

Nanjing Jinling Grid Connected Natural Gas Combined Cycle Power Plant Project

Document Prepared By Goldchina Consultancy International Co., Ltd.

Project Title	Nanjing Jinling Grid Connected Natural Gas Combined Cycle Power Plant Project
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Monitoring Period	01-04-2011 to 31-12-2012
Prepared By	Dr. Zhaoning Zheng Goldchina Consultancy International Co., Ltd.
Contact	Address: Room 3103, Unit 3, Building 1, Tangning One, No.16 Zhongguancun East Road, Haidian District, Beijing, P.R. of China (100083) Telephone: 86-10-6268 2682 Fax: 86-10-6268 2682 Email: zzn01@mails.tsinghua.edu.cn , zzn@gcci-carbon.com Website: www.gcci-carbon.com

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Nanjing Jinling Grid Connected Natural Gas Combined Cycle Power Plant Project (hereafter referred to as the "Project") is a grid-connected natural gas combined cycle electricity generation plant, constructed, owned and operated by Huaneng Nanjing Jinling Power Generation Co. Ltd (hereinafter called "the Project Owner") in Jiangsu Province, China. The project has a total installed capacity of 780MW, and will supply approximately 2,716,000 MWh of electricity per annum to East China Power Grid (ECPG).

The purpose of the project activity is to displace an equal amount of electricity generated by coal-fired thermal power plants which would have been built otherwise, by applying a less GHG intensive fuel (natural gas), and consequently achieve greenhouse gas (GHG) emission reductions. The project has been registered as a CDM project on 05/08/2010, with registration number of 3008.

The first 390 MW unit of the project has been put into operation on 31/12/2006 and the second 390 MW unit of the project has been put into operation on 05/03/2007. The expected lifetime of the project is 20 years.

During the monitoring period (from 01/04/2011 to 31/12/2012), the monitoring activities were conducted strictly in accordance with the monitoring plan in the registered PDD. The project has operated without any accidental or emergency events that might impact the accuracy and/or implementation of monitoring activities. The emission reduction achieved by the project in this monitoring period is 2,126,828 tCO₂e. The emission reductions in the monitoring period will be verified and issued under VCS rules.

1.2 Sectoral Scope and Project Type

This category would fall within sectoral scope 1: energy industries (Renewable sources).

1.3 Project Proponent

Organization name	Huaneng Nanjing Jinling Power Generation Co., Ltd
Contact person	Wan Yong
Title	Assistant General Manager
Address	8 QiXia Economy and Technique Development District 210034 Nanjing, Jiangsu Province China
Telephone	+86 (0)25 8572-8007

Email	wanyong@hpijl.com.cn
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1.4 Other Entities Involved in the Project

Organization name	Goldchina Consultancy International Co., Ltd.
Role in the project	The buyer
Contact person	Dr. Zheng Zhaoning
Title	Technical director
Address	Room 3103, Unit 3, Building 1, Tangning One, No.16, Zhongguancun East Road, Haidian District, Beijing, 100083
Telephone	86-18010121386
Email	zzn@gcci-carbon.com

1.5 Project Start Date

31/12/2006 (First 390 MW unit put into operation)

1.6 Project Crediting Period

The starting date of the first crediting period is 05/08/2010. Renewable crediting period (7yrs×3) is adopted by the project, so the first 7-year renewable crediting period is from 05/08/2010 to 04/08/2017.

1.7 Project Location

The Project is located at Longtan County, Qixia district of Nanjing City within Jiangsu Province, and the geographical coordinates are 119°00'45" east longitude and 32°10'17" north latitude as show in the Figure 1. Close to the Yangtse River, the Project lies to the north, approximately 30 km away from the centre of Nanjing City, as shown in the figure below.

Figure 1: Geography Location of the Project



1.8 Title and Reference of Methodology

Version 03 of Approved baseline methodology AM0029: “Baseline Methodology for Grid Connected Electricity Generation project using Natural Gas” and “Monitoring methodology for grid connected generation plants using non-renewable and less GHG intensive fuel” (Version 03, 16/05/2008).

1.9 Other Programs

Emission Trading Programs and Other Binding Limits:

The project has been registered as a CDM project on 05/08/2010, for which a renewable crediting period of 3×7 years will be used under the CDM GHG Program. The project proponent

confirmed that, once emission reductions generate during 01/04/2011-31/12/2012 are issued under VCS rules, those credits will not be claimed as CERs. For the period 01/04/2011-31/12/2012, three monitoring reports were published in UNFCCC website but will not be issued forever.

China is Non-annex I country and there is no compliance with an emission trading program or to meet binding limits on GHG emissions for this project activity.

Other Forms of Environmental Credit:

The project does not result in creation of any other form of GHG related environmental credit during the period for which VCUs are claimed.

Participation under Other GHG Programs:

The Project has been registered as a CDM project with registration number 3008.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The first gas turbine unit started operations in 31 December, 2006 and the second unit started operations in 05 March, 2007.

The Natural Gas Combined Cycle (NGCC) technology (unit code GE-109FA) applied by the Project is supplied by the US manufacturer General Electric. The project consists of two sets of 390MW gas steam combined cycle generation system. Each set contains one gas turbine, one steam turbine, one generator and one heat recovery steam generator (HRSG). The gas and steam turbines are coupled to the generator in a tandem arrangement on a single shaft. The main performance data of the combined cycle unit is given in the table below:

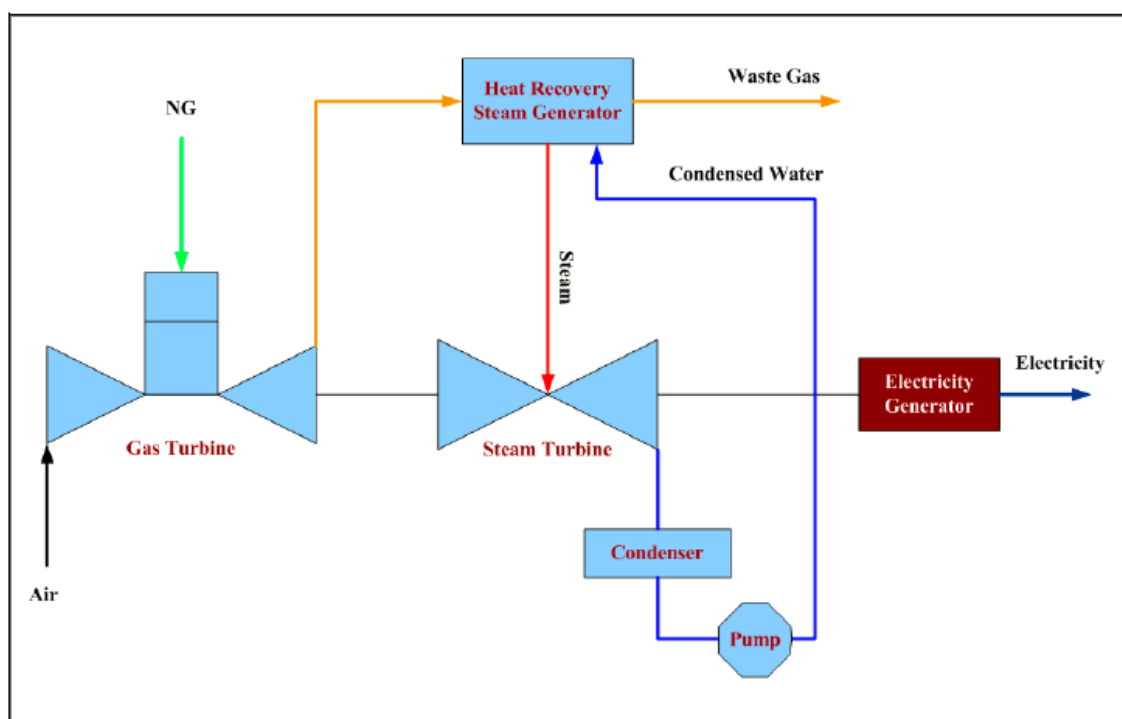
Equipment	Specifications	Manufacturer
Gas turbine	Model: PG-9351FA Capacity: 255.6MW; Firing temperature: 1326.7°C Rotational speed:3000r/min	GE-Harbin Power Equipment Company
Heat Recovery Steam Generator (HRSG)	High pressure steam volume: 286.1 t/h Reheated steam volume: 314.2 t/h Low pressure steam volume: 42.7 t/h	NEM-Wuhan Boiler Works
Steam turbine	Model: D10 Capacity: 141MW; Rotational speed: 3000r/min	GE-Harbin Power Equipment Company

Electricity Generator	Model: 390H Capacity: 397.8MW Rated pressure:19000V Power factor: 0.85	GE-Harbin Power Equipment Company
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The combustor is fired with natural gas and produces hot, high pressure, low NOx gases, which expand in the gas turbine. The gas turbine drives the generator at one end, and an axial compressor at the other end, which supplies compressed ambient air to the combustor. The thermal energy contained in the high temperature exit gases of the gas turbine is recovered in the HRSG, which is designed to maximize the heat recovery of gases and allows a minimum stack temperature of the exhaust gases. The steam generated from the HRSG is introduced to and expand in the steam turbine to drive the generator.

The process flow diagram of the Project is shown below, in Figure 2:

Figure 2: Process Flow Diagram of the Project



According to the power generation and distribution layout stated in the PPA and the arrangement of the Jiangsu Grid Company, the proposed project is connected, via 220kv Xidu Substation from 27/01/2011 onwards, to a 500kv substation linking to the Jiangsu Grid, which is a sub-grid of ECPG. The post – registration change was included in the revised PDD version 06.5 dated 26/11/2012 and approved by EB 12/04/2013.

The project was implemented as described in the registered PDD version 06.5. During this monitoring period, the project had a smooth operation and the monitoring system worked properly, no special events occurred.

2.2 Deviations

2.2.1 Methodology Deviations

There is no deviation applied to this monitoring period.

2.2.2 Project Description Deviations

There is no deviation applied to this monitoring period.

2.3 Grouped Project

The Project is not a grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{NG,upstream,y}$
Data unit	tCH ₄ /GJ
Description	Emission factor for upstream fugitive methane emissions of natural gas
Source of data	AM0029
Value applied:	0.000296
Justification of choice of data or description of measurement methods and procedures applied	AM0029 is the reliable source.
Purpose of the data	Leakage emission calculation
Comments	-

Data / Parameter	$OXID_i$
Data unit	-
Description	The oxidation factor of fuel i
Source of data	IPCC default value in 2006 IPCC Guideline for National Greenhouse Gas Inventories
Value applied:	See CDM PDD Annex 3
Justification of choice of data or description of measurement methods and procedures applied	IPCC is the reliable source.

Purpose of the data	Baseline emission calculation
Comments	-

Data / Parameter	GWP_{CH_4}
Data unit	tCO ₂ e/CH ₄
Description	Global warming potential of methane, valid for the first commitment period
Source of data	IPCC
Value applied:	21
Justification of choice of data or description of measurement methods and procedures applied	IPCC is the reliable source.
Purpose of the data	leakage emissions Calculation
Comments	-

Data / Parameter	$EF_{CO_2, upstream, LNG}$
Data unit	tCO ₂ /TJ
Description	Emission factor for upstream CO ₂ emissions due to fossil fuel combustion / electricity consumption associated with LNG processing
Source of data	Barclay, M. and N. Denton, 2005. Selecting offshore LNG process. LNG Journal, Oct, P34-36< http://www.offshorecenter.dk/log/bibliotek/Selecting%20offshore%20LNG%20processes.PDF >
Value applied:	6
Justification of choice of data or description of measurement methods and procedures applied	Public technical literature is a reliable source
Purpose of the data	Leakage emission calculation
Comments	-

Data / Parameter	$EF_{k, upstream, CH_4}$
Data unit	tCH ₄ /ktcoal
Description	Emission factor for upstream fugitive methane emissions from production of the fuel (coal)

Source of data	IPCC
Value applied:	13.4
Justification of choice of data or description of measurement methods and procedures applied	IPCC is the reliable source.
Purpose of the data	Baseline emission calculation
Comments	-

Data / Parameter	$F_{i,y}$
Data unit	t or m ³
Description	Amount of fuel consumed in year(s) y for power generation
Source of data	China Energy Statistical Yearbook
Value applied:	See CDM PDD Annex 3
Justification of choice of data or description of measurement methods and procedures applied	As detailed information on fuel consumed by power plants is not publicly available, aggregated data on the fuel types is used instead. China Energy Statistical Yearbook is the reliable source.
Purpose of the data	Baseline emission calculation
Comments	-

Data / Parameter	$GEN_{i,y}$
Data unit	MWh
Description	Electricity (MWh) delivered to the grid excluding low operation cost/must run power plants in year y
Source of data	China Electricity Power Yearbook
Value applied:	See CDM PDD Annex 3
Justification of choice of data or description of measurement methods and procedures applied	As detailed information on power generation is not publicly available, aggregated data on the fuel types is used instead. China Electricity Power Yearbook is the reliable source.
Purpose of the data	Baseline emission calculation
Comments	-

Data / Parameter	NCV_i
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Data unit	GJ/t(ce)
Description	Net caloric value of fuel i used in the project activity
Source of data	China Energy Statistics Yearbook
Value applied:	See CDM PDD Annex 3
Justification of choice of data or description of measurement methods and procedures applied	China Energy Statistics Yearbook is the reliable source.
Purpose of the data	Baseline emission calculation
Comments	-

Data / Parameter	$EF_{CO_2,i,y}$
Data unit	tCO ₂ /GJ
Description	The emission factor of fuel i
Source of data	IPCC default value in 2006 IPCC Guideline for National Greenhouse Gas Inventories
Value applied:	See CDM PDD Annex 3
Justification of choice of data or description of measurement methods and procedures applied	As detailed information on fuel consumed by power plants is not publicly available, the aggregated data on the fuel types is used instead. IPCC is the reliable source.
Purpose of the data	Baseline emission calculation
Comments	-

Data / Parameter	$COEF_i$
Data unit	tCO ₂ /t(m ³)
Description	CO ₂ emission coefficient of fuel i
Source of data	Calculated
Value applied:	See CDM PDD Annex 3
Justification of choice of data or description of measurement methods and procedures applied	Calculated according to the formula suggested by AM0029.
Purpose of the data	Baseline emission calculation
Comments	-

3.2 Data and Parameters Monitored

Data / Parameter	$EG_{PJ,y}$																																																	
Data unit	MWh																																																	
Description	Electricity supplied to the grid by the project activity																																																	
Source of data	Electricity supplied to the grid by the Project, which is calculated as electricity sold to the grid ($EG_{out,y}$) minus electricity imported from the grid ($EG_{in,y}$). i.e. $EG_{PJ,y} = EG_{out,y} - EG_{in,y}$ $EG_{out,y}$ and $EG_{in,y}$ are read from the electricity meters and cross-checked by the commercial invoices.																																																	
Description of measurement methods and procedures to be applied	calculated,																																																	
Frequency of monitoring/recording	The meter readings are continuously measured hourly and recorded monthly.																																																	
Value monitored:	6,989,794.416																																																	
Monitoring equipment	<table><tr><th>Type</th><th>Meters</th><th>Serial number</th><th>Calibration Date</th><th>Validity</th><th>Accuracy</th></tr><tr><td rowspan="9">Electricity meter</td><td>M1</td><td>96347828</td><td>29/01/2011</td><td>28/04/2011</td><td rowspan="9">0.2S</td></tr><tr><td>BM1</td><td>96348248</td><td>17/04/2011</td><td>16/07/2011</td></tr><tr><td>M2</td><td>96348243</td><td>16/07/2011</td><td>15/10/2011</td></tr><tr><td>BM2</td><td>96348247</td><td>12/10/2011</td><td>11/01/2012</td></tr><tr><td>M3</td><td>96348211</td><td>07/01/2012</td><td>06/04/2012</td></tr><tr><td>BM3</td><td>96347836</td><td>07/04/2012</td><td>06/07/2012</td></tr><tr><td></td><td></td><td>11/06/2012</td><td>10/09/2012</td></tr><tr><td></td><td></td><td>09/09/2012</td><td>08/12/2012</td></tr><tr><td></td><td></td><td>07/12/2012</td><td>06/03/2013</td></tr></table> M1-M3: Main meters BM1-BM3: Backup meters						Type	Meters	Serial number	Calibration Date	Validity	Accuracy	Electricity meter	M1	96347828	29/01/2011	28/04/2011	0.2S	BM1	96348248	17/04/2011	16/07/2011	M2	96348243	16/07/2011	15/10/2011	BM2	96348247	12/10/2011	11/01/2012	M3	96348211	07/01/2012	06/04/2012	BM3	96347836	07/04/2012	06/07/2012			11/06/2012	10/09/2012			09/09/2012	08/12/2012			07/12/2012	06/03/2013
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	BM2	96348247	12/10/2011	11/01/2012																																														
	M3	96348211	07/01/2012	06/04/2012																																														
	BM3	96347836	07/04/2012	06/07/2012																																														
			11/06/2012	10/09/2012																																														
			09/09/2012	08/12/2012																																														
			07/12/2012	06/03/2013																																														

	All meters above are calibrated by Jiangsu Electric Power Research Institute Corporation Limited in accordance with Technical Norm of the Calibration of AC Watt-hour Meters at Place of Installation (JJG 1055-1997).
QA/QC procedures to be applied	Electricity supplied by the project activity to the grid is monitored and recorded at the control center using a computer system. Commercial invoices for electricity are also kept for cross checking. All meters are calibrated every three month by a qualified third party. Data record and relevant documents will be archived for a period of 2 years after the crediting period
Purpose of the data	Baseline emission calculation and leakage emission calculation
Calculation method	The amount of electricity supplied to the Grid is calculated as the difference between electricity sold to ECPG ($EG_{out,y}$) measured by M1 and M2 and electricity imported from the grid ($EG_{in,y}$) measured by M1-M2-M3.
Comments	-

Data / Parameter	$EF_{Grid,BM,y}$
Data unit	tCO ₂ /MWh
Description	Build margin emission factor of ECPG
Source of data	Calculated based on public available data (http://cdm.ccchina.gov.cn)
Description of measurement methods and procedures to be applied	Calculated
Frequency of monitoring/recording	As demonstrated in PDD Section B.6.1, the lowest value of the three options given in AM0029 Version03 is Option1-Build Margin of ECPG, it should therefore be monitored ex post as per AM0029 Ver03. According to the "Tool to calculate emission factor for an electricity system", for the first crediting period, the build margin emission factor shall be updated annually, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available.
Value monitored:	0.6622 Vintage 2011 0.6889 Vintage 2012
Monitoring equipment	NA
QA/QC procedures to be applied	As per QA/QC procedures for relevant monitored parameters in the "Tool to calculate emission factor for an electricity system"

Purpose of the data	Calculation of baseline emissions
Calculation method	"Tool to calculate emission factor for an electricity system" Version 01.1
Comments	-

Data / Parameter	FC _{f,y}					
Data unit	Nm ³ (the computer system automatically converts the volume unit of natural gas into Nm ³)					
Description	Net amount of NG consumed by the project.					
Source of data	Fuel flow meter readings					
Description of measurement methods and procedures to be applied	Measured					
Frequency of monitoring/recording	The natural gas flow rate is monitored continuously by the supplier and the project owner. The natural gas consumption is aggregated automatically and recorded daily.					
Value monitored:	1,351,078,300					
Monitoring equipment	NG flow meters					
	Meters at supplier side are ultrasonic flow meters, which have been calibrated by Nanjing Branch of National Station of Petroleum & Natural Gas Flow Measurement in accordance with the Verification Regulation of Ultrasonic Flow Meter (JJG1030-2007)					
	Type	Meters	Serial number	Calibration Date	Validity	Accuracy
	NG flow meters at supplier side	GM1	03-110136	03/02/2010 03/02/2012	02/02/2012 02/02/2014	1.0
		GM2	03-110137	03/08/2010 03/08/2012	02/08/2012 02/08/2014	1.0
Meters at project side are orifice plate flow meters, which have been calibrated by the Jiangsu Frontier Electric Technology Co., LTD in accordance with the Verification Regulation of the Pressure Transmitter (JJG882-2004)						
Type	Meters	Serial	Calibration	Validity	Accuracy	

			number	Date		
	NG flow meters at project side	GM3	0139943	30/07/2010 22/06/2011 12/06/2012	29/06/2011 21/06/2012 11/06/2013	0.25
		GM4	0139940	30/07/2010 15/06/2011 11/06/2012	29/06/2011 14/06/2012 10/06/2013	0.25
QA/QC procedures to be applied	The total amount of natural gas consumed by the Project is monitored both by supplier and the project owner for internal cross-checking. To be conservative, the larger of these two values is used to calculate the gas consumed by the Project. All meters used for the reading of the gas supplied have been retained for regular maintenance and testing services for an ensured accuracy. Their calibration frequencies are shown below: - Meters at supplier side (GM1 and GM2): once every two years; - Meters at project side (GM3 and GM4): once per year All electronic and paper documents will be archived during the crediting period and for two years after the end of the crediting period.					
Purpose of the data	Project emission calculation					
Calculation method	N/A					
Comments	-					

Data / Parameter	NCV _{f,y}
Data unit	GJ/Nm ³ (GJ/Nm ³ is used in NG test reports provided by gas supplier)
Description	Net calorific value per volume unit of natural gas
Source of data	NG test reports issued by gas supplier
Description of measurement methods and procedures to be applied	Measured and calculated as weighted average value
Frequency of monitoring/recording	Measured and recorded fortnightly as per AM0029 Version 3 and the revised PDD.
Value monitored:	01/04/2011-31/12/2011: 0.034389 2012 year: 0.034238

Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of the data	Project emission calculation and leakage emission calculation
Calculation method	N/A
Comments	-

Data / Parameter	EF _{CO₂,f,y}
Data unit	tCO ₂ /GJ
Description	Emission factor of natural gas
Source of data	Conservative value between National data (0.0543 t CO ₂ /GJ) issued by Chinese DNA (http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2975.pdf) and the data (0.0561 t CO ₂ /GJ) in the revised PDD
Description of measurement methods and procedures to be applied	default value
Frequency of monitoring/recording	annually
Value monitored:	0.0561
Monitoring equipment	NA
QA/QC procedures to be applied	NA
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	-

3.3 Monitoring Plan

1) The equipment for monitoring and the installation of Meters

1.1) Monitoring of the net electricity generated by the Project and sold into the Grid (ECPG)

The Project supplies electricity via 220kv Xidu Substation linked to the Jiangsu Grid, a sub-grid of ECPG. The Metering Points for electricity sold to ECPG ($EG_{out,y}$) are set at the project side of each transmission line, as shown in the Figure 3. A main meter and a backup meter are

installed at each Metering Point, including M1 and BM1 (backup meter to M1) for the first line, and M2 and BM2 (backup meter to M2) for the second line.

The four meters mentioned above are bi-directional meters which can measure electricity sold to and imported from the ECPG.

Serving as a peak-load balancing power plant, the Project is in standby mode at certain points of time during the course of operation. An additional meter M3 and its backup meter BM3 is installed at the project side to measure the electricity imported from the grid ($EG_{in,y}$) whilst it in idle status (please see the Figure 3 for details). M3 and BM3 are one directional meters measuring only electricity imported from the grid.

The readings of the main meters (M1-M3) are taken for billing between the Project Owner and Grid Company, as well as for CDM purposes, while the readings of the backup meters (BM1-BM3) only serve for emergency situations.

The meter readings are readily accessible for the DOE. Calibration records are also be maintained for verification.

The net amount of electricity supplied to the Grid equals to $(EG_{out,y} - EG_{in,y})$.

The online meter readings of $EG_{out,y}$ and $EG_{in,y}$ are transferred to the computerized control center directly. Hourly readings are also manually recorded each day to give a daily output, and aggregated each month to give a monthly total.

Commercial invoices of each month can be used for cross checking.

1.2) Monitoring of quantity of NG combusted

The amount of natural gas combusted in Nm^3 is monitored both at the NG supplier and project end through flow meters and meter readings are recorded automatically. The two meters at the NG supplier side (GM1 and GM2) are taken for billing purpose between NG supplier and the Project Owner, as well as for emission reduction calculation purpose. In addition, two flow meters (GM3 and GM4) are installed respectively before the gas inlet for Unit 1 and Unit 2 at the project side for internal cross-checking (See the Figure 3 for details).

To be conservative, the larger of these two values (i.e. the annual quantity of natural gas monitored by GM1 and GM2, and the annual quantity of natural gas monitored by GM3 and GM4) will be used to calculate the NG consumed by the proposed project.

The natural gas flow rate is monitored continuously both by the supplier and the Project Owner. The natural gas consumption is aggregated automatically and recorded daily.

The meters' readings are also readily accessible for the DOE. Calibration records are maintained for verification.

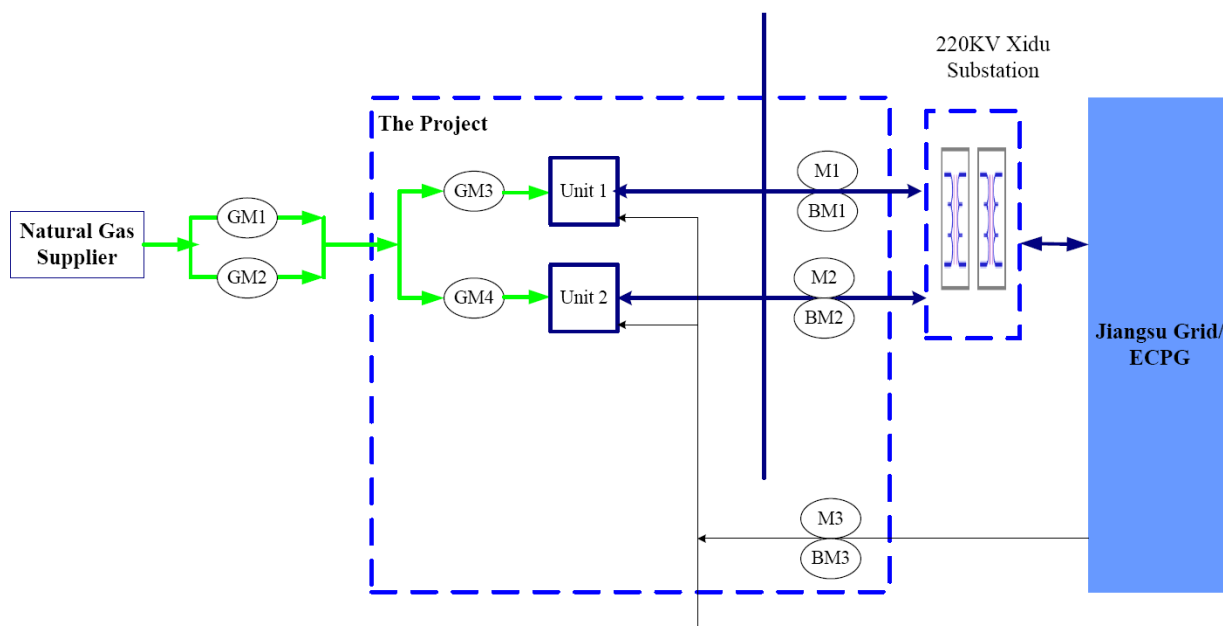
The commercial receipts for the gas purchased by the Project Owner are kept and are readily accessible for verification by the DOE

1.3) Monitoring of NCV

NCV of the natural gas is obtained from the fuel supplier's NG test reports.

The line diagram showing all relevant monitoring points is as follows:

Figure 3. Metering System



1.4) Data management

A CDM working team assigned by the project owner is responsible to collect, record and document all the related monitoring records.

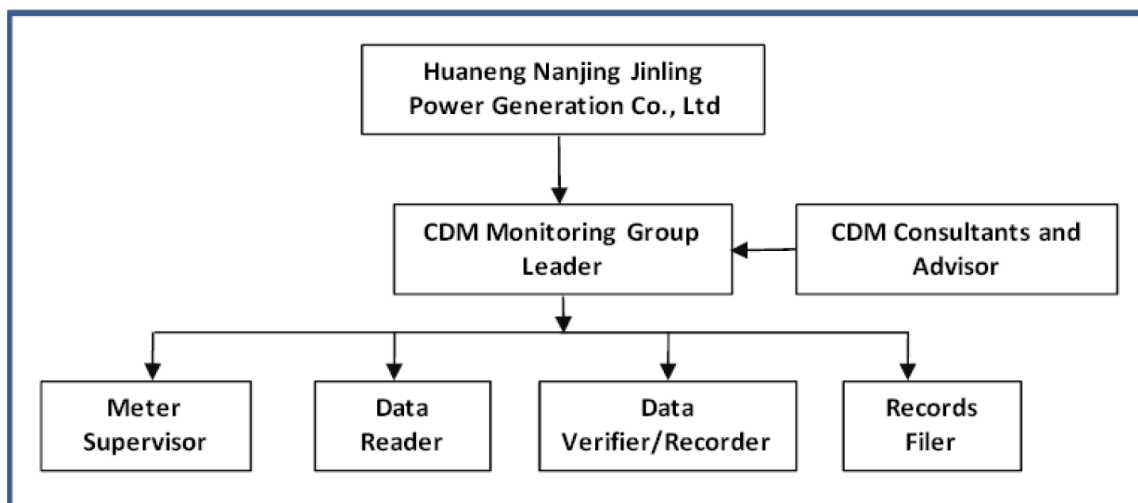
Any other physical documentation such as paper-based maps, diagrams and environmental assessments are collected, together with this monitoring plan, and indexed for the auditor's reference.

All relevant paper-based information is stored by the CDM working team and kept, at least with one hard copy, for two more years after the end of the crediting period for the Project.

2) Operational and Organizational Structure of Monitoring

The Project Owner is responsible for the work related to the monitoring, including the relevant data collection, documentation, monitoring and verification. A CDM working group has been established internally. The operational and organizational structure for the monitoring process is shown in Figure 4.

Figure 4. Operational and Organizational Structure of Monitoring



Responsibilities are shared between the PO and the CDM consultant as follows:

Roles	Responsibility
CDM Monitoring Group Leader	- Overall management of CDM monitoring group - Supervision of the implementation of the monitoring plan
Meter Supervisor	Meters registration, maintenance for meters, regular calibration of meters
Data Reader	Record and aggregate the readings related to electricity, natural gas, NCV according to specified frequency
Data Verifier/Recorder	Verification of monitoring data related to electricity, natural gas, NCV, etc.
Records Filer	Collection, compilation, and archiving the monitoring data
CDM Consultants and Advisor	CDM monitoring advice. Calculation of the baseline emission factors and emission reductions

The CDM group is responsible for finalizing the monitoring report of the Project. All the related records of calibration, reading and invoices are readily accessible for the verification of the DOE.

Calibration

All the metering equipments are properly calibrated for accuracy in compliance with relevant industrial standards in China. Calibration details can be found in section 3.2.

3) Emergency procedures for the monitoring system

For electricity monitoring, if the Main Meters become in-operable for any reason then the electricity supplied and imported can still be calculated as follows:-

(1) First, by reading the Backup Meter, unless a test by either party reveals it is inaccurate;

(2) if the backup system is not within the acceptable limits of accuracy or is otherwise performing improperly the Project Owner and the Jiangsu Grid Company/ECPG shall jointly prepare an estimate of the correct readings; and

(3) If the Project Owner and the Jiangsu Grid Company/ECPG fail to agree the estimate of the correct reading, then the matter will be referred for arbitration according to agreed procedures.

There is no malfunction of the main meters, hence emergency procedure was not implemented during this monitoring period.

4) Data archive and protection procedure

A CDM working team assigned by the project owner will be responsible to collect, record and document all the related monitoring records.

Any other physical documentation such as paper-based maps, diagrams and environmental assessment will be collected, together with this monitoring plan, and indexed for auditor's reference.

All relevant paper-based information will be stored by the CDM working team and kept, at least with one hard copy, for two more years after the end of the crediting period for the Proposed Project.

The CDM group is responsible for finalising the monitoring report of the Proposed Project. All the related records of calibration, reading and invoices will be readily accessible for the verification of the DOE. The monitoring report shall include all information used to calculate the emission reductions of the Proposed Project, which reflect the real, measurable and long-term GHG reductions achieved by the Proposed Project.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions are calculated by multiplying the electricity supplied to the ECPG ($EG_{PJ,y}$) with a baseline CO₂ emission factor ($EF_{BL,CO_2,y}$) as follows:

$$BE_y = EG_{PJ,y} \times EF_{BL,CO_2,y} \quad (1)$$

Where:

Parameter		Unit	Value
$EG_{PJ,y}$	Electricity supplied to the grid by the Project, which is calculated as electricity sold to the grid ($EG_{out,y}$) minus electricity imported from the grid ($EG_{in,y}$). See the table below for details.	MWh	6,989,794.416

EF _{BL, CO2, y}	The baseline CO ₂ emission factor According to the revised registered PDD, Option 1, i.e EF _{grid, BM, y} is selected as the baseline emission factor of ECPG, which is ex-post calculated and updated. See the ERs spreadsheet for details.	tCO ₂ /MWh		
			Year	Value
			2011	0.6622
			2012	0.6889

$$\text{So, } BE_y = EG_{PJ,y} \times EF_{grid, BM, y} \quad (2)$$

EG_{PJ,y} Determination:

No.	period		EG _{out,y}	EG _{in,y}	EG _{PJ,y}
	From	To	(MWh)	(MWh)	(MWh)
A	B	C	D	E	F=D-E
1	01/04/2011	30/04/2011	363,113.960	390.742	362,723.218
2	01/05/2011	31/05/2011	353,577.400	656.458	352,920.942
3	01/06/2011	30/06/2011	337,095.800	404.228	336,691.572
4	01/07/2011	31/07/2011	455,504.720	551.562	454,953.158
5	01/08/2011	31/08/2011	447,254.280	156.992	447,097.288
6	01/09/2011	30/09/2011	441,868.680	135.036	441,733.644
7	01/10/2011	31/10/2011	321,835.800	351.890	321,483.910
8	01/11/2011	30/11/2011	246,144.800	241.340	245,903.460
9	01/12/2011	31/12/2011	331,162.920	551.694	330,611.226
Total in 2011			3,297,558.440	3,439.942	3,294,118.498
1	01/01/2012	31/01/2012	285,022.760	910.536	284,112.224
2	01/02/2012	29/02/2012	209,627.000	985.204	208,641.796
3	01/03/2012	31/03/2012	334,010.160	638.748	333,371.412
4	01/04/2012	30/04/2012	468,885.200	90.090	468,795.110
5	01/05/2012	31/05/2012	296,880.320	384.384	296,495.936
6	01/06/2012	30/06/2012	356,210.800	196.460	356,014.340
7	01/07/2012	31/07/2012	461,922.080	43.560	461,878.520
8	01/08/2012	31/08/2012	433,030.400	159.720	432,870.680
9	01/09/2012	30/09/2012	394,027.920	289.014	393,738.906
10	01/10/2012	31/10/2012	310,256.760	647.218	309,609.542
11	01/11/2012	30/11/2012	130,281.360	1,170.686	129,110.674
12	01/12/2012	31/12/2012	22,477.400	1,480.622	20,996.778
Total in 2012			3,702,672.160	6,996.242	3,695,675.918

Total			6,989,794.416
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Note: Please see the ERs spreadsheet for more details.

Calculate the build margin (BM) emission factor ($EF_{grid,BM,y}$):

The build margin emissions factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (2)$$

Where:

$EF_{grid,BM,y}$ Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ CO₂ emission factor of power unit m in year y (tCO₂/MWh)

m Power units included in the build margin

y Most recent historical year for which power generation data is available

The sample group of power units m used to calculate the build margin consists of the set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. This option is chosen as it comprises larger annual generation than the five units built most recently. Following the deviation¹, the latest statistical data available (from the China Power Yearbook) is used by the DNA to determine the most recent year from which the added generation capacity is equal to or just exceeds 20% of the latest statistic year. The added generation capacity is the sample group of power units m used to calculate the build margin.

Therefore for the Project: First, calculate the share of different power generation technology in recent capacity additions; second, calculate the weight for capacity additions of each power generation technology; and finally, calculate the emission factor use the efficiency level of the best technology commercially available in China.

Because the generating capacity of the coal-fired, oil-fired and gas-fired technology can not be separated from the existing statistical data, the BM calculation in this PDD adopts the following method: First, use the available data in the energy balance tables on the most recent year, then calculate the proportion of CO₂ emissions from solid, liquid and gaseous fuels corresponding to the total emissions of CO₂ emissions. Second, the proportion used as the weight, based on the emission factors of the optimal efficient and commercial technologies, calculate the emission factor of the thermal power in each grid. Finally, this

¹ Deviation for projects in China (DNV, 7 Oct 05), see <https://cdm.unfccc.int/Projects/deviations/87512>

thermal emission factor is multiplied by the proportion of thermal power added capacity in the additional 20% capacity. The result is BM emission factor.

According to “Tool to calculate the emission factor for an electricity system” and clarifications by EB, the main steps for BM calculation are as following:

Sub-step a: Calculation of weights of CO₂ emissions by coal-fired, oil-fired and gas-fired plants in total CO₂ emissions of NWPG.

$$\lambda_{Coal} = \frac{\sum_{i \in coal, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (3)$$

$$\lambda_{oil} = \frac{\sum_{i \in oil, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (4)$$

$$\lambda_{gas} = \frac{\sum_{i \in gas, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (5)$$

Where:

$F_{i,j,y}$ Is the total amount of fuel i (in a mass or volume unit) consumed by Province j in NWPG for power generation in year y;

$NCV_{i,y}$ Is the net calorific value of fuel i (GJ/t or GJ/m³) in year y;

$EF_{CO_2,i,j,y}$ Is the emission factor of fuel i (tCO₂/ GJ)

COAL, OIL, and GAS is the aggregation of various kinds of coal, oil, and gas as fossil fuels.

Sub-step b: Calculation of emission factor of thermal power ($EF_{thermal\ power}$)

The EF thermal power is calculated as a weighted emission factor as the following formula:

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (6)$$

Where:

$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are the emission factors for the best commercially available technology of coal fired power generation, oil fired power generation, and gas fired power generation respectively.

Based on the above calculation principle for BM, basic data and parameter, the calculation process for BM is shown in ERs spread sheet.

Sub-step c: Calculation of Build Margin (BM) emission factor

Finally, weighted average of build margin emission factor ($EF_{grid,BM,y}$) is calculated by multiplying the $EF_{thermal}$ with the weight of new capacity addition by thermal power of total capacity addition in ECPG.

$$EF_{grid,BM,y} = \frac{CAP_{thermal,y}}{CAP_{Total,y}} * EF_{thermal,y} \quad (7)$$

Where:

$CAP_{thermal,y}$ Is the incrementally installed capacity of thermal power capacity(MW) in year y

$CAP_{total,y}$ Is the aggregate incrementally installed capacity of all kind of power generation capacity (MW) in year y

$EF_{thermal,y}$ Is the emissions factor of thermal power generation capacity of the applicable electricity system with the efficiency level of the best commercially available technology in China in the previous three years.

Base on the formulas above, the result is:

No.	Period		$EF_{grid,BM,y}$
	From	To	(t CO ₂ e/MWh)
1	01/04/2011	31/12/2011	0.6622
2	01/01/2012	31/12/2012	0.6889

For the detailed information, please see the ERs spread sheet.

During this monitoring period, Baseline Emission is calculated as follows:

No.	Period	$EG_{PJ,y}$ (MWh)	$EF_{grid,BM,y}$ (t CO ₂ e/MWh)	BE (t CO ₂ e)
1	01/04/2011 – 31/12/2011	3,294,118.498	0.6622	2,181,365
2	01/01/2012 – 31/12/2012	3,695,675.918	0.6889	2,545,951
	Total	6,989,794.416		4,727,316

4.2 Project Emissions

The project activity is on-site combustion of natural gas to generate electricity without auxiliary fuels in project operation. The CO₂ emissions from electricity generation (PE_y) are calculated as follows:

$$PE_y = \sum_f FC_{f,y} \times COEF_{f,y} \quad (8)$$

$$COEF_{f,y} = COEF_{NG,y} = \sum NCV_y \times EF_{CO_2,NG,y} \times OXID_{NG} \quad (9)$$

Where:

Parameter	Description	Unit	Value
FC _{f,y}	Total volume of natural gas combusted during this monitoring period, which is measured both by the gas supplier and the project owner for crosschecking. To be conservative, the larger of these two values is used. (See the table below for details).	Nm ³	1,351,078,300
NCV _y	Net calorific value (energy content) per volume unit of natural gas during this monitoring period as provided by the fuel supplier	GJ/ Nm ³	Average:0.03431
EF _{CO2,f,y}	CO ₂ emission factor per unit of energy of natural gas during this monitoring period.	tCO ₂ /GJ	0.0561
OXID _{NG}	Oxidation factor of natural gas		100%

FC_y Determination:

Monitoring Period		FC _{f,y} (Nm ³) Recorded by Supplier Side	FC _{f,y} (Nm ³) Recorded by Project Side	Conservative Value (MAX of the above two FC _{i,y} Value)
From	To			
01/04/2011	31/12/2011	635,050,890	634,986,610	635,050,890.
01/01/2012	31/12/2012	716,027,410	694,681,478	716,027,410.
total		1,351,078,300	1,329,668,088	1,351,078,300

Note: Please see the ERs spreadsheet for more details.

Therefore, the project emissions during this monitoring period are as follows:

$$PE_y = FC_{f,y} \times NCV_{f,y} \times EF_{CO_2,f,y} \times OXID_f$$

EF _{CO2,f,y}	t CO ₂ /GJ	0.0561
OXID _f		100%
PE (2011 year)	t CO ₂ e	1,225,159
PE (2012 year)	t CO ₂ e	1,375,329
Total	t CO ₂ e	2,600,488

4.3 Leakage

According to the registered PDD, leakage may result from upstream processes of fossil fuels outside of the project boundary. This includes mainly fugitive CH₄ emissions and CO₂ emissions from associated fuel combustion and flaring. In line with AM0029 version 03, as no LNG is used in the project plant in this monitoring period, only leakage emissions from using natural gas (LE_{CH4,y}) are considered, which can be calculated based on following steps as mentioned in the registered PDD.

Calculation of LE_{CH4,y}

According to AM0029, for the purpose of estimating fugitive CH₄ emissions, the project participants should multiply the quantity of natural gas consumed by the project in year y with an emission factor for fugitive CH₄ emissions (EF_{NG,upstream,CH4}) from natural gas consumption and subtract the emissions occurring from fossil fuels used in the absence of the project activity, as follows:

$$LE_{CH4,y} = (FC_{NG,y} \times NCV_y \times EF_{NG,upstream,CH4,y} - EG_{PJ,y} \times EF_{BL,upstream,CH4,y}) \times GWP_{CH4} \quad (10)$$

Parameter	Description	Unit
FC _{NG,y}	Total volume of natural gas combusted during this monitoring period	NM ³
NCV _y	Net calorific value (energy content) per volume unit of natural gas during this monitoring period as provided by the fuel supplier	GJ/Nm ³
EF _{NG,upstream,CH4,y}	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, and, in the case of LNG, liquefaction, transportation, re- gasification and compression into a transmission or distribution system	t CH ₄ /GJ
EG _{PJ,y}	Electricity supplied to the grid by the Project	MWh

$EF_{BL,upstream,CH_4,y}$	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity per MWh electricity generation in the project plant	tCH ₄ /MWh
GWP_{CH_4}	Global warming potential of methane valid for the relevant commitment period	
$LE_{CH_4,y}$	Leakage emissions due to fugitive upstream methane emissions during this monitoring period	t CO ₂ e

$EF_{BL,upstream,CH_4}$ Calculation:

According to AM0029, the emission factor for upstream fugitive CH₄ emissions occurring in the absence of the project activity ($EF_{BL,upstream,CH_4}$) should be calculated consistent with the baseline emission factor (EF_{BL,CO_2}) used in step 2, so the $EF_{BL,upstream,CH_4}$ is calculated as follows:

$$EF_{BL,upstream,CH_4} = \frac{\sum_j FF_{j,k} \times EF_{k,upstream,CH_4}}{\sum_j EG_j} \quad (11)$$

Where:

j: Plants included in the build margin;

$FF_{j,k}$: Amount of fuel k (a coal or oil type) combusted in power plant j included in the build margin;

$EF_{k,upstream,CH_4}$: Emission factor for upstream fugitive methane emissions from production of the fuel type k (a coal) in t CH₄ per MJ fuel produced.

Based on the method of calculating BM emission factor taken by the Chinese DNA, the calculation formula for $EF_{BL,upstream,CH_4}$ could be converted to:

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal,upstream,CH_4} \quad (12)$$

	2011	2012
$CAP_{Thermal}/CAP_{Total}$	84.33%	90.23%

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,upstream,CH_4} + \lambda_{Oil} \times EF_{Oil,upstream,CH_4} + \lambda_{Gas} \times EF_{Gas,upstream,CH_4} \quad (13)$$

	2011	2012
$EF_{coal,upstream,CH_4}$	0.005844	0.005814

λ_{Coal}	97.14%	92.86%
$EF_{Oil,upstream,CH_4}$	4.1(AM0029 default value)	
λ_{Oil}	0.31%	0.41%
$EF_{Gas,upstream,CH_4}$	296(AM0029 default value)	
λ_{Gas}	2.55%	6.73%
$EF_{Thermal,upstream,CH_4}$ t CH ₄ /MWh	0.005704	0.005470
$EF_{BL,upstream,CH_4}$ t CH ₄ /MWh	0.004810	0.004936

$EF_{NG,upstream,CH_4,y}$ Calculation:

$$EF_{NG,upstream,CH_4,y} = 0.000296 \text{ t CH}_4/\text{GJ}$$

2011	$LE_{LNG,y} = FC_{LNGy} \times EF_{CO_2,upstream,LNG}$	131,033	t CO ₂ e
	$LE_{CH_4,y} = (FC_y \times NCV_y \times EF_{NGupstream,CH_4} - EG_y \times EF_{BL,upstream,CH_4}) \times GWP_{CH_4}$	-196,988	t CO ₂ e
	$LE_y = LE_{LNG,y} + LE_{CH_4,y} \text{ (If } LE_y < 0, LE_y = 0)$	0	t CO ₂ e
2012	$LE_{LNG,y} = FC_{LNGy} \times EF_{CO_2,upstream,LNG}$	147,094	t CO ₂ e
	$LE_{CH_4,y} = (FC_y \times NCV_y \times EF_{NGupstream,CH_4} - EG_y \times EF_{BL,upstream,CH_4}) \times GWP_{CH_4}$	-230,663	t CO ₂ e
	$LE_y = LE_{LNG,y} + LE_{CH_4,y} \text{ (If } LE_y < 0, LE_y = 0)$	0	t CO ₂ e

According to AM0029 Version 3, the Project should assume leakage as zero when the total net leakage effects are negative, i.e. $LE_y = 0$.

For more detailed information please refer to ERs spreadsheet.

4.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
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01/04/2011-31/12/2011	2,181,365	1,225,159	0	956,206
01/01/2012 - 31/12/2012	2,545,951	1,375,329	0	1,170,622
Total	4,727,316	2,600,488	0	2,126,828

The estimated annual emission reductions are 1,044,328tCO₂e as per registered PDD. The monitoring period covers 641days, $1,044,328 \times 641 / 365 = 1,834,011$ tCO₂e, and the emission reduction achieved by the project in this monitoring period is 2,126,828 tCO₂e, 15.96% higher than the estimated emission reductions in this monitoring period.

The emission reductions from 05/08/2010 to 31/12/2012 are analyzed (total 880days). In the 880 days, total 2,574,722tCO₂e emission reduction is generated.

	Period	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period	Covering days
The First Monitoring period	05/08/2010 – 31/08/2010	77,252 tCO ₂ e	55,536 tCO ₂ e	27 days
The Second Monitoring Period	01/09/2010 – 30/11/2010	260,367 tCO ₂ e	240,270 tCO ₂ e	91 days
The Third Monitoring Period	01/12/2010 – 31/12/2010	88,696 tCO ₂ e	54,864 tCO ₂ e	31 days
The Fourth Monitoring Period	01/01/2011 – 31/03/2011	257,506 tCO ₂ e	97,224 tCO ₂ e	90 days
	01/04/2011 – 31/12/2012	1,834,012 tCO ₂ e	2,126,828 tCO ₂ e	641 days
Total		2,517,833 tCO ₂ e	2,574,722 tCO ₂ e	880 days

So, it is about 2.26 % $(= (2,574,722 - 2,517,833) / 2,517,833)$ higher than the estimated emission reductions in the 880 days (05/08/2010 - 31/12/2012) .

As a peak-load regulating power plant as described in the registered PDD, the project functions as a peak-load regulating power plant, and the amount of electricity generation will fluctuate as per Grid Company. Therefore, the exceeding in this monitoring period is a normal variation for the Project.