collected and stored both electronically and on paper; before compiling the annual monitoring reports, data will be cross-checked on consistency.

Data / Parameter:	**Cogeneration system electricity output (CEO)**
Data unit:	MWh
Description:	The cogen plant produces electricity for the supply of the fertilizer complex by the electric generators driven by the gas turbines. This cogeneration system electricity output (CEO) is needed to calculate *ex-post* the baseline fuel consumption for electricity supply $ABEC_{BF,\ elec}$, and the Baseline CO_2 emissions from combustion of baseline fuel for electricity supply, BE_{elec}.
Measured /Calcuated / Default:	Measured
Source of data:	The net electric energy supplied to the fertilizer complex excluding own electricity consumption of the cogen power plant will be metered and recorded. <u>Formula:</u> (Daily average power output of all GTs in MW - Daily average own consuption in MW)*24hours = Cogeneration system electricity output (CEO) in MWh/day The CEO is calculated for each day. These daily results are aggregated for each month. Please refer also to log sheets excel file
Value(s) of monitored parameter:	50,487 MWh
Indicate what the data re used for (Baseline/Project/Leakage emission calcualtion)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(For point of installation of the following see Annex 5) <u>Type</u>: electricity meters (C4-Gas Turbine Generator-1) <u>Model No</u> :Simeas P50 <u>Serial number:</u> BF080895705 <u>Calibration frequency</u>: 2 Yearly <u>Commissioning Date</u>: 22-01-2009 <u>Date of last calibration:</u> 26-08-2008 (factory calibrated) <u>Validity:</u> 22-01-2011 <u>Type</u>: electricity meters (C10- Gas Turbine Generator -2) <u>Model No</u> :Simeas P50 <u>Serial number:</u> BF0808095712 <u>Calibration frequency:</u> : 2 Yearly <u>Commissioning Date</u>: 22-01-2009 <u>Date of last calibration</u>: 26-08-2008 (factory calibrated) <u>Validity</u>: 22-01-2011

	Type: electricity meters (C16- Gas Turbine Generator -3) Model No :Simeas P50 Serial number: BF0808095707 Calibration frequency: : 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008(factory calibrated) Validity: 22-01-2011 Type: electricity meters (C11-Emergency diesel Generator) Model No :Simeas P50 Serial number: BF0808095702 Calibration frequency: : 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008 (factory calibrated) Validity: 22-01-2011 Type: electricity meters (C6-Station transformer- 1) Model No :Simeas P50 Serial number: BF0808095710 Calibration frequency: : 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008(factory calibrated) Validity: 22-01-2011 Type: electricity meters (C14- Station transformer -2) Model No :Simeas P50 Serial number: BF0808095706 Calibration frequency: : 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008(factory calibrated) Validity: 22-01-2011 Standards used: according to NEPRA (National Electric Power Regulatory Authority) Grid Code and relevant IECs (note that the plant is not grid connected, and therefore Grid Code otherwise not applicable but used for CDM monitoring) Responsible person: plant manager Calibration procedures: according to meter supplier information with calibration package Accuracy of measurement: +/- 0.2%
Measuring/Recording frequency:	Measurement interval: continuously, Values are recorded every two hours
Calculation method (if applicable):	--
QA/QC procedures to be applied:	Regular monthly sensor and meter checks and signed off records by plant manager; monthly data will be collected and stored both electronically and on paper; before compiling the annual monitoring reports, data will be cross-checked on consistency.

Data / Parameter:	**Natural gas consumption of cogen plant (V_{NG}):**
Data unit:	Nm^3 (based on 15.55°C and 1.010 bar)
Description:	The cogen plant will use natural gas to be fired in the gas turbines and the supplementary firing of the HRSGs. This natural gas consumption (AEC_{NG}) is needed to calculate *ex-post* the project CO_2 emissions from combustion of fuel by the cogen system, PE_{CS}.
Measured /Calcuated / Default:	Measured
Source of data:	The natural gas consumption of both the gas turbines and the supplementary firing of the HRSGs of the cogen power plant is metered and recorded.
Value (s) of monitored parameter	Natural gas volume: 39,003,101 Nm^3 (based on 15.55°C and 1.010 bar)
Indicate what the data re used for (Baseline/Project/Leakage emission calcualtion)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(For point of installation of the following see Annex 2) Type: Gas Flowmeter to GTGs (FT-01) Measuring Method : Orifice Plate d/p cell Transmitter Model No : IDP10-T22B21F-M1 Serial number: 8470118 Instrument Range: 0 ~ 5000 mmH2O Instrument Vendor Defined Accuracy: ± 0.13 % Make : FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 5 May, 2010 Validity: 4 June,2010 Type : Natural gas to GTGs pressure Sensor (PT-01) Measuring Method : Gauge Pressure Transmitter Model No : IGP10-T22E1F-M1L1V3 Serial No : 08470107 Instrument Range: 0 ~ 60 Barg Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration Frequency : Monthly. Date of Last Calibration: 5 May, 2010 Validity: 4 June,2010 Type : Natural gas to GTGs Temperature Sensor (TT-01) Measuring Method : RTD , 4-Wire PT-100 Temperature Transmitter Model No : RTT15-T1EM4TXF Serial No : 08470015 Instrument Range: 0 ~ 55 DegC Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration Frequency : Monthly. Date of Last Calibration: 5 May, 2010 Validity: 4 June,2010 (For point of installation of the following see Annex 3) Type: Gas Flowmeter to HRSGs (FT-12) Measuring Method :Orifice Plate d/p cell Transmitter Model No : IDP10-T22B21F-M1 Serial number: 8470125 Instrument Range: 0 ~ 2500 mmH2O Instrument Vendor Defined Accuracy: ± 0.13 % Make :FOXBORO ,USA Calibration frequency: monthly Date of last calibration: 3 May, 2010 Validity: 2 June ,2010 Type : Natural gas to HRSGs pressure Sensor (PT-10) Measuring Method : Gauge Pressure Transmitter Model No : IGP10-T22D1F-M1L1V3 Serial No : 08470117 Instrument Range: 0 ~ 20 Barg Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration Frequency : Monthly. Date of Last Calibration: 3 May, 2010

	Validity: 2 June,2010 Type : Natural gas to HRSGs Temperature Sensor (TT-10) Measuring Method : RTD , 4-Wire PT-100 Temperature Transmitter Model No : RTT15-T1ER4TXF Serial No : 08470023 Instrument Range: 0 ~ 55 DegC Instrument Vendor Defined Accuracy: ± 0.10 % Make : FOXBORO ,USA Calibration Frequency : Monthly. Date of Last Calibration: 3 May, 2010 Validity: 2 June,2010 Type : Gas Flowmeter (Old Power House) FT-1501 Measuring Method :Orifice Plate d/p cell Transmitter Model No : NDP22-2222 Serial No : 114.9166.0450.4 Instrument Range: 0 ~ 6400 mmH2O Instrument Vendor Defined Accuracy: ± 0.5 % Make :YAMATAKE-HONEYWELL, JAPAN Calibration Frequency : 5 Months Date of Last Calibration: 26 February,2010. Validity: 10 July,2010 Standards used: ISO-5167 Responsible person: plant manager **Calibration procedures:** Metering devices are flow calibrated as part of the manufacturing process. The purpose of this calibration is to determine a calibration factor which is applied to the flow calculations as an adjustment to correct for bias error from the ISO-5167 discharge coefficient equations. Accuracy of measurement: +/- 2.5%
Measuring/Recording frequency:	Measurement interval: gas volume will be recorded continuously; conversion to energy on monthly basis via official calorific value of gas supplier Values are recorded every two hours
Calculation method (if applicable):	Formula: (Daily average gas consumption of all GTs in Nm^3/h + Daily average gas consumption of all HRSGs in Nm^3/h)*24h = Natural gas consumption of cogen plant (V_{NG}) in Nm^3/day The CEO is calculated for each day. These daily results are aggregated for each month. Please refer to log sheets excel file For method of temperature and pressure compensation see Annex 9.
QA/QC procedures applied:	Regular monthly meter checks and signed off records by plant manager; monthly data will be collected and stored both electronically and on paper; before compiling the annual monitoring reports, data will be cross-checked on consistency.

Data / Parameter:	Natural gas Calorific values (NCV_{NG} ; GCV_{NG})
Data unit:	kJ/Nm³ (Nm³ based on 15.55°C 1.010 bar)
Description:	The cogen plant will use natural gas to be fired in the gas turbines and the supplementary firing of the HRSGs. The Net Calorific Value NCV_{NG} will be used to calculate the annual natural gas consumption AEC_{NG} in TJ/yr
Measured /Calcuated / Default:	GCV: invoice of gas supplier, NCV: Calculated
Source of data:	Monthly invoices by gas supplier for GCV – NCV. Please refer to Annex 6, 7 and 8 Calorific Values mentioned in the log sheets are not used for the calculation.
Value(s) of monitored parameter:	GCV in BTU/Sft³: Dec 917, Jan 915, Feb 919, March 918, April 918, May 918 NCV in kJ/Nm³ based on based on 15.55°C and 1.010 bar: Dec 30,773.46, Jan 30814.44, Feb 30,847.97, March 30,814.44, April 30,810.71, May 30,814.44
Indicate what the data re used for (Baseline/Project/Leakage emission calcualtion)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	**Method and equipment:** - Standards used: ISO 6976: Natural gas -- Calculation of calorific values, density, relative density and Wobbe index from composition Responsible person: plant manager The calculation procedure according to ISO6976 is described in Annex 6. **Calibration procedures:** -
Measuring/Recording frequency:	Measurement interval: official calorific value of gas supplier provided on monthly basis by invoice for natural gas
Calculation method (if applicable):	--
QA/QC procedures to be applied:	Regular monthly records and cross checks by plant manager; monthly data will be collected and stored both electronically and on paper.

Data / Parameter:	Fate of electricity generated by baseline dedicated power plant
Data unit:	MWh
Description:	Represents the level of utilization of the baseline dedicated power plant
Measured /Calcuated / Default:	Measured
Source of data:	On-site check as long as old power plant is not scrapped
Value(s) of monitored parameter:	as absolute value and percentage compared to electricity generated by the project activity cogeneration plant
Indicate what the data re used for (Baseline/Project/Leakage emission calcualtion)	The project proponent is aware of the special note included in the monitoring methodology. It is planned to put the existing power plant out of regular operation, and to use it only as back-up plant when the new cogeneration plant as planned or unplanned outages. The project proponent will show in each Verification report the electricity produced by the baseline dedicated power plant, and indicate that during their operation the new co-generation plant has not been available. It will be also shown that the baseline dedicated power plant generation has been reduced by at least the same amount as the electricity generated by the project activity cogeneration plant (which has to be corrected for the increased capacity and demand). If for some reasons, this should not be the case, the credits for the electricity generation will be reduced to the equivalent of excess electricity produced by the baseline dedicated power plant, but takeing the demand increase into consideration. The project proponent will provide such reports as long as the old power plant will not be scrapped. In case the old plant will be scrapped, sufficient evidence will be provided to the Verifying DOE.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity	(For point of installation of the following see Annex 5) Type: electricity meters (Steam Turbo Generator-1) Model No :Simeas P50 Serial number: BF0808095703 Calibration frequency: 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008(factory calibrated) Validity: 22-01-2011 Type: electricity meters (Steam Turbo Generator -2) Model No :Simeas P50 Serial number: BF0808095704 Calibration frequency: 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008(factory calibrated) Validity: 22-01-2011 Type: electricity meters (Steam Turbo Generator -3) Model No :Simeas P50 Serial number: BF0808095709 Calibration frequency: 2 Yearly Commissioning Date: 22-01-2009 Date of last calibration: 26-08-2008(factory calibrated) Validity: 22-01-2011
Measuring/Recording frequency:	Every second year
Calculation method (if applicable):	--
QA/QC procedures to be applied:	Regular monthly meter checks and signed off records by plant manager

SECTION E. Emission reduction calculation

E.1. Baseline emission calculation:

The formulae, calculation and calculation procedure can be found in section D2, log sheets (excel file) and Monitoring protocol (excel file).

The baseline emissions are determined by *ex-post* monitoring of electricity and heat generation, and *ex-ante* calculation of the efficiencies for separate generation of electricty and heat in the baseline situation. The consumption of the fuel avoided in the baseline for the supply of heat is determined as follows:

Baseline emissions of CO_2 from combustion of baseline fuel for heat supply:

The energy consumption for heat supply at baseline plant $ABEC_{BF}$ (TJ) for the monitoring period is calculated accroding to following formula:

$ABEC_{BF,th} = CAHO \times FR_{th}$		**(3.1)**
Where:		
CAHO *(TJ)*	=	cogeneration system heat output in monitoring period
FR_{th} *(GJ_{NCV}/GJ_{th})*	=	fuel rate for heat of the existing power station

The CAHO is determined based on daily log sheets (2h resolution).
On a daily basis the difference ot the heat content of the steam minus the heat content of the returned condensate and minus the heat content of the make up water to balance the condensate losses is calcualted. In a second step the delivered daily heat content is summarized to a monthly value.
The energy consumption for heat supply at baseline plant ($ABEC_{BF,\ th}$) is determined *ex-post* by monitoring of cogeneration heat output (CAHO) and multiplication with the fuel rate for heat (FR_{tH}) of the existing power station. The following table shows the calculation and results of the $ABEC_{BF\ th}$:

Baseline energy consumption for heat supply ($ABEC_{BF,\ th}$)

Year	Month	CAHO (TJ)	FR_{th} (GJ_{NCV}/GJ_{th})	$ABEC_{BF,\ th}$ (TJ)
2009	December 2009	53.35	1.10	58.68
2010	January 2010	26.90	1.10	29.59
	February 2010	126.38	1.10	139.02
	March 2010	181.56	1.10	199.72
	April 2010	182.11	1.10	200.32
	May 2010	182.53	1.10	200.78
Total in Monitoring Period		752.84		828.12

Source: calculated from daily log sheets, Pakarab
FR_{th}: standard value as per section D.1 Monitoring Report / B.6.2 PDD
The formula and calculation of CAHO can be found in section D2 and in the log sheets (excel file)

The Baseline CO_2 emissions from combustion of baseline fuel for heat supply, BE_{th} (t CO_2) are calculated according to following formula:

$BE_{th} = ABEC_{BF,\ th} \times EF_{BF}$		**(3.3)**
Where:		
$ABEC_{FH}$ *(TJ)*	=	energy consumption for heat supply at baseline plant in monitoring period
EF_{BF} *(t CO_2/TJ)*	=	CO_2 emission factor of the fuel used to generate heat = EF_{NG}

According to the hierarchy for EF_{BF} as set by the applied AM0014, EF_{BF} will be determined according to the IPCC 2006 guidelines because no specific value from the National GHG inventory is available. Baseline CO_2 emissions from combustion of baseline fuel for heat supply (BE_{th}) is determined by multiplication of actual baseline fuel consumption for heat supply ($ABEC_{BF,\ th}$) with the CO_2 emission factor of the fuel used to generate heat (EF_{BF}) which is also known as EF_{NG}.

Baseline CO_2 emissons from combustion for heat supply (BE_{th})

Year	Month	$ABEC_{BF, th}$ (TJ)	$EF_{BF} = EF_{NG}$ (tCO_2/TJ)	BE_{th} (tCO_2)
2009	December 2009	58.7	56.1	3,292
2010	January 2010	29.6	56.1	1,660
	February 2010	139.0	56.1	7,799
	March 2010	199.7	56.1	11,204
	April 2010	200.3	56.1	11,238
	May 2010	200.8	56.1	11,264
Total in Monitoring Period		828.12		46,458

EF_{NG}: standard value as per section D.1 Monitoring Report / B.6 PDD

According to the PDD Section B 3. CH4 and N2O emissions are, for conservative reasons, not considered to calcualte the project emissions as well as the baseline emissions (please refer also to section D.3.).

Baseline emissions of CO_2 from electricity supply to industrial plant, that are offset by electricity supplied from cogeneration system:

Because PFL is not connected to the power grid, the baseline is the dedicated fossil fuel power plant. The consumption of the fuel avoided in the baseline for the supply of electricity is determined in accordance with the following formula:

Electricity displaced, that would have to be generated through dedicated fossil fuel power plant
Baseline carbon dioxide emissions for electricity supplied, $BE_{elec\ fossil\ fuel}$ (t CO_2):

$$BE_{elec\ fossil\ fuel} = CEO \times BEF_{elec\ fossil\ fuel} \quad \textbf{(3.11)}$$

Where:
CEO (*MWh*) = cogeneration electricity output in monitoring period
BEF $_{elec\ fossil\ fuel}$ (*t CO_2/MWh*) = baseline CO_2 emission factor for electricity from the dedicated fossil fuel power plant

The actual cogeneration electricity output (CEO) is determined *ex-post* by monitoring based on daily log sheets and monthly aggregated as follows:

Cogeneration system electricity output (CEO)

Year	Month	CEO (MWh)
2009	December 2009	4,064
2010	January 2010	2,639
	February 2010	8,683
	March 2010	11,457
	April 2010	11,262
	May2010	12,383
Total in Monitoring Period		50,487

Source: calculated from daily log sheets, Pakarab

Because there is only one dedicated power plant, which is fired by natural gas the formula 3.11 or 3.12 of PDD or 3.12 of AM0014 ist not applicable and formula 3.11 b and 3.11 c can be simplified as follows in order to calculate the baseline CO_2 emission factor for electricity from the dedicated fossil fuel power plant BEF $_{elec\ fossil\ fuel}$ (t CO_2/MWh):

$$BEF_{elec\ fossil\ fuel} = SEF_i = FR_{elec} \times EF_{BF}$$ **(3.11b and3.11c of PDD)**

Where:

FR_{elec} *(GJ/MWh)* = fuel rate for electricty of the existing steam turbine power station

$EF_{BF} = EF_{NG}$ *(t CO_2/TJ)* = CO_2 emission factor of the fuel used to generate heat (natural gas)

SEF_i =*(t CO_2/MWh)* specific CO_2 emission factor of the fossil fuel power generation sources

Baseline CO_2 emisson factor for electricity from fossil fuel power plant ($BEF_{elec\ fossil\ fuel}$ / SEF_i)

Year	Month	FR_{el} (GJ_{NCV}/MWh)	$EF_{BF} = EF_{NG}$ (tCO_2/TJ)	$BEF_{elec\ fossil\ fuel}$ SEF_i (tCO_2/MWh)
2009	December 2009	15.38	56.1	0.86
2010	January 2010	15.38	56.1	0.86
	February 2010	15.38	56.1	0.86
	March 2010	15.38	56.1	0.86
	April 2010	15.38	56.1	0.86
	May 2010	15.38	56.1	0.86

EF_{NG}/ FR_{el}: standard value as per section D.1 Monitoring Report / B.6 PDD

Baseline CO_2 emissions from combustion of baseline fuel for electricity supply (BE_{elec})

Year	Month	CEO (MWh)	$BEF_{elec\ fossil\ fuel}$ SEF_i (t CO_2/MWh)	BE_{elec} (t CO_2)
2009	December 2009	4,064	0.86	3,506
2010	January 2010	2,639	0.86	2,277
	February 2010	8,683	0.86	7,491
	March 2010	11,457	0.86	9,885
	April 2010	11,262	0.86	9,717
	May 2010	12,383	0.86	10,684
Total in Monitoring Period		50,487		43,561

The ex-post calculated baseline CO_2 emissions (BE_{total}) are given by the following formula:

$$BE_{total} = BE_{th} + BE_{elec}$$

Where:

BEt_h *(t CO_2)* = baseline CO_2 emissions from combustion of baseline fuel for heat supply in monitoring period

BE_{elec} *(t CO_2)* = baseline CO_2 emissions from combustion of baseline fuel for electricity supply in monitoring period

Ex-post calculated baseline CO_2 emissions (BE_{total})

Year	Month	BE_{th} (t CO_2)	BE_{elec} (t CO_2)	BE_{total} (t CO_2)
2009	December 2009	3,292	3,506.25	6,798
2010	January 2010	1,660	2,277.00	3,937
	February 2010	7,799	7,491.45	15,291
	March 2010	11,204	9,885.24	21,090
	April 2010	11,238	9,716.90	20,955
	May 2010	11,264	10,684.33	21,948
Total in Monitoring Period		46,458		90,019

Fate of electricity:

According to section D of this monitoring report and the PDD section B.7.1. and the AM0014 the fate of electricity . Electricity was produced by baseline plant from 6 February 2010 to 9 February 2010.

Fate of electricity generated by baseline dedicated power plant

Year	Month	Power generated by cogen plant (MWh)	Electricity generated by back up plant (MWh)	Fate of back up plant
2009	December 2009	4,064	-	0.0%
2010	January 2010	2,639	-	0.0%
	February 2010	8,683	217	2.5%
	March 2010	11,457	-	0.0%
	April 2010	11,262	-	0.0%
	May 2010	12,383	-	0.0%
Total in Monitoring Period		50,487	217	0.4%

Source: calculated from daily log sheets, Pakarab

The fate of electricity produced by the baseline dedicated power plant (back up plant) was monitored at about 0.4% of the production compared to the project activity. Therefore the main power source is the project activity and the baseline dedicated power plant was only running as a backup plant.

E.2. Project emission calculation:

The formulae, calculation and calculation procedure can be found in section D2, log sheets (excel file) and monitoring protocol (excel file).

The project emissions are calculated *ex-post* based on the gas consumption as measured and monitored by daily logsheets. Project emissions correspond to the consumption of natural gas by the cogeneration system. CO_2 emissions from combustion in the gas turbines and in the supplementary firing of the heat recovery steam generator are relevant. Carbon dioxide emissions from natural gas combustion in the cogeneration system, PE_{CS} (t CO_2) are calculated according to the following formula:

$$PE_{CS}* = AEC_{NG} \times EF_{NG} \qquad \textbf{(4.1)}$$

Where:

AEC_{NG} *(TJ)* = natural gas consumption in monitoring period

EF_{NG} *(t CO_2/TJ)* = CO_2 emission factor of natural gas

*: PE is used instead of E as acronym for Project Emissions as indicated in the methodology.

The natural gas consumption AEC_{NG} of the new cogeneration plant is calculated as follows:

$$AEC_{NG} = V_{NG} \times NCV_{NG} \times 10^{-9} \qquad \textbf{(4.1a)}$$

Where:

V_{NG} *(Nm³)* = annual natural gas consumption in monitoring period

NCV_{NG} *(kJ/Nm³)* = net calorific value of natural gas

From the daily log sheets (2h resolution) the daily average gas consumption is taken to calculate V_{NG} on an monthly basis. The natural gas consumtion during the monitoring period is stated in the figure below. The formula and calculation of the natural gas consumption can be found in section D2 and log sheets (excel file).

Natural gas consumption (V_{NG})

Year	Month	V_{NG} Total (Nm³)
2009	December 2009	2,621,686
2010	January 2010	2,216,072
	February 2010	6,343,238
	March 2010	9,005,130
	April 2010	9,095,249
	May 2010	9,721,726
Total Monitoring Period		39,003,101

Source: aggregated from daily log sheets, Pakarab

The gross calorific value (GCV_{NG}– BTU/SCF) is taken from the monthly invoices of the gas supplier. From this value the GCV and NCV of natural gas is converted and calcualted (in kJ/Nm³) – table below. The formula and caluclation procedure can be found in section D2 and Annex 6.

Natural gas calorific values (NCV, GCV)

Year	Month	GCV Invoice by SNGLP (BTU/Sft³)	GCV PFL Lab ISO-6976 (BTU/Sft³)	NCV PFL Lab ISO-6976 (BTU/Sft³)	NCV (GCV SNGPL*NCV PFL)/GCVPLF (BTU/Sft³)	NCV (to be used) (kJ/Nm³)
2009	December 2009	917.0	917.0	826.0	826.0	30,773.46
2010	January 2010	915.0	916.0	828.0	827.1	30,814.44
	February 2010	919.0	919.0	828.0	828.0	30,847.97
	March 2010	918.0	919.0	828.0	827.1	30,814.44
	April 2010	918.0	918.0	827.0	827.0	30,810.71
	May 2010	918.0	919.0	828.0	827.1	30,814.44

Source: taken from monthly invoices from gas supplier and GCV and NCV calculation procedure of PFL

Conversion factors: 1ft³ = 0.02832 m³ 1BTU = 1.0551 kJ

Energy consumption of natural gas in co-generation system (AEC_{NG})

Year	Month	V_{NG} (Nm³)	NCV (kJ/Nm³)	AEC_{NG} (TJ)
2009	December 2009	2,621,686	30,773.46	80.68
2010	January 2010	2,216,072	30,814.44	68.29
	February 2010	6,343,238	30,847.97	195.68
	March 2010	9,005,130	30,814.44	277.49
	April 2010	9,095,249	30,810.71	280.23
	May 2010	9,721,726	30,814.44	299.57
Total in Monitoring Period		39,003,101		1,201.93

Total project emissions PE_{total} (t CO_2) are given by the sum of the components analyzed above:

$$PE_{total} = PE_{CS} + PE_{equiv\ met\ comb} + PE_{equiv\ N2Ocomb} + PE_{equiv\ fug} \quad \textbf{(4.8)}$$

According to the PDD Section B 3., CH_4 and N_2O emissions are, for conservative reasons, not considered to calculate the project emissions as well as the baseline emissions (please refer also to section D.3.). Therefore,

$PE_{total} = PE_{CS}$

PE_{total} *(t CO_2)* = total project emissions in monitoring period

PE_{CS} *(t CO_2)* = CO_2 emissions from natural gas combustion in the cogeneration system in monitoring period

Project emissions from natural gas combustion in the cogeneration system (PE_{total})

Year	Month	AEC_{NG} (TJ)	EFng (tCO_2/TJ)	PEcs = PEtotal (tCO_2)
2009	December 2009	80.68	56.1	4,526
2010	January 2010	68.29	56.1	3,831
	February 2010	195.68	56.1	10,977
	March 2010	277.49	56.1	15,567
	April 2010	280.23	56.1	15,721
	May 2010	299.57	56.1	16,806
Total in Monitoring Period		1,201.93		67,428

EF_{NG}: standard value as per section D.1 Monitoring Report / B.6.2 PDD

E.3. Leakage calculation / Fate of electricity

According to the PDD Section B 3. CH_4 and N_2O emissions are, for conservative reasons, not considered to calculate the project emissions as well as the baseline emissions:
b) Methane emissions from natural gas combustion in cogeneration system are neglected.
c) Nitrous oxide emissions from natural gas combustion in cogeneration system are neglected.
d) Methane emissions from natural gas production and pipeline leaks in the transport and distribution of natural gas, including leakage within the industrial plant are neglected.

All these emissions will be smaller in the case of the project activity rather than the baseline situation, because the national gas consumption will be reduced.

Project emissions of CH_4 and N_2O as well as emissions from leaks by the production and distribution of the natural gas are lower than those of the baseline scenario due to the reduction in fuel consumption. Their consideration would result in a slightly higher reduction of emissions. As conservative approach they are not considered for the calculation of emissions reductions.

E.4. Emission reduction calculation / table:

The emission reductions are calculated as the difference between the baseline and the project emissions on annual basis. Fuel consumption, electricity and heat production of the cogeneration system are metered and monitored (see also Section B7.2).

$$ER = BE_{total} - PE_{total}$$

Total emission reductions (ER)

Year	Month	BE_{total} (t CO_2)	PE_{total} (t CO_2)	ER_{total} (t CO_2)
2009	December 2009	6,798	4,526	2,272
2010	January 2010	3,937	3,831	106
	February 2010	15,291	10,977	4,313
	March 2010	21,090	15,567	5,522
	April 2010	20,955	15,721	5,234
	May 2010	21,948	16,806	5,142
Total in Monitoring Period		90,019	67,428	22,590

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

According to the PDD the estimation of annual emission reductions is 119,481 tCO_2. Based on these annual emission reductions the expected emission reductions of the monitoring period (162 days) are 53,030 tCO_2.

Comparison expected emission reduction to real emisson reduction

Item		Ex-ante as per PDD	Ex-post as monitored	Difference
Total in Monitoring Period		53,030	22,590	30,439

E.6. Remarks on differences from estimated value in the PDD:

The actual production of the cogeneration plant (project activity) during the monitoring period was lower compared to the forecasted values in the PDD since plant was not in full operation during the entire period because it was Annual Turnaround from January 4, 2010 to Feb 6, 2010. More over during this monitoring period there was Gas curtailment from the Gas supplier and COGEN CER were forecast for plant peak load of 22.5 MW but actually average plant load remained below 18.5 MWH during this monitoring period.

Annex 1: Calibration Report and Instrumentation List:

1/12/ 2009 TO 31/5/2010

S.NO	INSTRUMENT TAG NO	CALIBRATION DATE	% Minimum Error Found	% Maximum Error Found	CALIBRATION FREQUENCY	NEXT CALIBRATION DUE DATE	% ACCEPT-ABLE ERROR (Acc. PDD)
1	*FT-08*	5-Dec-2009	0	0.06	*Monthly*	4-Jan-2010	± 2.5
		4-Jan-2010	-0.06	0.06	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	0	0.06	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	-0.06	0.06	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	-0.06	0.06	*Monthly*	5-May-2010	± 2.5
		5-May-2010	0	0.06	*Monthly*	4-Jun-2010	± 2.5
2	*PT-05*	5-Dec-2009	0	0	*Monthly*	4-Jan-2010	± 2.5
		4-Jan-2010	0	0	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	0	0	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	0	0	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	0	0	*Monthly*	5-May-2010	± 2.5
		5-May-2010	0	0	*Monthly*	4-Jun-2010	± 2.5
3	*TT-05*	5-Dec-2009	-0.06	0.06	*Monthly*	4-Jan-2010	± 2.5
		4-Jan-2010	-0.06	0	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	-0.06	0	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	-0.06	0	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	-0.06	0	*Monthly*	5-May-2010	± 2.5
		5-May-2010	-0.06	0	*Monthly*	4-Jun-2010	± 2.5
4	*FT-09*	5-Dec-2009	0	0.06	*Monthly*	4-Jan-2010	± 2.5
		5-Jan-2010	0	0.06	*Monthly*	4-Feb-2010	± 2.5
		4-Feb-2010	0	0.12	*Monthly*	6-Mar-2010	± 2.5
		8-Mar-2010	0.06	0.06	*Monthly*	7-Apr-2010	± 2.5
		7-Apr-2010	0.06	0.12	*Monthly*	7-May-2010	± 2.5
		7-May-2010	0.06	0.12	*Monthly*	6-Jun-2010	± 2.5
5	*TT-06*	2-Dec-2009	-0.06	0	*Monthly*	1-Jan-2010	± 2.5
		1-Jan-2010	-0.06	0	*Monthly*	31-Jan-2010	± 2.5
		1-Feb-2010	-0.06	0	*Monthly*	3-Mar-2010	± 2.5
		3-Mar-2010	-0.06	0	*Monthly*	2-Apr-2010	± 2.5
		2-Apr-2010	-0.06	0	*Monthly*	2-May-2010	± 2.5
		3-May-2010	-0.06	0	*Monthly*	2-Jun-2010	± 2.5
6	*PT-06*	4-Dec-2009	0	0	*Monthly*	3-Jan-2010	± 2.5
		4-Jan-2010	0	0	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	0	0	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	0	0	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	0	0	*Monthly*	5-May-2010	± 2.5
		5-May-2010	0	0	*Monthly*	4-Jun-2010	± 2.5

1/12/ 2009 TO 31/5/2010

S.NO	INSTRUMENT TAG NO	CALIBRATION DATE	% Minimum Error Found	% Maximum Error Found	CALIBRATION FREQUENCY	NEXT CALIBRATION DUE DATE	% ACCEPT-ABLE ERROR (Acc. PDD)
7	*FT-05*	6-Dec-2009	0	0.06	*Monthly*	5-Jan-2010	± 2.5
		5-Jan-2010	0	0.06	*Monthly*	4-Feb-2010	± 2.5
		4-Feb-2010	-0.06	0.12	*Monthly*	6-Mar-2010	± 2.5
		8-Mar-2010	0.06	0.06	*Monthly*	7-Apr-2010	± 2.5
		7-Apr-2010	0.06	0.12	*Monthly*	7-May-2010	± 2.5
		7-May-2010	0.06	0.12	*Monthly*	6-Jun-2010	± 2.5
8	*TT-02*	2-Dec-2009	0	0	*Monthly*	1-Jan-2010	± 2.5
		1-Jan-2010	-0.06	0	*Monthly*	31-Jan-2010	± 2.5
		1-Feb-2010	-0.06	0	*Monthly*	3-Mar-2010	± 2.5
		3-Mar-2010	-0.06	0	*Monthly*	2-Apr-2010	± 2.5
		2-Apr-2010	-0.06	0	*Monthly*	2-May-2010	± 2.5
		3-May-2010	-0.06	0	*Monthly*	2-Jun-2010	± 2.5
9	*FT-01*	4-Dec-2009	0	0.06	*Monthly*	3-Jan-2010	± 2.5
		4-Jan-2010	-0.06	0.06	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	0	0.06	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	0	0.06	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	-0.06	0.06	*Monthly*	5-May-2010	± 2.5
		5-May-2010	0	0.12	*Monthly*	4-Jun-2010	± 2.5
10	*FT-12*	1-Dec-2009	-0.06	0	*Monthly*	31-Dec-2009	± 2.5
		1-Jan-2010	0	0.06	*Monthly*	31-Jan-2010	± 2.5
		1-Feb-2010	0	0.12	*Monthly*	3-Mar-2010	± 2.5
		3-Mar-2010	0	0.12	*Monthly*	2-Apr-2010	± 2.5
		2-Apr-2010	0	0.12	*Monthly*	2-May-2010	± 2.5
		3-May-2010	0	0.06	*Monthly*	2-Jun-2010	± 2.5
11	*FT-1501*	10-Jul-2009	0	0	*5- Months*	26-Feb-2010	± 2.5
		26-Feb-2010	0	0	*5- Months*	10-Jul-2010	± 2.5

1/12/ 2009 TO 31/5/2010

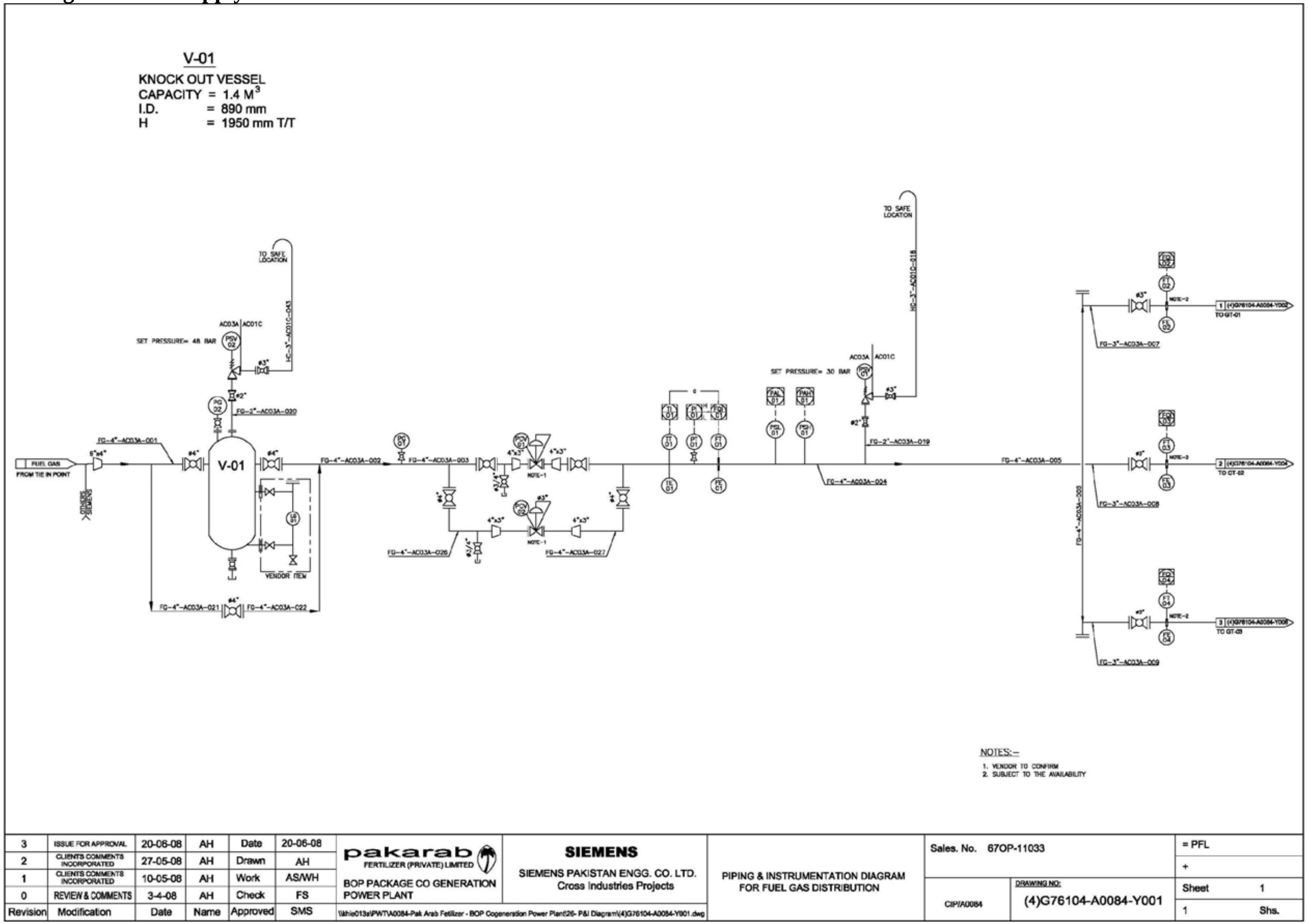
S.NO	INSTRUMENT TAG NO	CALIBRATION DATE	% Minimum Error Found	% Maximum Error Found	CALIBRATION FREQUENCY	NEXT CALIBRATION DUE DATE	% ACCEPT-ABLE ERROR (Acc. PDD)
12	*PT-01*	4-Dec-2009	0	0	*Monthly*	3-Jan-2010	± 2.5
		4-Jan-2010	0	0	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	0	0	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	0	0	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	0	0	*Monthly*	5-May-2010	± 2.5
		5-May-2010	0	0	*Monthly*	4-Jun-2010	± 2.5
		4-Jun-2010	-0.06	0	*Monthly*	4-Jul-2010	± 2.5
13	*TT-01*	4-Dec-2009	-0.06	0	*Monthly*	3-Jan-2010	± 2.5
		4-Jan-2010	0	0	*Monthly*	3-Feb-2010	± 2.5
		3-Feb-2010	-0.06	0	*Monthly*	5-Mar-2010	± 2.5
		5-Mar-2010	-0.06	0	*Monthly*	4-Apr-2010	± 2.5
		5-Apr-2010	-0.06	0	*Monthly*	5-May-2010	± 2.5
		5-May-2010	-0.06	0	*Monthly*	4-Jun-2010	± 2.5
		4-Jun-2010	-0.06	0	*Monthly*	4-Jul-2010	± 2.5
14	*PT-10*	1-Dec-2009	0	0	*Monthly*	31-Dec-2009	± 2.5
		1-Jan-2010	0	0	*Monthly*	31-Jan-2010	± 2.5
		1-Feb-2010	0	0	*Monthly*	3-Mar-2010	± 2.5
		3-Mar-2010	0	0	*Monthly*	2-Apr-2010	± 2.5
		2-Apr-2010	0	0	*Monthly*	2-May-2010	± 2.5
		3-May-2010	0	0	*Monthly*	2-Jun-2010	± 2.5
		2-Jun-2010	0	0.06	*Monthly*	2-Jul-2010	± 2.5
15	*TT-10*	1-Dec-2009	0	0	*Monthly*	31-Dec-2009	± 2.5
		4-Jan-2010	-0.06	0	*Monthly*	3-Feb-2010	± 2.5
		1-Feb-2010	-0.06	0	*Monthly*	3-Mar-2010	± 2.5
		3-Mar-2010	-0.06	0	*Monthly*	2-Apr-2010	± 2.5
		2-Apr-2010	-0.06	0.06	*Monthly*	2-May-2010	± 2.5
		3-May-2010	-0.06	0	*Monthly*	2-Jun-2010	± 2.5
		2-Jun-2010	-0.06	0	*Monthly*	2-Jul-2010	± 2.5

CDM - COGEN INSTRUMENTS LIST

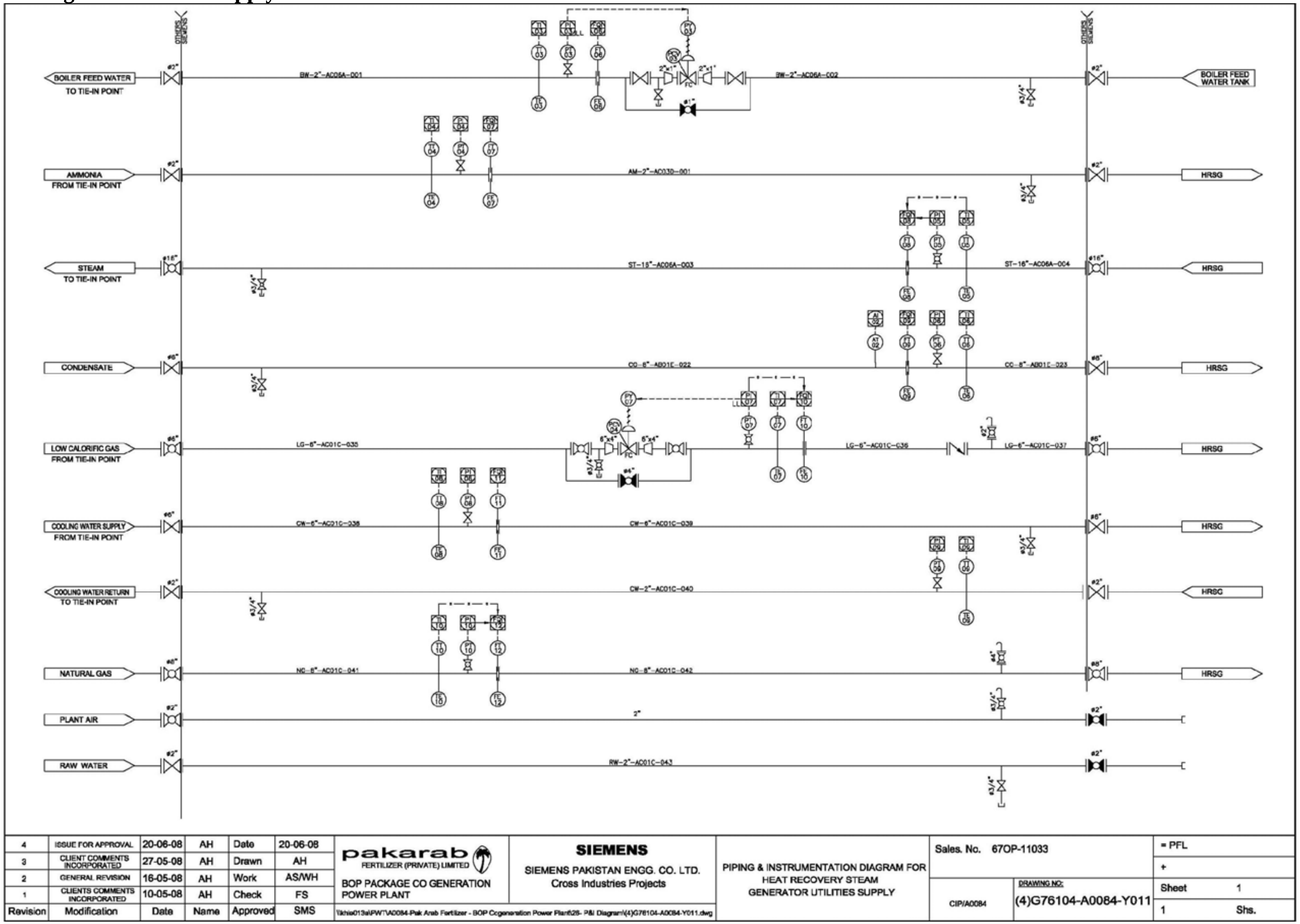
S.NO	TAG	SERVICE	MEASURING RANGE	PM FREQUENCY	PFL PROCEDURE #
1	FT-08	Steam Flow.	0 ~ 5000 mmH2O	Monthly	INS - WI - IMS - 011 Rev 01
2	PT-05	Steam Pressure.	0 ~ 60 Barg	Monthly	INS - WI - IMS - 011 Rev 01
3	TT-05	Steam Common Header Temp.	0 ~ 450 DegC	Monthly	INS - WI - IMS – 006 Rev 01
4	FT-09	Condensate Flow.	0 ~ 2500 mmH2O	Monthly	INS - WI - IMS – 011 Rev 01
5	TT-06	Condensate temp	0 ~ 200 DegC	Monthly	INS - WI - IMS – 006 Rev 01
6	PT-06	Condensate pressure	0 ~ 10 Barg	Monthly	INS - WI - IMS - 011 Rev 01
7	FT-05	Demin Water Flow.	0 ~ 2500 mmH2O	Monthly	INS - WI - IMS - 011 Rev 01
8	TT-02	Demin water Temperature	0 ~ 100 DegC	Monthly	INS - WI - IMS - 006 Rev 01
9	FT-01	Total Gas Flow on GTG's	0 ~ 5000 mmH2O	Monthly	INS - WI - IMS - 011 Rev 01
10	FT-12	Total Gas Flow to HRSG's	0 ~ 2500 mmH2O	Monthly	INS - WI - IMS – 011 Rev 01
11	FT-1501	Common gas flow at old power house	0 ~ 6400 mmH2O	5- Months	INS - WI - IMS - 019 Rev 01
12	PT-01	Natural Gas to GTGs Pressure.	0 ~ 60 Barg	Monthly	INS - WI - IMS – 011 Rev 01
13	TT-01	Natural Gas to GTGs Temperature.	0 ~ 55 DegC	Monthly	INS - WI - IMS – 006 Rev 01
14	PT-10	Natural Gas to HRSGs Pressure.	0 ~ 20 Barg	Monthly	INS - WI - IMS - 011 Rev 01
15	TT-10	Natural Gas to HRSGs Temperature.	0 ~ 55 DegC	Monthly	INS - WI - IMS - 006 Rev 01

Sr. No.	Installation Location	Energy Meter Data				Commissioning Date	Calibration Frequency	Next Due date
		Model	Serial no.	Make	Factory Calibration Date			
1	C4 - Gas Turbine Generator no.1	Simeas P50	BF0808095705	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
2	C10 - Gas Turbine Generator no.2	Simeas P50	BF0808095712	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
3	C16 - Gas Turbine Generator no.3	Simeas P50	BF0808095707	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
4	Steam Turbine Generator no.1	Simeas P50	BF0808095703	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
5	Steam Turbine Generator no.2	Simeas P50	BF0808095704	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
6	Steam Turbine Generator no.3	Simeas P50	BF0808095709	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
7	C11 – Emergency Diesel Generator	Simeas P50	BF0808095702	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
8	C6 - Station Transformer no.1	Simeas P50	BF0808095710	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011
9	C14 – Station Transformer no.2	Simeas P50	BF0808095706	Siemens	26-8-08	22-1-09	2 yearly	22-1-2011

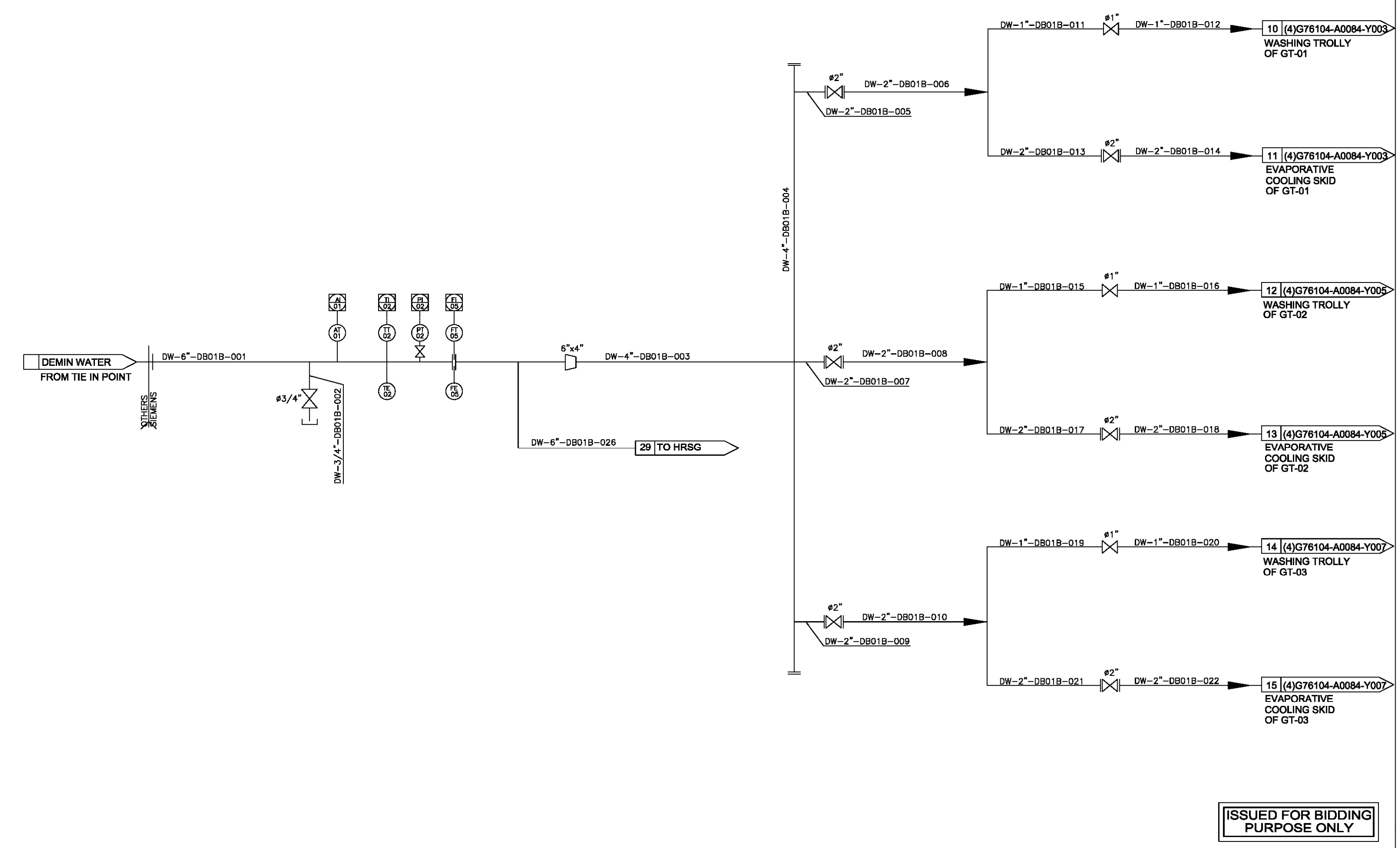
Annex 2: P&I Diagram – Gas supply to GTGs:



Annex 3: P&I Diagram – HRSGs supply:



Annex 4: P&I Diagram – Demin Water supply:



Revision	Modification	Date	Name	Approved		
4	ISSUE FOR APPROVAL	20-06-08	AH	Date	20-06-08	
3	CLIENTS COMMENTS INCORPORATED	09-06-08	AH	Drawn	AH	
2	CLIENTS COMMENTS INCORPORATED	27-05-08	AH	Work	AS/WH	
1	CLIENTS COMMENTS INCORPORATED	10-05-08	AH	Check	FS	
					SMS	

pakarab FERTILIZER (PRIVATE) LIMITED
BOP PACKAGE CO GENERATION POWER PLANT

SIEMENS
SIEMENS PAKISTAN ENGG. CO. LTD.
Cross Industries Projects

PIPING & INSTRUMENTATION DIAGRAM FOR DEMIN WATER

Sales. No. 67OP-11033

CIP/A0084

DRAWING NO: (4)G76104-A0084-Y008

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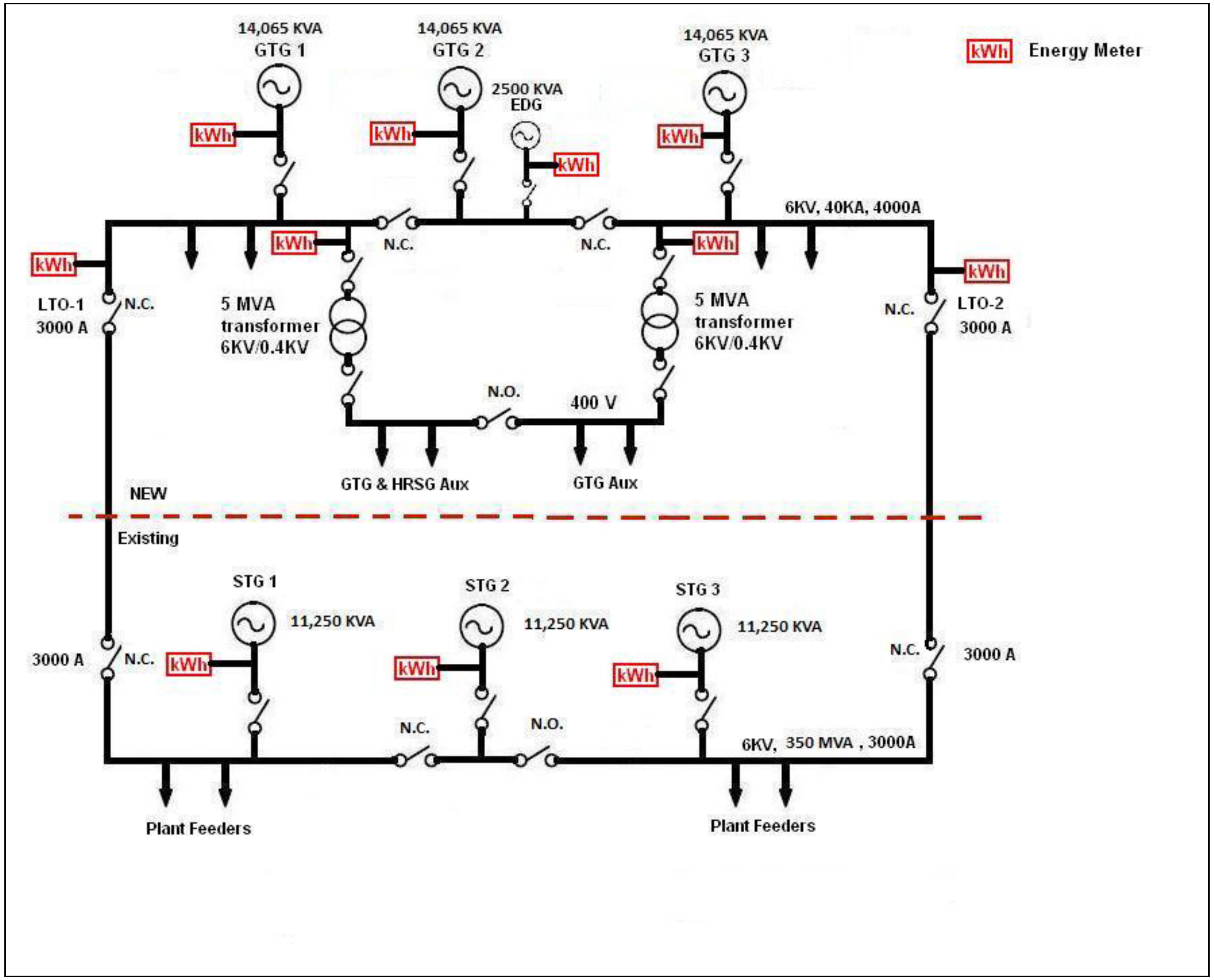
Sheet 1
1 Shs.

\\khie013a\PWT\A0084-Pak Arab Fertilizer - BOP Cogeneration Power Plant\26- P&I Diagram\(4)G76104-A0084-Y008.dwg

Annex 5: Simplified Interconnection Diagram:



Annex 6: GCV and NCV Calculation Procedure according to ISO 6976:

Description:

Gas Analysis on Volumetric Percentage Basis are done on the Apparatus of Gas Chromatograph for Argon (Ar), Carbon Di-oxide (CO_2), Nitrogen (N_2), Methane (CH_4), Ethane (C_2H_6), Propane (C_3H_8), n-Butane (C_4H_{10}) and n-Pentane (C_5H_{12}).

Apparatus Used:	Name	:	Gas Chromatograph (GC-1400)
	Manufacturer	:	Varian Aerograph
	Model #	:	142010-01

Formulas Used: **(**As per Standard ISO-6976**)**

$\tilde{H}\,[t_1,V(t_2,p_2)] = \Sigma(\tilde{H}_i^o\,[t_1,V(t_2,p_2)] \times x_i)$

Where,	$\tilde{H}\,[t_1,V(t_2,p_2)]$	=	Real-gas Calorific Value on volumetric basis (either superior (GCV) or inferior (NCV);
	$V(t_2,p_2)$	=	Volume of Natural Gas at Temperature t_2 and Pressure p_2
	x_i	=	Volumetric Composition of each Hydrocarbon in BTU/SCF
	$\tilde{H}_i^{15.5}\,[t_1,V(t_2,p_2)]$	=	Calorific Value of component i at combustion temperature t_1 and Volume $V(t_2,p_2)$
	t_1	=	15.00 °C
	t_2	=	15.55 °C (60 °F)
	p_2	=	14.65 psia
	i	=	it refers to all Hydrocarbon Gases (Methane, Ethane, Propane, n-Butane and n-Pentane)

Month-Year	**GCV ; BTU / S ft^3**		**NCV; BTU / Sft^3**	**NCV; BTU / Sft^3**	**NCV to be used; KJ / Sm^3 ***
	By SNGPL	*By PFL as per ISO-6976*	*By PFL Lab as per ISO-6976*	*By SNGPL * PFL NCV/PFL GCV*	*By SNGPL * PFL NCV/PFL GCV*
Dec-09 (21st to 31st)	917	917	826	826	30773.46
Jan-10	915	916	828	827.1	30814.44
Feb-10	919	919	828	828	30847.97
Mar-10	918	919	828	827.1	30814.44
April-10	918	918	827	827	30810.71
May-10	918	919	828	827.1	30814.44

*Conversion Factor s: 1 ft^3 = 0.02832 m^3
1 BTU = 1.0551 KJ

Where, each components calorific values (at Combustion Temperature (°C) / Metering Temperature (°C)) are given in the table below:

Gas Component	**Calorific Value (in KJ / m^3)**	
	15 / 15** **(**at 14.696 psia**)**	**15/15.5** **(**at 14.65 psia**)*****
Methane	33,948	**33,777**
Ethane	60,430	**60,125**
Propane	86,420	**85,984**
n-Butane	112,400	**111,833**
n-Pentane	138,380	**137,681**

** ISO-6976 standard has provided all values at 15 °C temperature and 14.696 psia pressure, but our supplier has given at 15.5 °C and 14.650 psia pressure.

*** All values are simply multiplied with pressure ratio factor (14.65 psia / 14.696 psia) and Temperature ratio factor (288.15 Kelvin / 288.65Kelvin).

Annex 7: Invoices of Gas supplier SNGPL:

SUI NORTHERN GAS PIPELINES LIMITED

PIRAN GHAIB ROAD, MULTAN.

INVOICE - INDUSTRIAL

FOR COST NATURAL GAS SOLD TO
PAKARAB FERTILIZERS (PVT) LTD. ,
KHANEWAL ROAD,
MULTAN.

G.S.T No: 03-91-9999-967-19

DUE DATE : 15.01.2010

CONSUMER No: 11/0010-003

BILLING PERIOD: FROM: 01.12.2009 TO: 31.12.2009

ISSUE DATE : 01.10.2010

CONSUMER GST No : 04-07-2806-001-91

BILLING DEPARTMENT SNGPL MULTAN REGION

CONSUMPTION CATEGORY	GROSS CALORIFIC VALUE IN BTU/SCF	CORRECTED VOLUME		TOTAL	RATE	DESCRIPTION	AMOUNT
		MCF	HM^3	MMBTU	Rs/MMBTU		Rs.
FEED STOCK	917	1286662	362502	1179858	102.01	GAS CHARGES	120,358,335
FUEL STOCK	917	361305	101794	331318	324.30	GAS CHARGES	107,446,427
						METER RENT	6,000
DETAILS OF LPS:						SUB TOTAL	227,810,762
						GST (16%)	36,449,722
						ADJUSTMENT	-
				AMOUNT FOR THE MONTH			264,260,484
				ARREARS			-
				LATE PAYMENT SURCHARGE			-
				Total Amount Due			264,260,484

Bill is verified,
Gas metering checked,
Payment may be released

Asifa Saleem (?)

QKJ
Jan 6/2010

(MUHAMMAD SHAHID JAVED)
REGIONAL BILLING INCHARGE

SUI NORTHERN GAS PIPELINES LIMITED

PIRAN GHAIB ROAD, MULTAN.

INVOICE - INDUSTRIAL

FOR COST NATURAL GAS SOLD TO
PAKARAB FERTILIZERS (PVT) LTD. ,
KHANEWAL ROAD,
MULTAN.

G.S.T No: 03-91-9999-967-19

REVISED

DUE DATE : 15.02.2010

CONSUMER No: 11/0010-003 BILLING PERIOD: FROM 01.01.2010 TO: 31.01.2010 ISSUE DATE : 01.02.2010

CONSUMER GST No : 04-07-2806-001-91

BILLING DEPARTMENT SNGPL MULTAN REGION

CONSUMPTION CATEGORY	GROSS CALORIFIC VALUE IN BTU/SCF	CORRECTED VOLUME MCF	CORRECTED VOLUME HM^3	TOTAL MMBTU	RATE Rs/MMBTU	DESCRIPTION	AMOUNT Rs.
FEED STOCK	915	131976	37183	120759	102.01	GAS CHARGES	12,318,626
FUEL STOCK	915	105565	29742	96593	382.37	GAS CHARGES	36,934,265
						METER RENT	6,000
DETAILS OF LPS:						SUB TOTAL	49,258,891
						GST (16%)	7,881,423
						ADJUSTMENT	-
				AMOUNT FOR THE MONTH			57,140,314
AMOUNT OF DEFAULT	DUE DATE	LPS @ 18% UPTO	NO. OF DEFAULT DAYS	ARREARS			-
264,260,484	15/01/2010	31/01/2010	16	LATE PAYMENT SURCHARGE			2,085,124
				Total Amount Due			**59,225,438**

Bill verified, Payment may be released. / [illegible] 6/2/10

OK. Approved for payment. [illegible] 6/2/10

Khurram

(MIRZA KHURRAM BAIG)
REGIONAL BILLING INCHARGE

SUI NORTHERN GAS PIPELINES LIMITED

PIRAN GHAIB ROAD, MULTAN.

INVOICE - INDUSTRIAL

FOR COST NATURAL GAS SOLD TO

PAKARAB FERTILIZERS (PVT) LTD. ,

KHANEWAL ROAD,

MULTAN.

G.S.T No: 03-91-9999-967-19

DUE DATE : 15.03.2010

CONSUMER No: 11/0010-003

BILLING PERIOD: FROM 01.02.2010 TO: 28.02.2010

ISSUE DATE : 01.03.2010

CONSUMER GST No : 04-07-2806-001-91

BILLING DEPARTMENT SNGPL MULTAN REGION

CONSUMPTION CATEGORY	GROSS CALORIFIC VALUE IN BTU/SCF	CORRECTED VOLUME		TOTAL	RATE	DESCRIPTION	AMOUNT
		MCF	HM^3	MMBTU	Rs/MMBTU		Rs.
FEED STOCK	919	1112603	313463	1022482	102.01	GAS CHARGES	104,303,389
FUEL STOCK	919	263511	74241	242166	382.37	GAS CHARGES	92,597,013
						METER RENT	6,000
						SUB TOTAL	196,906,402
						GST (16%)	31,505,024
						ADJUSTMENT	-
				AMOUNT FOR THE MONTH			228,411,426
				ARREARS			-
				LATE PAYMENT SURCHARGE			390,961
				Total Amount Due			**228,802,387**

DETAILS OF LPS:

AMOUNT OF DEFAULT	NO. OF DEFAULT DAYS	LPS @
264,260,484	3	18%

Bill is verified,
Gas metering checked,
Payment may be released.

01/03/2010

01/03

(MUHAMMAD SHAHID JAVED)

REGIONAL BILLING INCHARGE

SUI NORTHERN GAS PIPELINES LIMITED

PIRAN GHAIB ROAD, MULTAN.

INVOICE - INDUSTRIAL

FOR COST NATURAL GAS SOLD TO
PAKARAB FERTILIZERS (PVT) LTD. ,
KHANEWAL ROAD,
MULTAN.

G.S.T No: 03-91-9999-967-19

DUE DATE : 15.04.2010

CONSUMER No: 11/0010-003 BILLING PERIOD: FROM: 01.03.2010 TO: 31.03.2010 ISSUE DATE : 01.04.2010

CONSUMER GST No : 04-07-2806-001-91

CONSUMPTION CATEGORY	GROSS CALORIFIC VALUE IN BTU/SCF	CORRECTED VOLUME MCF	CORRECTED VOLUME HM^3	TOTAL MMBTU	RATE Rs/MMBTU	DESCRIPTION	AMOUNT Rs.
FEED STOCK	918	1332127	375311	1222891	102.01	GAS CHARGES	124,747,111
FUEL STOCK	918	337418	95064	309751	382.37	GAS CHARGES	118,439,490
						METER RENT	6,000
DETAILS OF LPS:						SUB TOTAL	243,192,601
						GST (16%)	38,910,816
						ADJUSTMENT	-
						AMOUNT FOR THE MONTH	282,103,417
						ARREARS	-
						LATE PAYMENT SURCHARGE	-
						Total Amount Due	**282,103,417**

Bill is verified.
Gas metering checked.
3/4/2010
Aijaz Batool

(MUHAMMAD SHAHID JAVED)

REGIONAL BILLING INCHARGE

SUI NORTHERN GAS PIPELINES LIMITED

PIRAN GHAIB ROAD, MULTAN.

INVOICE - INDUSTRIAL

FOR COST NATURAL GAS SOLD TO

PAKARAB FERTILIZERS (PVT) LTD. ,

KHANEWAL ROAD,

MULTAN.

G.S.T No: 03-91-9999-967-19

DUE DATE : 17.05.2010

CONSUMER No: 11/0010-003

BILLING PERIOD: FROM: 01.04.2010 TO: 30.04.2010

ISSUE DATE : 03.05.2010

CONSUMER GST No : 04-07-2806-001-91

CONSUMPTION CATEGORY	GROSS CALORIFIC VALUE IN BTU/SCF	CORRECTED VOLUME MCF	HM³	TOTAL MMBTU	RATE Rs/MMBTU	DESCRIPTION	AMOUNT Rs.
FEED STOCK	918	1263884	356085	1160246	102.01	GAS CHARGES	118,356,694
FUEL STOCK	918	347880	98011	319353	382.37	GAS CHARGES	122,111,007
						METER RENT	6,000
DETAILS OF LPS:						SUB TOTAL	240,473,701
						GST (16%)	38,475,792
						ADJUSTMENT	-
				AMOUNT FOR THE MONTH			278,949,493
				ARREARS			-
				LATE PAYMENT SURCHARGE			-
				Total Amount Due			278,949,493

Bill is verified. Gas metering checked.
Raja Batool
4/5/2010

OK
5/5/

MULTAN

(MUHAMMAD SHAHID JAVED)
REGIONAL BILLING INCHARGE

SUI NORTHERN GAS PIPELINES LIMITED

PIRAN GHAIB ROAD, MULTAN.

INVOICE - INDUSTRIAL

FOR COST NATURAL GAS SOLD TO
PAKARAB FERTILIZERS (PVT) LTD. ,
KHANEWAL ROAD,
MULTAN.

G.S.T No: 03-91-9999-967-19

DUE DATE : 15.06.2010

CONSUMER No: 11/0010-003 BILLING PERIOD: FROM: 01.05.2010 TO: 31.05.2010 ISSUE DATE : 01.06.2010

CONSUMER GST No : 04-07-2806-001-91

CONSUMPTION CATEGORY	GROSS CALORIFIC VALUE IN BTU/SCF	CORRECTED VOLUME MCF	CORRECTED VOLUME HM^3	TOTAL MMBTU	RATE Rs/MMBTU	DESCRIPTION	AMOUNT Rs.
FEED STOCK	918	1270088	357833	1165942	102.01	GAS CHARGES	118,937,743
FUEL STOCK	918	370338	104338	339969	382.37	GAS CHARGES	129,993,947
DETAILS OF LPS:						METER RENT	6,000
						SUB TOTAL	248,937,690
						GST (16%)	39,830,030
						ADJUSTMENT	-
				AMOUNT FOR THE MONTH			288,767,720
				ARREARS			-
				LATE PAYMENT SURCHARGE			-
				Total Amount Due			**288,767,720**

QK

June 7/2010

Annex 8: GCV and NCV according to PFL Laboratory:

PFL

NATURAL GAS ANALYSIS
DECEMBER, 2009

LABORATORY

Date	Time	Ar	CO_2	N_2	CH_4	C_2H_6	C_3H_8	$C_4H_{10}+C_5H_{12}$	Heating Value (Calculated) Low	Heating Value (Calculated) Gross
	Hrs.	%	%	%	%	%	%	%	BTU/Cu.ft.	BTU/Cu.ft.
01.12.09	1015	0.02	1.99	9.06	87.48	0.99	0.26	0.20	828	919
02.12.09	1110	0.02	1.99	9.24	87.32	0.94	0.29	0.20	826	917
03.12.09	0950	0.02	1.99	9.24	87.37	0.92	0.26	0.20	825	916
04.12.09	0950	0.02	2.09	9.17	87.30	0.98	0.24	0.20	825	916
05.12.09	0900	0.02	2.05	9.08	87.48	0.97	0.2	0.20	826	917
06.12.09	0830	0.02	2.05	9.17	87.39	0.97	0.2	0.20	825	916
07.12.09	0900	0.02	2.09	9.17	87.39	0.93	0.2	0.20	824	915
08.12.09	1045	0.02	2.01	9.08	87.54	0.95	0.20	0.20	826	917
09.12.09	1015	0.02	1.94	8.90	87.85	0.87	0.22	0.20	828	919
10.12.09	1130	0.02	1.97	9.17	87.47	0.93	0.24	0.20	826	917
11.12.09	1000	0.02	1.97	8.99	87.68	0.92	0.22	0.20	827	918
12.12.09	1230	0.02	2.05	9.08	87.52	0.93	0.20	0.20	826	916
13.12.09	1000	0.02	1.97	9.17	87.51	0.93	0.20	0.20	825	916
14.12.09	0820	0.02	2.16	9.11	87.28	1.03	0.20	0.20	825	916
15.12.09	1000	0.02	2.12	8.93	87.48	1.01	0.24	0.20	827	918
16.12.09	0830	0.02	2.16	9.11	87.26	1.01	0.24	0.20	825	916
17.12.09	1140	0.02	2.44	8.57	87.52	0.98	0.27	0.20	828	919
18.12.09	0950	0.02	2.00	8.75	87.82	0.98	0.23	0.20	830	921
19.12.09	1220	0.02	2.00	9.02	87.49	1.00	0.27	0.20	828	919
20.12.09	0830	0.02	2.00	9.11	87.35	1.05	0.27	0.20	828	919
21.12.09	1230	0.02	2.12	9.11	87.26	1.05	0.24	0.20	826	917
22.12.09	1020	0.02	2.04	9.20	87.29	1.01	0.24	0.20	826	916
23.12.09	1000	0.02	2.00	9.02	87.49	1.03	0.24	0.20	828	919
24.12.09	1115	0.02	1.92	9.11	87.45	1.00	0.30	0.20	828	919
25.12.09	0945	0.02	2.04	9.11	87.36	1.00	0.27	0.20	827	918
26.12.09	0800	0.02	2.08	9.20	87.23	1.00	0.27	0.20	826	916
27.12.09	1045	0.02	2.00	9.20	87.23	1.05	0.30	0.20	827	918
28.12.09	0900	0.02	2.12	9.11	87.27	1.01	0.27	0.20	826	917
29.12.09	1200	0.02	2.12	9.11	87.30	0.98	0.27	0.20	826	917
30.12.09	0835	0.02	2.16	9.20	87.14	1.01	0.27	0.20	825	916
31.12.09	1140	0.02	2.08	9.29	87.16	0.98	0.27	0.20	825	915
Average		**0.02**	**2.05**	**9.08**	**87.42**	**0.98**	**0.24**	**0.20**	**826**	**917**

Heating Value	HHV(BTU/Cu.ft.)	LHV(BTU/Cu.ft.)	HHV(Kcal/NM³)	LHV(Kcal/NM³)
Minimum	915	824	8597	7745
Maximum	921	830	8653	7797
Average	917	826	8619	7765

Section Head Lab. FAT 01/01/10

Unit Manager (P.E.)
cc.
Unit Manager (Ammonia)
Unit Manager (CDM)

PFL — NATURAL GAS ANALSYIS — LABORATORY

January, 2010

Date	Time	Ar	CO_2	N_2	CH_4	C_2H_6	C_3H_8	$C_4H_{10}+C_5H_{12}$	Heating Value (Calculated) Low	Gross
	Hrs.	%	%	%	%	%	%	%	BTU/Cu.ft.	BTU/Cu.ft.
01.01.10	1000	0.02	2.08	9.20	87.23	1.00	0.27	0.20	826	916
02.01.10	0700	0.02	2.12	9.29	87.07	1.03	0.27	0.20	825	915
03.01.10	1230	0.02	1.96	9.20	87.41	0.94	0.27	0.20	826	917
04.01.10	1200	0.02	2.12	9.29	87.12	0.98	0.27	0.20	824	915
05.01.10	1130	0.02	2.08	9.20	87.28	0.98	0.24	0.20	825	916
06.01.10	Analysis Not Performed due to Unavailabality of Sample Point									
07.01.10										
08.01.10										
09.01.10										
10.01.10										
11.01.10										
12.01.10										
13.01.10										
14.01.10										
15.01.10										
16.01.10										
17.01.10										
18.01.10										
19.01.10										
20.01.10										
21.01.10										
22.01.10	1320	0.02	2.12	9.11	87.14	1.11	0.30	0.20	827	918
23.01.10	Analysis Not Performed due to Unavailabality of Sample Point									
24.01.10										
25.01.10										
26.01.10										
27.01.10										
28.01.10	1600	0.02	2.16	9.20	87.03	1.09	0.30	0.20	826	917
29.01.10	1230	0.02	2.12	9.11	87.14	1.11	0.30	0.20	827	918
30.01.10	1620	0.02	2.08	9.65	86.68	1.07	0.30	0.20	823	913
31.01.10	1445	0.02	2.13	9.11	87.19	1.05	0.30	0.20	827	918
Average		**0.02**	**2.097**	**9.24**	**87.13**	**1.04**	**0.282**	**0.20**	**826**	**916**

Heating Value	LHV(BTU/Cu.ft.)	HHV(BTU/Cu.ft.)		LHV(Kcal/NM^3).	HHV(Kcal/NM^3).
Minimum	823	913		7728	8577
Maximum	827	918		7774	8627
Average	826	916		7757	8610

Section Head Lab.

FAT 02/02/10

Unit Manager (P.E.)

CC.

Unit Manager (Ammonia)

Unit Manager (CDM)

NATURAL GAS ANALSYIS

PFL — LABORATORY

February, 2010

Date	Time	Ar	CO_2	N_2	CH_4	C_2H_6	C_3H_8	$C_4H_{10}+C_5H_{12}$	Heating Value (Calculated) Low	Heating Value (Calculated) Gross
	Hrs.	%	%	%	%	%	%	%	BTU/Cu.ft.	BTU/Cu.ft.
01.02.10	1645	0.02	1.89	9.28	87.30	1.01	0.3	0.20	827	918
02.02.10	0930	0.02	2.09	9.11	87.28	1.03	0.27	0.20	827	917
03.02.10	1215	0.02	2.09	9.11	87.23	1.05	0.30	0.20	827	918
04.02.10	1600	0.02	1.89	9.20	87.56	0.83	0.30	0.20	827	917
05.02.10	0700	0.02	1.93	9.03	87.67	0.85	0.30	0.20	828	919
06.02.10	0800	0.02	1.89	9.03	87.71	0.85	0.30	0.20	828	919
07.02.10	0800	0.02	1.89	8.95	87.75	0.89	0.30	0.20	829	920
08.02.10	1020	0.02	1.89	8.86	87.89	0.87	0.27	0.20	830	921
09.02.10	0840	0.02	1.89	9.11	87.64	0.87	0.27	0.20	827	918
10.02.10	1430	0.02	1.89	8.95	87.83	0.87	0.24	0.20	828	919
11.02.10	0800	0.02	1.89	9.11	87.71	0.83	0.24	0.20	827	917
12.02.10	0800	0.02	2.12	9.06	87.29	1.07	0.24	0.20	827	917
13.02.10	0640	0.02	2.05	9.06	87.34	1.09	0.24	0.20	827	918
14.02.10	0640	0.02	2.01	8.59	87.87	1.07	0.24	0.20	832	923
15.02.10	1220	0.02	2.05	9.06	87.17	1.13	0.37	0.20	830	921
16.02.10	0800	0.02	1.96	9.16	87.19	1.13	0.34	0.20	829	920
17.02.10	0800	0.02	2.05	9.06	87.32	1.11	0.24	0.20	828	919
18.02.10	0800	0.02	2.10	9.16	87.17	1.11	0.24	0.20	826	917
19.02.10	0700	0.02	2.05	9.16	87.28	1.02	0.27	0.20	826	917
20.02.10	1600	0.02	2.10	9.63	86.67	1.11	0.27	0.20	822	913
21.02.10	1100	0.02	2.10	9.25	86.91	1.18	0.34	0.20	827	918
22.02.10	0800	0.02	2.05	9.16	87.19	1.11	0.27	0.20	827	918
23.02.10	0800	0.02	2.10	9.06	87.10	1.18	0.34	0.20	829	920
24.02.10	0800	0.02	2.05	9.16	87.05	1.15	0.37	0.20	829	920
25.02.10	0800	0.02	1.96	9.06	87.27	1.15	0.34	0.20	830	921
26.02.10	0800	0.02	2.01	9.16	87.15	1.09	0.37	0.20	829	920
27.02.10	0830	0.02	2.01	9.06	87.32	1.05	0.34	0.20	829	920
28.02.10	1430	0.02	1.96	9.06	87.40	1.09	0.27	0.20	829	920
Average		**0.02**	**2.00**	**9.09**	**87.37**	**1.03**	**0.29**	**0.20**	**828**	**919**

Heating Value	LHV(BTU/Cu.ft.)	HHV(BTU/Cu.ft.)		LHV(Kcal/NM³).	HHV(Kcal/NM³).
Minimum	822	913		7727	8575
Maximum	832	923		7817	8676
Average	828	919		7779	8633

Section Head Lab.
FAT.
01/03/10.

Unit Manager (P.E.)

CC.
Unit Manager (Ammonia)
Unit Manager (CDM)

PFL

NATURAL GAS ANALYSIS

March, 2010

LABORATORY

Date	Time	Ar	CO_2	N_2	CH_4	C_2H_6	C_3H_8	$C_4H_{10}+C_5H_{12}$	Heating Value (Calculated) Low	Heating Value (Calculated) Gross
	Hrs.	%	%	%	%	%	%	%	BTU/Cu.ft.	BTU/Cu.ft.
01.03.10	0830	0.02	2.01	9.06	87.29	1.15	0.27	0.20	829	920
02.03.10	0830	0.02	2.10	9.16	87.03	1.22	0.27	0.20	827	918
03.03.10	1410	0.02	2.05	9.06	87.22	1.18	0.27	0.20	829	920
04.03.10	0800	0.02	1.96	9.06	87.39	1.13	0.24	0.20	829	920
05.03.10	0800	0.02	2.14	9.25	87.03	1.09	0.27	0.20	825	916
06.03.10	1000	0.02	2.05	8.87	87.54	1.05	0.27	0.20	829	920
07.03.10	0800	0.02	1.82	9.06	87.63	1.00	0.27	0.20	829	920
08.03.10	0820	0.02	2.01	9.06	87.44	1.00	0.27	0.20	828	919
09.03.10	0810	0.02	2.05	8.87	87.68	0.91	0.27	0.20	828	919
10.03.10	0800	0.02	2.19	8.87	87.49	0.96	0.27	0.20	827	918
11.03.10	0820	0.02	2.05	9.06	87.44	0.96	0.27	0.20	827	918
12.03.10	0750	0.02	2.01	8.97	87.48	1.05	0.27	0.20	829	920
13.03.10	0800	0.02	1.96	8.97	87.58	1.00	0.27	0.20	829	920
14.03.10	0630	0.02	1.92	9.16	87.21	1.22	0.27	0.20	829	920
15.03.10	1030	0.02	1.87	9.16	87.33	1.15	0.27	0.20	829	920
16.03.10	0815	0.02	1.87	9.16	87.39	1.09	0.27	0.20	829	920
17.03.10	0745	0.02	2.01	9.25	87.18	1.07	0.27	0.20	826	917
18.03.10	0815	0.02	2.01	9.16	87.34	1.00	0.27	0.20	827	918
19.03.10	0745	0.02	2.05	9.25	87.23	0.91	0.34	0.20	826	917
20.03.10	0745	0.02	1.96	9.16	87.38	0.87	0.41	0.20	828	919
21.03.10	1145	0.02	2.05	8.87	87.57	1.05	0.24	0.20	829	920
22.03.10	0815	0.02	1.82	8.97	87.72	1.00	0.27	0.20	830	921
23.03.10	0615	0.02	1.96	9.06	87.21	1.28	0.27	0.20	830	921
24.03.10	0530	0.02	1.82	8.97	87.72	1.00	0.27	0.20	830	921
25.03.10	0750	0.02	2.01	8.97	87.41	1.15	0.24	0.20	829	920
26.03.10	0750	0.02	1.96	9.16	87.24	1.15	0.27	0.20	828	919
27.03.10	0800	0.02	1.92	9.25	87.16	1.18	0.27	0.20	828	919
28.03.10	0650	0.02	2.01	9.16	87.21	1.13	0.27	0.20	828	919
29.03.10	0820	0.02	1.92	9.16	87.28	1.11	0.31	0.20	829	920
30.03.10	0820	0.02	2.01	9.25	87.16	1.09	0.27	0.20	827	917
31.03.10	0800	0.02	2.05	9.16	87.19	1.11	0.27	0.20	827	918
Average		**0.02**	**1.99**	**9.08**	**87.37**	**1.07**	**0.28**	**0.20**	**828**	**919**

Heating Value	**HHV(BTU/Cu.ft.)**	**LHV(BTU/Cu.ft.)**		**HHV(Kcal/NM^3)**	**LHV(Kcal/NM^3)**
Minimum	**916**	**825**		**8606**	**7755**
Maximum	**921**	**830**		**8657**	**7800**
Average	**919**	**828**		**8636**	**7782**

Section Head Lab.
FAT
01/04/10

Unit Manager (P.E.)
cc.
Unit Manager (Ammonia)
Unit Manager (CDM)

PFL

NATURAL GAS ANALYSIS
April, 2010

LABORATORY

Date	Time	Ar	CO_2	N_2	CH_4	C_2H_6	C_3H_8	$C_4H_{10}+C_5H_{12}$	Heating Value (Calculated) Low	Heating Value (Calculated) Gross
	Hrs.	%	%	%	%	%	%	%	BTU/Cu.ft.	BTU/Cu.ft.
01.04.10	0800	0.02	2.05	9.16	87.17	1.13	0.27	0.20	827	918
02.04.10	0830	0.02	2.10	9.16	87.01	1.24	0.27	0.20	828	918
03.04.10	0800	0.02	2.10	9.16	87.10	1.18	0.24	0.20	827	918
04.04.10	0800	0.02	2.01	9.25	87.03	1.22	0.27	0.20	827	918
05.04.10	0830	0.02	1.96	9.35	86.85	1.31	0.31	0.20	828	919
06.04.10	0800	0.02	2.01	9.25	86.93	1.35	0.24	0.20	828	919
07.04.10	0750	0.02	2.05	9.35	86.83	1.28	0.27	0.20	827	917
08.04.10	0800	0.02	2.01	9.35	86.93	1.22	0.27	0.20	827	917
09.04.10	0800	0.02	2.05	9.16	87.17	1.13	0.27	0.20	827	918
10.04.10	0745	0.02	2.10	9.16	87.10	1.15	0.27	0.20	827	918
11.04.10	0800	0.02	2.10	9.16	87.05	1.20	0.27	0.20	827	918
12.04.10	0900	0.02	2.05	9.06	87.27	1.13	0.27	0.20	828	919
13.04.10	1000	0.02	2.10	8.97	87.29	1.15	0.27	0.20	829	920
14.04.10	1500	0.02	2.01	9.06	87.45	1.01	0.25	0.20	827	918
15.04.10	0815	0.02	1.93	9.15	87.51	0.94	0.25	0.20	827	918
16.04.10	0800	0.02	1.93	9.15	87.49	0.99	0.22	0.20	827	918
17.04.10	1030	0.02	1.93	9.06	87.55	1.02	0.22	0.20	828	919
18.04.10	1000	0.02	1.90	9.24	87.37	1.02	0.25	0.20	827	918
19.04.10	0830	0.02	1.93	9.06	87.64	0.93	0.22	0.20	827	918
20.04.10	1000	0.02	1.86	9.24	87.50	0.96	0.22	0.20	826	917
21.04.10	0900	0.02	1.86	9.06	87.59	0.99	0.28	0.20	829	920
22.04.10	0900	0.02	1.86	9.15	87.56	0.96	0.25	0.20	828	919
23.04.10	0800	0.02	1.90	9.24	87.39	0.97	0.28	0.20	827	918
24.04.10	0800	0.02	1.86	9.32	87.33	0.99	0.28	0.20	827	917
25.04.10	0830	0.02	1.90	9.24	87.37	0.99	0.28	0.20	827	918
26.04.10	0830	0.02	1.93	9.41	87.25	0.91	0.28	0.20	825	915
27.04.10	0830	0.02	1.90	9.32	87.38	0.90	0.28	0.20	826	916
28.04.10	0800	0.02	1.86	8.97	87.88	0.85	0.22	0.20	828	919
29.04.10	0800	0.02	1.83	9.15	87.67	0.85	0.28	0.20	827	918
30.04.10	0800	0.02	1.86	9.06	87.72	0.86	0.28	0.20	828	919
Average		**0.02**	**1.96**	**9.18**	**87.31**	**1.06**	**0.26**	**0.20**	**827**	**918**

Heating Value	**HHV(BTU/Cu.ft.)**	**LHV(BTU/Cu.ft.)**		**HHV(Kcal/NM^3)**	**LHV(Kcal/NM^3)**
Minimum	**915**	**825**		**8599**	**7748**
Maximum	**920**	**829**		**8645**	**7789**
Average	**918**	**827**		**8626**	**7772**

Section Head Lab.

FAT 03/05/10.

Unit Manager (P.E.)

CC.

Unit Manager (Ammonia)

Unit Manager (CDM)

O/C

NATURAL GAS ANALYSIS

PFL

May, 2010

LABORATORY

Date	Time	Ar	CO_2	N_2	CH_4	C_2H_6	C_3H_8	$C_4H_{10}+C_5H_{12}$	Heating Value (Calculated) Low	Gross
	Hrs.	%	%	%	%	%	%	%	BTU/Cu.ft.	BTU/Cu.ft.
01.05.10	1100	0.02	1.90	9.15	87.60	0.88	0.25	0.20	827	917
02.05.10	0815	0.02	1.76	9.15	87.82	0.83	0.22	0.20	827	918
03.05.10	0820	0.02	1.86	9.06	87.76	0.82	0.28	0.20	828	919
04.05.10	0800	0.02	1.90	9.15	87.68	0.83	0.22	0.20	826	917
05.05.10	1200	0.02	1.86	9.06	87.79	0.85	0.22	0.20	827	918
06.05.10	0820	0.02	1.83	8.88	87.94	0.85	0.28	0.20	830	921
07.05.10	0800	0.02	1.86	8.88	88.00	0.82	0.22	0.20	829	920
08.05.10	0840	0.02	1.90	8.97	87.86	0.83	0.22	0.20	827	918
09.05.10	0650	0.02	1.68	9.06	88.05	0.77	0.22	0.20	828	919
10.05.10	0820	0.02	1.72	8.97	88.08	0.79	0.22	0.20	829	920
11.05.10	0800	0.02	1.79	9.06	87.90	0.75	0.28	0.20	828	919
12.05.10	0800	0.02	1.83	9.15	87.81	0.77	0.22	0.20	826	917
13.05.10	0800	0.02	1.86	9.06	87.85	0.79	0.22	0.20	827	918
14.05.10	0800	0.02	1.90	8.97	87.94	0.75	0.22	0.20	827	918
15.05.10	0815	0.02	1.61	9.06	88.14	0.75	0.22	0.20	829	920
16.05.10	1215	0.02	1.61	9.06	88.12	0.74	0.25	0.20	829	920
17.05.10	0830	0.02	1.72	9.15	87.94	0.75	0.22	0.20	827	918
18.05.10	0800	0.02	1.72	8.97	88.04	0.83	0.22	0.20	829	920
19.05.10	0800	0.02	1.72	9.06	87.96	0.82	0.22	0.20	828	919
20.05.10	0815	0.02	1.68	8.97	88.17	0.71	0.25	0.20	829	920
21.05.10	0830	0.02	1.76	9.06	88.03	0.68	0.25	0.20	827	918
22.05.10	0815	0.02	1.90	8.88	87.93	0.82	0.25	0.20	829	920
23.05.10	0800	0.02	1.83	8.88	88.00	0.82	0.25	0.20	829	920
24.05.10	0830	0.02	1.79	9.06	87.86	0.85	0.22	0.20	828	919
25.05.10	0800	0.02	1.83	8.97	87.94	0.82	0.22	0.20	828	919
26.05.10	0815	0.02	1.76	8.97	88.03	0.80	0.22	0.20	829	920
27.05.10	0820	0.02	1.83	8.97	87.94	0.82	0.22	0.20	828	919
28.05.10	0820	0.02	1.79	8.97	87.95	0.79	0.28	0.20	829	920
29.05.10	0830	0.02	1.72	8.97	88.05	0.82	0.22	0.20	829	920
30.05.10	0845	0.02	1.72	9.06	87.96	0.82	0.22	0.20	828	919
31.05.10	0845	0.02	1.79	8.97	87.95	0.85	0.22	0.20	829	920
Average		**0.02**	**1.79**	**9.02**	**87.94**	**0.80**	**0.23**	**0.20**	**828**	**919**

Heating Value	HHV(BTU/Cu.ft.)	LHV(BTU/Cu.ft.)	HHV(Kcal/NM^3)	LHV(Kcal/NM^3)
Minimum	917	826	8612	7759
Maximum	921	830	8655	7798
Average	919	828	8635	7780

Section Head Lab FAT, 01/06

Unit Manager (P.E.)

cc.

Unit Manager (Ammonia)

Unit Manager (CDM)

Unit Manager (Utilities)

O/c

Annex 9: Temperature and Pressure Compensation:

The Flow meters referred below are neither temperature nor pressure compensated. The compensation entered in the BOP panel is given below:

For Gas meter (Orifice Mass Flowmeter) (FT-01; Serial number: 8470118)

Design Actual Temperature	=	38.0	^{o}C
Design Base Pressure	=	14.696	psia
Actual SNGPL Base Pressure	=	14.650	psia
Actual Running Temperature	=	(From TT-01; temperature guage at common line for GTG in ^{o}C)	
Actual Operating Pressure=	28.0	barg	

Formula Used for Temperature Compensation : (F_{TD})

F_{TD} = (Actual Running temp in Kelvin / Design Actual Temp in Kelvin)$^{\wedge 0.5}$

Formula Used for Pressure Compensation to revert to SNGPL base Pressure: (F_{PD})

F_{PD} = (Design base Pressure / Actual SNGPL base Pressure)

In BOP the Actual Reading of FT-01 is multiplied with the above quoted factors:

Compensated Flow = Actual FT-01 Flow reading in Nm^3 / hr at design base conditions $\times F_{TD} \times F_{PD}$

For Gas meter (Orifice Mass Flowmeter) (FT-12; Serial number: 8470125)

Design Actual Temperature	=	10.0	^{o}C
Design Base Pressure	=	14.696	psia
Actual SNGPL Base Pressure	=	14.650	psia
Actual Running Temperature	=	(From TT-10; temperature guage at common line for HRSG in ^{o}C)	
Actual Operating Pressure=	08.0	barg	

Formula Used for Temperature Compensation : (F_{TD})

F_{TD} = (Actual Running temp in Kelvin / Design Actual Temp in Kelvin)$^{\wedge 0.5}$

Formula Used for Pressure Compensation to revert to SNGPL base Pressure: (F_{PD})

F_{PD} = (Design base Pressure / Actual SNGPL base Pressure)

In BOP the Actual Reading of FT-12 is multiplied with the above quoted factors:

Compensated Flow = Actual FT-12 Flow reading in Nm^3 / hr at design base conditions $\times$ $F_{TD} \times F_{PD}$