Henan Zhengzhou Grid Connected Natural Gas Combined Cycle Power Plant

CDM MONITORING REPORT NO.3
Version 01

CDM Registration Ref. No. 1304

Monitoring Period: 01 January – 30 November 2009
Date of Report: 21 January 2010

***Project Participants*:**

Zhengzhou Combined Cycle Power Co., Ltd

Total Gas & Power Limited

***CDM Consultant*:**

CPI Carbon Asset Management Co., Ltd

Contents

1 General Project Activity and Monitoring Information

1.1 Title of the Project Activity

Henan Zhengzhou Grid Connected Natural Gas Combined Cycle Power Plant(hereinafter referred to as "the Project")

1.2 CDM Registration Date and Number

This CDM Monitoring Report refers to the CDM Project titled "Henan Zhengzhou Grid Connected Natural Gas Combined Cycle Power Plant" registered by the CDM Executive Board on 22nd February 2008 (Ref. No. 1304).

1.3 Short description of the project activity

The Project is located in Xiangying village, Zhengzhou city, Henan province, and has geographical coordinates of 113°31'47" east longitude and 34°47' 45" north latitude.

The Project is to be built as a grid connected electricity generation plant using natural gas (NG), serving as a peak load balancing power plant, the Project has an installation capacity of 780 MW by 2×390 MW gas/steam turbines using combined cycle technology.

The gas turbine and steam turbine generator output are stepped up into 500 KV in a newly built switchyard where is connected into the China Central Grid (CCG), an independent regional grid in the PRC.

1.4 Monitoring Period

The third monitoring period is from 00:00hrs, 01st January 2009 to 24:00hrs, 30st November 2009. This is the third monitoring report for this project.

1.5 Implementation Status of the Project activity

During the third monitoring period, all the Project equipments, processes and operation remain the same as the registered CDM-PDD. The project monitoring activity was implemented according to the registered CDM-PDD monitoring plan, which also remains unchanged.

1.6 Methodology Applied to the Project Activity

1.6.1 Baseline Methodology

The Project utilizes the Approved Baseline Methodology AM0029 Version 01: "Methodology for Grid Connected Electricity Generation Plants using Natural Gas."

1.6.2 Monitoring Methodology

The Project utilizes the Approved Baseline Methodology AM0029 Version 01: "Grid Connected Electricity Generation Plants using Non-Renewable and Less GHG Intensive Fuel."

1.7 Intended deviations, revisions and clarifications to the registered PDD:

No deviations or revisions to the registered PDD are observed.

1.8 Intended deviations or revisions to the registered monitoring plan (Decision 17/CP.7, Annex H, paragraph 57 to be considered):

No deviations or revisions to the Monitoring Plan are observed.

1.9 Person(s) responsible for the preparation and submission of the monitoring report:

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2 Monitoring Data and Calculations of Emission Reductions

2.1 Data Requirements for Monitoring as Prescribed in PDD

The monitoring data requirements are consistent with those listed in the Clean Development Mechanism Project Design Document (CDM-PDD). The parameters monitored by this project are listed in the following tables:

Data/Parameter	Description	Data Unit	Comment
$EG_{out,p3}$	Electricity generated by the Project and sold into CCG during the third monitoring period *p3.*	MWh	
$EG_{in,p3-1}$	Electricity purchased by the Project from the CCG (MWh) at ***Songshan Transformer Station*** during the third monitoring period *p3.*.	MWh	
$EG_{in,p3-2}$	Electricity purchased by the Project from the CCG (MWh) at ***Suohe Transformer Station*** during the third monitoring period *p3.*	MWh	
$FC_{f,p3}$	Natural gas consumed by the Project during the third monitoring period *p3.*	m^3	
$NCV_{f,p3}$	Net calorific value per volume unit of natural gas during the third monitoring period *p3.*	GJ/m^3	

A complete list of the data monitoring requirements is listed in Annex 1.

2.2 Management of Database

Since the project began operation, the Monitoring Working Group (MWG) has been continuously managing the monitoring database. The MWG consists of five operational managers and engineers who are trained and qualified to deal with the CDM data monitoring process.

2.3 Data and Record Archiving System

The data archiving system continues to document all the monitoring data collected and recorded in the specific forms, together with other related documents and collectables as required, such as commercial receipts. The data is recorded in either electronic and/or hard copy formats and is archived for two years following the end of the crediting period. The MWG manages the data and archives it on a monthly basis according to the quality assurance and control (QA/QC) procedures.

2.4 Calculations of Emission Reductions

2.4.1 Project Emission

The Project continues to use natural gas (NG) to generate electricity without using any auxiliary fuels for power production during this third monitoring period *(p3)*.

The CO_2 emitted as a result of the project activities (PE_{p3}) is calculated as follows:

$$PE_{p3} = \sum FC_{f,p3} \times COEF_{f,p3}$$

Where;

$FC_{f,p3}$ is the amount of NG (m^3) combusted by the Project during the third monitoring period *(p3)*;

$COEF_{f,p3}$ is the CO_2 emission coefficient (tCO_2e/m^3) of the NG during the third monitoring

period (*p3)* and is calculated as follows;

$$\boldsymbol{COEF_{f,p3} = \sum NCV_{f,p3} \times EF_{CO2,f,p3} \times OXID_f}$$

Where;

$\boldsymbol{NCV_{f,p3}}$ is the net calorific value (energy content) per volume unit of NG (GJ/m^3) during the third monitoring period (*p3)* as provided by the fuel supplier;

$\boldsymbol{EF_{CO2,f,p3}}$ is the CO_2 emission factor per unit of energy of NG during the third monitoring period (*p3)* ($kgCO_2/TJ$). The $\boldsymbol{EF_{CO2,f,p3}}$ was 54,300 $kgCO_2/TJ$ (IPCC 2006, p.24);

$\boldsymbol{OXID_f}$ is the oxidation factor of NG with the value of 1 (100%) as defined by the Intergovernmental Panel on Climate Change (IPCC);

For the third monitoring period (*p3),* the monitoring records provided by the NG Supplier's indicates that the total amount of NG consumption ($\boldsymbol{FC_{f,p3}}$) is 353,463,092 (m^3).

Therefore;

$\boldsymbol{FC_{f,p3}}$ = 353,463,092 (m^3);

Consistent with the registered CDM-PDD, the data of the $\boldsymbol{NCV_{f,p3}}$ is provided by the NG Supplier and the weighted average $\boldsymbol{NCV_{f,p3}}$ is 0.03372453 (GJ/m^3). Therefore;

$\boldsymbol{NCV_{f,\,p3}}$ =0.03372453 (GJ/m^3);

Therefore, the $\boldsymbol{NCV_{f,p3}}$, $\boldsymbol{COEF_{f,p3}}$, and $\boldsymbol{PE_{p3}}$ yielded the following;

$\boldsymbol{NCV_{f,p3}}$ = 0.03372453 (GJ/m^3)

$\boldsymbol{COEF_{f,p3}}$ = 0.00183124(tCO_2e/m^3)

$\boldsymbol{PE_{p3}}$ =647,276.53(tCO_2e)

Detailed calculations can be found in the annexed spreadsheets

2.4.2 Baseline Emissions

Pursuant to the registered CDM-PDD, baseline emissions are calculated by multiplying the net amount of electricity generated by the Project ($\boldsymbol{EG_{PJ,p3}}$) with an updated baseline emission factor ($\boldsymbol{EF_{p3,}}$) as seen in the following equation:

$$\boldsymbol{BE_{p3} = EG_{PJ,p3} \times EF_{p3}}$$

Where;

$\boldsymbol{EG_{PJ,p3}}$ is the net amount of electricity generated by the project and sold to CCG during the third monitoring period (*p3*);

Where;

$$\boldsymbol{EG_{PJ,p3} = EG_{out,p3} - EG_{in,p3}}$$

$\boldsymbol{EG_{out,p3}}$ is the amount of electricity generated by the Project and sold to the CCG during the third monitoring period (*p3*);

$\boldsymbol{EG_{in,p3}}$ is the amount of the electricity purchased by the Project during the third monitoring period (*p3)* from the CCG from the following two sources:

- $\boldsymbol{(EG_{in,p3-1})}$ is the amount electricity purchased by the Project from the CCG (MWh) at the ***Songshan Transformer Station***;

- $(EG_{in,p3-2})$ is the amount electricity purchased by the Project from the CCG (MWh), at the ***Suohe Transformer Station***;

Therefore;

$$EG_{in,p3} = (EG_{in,p3-1} + EG_{in,p3-2})$$

Both the CCG and project owner's records indicated that the total amount of $EG_{out,p3}$ during the third monitoring period (*p3)* was 1,773,308.25 (MWh).

Accordingly, $EG_{in,p3-1}$ and $EG_{in,p3-2}$ equals:

$EG_{in,p3-1}$ =5,670.75 (MWh); $EG_{in,p3-2}$ = 2362.8 (MWh).

As such, $EG_{PJ,p3}$ is calculated as follows:

$$EG_{PJ,p3}=EG_{out,p3}-(EG_{in,p3-1}+EG_{in,p3-2})= 1,765,274.7 \text{ (MWh)}.$$

According to the registered CDM-PDD, $EF_{BM,p3}$ is the baseline emission factor of the CCG (EF_{p3}) and is used in the calculation of the emission reductions achieved by the Project.

At July 2nd 2009, the Chinese DNA have stated that 2007 CCG Baseline Emission Factor ($EF_{BM,p3}$) is now 0.5802 tCO_2e/MWh instead of 0.6758 tCO_2e/MWh as was accounted for during the first selected monitoring period.

Therefore;

BE_{p3} = 1,024,212.38 (tCO_2e)

Detailed calculations can be found in Annex 3.

2.4.3 Monitoring Leakage

The leakage emission amount is calculated by using the following equation:

$$LE_{p3} = LE_{CH4,p3} + LE_{LNG,CO2,p3}$$

Where;

LE_{p3} is a leakage emission during the third monitoring period (*p3)* in tCO_2e;

$LE_{CH4,p3}$ is a leakage emission due to fugitive upstream CH_4 emissions during the third monitoring period (*p3)* in tCO_2e;

$LE_{LNG,CO2,p3}$ is leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of liquefied natural gas (LNG) into a natural gas transmission or distribution system during the third monitoring period (*p3)* in tCO_2e.

No LNG is used by the Project; thus only fugitive upstream CH_4 emissions are taken into account. Therefore $LE_{p3} = LE_{CH4,p3}$. Furthermore, the fugitive CH_4 emissions of the Project in the third monitoring period (*p3)* is calculated as follows:

$$LE_{CH4,p3}=(FC_{f,p3} \times NCV_{f,p3} \times EF_{NG,upstream,CH4} - EG_{PJ,p3} \times EF_{BL,upstream,CH4}) \times GWP_{CH4}$$

Where;

$FC_{f,p3}$ is the amount of NG (m^3) consumed by the Project during the third monitoring period (*p3)*, which equals 353,463,092m^3;

$NCV_{f,p3}$ is the weighted average net calorific value of the NG (GJ/m^3) consumed by the Project during the third monitoring period (*p3),* which equals 0.03372453 GJ/m^3;

$EF_{NG, upstream,CH4}$ is determined by the IPCC as 296×10^{-6}t CH_4 per GJ;

$EG_{PJ,p3}$ is the electricity generated by the Project and sold to the CCG during the third monitoring period (*p3),* which equals 1,765,274.7MWh;

GWP_{CH4} is the global warming potential of methane valid for the relevant commitment period, and is determined as 21; and

$EF_{BL,upstream,CH4}$ is the emission factor for upstream fugitive methane emissions occurring in the absence of the Project activity (*t*CH_4/MWh) electricity generated by the Project. It is defined as follows:

The emission factor for upstream fugitive CH_4 emissions ($EF_{BL,upstream,CH4}$) occurring in the absence of the Project activity is calculated consistent with the baseline emission factor ($EF_{BL,CO2,p3}$); the $EF_{BL,upstream,CH4}$ for the third monitoring period (*p3)* therefore equals: $EF_{BL,upstream,CH4}$ = 0.00425691 (tCH_4/MWh).

Detailed calculations can be found in Annex 2.

Therefore;

$LE_{CH4,p3}$ = -83,710.03 (tCO_2e).

As the calculated result above gives a negative value, the leakage is zero (LE_{p3} = 0).

2.4.4 Emissions Reduction Calculations for the Project

According to the registered CDM-PDD, to calculate the emission reductions the following equation applies:

$$ER_{p3} = BE_{p3} - PE_{p3} - LE_{p3}$$

Where;

ER_{p3} is the total amount of emission reductions during the third monitoring period (*p3)* (tCO_2e);

BE_{p3} is the emissions of the baseline scenario during the third monitoring period (*p3)* (tCO_2e);

PE_{p3} is the emissions of the Project scenario during the third monitoring period (*p3)* (tCO_2e);

LE_{p3} is the leakage of the third monitoring period (*p3)* (tCO_2e) which equals "0" according to the calculation provided above;

In conclusion, the total amount of emission reductions due to the Project activities during the third monitoring period (*p3)* is calculated for:

ER_{p3} = 376,935 (tCO_2e)

2.4.5 Comparison with CDM-PDD estimation

According to the Emission Reduction (ER) calculation method of prescribed in the registered CDM-PDD, the Project estimated annual ER are 691,502 tCO2e and about 633,877 tCO2e for the third monitoring period. However, according to the methodology prescribed in the registered CDM-PDD, if BM was selected as emission factor, ER should be estimated *ex post* through updated baseline emission factor. Chinese DNA issued new emission factors in July 2009, according to this new emission factor, emission factor used in the third selected monitoring period is 0.5802 tCO2/MWh instead of 0.6494 tCO2/MWh used in registered PDD. ER of the third monitoring period is 376,935 tCO2e which are smaller than the

estimation basing on the registered CDM-PDD.

3 Quality Assurance and Quality Control Measures

3.1 QA and QC Procedures of Measuring Data

QA and QC Procedures are as follow:

Based on the defined quality assurance and control measures (QA/QC) defined in the registered CDM-PDD, in order to ensure the monitoring process is consistent with the registered CDM-PDD and meets the CDM requirements and related international rules, the project owner engaged a project Monitoring Working Group (MWG) in Oct 2007. As a result, a CDM Manual was developed with a purpose of providing the owner with detailed guidelines and requirements on its monitoring management and archiving system operations. At the same time, a set of related recording forms were also developed and tested for the monitoring activities including data monitoring and archiving as well as the staff monitoring training and reporting activities.

The data quality assurance and control procedures are assembled in the monitoring management and data archiving systems. The procedures enforce and emphasize the importance of the reliability, stability, and accuracy of the data.

3.2 Calibration of Metering Equipments

During the third monitoring period, the calibration are carried out in accordance with the registered CDM-PDD.

The calibration of electricity meters is the responsibility by the grid company which is defined by the Power Purchase Agreement signed by the owner of project and the grid company. During this monitoring period, the calibrations have been carried out in accordance with the registered CDM-PDD, all the related copies of calibration reports issued by those qualified calibration institutions for each calibrated electricity meter are collected for further verifications upon request.

Further, the calibration of the natural gas flow meter and composition analysis meter is the responsibility of the NG supplier which is defined by the NG Supply Agreement signed between the project owner and the NG supplier. During this monitoring period, the calibrations have been carried out in accordance with the registered CDM-PDD, all the related original copies of Calibration Reports issued by the selected calibrators were collected by the Monitoring Group for further verifications upon request.

All measure instruments are qualified through calibration.

The related information on calibration of the monitoring instruments is provided in details as follows:

Instruments	S/N	Calibration entity
Main electric meter of Songshan	41504307	Henan Electric Power Research Institute, Henan Metrological Testing Center of Electric Power Ministry
Backup electric meter of Songshan	41504296	Henan Electric Power Research Institute, Henan Metrological Testing Center of Electric Power Ministry
Electric meter of Suohe	0106000161	Henan Electric Power Research Institute, Henan Metrological Testing Center of Electric Power Ministry
Ultrasonic natural gas flowmeter-1 of gas station	06-400027	National Crude Oil Metering Station

Ultrasonic natural gas flowmeter-2 of gas station	06-400028	National Crude Oil Metering Station
Turbine flower-1 of PP	10501760	Flow measurement Center of Aviation Industries of China
Turbine flower-2 of PP	10501761	Flow measurement Center of Aviation Industries of China

3.3 Monitoring Institution

The monitoring activities are under the responsibility of the Monitoring Working Group (MWG) consisting of five staff assigned by the project company. All the members of the MWG were trained with the qualifications that are required for handling the monitoring activities. According to the CDM Manual, monitoring staff must pass the test demonstrating their understanding and responsibility of the assigned monitoring position, CDM and monitoring know-how, system integrity, and etc. All staff that passed the exam were certified by the CDM training organization, and only those certified staffs are qualified to be assigned to the Monitoring Working Group.

During January 2009, all the staff assigned to the MWG were trained on the CDM Manual and passed the exams, thus were certified with the qualifications for handling the monitoring activities

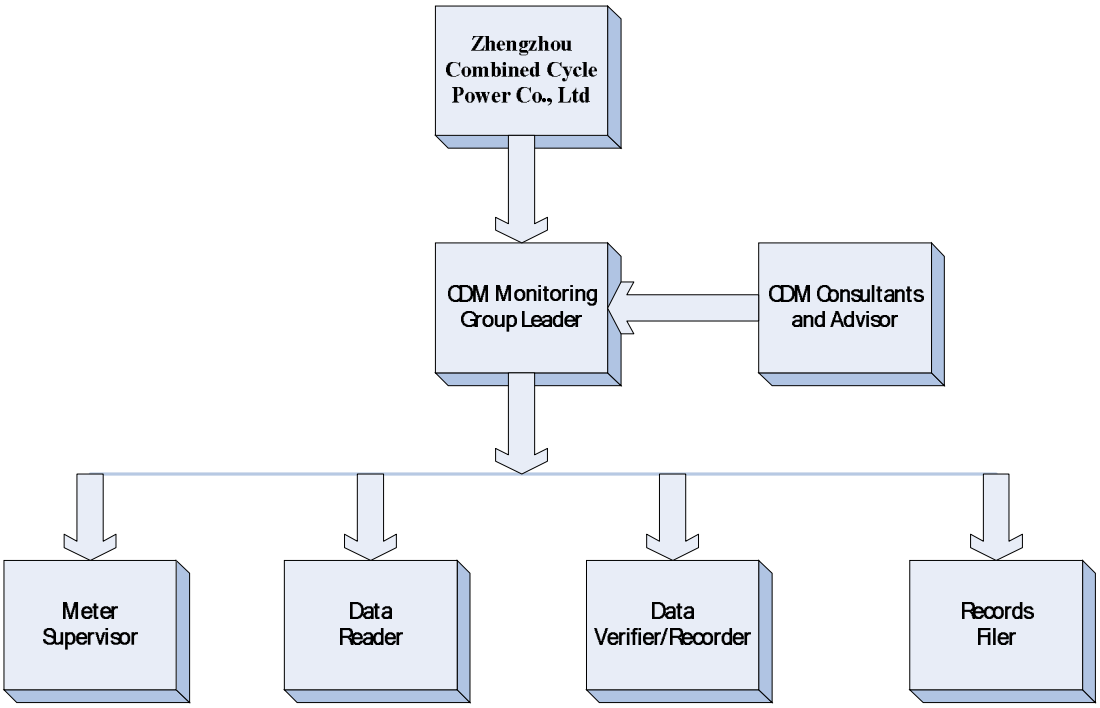

Figure 1. Organization Structure for the Monitoring Activities

The MWG is under the supervision of the CDM Steering Committee consisting of the senior managements of project and parent companies. Its day-to-day monitoring activities are under the guidance provided by the external CDM consultants. Staffs currently working for the MWG are all qualified for the assigned monitoring activities, as a result of a training workshops held in January 2009 which were provided by the CDM consultant team. The operational and management structure is shown in the Figure 1.

3.3.1 Roles and Responsibilities

According to the CDM Manual, the MWG was designed as a functional working team to

deal with all the issues related to the CDM monitoring activities. The detailed descriptions on the responsibilities and working scopes of each role of this working team are provided in the CDM Manual.

4 Records Archiving

The records archiving activities of the project will be under the responsibility of the File Keeper of the Monitoring Group, and all the monitoring records are archived for 2 years after the ending of the crediting period of the project.

A set of recording forms were designed and used for recording each set of data to be monitored as well as the related monitoring activities as specified and required by the CDM Manual.

As an example, some of the specific Forms defined by the CDM Manual are illustrated at the Table below.

Recording Forms	Monitoring Data and Activities
Electricity Generated and Sold *($EG_{PJ,p3t}$)* Monthly Monitoring Recording Form	Month reading from the meter defined by the registered CDM-PDD is recorded as the original data of *Electricity Generated and Sold into the Grid*, and all the recorded monthreadings are required to be further put into a Annually Monitoring Form accordingly.
NG Consumption *($FC_{f,p3}$)* Weekly Monitoring Recording Form	Daily reading from the flow meter defined by the registered CDM-PDD is recorded as the original data of the amount of NG supplied to the Project and all the recorded daily readings are required to be further put into the related Monthly Monitoring Form accordingly.
NCV Bi-Weekly Monitoring Recording Form	The daily NCV value provided by NG supplier is collected and further recorded into the related Bi-Weekly Monitoring Form accordingly.
Electricity Purchased ($EG_{in,p3-1}$) Monitoring Recording Form *(Songshan Station)*	Month reading from the meter defined by the registered CDM-PDD is recorded as the original data of *Electricity Bought at the Songshan Station,* and all the recorded month readings are required to be further put into the related Annually Monitoring Form accordingly.
Electricity Purchased ($EG_{in,p3-2}$) Monitoring Recording Form *(Suohe Station)*	Month reading from the meter defined by the registered CDM-PDD is recorded as the original data of *Electricity Bought at the Suohe Station,* and all the recorded month readings are required to be further put into the related Annually Monitoring Form accordingly
Training Activities Monitoring Recording Form	The activities related to each monitoring training workshops is recorded as the case might be.
Monitoring Staffing Monitoring Recording Form	Staff assigned to the monitoring position with the No. Certification, and related responsibilities, and monitoring training and working history is recorded as the case might be.

In addition, Forms for other related activities were also used for monitoring recording activities, such as the management steering committee, the QA/QC review and check up recording forms and etc.

All the Forms are available in both electronic and printed formats under the daily working responsibility of the file keeper.

Before archiving and cross checking, all the recording forms require a signature by the responsible team members (the team leader, the staff member responsible for recording, or the meter supervisor). The Form which is signed by the team members are archived into the data archiving system by the trained and qualified File Keeper either in electronic or the printed formats depending on the nature of the records. Two copies of the original records are made, of which one copy is provided to the external CDM consultants (on a monthly basis), and the other is kept by the team leader for checking and back-up purposes.

Furthermore, according to the QA/QC Measures defined by the CDM Manual of the

proposed project, all the records archived in the monitoring archiving system, together with the calibration reports, sales and purchasing receipts, and other related archived data are available for CDM verification.

Annexes

Annex 1. Data Monitored for the Selected Monitoring Period *p3*

Data	Description	Source of Data	Data Unit	Measured (m) Calculate (c)	Recording Frequency	Proportion of Data Monitored	Data to be Archived (Electronic/Paper)	Note
$EG_{out,p3}$	Amount of electricity generated by the Project and sold into CCG during the third monitoring period *p3*.	Data readings collected and recorded by the owner in Form	MWh	m	Monthly	100%	Electronic/ Paper	Month reading is recorded in the Forms to be filed by the trained and qualified staff. All the original readings, recording forms, and the related commercial receipts are archived in consistency with the QA and QC measures setup for the monitoring activities of the Project. Commercial receipts issued by the grid company are to be used for cross-check.
$EG_{in,p3-1}$	The amount of electricity purchased by the Project from the CCG (MWh) at ***Songshan Transformer Station*** and connected to the Project during the third monitoring period *p3*..	Data readings collected at *Songshan Station* and recorded by the owner in Form	MWh	m	Monthly	100%	Electronic/ Paper	Month reading is recorded in the Form to be filed by the trained and qualified staff. All the original data readings, recording forms, and the related commercial receipts are archived in consistency with the QA and QC measures setup for the monitoring activities of the Project. Commercial receipts issued by the grid company are to be used for cross-check.
$EG_{in,p3-2}$	The amount electricity purchased by the Project from the CCG (MWh) at ***Suohe Transformer Station*** and connected to the Project during the third	Data readings collected at *Suohe Station* and recorded by the owner in Form	MWh	m	Monthly	100%	Electronic/ Paper	Month reading is recorded in the Form to be filed by the trained and qualified staff. All the original data readings, recording forms, and the related commercial receipts are archived in consistency with the QA and QC measures setup for the monitoring activities of the Project. Commercial receipts issued by the grid company are to be used for cross-check.

	monitoring period *p3*.							
$FC_{f,p3}$	The amount of NG consumed by the Project during the third monitoring period *p3*.	Commercial receipts provided by the fuel supplier	m^3	m	Daily	100%	Electronic/ Paper	In Addition to the commercial receipts, daily readings are collected for weekly recording in the Form to be filed by the trained and qualified staff of the owner. All the original data readings, recording forms, and the related commercial receipts are archived in consistency with the QA and QC measures setup for the monitoring activities of the Project. Commercial receipts issued by the grid company are to be used for cross-check.
$NCV_{f,p3}$	Net calorific value per volume unit of natural gas during the third monitoring period *p3*.	Data supplied by the NG supplier and recorded by the owner in Forms	GJ/m^3	c	Bi-Weekly	100%	Electronic/paper	Daily reading is provided by the NG Supplier for the bi-weekly recording in the Form to be filed by the trained and qualified staff of the owner. All the original data sheets, recording forms are archived in consistency with the QA and QC measures setup for the monitoring activities of the Project.

Annex 2. Technical Drawing

According to the registered CDM-PDD, the project installed 2×390MW gas/steam turbines that use NG combined cycle technology to generate electricity and sold into the Henan Grid, a sub-grid of an independent regional grid-CCG.

The technical drawing for the process flow, together with the monitoring meter points, of the project is illustrated in Figure A1 below:

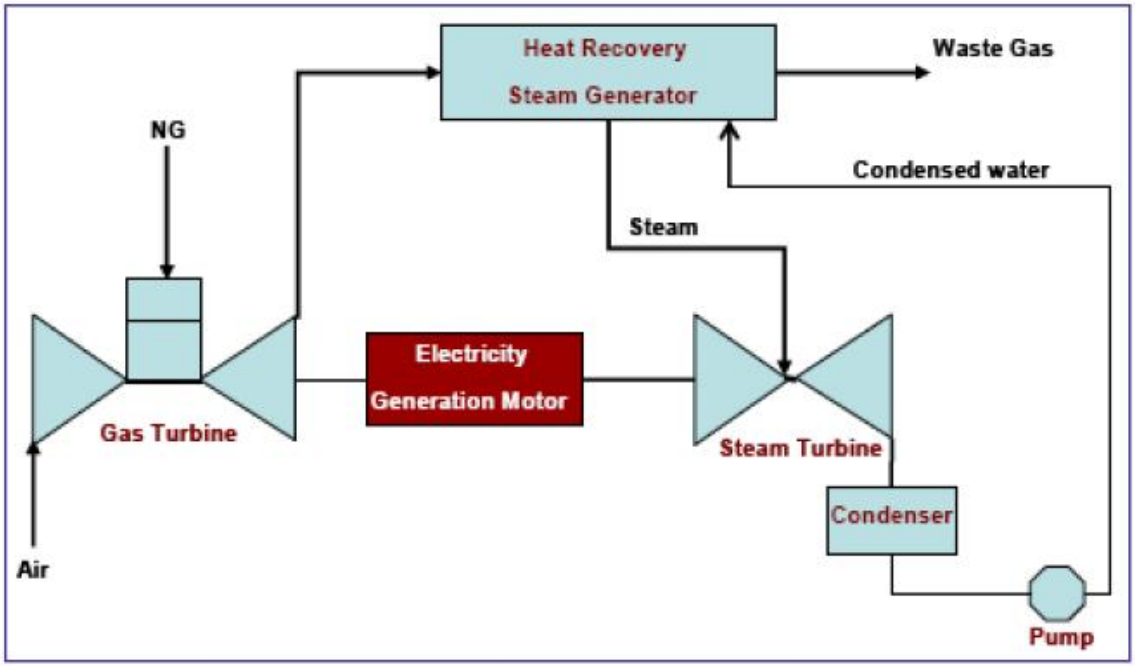

Figure A1. The Process Flow and Monitoring Meter Points of the Project

Annex 3. Calculation of EF_{p3} and $EF_{BL,upstream,CH4}$

1. Calculation of EF_{p3}

According to the registered CDM-PDD, the $EF_{BM,p3}$* is selected to calculate the *ex-post* baseline emission factor (EF_{p3}) of the CCG for the Project. As a result, the EF_{p3} is updated by *ex-post* calculation as follows:

According to the Table B1: λ_{Coal}=99.13%; λ_{Oil} =0.13%; λ_{Gas}=0.74%

According to the Table B2: $EF_{Coal,Adv}$ = 0.8249 (tCO_2e/MWh)

$EF_{Oil,Adv}$ = 0.5437 (tCO_2e/MWh)

$EF_{Gas,Adv}$ = 0.3910 (tCO_2e/MWh)

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv}$$

$$= 0.8213 \ (tCO_2e/MWh)$$

According to Table B4,

EF_{BM} = 0.5802 (tCO_2e/MWh)

**: For an ensured calculation of the baseline emission factor (EF_{p3}), all the three Options of calculating baseline emission factor ($EF_{BM,p3}$, $EF_{CM,p3}$, $EF_{BL,CO2,p3}$) have been tested based on the available 2007 data of CCG. As a result, the $EF_{BM,p3}$ is the selected option by calculation which has the lowest value among the three Options. This is in line with the registered PDD. (The related calculation sheets are submitted to the DOE for verification)*

2. Calculation of $EF_{BL,upstream,CH4}$

According to the methodology applied, the calculation of $EF_{BL,upstream,CH4}$ should be consistent with the calculation of CO_2 emissions in the build margin. As a result, the $EF_{BL,upstream,CH4}$ is updated by *ex-post* calculation as follows:

According to the Table C2: $EF_{CH4,Coal,Adv}$ = 0.0061(tCO_2e/MWh)

$EF_{CH4,Oil,Adv}$ = 0.0000(tCO_2e/MWh)

$EF_{CH4,Gas,Adv}$ = 0.0021(tCO_2e/MWh)

According to the Table C3: λ_{Coal}=98.51%; λ_{Oil} =0.00%; λ_{Gas}=1.49%

$$EF_{Thermal} = \lambda_{Coal} \times EF_{CH4,Coal,Adv} + \lambda_{Oil} \times EF_{CH4,Oil,Adv} + \lambda_{Gas} \times EF_{CH4,Gas,Adv}$$

$$= 0.00602622 \ (tCO_2e/MWh)$$

According to Table C3

$EF_{BL,upstream,CH4}$ = 0.00425691 (tCO_2e/MWh)

Table B1. Fossil Fuel Consumption of CCG in 2007[1]

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Emission Factor of the Fuel ($kgCO_2/TJ$)	Oxidation Factor (%)	Average low calorific Value ($MJ/t,km^3$)	Emission of CO_2 (tCO_2e)
Raw Coal	10^4t	2,200.57	9,357.00	3,479.81	2,683.81	1,547.70	3,239.00	**22,507.89**	87,300	100	20,908	410,829,404
Cleaned Coal	10^4t	0.00	3.07	0.00	0.00	3.80	0.00	**6.87**	87,300	100	26,344	157,998
Other washed Coal	10^4t	0.04	87.16	0.00	2.06	96.42	0.00	**185.68**	87,300	100	8,363	1,355,631
Briquettes	10^4t	0.00	0.00	0.00	0.00	0.00	0.01	**0.01**	87,300	100	20,908	183
Coke	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	95,700	100	28,435	0
Other Coking Products	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	95,700	100	28,435	0
											Subtotal	**412,343,216**
Crude Oil	10^4t	0.00	0.43	0.00	0.00	0.00	0.00	**0.43**	71,100	100	41,816	12,784
Gasoline	10^4t	0.00	0.00	0.00	0.04	0.01	0.00	**0.05**	67,500	100	43,070	1,454
Diesel	10^4t	0.98	3.21	2.51	2.83	1.93	0.00	**11.46**	72,600	100	42,652	354,863
Fuel Oil	10^4t	0.42	1.25	1.33	0.63	0.64	1.74	**6.01**	75,500	100	41,816	189,742
Other Petroleum Products	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	75,500	100	38,369	0
											Subtotal	**558,843**
Natural Gas	10^7 m^3	0.00	1.20	1.80	0.00	2.00	18.70	**23.7**	54,300	100	38,931	501,007
Coke Oven Gas	10^7 m^3	0.80	26.10	2.50	3.10	9.10	0.00	**41.6**	37,300	100	16,726	259,534
Other Gas	10^7 m^3	291.70	257.90	0.00	246.90	0.00	239.80	**1036.3**	37,300	100	5,227	2,020,444
LPG	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	64,600	100	50,179	0
Refinery Gas	10^4t	1.43	10.01	0.97	0.70	0.00	0.00	**13.11**	48,200	100	46,055	291,022
											Subtotal	**3,072,007**
											Total	**415,974,066**

λ_{Coal}=0.9913; λ_{Oil} =0.0013; λ_{Gas}=0.0074

[1] *Data source: China Energy Statistical Yearbook 2008*

Table B2. The Emission Factor of Optimized Coal, Oil, Gas-fired Power Plant

	Variable	Efficiency of Power Supply	Emission Factor of the Fuel ($kgCO_2/TJ$)	Oxidation factor	Emission factor (tCO2/MWh)
Coal-Fired Power Plant	$EF_{Coal,Adv}$	38.10%	87,300	1	0.8249
Oil-Fired Power Plant	$EF_{Gas,Adv}$	49.99%	75,500	1	0.5437
Gas-Fired Power Plant	$EF_{Oil,Adv}$	49.99%	54,300	1	0.3910

Based on the most updated ***Build Margin Emission Factor Calculation Procedure***[2] issued by the Chinese DNA on 2 July 2009, the data information for calculating the most efficient level of the best technology commercially available in China is sourced from China Electricity Council (CEC). Therefore, in the case of this Monitoring Report, the PP obtained the *2007 Statistical Data of CCG* from CEC, and further made the assumptions of being conservative for the emission calculations. As a result, $EF_{Coal,Adv}$, $EF_{Gas,Adv,}$ and $EF_{Oil,Adv}$ are calculated as **38.10%, 49.99%, and 49.99%** respectively. (Related calculation is provided to the DOE for further verifications).

Thus,

$$EF_{thermal}=\lambda_{Coal}\times EF_{Coal,Adv}+\lambda_{oil}\times EF_{Oil,Adv}+\lambda_{Gas}\times EF_{Gas,Adv}= 0.8213\ (tCO_2e/MWh)$$

[2] *Data source: The official document issued by the Chinese DNA on 2nd July, 2009, accessible at: http://qhs.ndrc.gov.cn/qjfzjz/W020090703644239079814.doc*

Table B3. The Installed Capacity of CCG[3]

The Installed Capacity of CCG in 2007								
Type of Fuel	**Unit**	**Jiangxi**	**Henan**	**Hubei**	**Hunan**	**Chongqing**	**Sichuan**	**Total**
Fuel-Fired Power	MW	9,270	38,540	13,040	13,360	6,370	12,000	**92,580**
Hydropower	MW	3,570	2,740	24,020	9,220	2,240	19,860	**61,650**
Nuclear Power	MW	0	0	0	0	0	0	**0**
Wind Power and Others	MW	0	0	10	17	24	0	**51**
Total	**MW**	**12,840**	**41,280**	**37,070**	**22,597**	**8,634**	**31,860**	**154,281**
The Installed Capacity of CCG in 2006								
Fuel-Fired power	MW	6,568	32,603	11,623	10,715	5,594	9,555	**76,658**
Hydropower	MW	3,288	2,553	18,320	8,648	1,979	17,730	**52,518**
Nuclear power	MW	0	0	0	0	0	0	**0**
Wind Power and Others	MW	0	0	0	17	24	0	**41**
Total	MW	**9,856**	**35,156**	**29,943**	**19,380**	**7,597**	**27,285**	**129,217**
The Installed Capacity of CCG in 2005								
Fuel-Fired power	MW	5,906	26,268	9,526	7,212	3,760	7,496	**60,167.2**
Hydropower	MW	3,019	2,540	17,889	7,905	1,893	14,960	**48,205.2**
Nuclear power	MW	0	0	0	0	0	0	**0**
Wind Power and Others	MW	0	0	0	0	24	0	**24**
Total	MW	**8,925**	**28,808**	**27,415**	**15,117**	**5,676**	**22,456**	**108,396.4**

[3] *Data source: China Power Yearbook 2006-2008*

Table B4. Changes in Installed Capacity of CCG in 2005~2007[4]

Type of Fuel	2005 A	2006 B	2007 C	Change in Installed Capacity from 2005 to 2007 D=C-A	The Proportion of the Total Change Capacity
Fuel-Fired Power(MW)	60,167.2	76,658.0	92,580.0	32,412.8	70.64%
Hydropower(MW)	48,205.2	52,518.0	61,650.0	13,444.8	29.30%
Nuclear Power	0.0	0.0	0.0	0.0	0.00%
Wind Power (MW)	24.0	41.0	51.0	27.0	0.06%
Total(MW)	**108,396.4**	**129,217.0**	**154,281.0**	**45,884.6**	**100.00%**
Changes in Total Installed Capacity of 2005	70.26%	83.75%	100%	29.74%	

$EF_{BM} = EF_{Thermal} \times CAP_{Thermal}/CAP_{Total}$ = 0.5802 (tCO_2e/MWh)

[19] *Data source: China Power Yearbook 2006-2008*

Table C1. Average Net Calorific Value of Coal for Coal-Fired Plant in 2007

Type of coal	Amount of coal consumed	Percentage	Low Calorific Value	Average Low Calorific Value
Raw Coal	22,507.89	99.15%	20,908.00	
Cleaned Coal	6.87	0.03%	26,344.00	
Other washed Coal	185.68	0.82%	8,363.00	**20,807.03**
Briquette Coal	0.01	0.00%	20,908.00	
Coke	0.00	0.00%	28,435.00	
Total	**22,700.45**			

Table C2. The Fugitive Methane Emission Factor of Thermal Power Plant

Type of Power Plant	Variable	Efficiency of Power Supply	Fugitive Methane Emission Factor of the Fuel (tCH_4/TJ)	Oxidation factor	Fugitive Methane Emission Factor (tCO_2/MWh)
Coal-Fired Power Plant	$EF_{CH4.Coal,Adv}$	38.10%	0.6440	1	0.0061
Oil-Fired Power Plant	$EF_{CH4.Oil,Adv}$	49.99%	0.0041	1	0.0000
Gas-Fired Power Plant	$EF_{CH4.Gas,Adv}$	49.99%	0.2960	1	0.0021

Note: According to the Methodology applied, the efficiency of the power supply by type of thermal power plant in the BM calculation is selected for the calculation of the fugitive methane emission factor, so that the leakage calculation is kept in consistent with the calculation of the EF and ER in the BM.

Table C3. Fugitive Methane Emission for Thermal Power Plant of CCG in 2007[5]

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Fugitive Methane Emission Factors (tc/TJ)	Oxidation Factor (%)	Average low calorific Value ($MJ/t,km^3$)	Emission of CO_2 (tCO_2e)
Raw Coal	10^4t	2,200.57	9,357.00	3,479.81	2,683.81	1,547.70	3,239.00	**22,507.89**	13.4(tCH_4/kt)	100	20,908	3,016,057
Cleaned Coal	10^4t	0.00	3.07	0.00	0.00	3.80	0.00	**6.87**	13.4(tCH_4/kt)	100	26,344	921
Other washed Coal	10^4t	0.04	87.16	0.00	2.06	96.42	0.00	**185.68**	13.4(tCH_4/kt)	100	8,363	24,881
Briquettes	10^4t	0.00	0.00	0.00	0.00	0.00	0.01	**0.01**	13.4(tCH_4/kt)	100	20,908	1
Coke	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	13.4(tCH_4/kt)	100	28,435	0
Other Coking Products	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	13.4(tCH_4/kt)	100	28,435	0
											Subtotal	**3,041,860**
Crude Oil	10^4t	0.00	0.43	0.00	0.00	0.00	0.00	**0.43**	0.0041	100	41,816	1
Gasoline	10^4t	0.00	0.00	0.00	0.04	0.01	0.00	**0.05**	0.0041	100	43,070	0
Diesel	10^4t	0.98	3.21	2.51	2.83	1.93	0.00	**11.46**	0.0041	100	42,652	20
Fuel Oil	10^4t	0.42	1.25	1.33	0.63	0.64	1.74	**6.01**	0.0041	100	41,816	10
Other Petroleum Products	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.0041	100	38,369	0
											Subtotal	**31**
Natural Gas	10^7 m^3	0.00	1.20	1.80	0.00	2.00	18.70	**23.7**	0.2960	100	38,931	2,731
Coke Oven Gas	10^7 m^3	0.80	26.10	2.50	3.10	9.10	0.00	**41.6**	0.6440	100	16,726	4,481
Other Gas	10^7 m^3	291.70	257.90	0.00	246.90	0.00	239.80	**1036.3**	0.6440	100	5,227	34,885
LPG	10^4t	0.00	0.00	0.00	0.00	0.00	0.00	**0**	0.6440	100	50,179	0
Refinery Gas	10^4t	1.43	10.01	0.97	0.70	0.00	0.00	**13.11**	0.6440	100	46,055	3,888
											Subtotal	**45,985**
											Total	**3,087,877**

***Note**: As there no fugitive methane emission factor for coke oven gas, other gas, LPG, and refinery gas is given, and for the purpose of being conservative, the fugitive methane emission factor for coal, rather than the oil, is selected as the factor for those gas as mentioned. The result of calculation is as follows:*

λ_{Coal}=0.9851*;* λ_{Oil} =0.0000; λ_{Gas}=0.0149

Therefore, $EF_{CH4,Thermal}$= 0.00602622 (tCH_4/MWh); $EF_{BL,upstream,CH4}$= 0.00425691 (tCH_4/MWh)

Related leakage calculation spreadsheet is provided for verifications further in details

[5] *Data source: China Energy Statistical Yearbook 2008*