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XIAOSHAN POWER PLANT'S NG POWER GENERATION PROJECT OF ZHEJIANG SOUTHEAST ELECTRIC POWER CO., LTD. PROJECT

Document Prepared by Goldchina Consultancy International Co., Ltd.

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Xiaoshan Power Plant's NG Power Generation Project of Zhejiang Southeast Electric Power Co., Ltd. (the "Project") is located in Xiaoshan District, Hangzhou City, Zhejiang Province of China, and operated by Zhejiang Southeast Electric Power Co., Ltd.

The project installed two sets of gas-steam combined cycle for power generation units with the total rated output of 806 MW. The selected technology for the Project is from the Germany manufacturer of Siemens V94.3A system, and the generated electricity will be sold into the Zhejiang Grid, a sub-grid of an independent regional grid- East China Power Grid (ECPG).

The purpose of the Project is to build a grid-connected electricity generation plant using natural gas (NG) as fuel and without other auxiliary fuels. The Project using natural gas as a fuel to generate clean power, and will achieve greenhouse gas (GHG) emission reductions by avoiding CO₂ emission from the business-as-usual scenario electricity generation of those coal-fired power plants connected into the ECPG.

Relevant dates for the project are as follows:

The construction starting date for the project was 28/12/2005.

Commissioning start date for project (the first unit began to operate): 28/06/2007.

The second unit began to operate: 02/03/2008.

The project was registered as a VCS project (VCS432). The first 10 year renewable crediting period started on 28/06/2007 and expired on 27/06/2017.

During the monitoring period (26/03/2015 to 27/06/2017), the emission reduction achieved by the project in this monitoring period is 407,254 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).

Project type: Renewable energy projects.

The project is not a grouped project.

1.3 Project Proponent

Organization name	Zhejiang Southeast Electric Power Co., Ltd.
Contact person	Sheng Yongxiao
Title	Legal Representative
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1.4 Other Entities Involved in the Project

Organization name	Goldchina Consultancy International Co., Ltd.
Role in the Project	Consultancy
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1.5 Project Start Date

The operation starting date for the project was 28/06/2007.

1.6 Project Crediting Period

3*7 years renewable crediting period is adopted by the project activity. The project was registered as CDM project (CDM ref no.:1343).

The first 10 years renewable crediting period started on 28/06/2007 and expired on 27/06/2017. The total VCS crediting period would be from 28/06/2007 to 27/06/2028.

1.7 Project Location

The project locates in Xiaoshan Power Plant, Xiaoshan District, Hangzhou City, Zhejiang Province, which is on the south bank of Qiantangjiang River. It is 2km northwest from Linpu Town, 15km far from the centre of Xiaoshan District and 23km far from the centre of Hangzhou City. The project has geographical coordinates with longitude of 120°14'E and latitude of 30°03'N.

1.8 Title and Reference of Methodology

AM0029 (Version 01): "Baseline Methodology for Grid Connected Electricity Generation project using Natural Gas" and "Monitoring methodology for grid connected generation plants using nonrenewable and less GHG intensive fuel".

1.9 Participation under other GHG Programs

The project has been registered as a CDM project with registration number 1343 and VCS project (project ID: 432).

1.10 Other Forms of Credit

The project has not created any other form of environmental credit during this monitoring period, which will be verified by VVB.

1.11 Sustainable Development

The project contributes to the sustainable development to both local, global and the host country in a number of ways:

- (1) The project leads a reduction in greenhouse gas emissions compared to a business as usual approach, thereby benefit the global climate change;
- (2) The project reduces other pollutants (e.g. SO₂, NO_x, dust, etc) compared to a business as usual approach, thereby improve the local environment quality;
- (3) The project enhances the ability of peak regulation to the local grid and improves the electric quality of the local grid;

2 SAFEGUARDS

2.1 No Net Harm

There is no net harm.

In line with the requirements of local government, an Environmental Impact Assessment (EIA) for the project was carried out. According to the EIA report of the project, the impacts on the

environment are not significant. Multiple measurement, such as environment monitoring and mitigation measures to deal with various environmental impacts during the construction and operation phase of the project activity are carried out strictly by the project owner.

Air impact

The fuel of the proposed project is natural gas, whose main component is methane. The smoke after burning almost not includes soot, the emission of SO₂ is very little, and the emission of NO_x is also much lower than the emission level of coal fired generating units. So the natural gas is a kind of clean fuel with high thermal value and low pollution. Besides, the gas-steam combined cycle technique taken by the proposed project has the merits of complete burning and minimal pollution emission.

Water Impact

The waste water of the proposed project could be divided into production waste water and living waste water. Production waste water mainly comprises of the acidic/basic regeneration waste water, polluted water discharged from cooling tower, cooling water and acidic waste water from waste heating boiler. Waste water from cooling tower occupies the largest proportion. Its water quality is similar with the primary water, and the main pollution factor is salt content. The living waste water mainly comes from the workers in the plant area, and the main pollutants are SS and COD. The living waste water occupies a small portion, and its polluting consistency is comparatively low.

Except for disposing the waste water, the project recycles to utilize the waste water as possible. Under the normal situation, only recirculation water, blow-down water and boiler blow-down water are discharged outside, and the part of waste water could meet the requirement of first class standard in GB9878-1996, so it affects little on the water quality of nearby water system; acidic/basic regeneration waste water produced by boiler makeup treatment system and the boiler acidic waste water are conveyed to the first stage engineering recirculation water system after counteract disposal. The project sets up underground living waste water disposal facilities (A/O Type). The living waste water is conveyed to the first stage recirculation water system after it reaches the standard.

Noise Impact

The noises of gas-steam combined cycle units mainly come from the running of facilities such as gas turbine, steam turbine, generating units, water-feeding pump, cycle water pump and cooling tower. According to the estimating result of the model, during the project's operation period, the noises are concentrated at the neighbourhood of the plants and the cooling tower. The noises within the plant boundary could almost meet the requirement of III class standard in GB12348-90 Standard of Noise at Boundary of Industrial Enterprises. Noises surpassed standard within the plant boundary will be far from sensitive place, and the induced effect is little.

In order to mitigate the impact of noises, facilities with less noise is possible selected to take into use. Requirement to the facility maker for avoiding noises is launched when taking order of the facilities. The main facilities with noises are concentrated in the main plant. A part of workshop with lots of noises takes use of sound absorption materials or set up sound insulation workroom. Doors and windows of controlling room of the plant area and office buildings are avoided to face strong sound source and are utilized sound absorption materials as possible. Appropriate virescence in the plant area is utilized to debase the noises' effect on environment.

2.2 Local Stakeholder Consultation

A stakeholder consultation has been carried out. Totally 30 questionnaires including the project instruction and comments inviting were sent out to the residents in nearby towns and villages. 30 questionnaires were returned back. 98% of the respondents thought the project would promote the local economic development and 100% of the respondents supported the construction of the project. The detailed information is in the following details.

Totally 30 pieces of questionnaires paper have been handed out and taken back, and the summary of the comments received is presented as follows:

- 1) 70% of the respondents are males, and the rest are females;
- (2)10% of the respondents are younger than 30 years old, 60% of the respondents are between 30 - 50 years old, 30% are older than 50 years old;
- 3)10% of the respondents are the education degree of primary school, 16.67% are the education degree of junior middle school, 60% are the education degree of senior middle school, 13.33% are the education degree of above senior high school;
- 4)100% of the respondents are satisfied with current living environment.
- 5) 100% of the respondents know the technical of natural gas power generation.
- 6) 100% of the respondents know about the project activity.
- 7)100% of the respondents consider that the project activity will promote the development of local economy, 70% consider that the project activity will increase the living level, 80% consider that the project activity will expansion the job opportunity, 90% consider that the project activity will increase the individual income.
- 8) 90% of the respondents consider that the project activity will make more benefits than its absence, the rest consider no comments.
- 9)100% of investigators consider that the proposed project has no negative impact.
- (10)100% of the respondents support the construction and operation of the project.

The project owner also has established a grievance and appeal mechanism, a grievance book has been placed in the lobby of the office which is available to all stakeholder with all contact information. No negative comments has been received so far.

2.3 AFOLU-Specific Safeguards

The project is not AFOLU projects.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

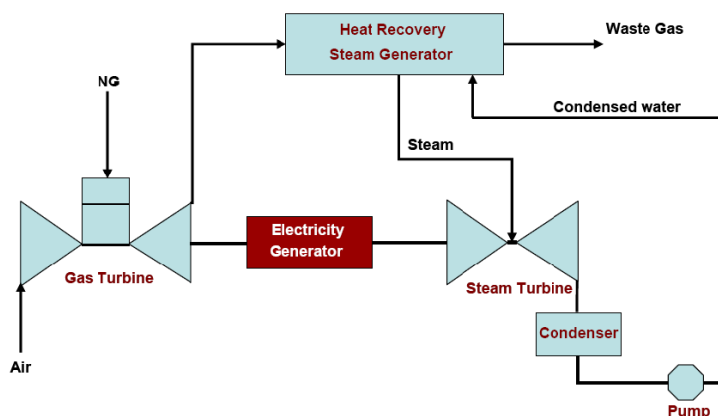
The operation principle of the gas-steam combined cycle power generation is: the gas turbine drives the power generator to generate electricity. At the same time the exhaust gas from the gas turbine after combustion of nature gas enters the heat recovery steam generator and generates steam using demieralised water, and then, the steam generated enters into the steam turbine and drive the generator to generate electricity. The project involves two sets of gas-steam combined cycle power generation units. Each unit includes a gas turbine, heat recovery steam generator, steam turbine and generator.

The selected technology for the project is from the Germany manufacturer of Siemens V94.3A system, which includes following main equipments:

Table 1. Main parameters of the gas-steam combined cycle power unit

Equipment	Model	Rated output	Manufacturer
Gas turbine	V94.3A type		Siemens
Heat recovery steam generator	NG-V94.3A-R		Hangzhou Heat Recovery Boiler Plant
Steam turbine	H30-25-25, E30-25-2-1×10	139.4MW	Siemens
Electricity generator	THDF108/53	403MW	Siemens

The process flow diagram of the Project is shown below.



The starting date of operation of the project activity was described as follows:

For the 1st unit: 28/06/2007

For the 2nd unit: 02/03/2008

During this monitoring period from 26/03/2015 to 27/06/2017, there are no any emergencies or special events which might impact the applicability of the chosen methodology.

3.2 Deviations

3.2.1 Methodology Deviations

There is no deviation applied to this monitoring period.

3.2.2 Project Description Deviations

The project was registered under VCS standard 2007, according to VCS standard 2007, the crediting period of the project activity is 10 year and could be renewed twice, as the project started operation which is also the start date of the project was 28/06/2007, therefore the first crediting period for project under VCS should from 28/06/2007 to 28/06/2017.

3.3 Grouped Projects

The project is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$F_{i,j,y}$
Data unit	t or m ³

Description	Amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y
Source of data	China Energy Statistical Yearbook
Value applied	See China's DNA CDM official data
Justification of choice of data or description of measurement methods and procedures applied	Since the detailed fuel consumption data by power plants are not publicly available, therefore the aggregated data by fuel types are used instead.
Purpose of Data	Calculation of baseline emissions
Comments	

Data / Parameter	GEN_{j,y}
Data unit	MWh
Description	Electricity delivered to the grid by relevant power sources j excluding low operating cost/must run power plants in year y
Source of data	China Electric Power Yearbook
Value applied	See China's DNA CDM official data
Justification of choice of data or description of measurement methods and procedures applied	Since the detailed generation data by power plants are not publicly available, therefore the aggregated data by fuel types are used instead.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	NCV_i
Data unit	TJ/t (m ³)
Description	Net calorific value (energy content) per mass or volume unit of fuel i
Source of data	China Energy Statistical Yearbook
Value applied	See China's DNA CDM official data
Justification of choice of data or description of measurement methods and procedures applied	According to ACM0002, the national specific value shall be used preferentially.
Purpose of Data	Calculation of project emissions

Comments	-
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Data / Parameter	OXID_i
Data unit	-
Description	Oxidation factor of the fuel <i>i</i>
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied	See China's DNA CDM official data
Justification of choice of data or description of measurement methods and procedures applied	The country specific values of oxidation factors in China are not available. As such IPCC default values are used instead.
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	EF_{CO₂,i}
Data unit	tCO ₂ /TJ
Description	CO ₂ emission factor per unit of energy of the fuel <i>i</i>
Source of data	2006 IPCC Guidelines for National Greenhouse Gas
Value applied	See China's DNA CDM official data
Justification of choice of data or description of measurement methods and procedures applied	The country specific values of fuel carbon emission factor in China are not available. As such IPCC default values are used instead.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	CAP_{j,y}
Data unit	MW
Description	Installed capacity of relevant power source <i>j</i> connected to the grid in year <i>y</i>
Source of data	China Electric Power Yearbook
Value applied	See China's DNA CDM official data

Justification of choice of data or description of measurement methods and procedures applied	Following the EB guidance regarding application of AM0005 in China, the capacity weighted is used instead of generation weighted in calculation of BM emission factor..
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$FC_{ADV,coal}$
Data unit	gce/kWh
Description	The coal consumption of power supply with the best thermal power technology commercially available.
Source of data	Fuel-fired Power Generation. http://www.ccchina.gov.cn/source/fa/fa2002082803.htm
Value applied	320g/kWh
Justification of choice of data or description of measurement methods and procedures applied	This is conservative compared with the data defined by the DNA of China
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	η_{BL}
Data unit	%
Description	Energy efficiency of the technology
Source of data	Chinese DNA
Value applied	36.53% This data is recommended by Chinese DNA
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Calculation of baseline emissions <i>Determination of baseline</i>
Comments	-

Data / Parameter	GWP_{CH4}
Data unit	tCO ₂ e/tCH ₄
Description	Global Warming Potential for CH ₄
Source of data	IPCC default value
Value applied	25 COP/MOP decision: "Standard for application of the global warming potentials to CDM project activities and PoAs for the second commitment period of the Kyoto Protocol" (a value of 25 is to be applied)
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of leakage emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	FC _{NG,y}				
Data unit	Nm ³				
Description	Net quantity of nature gas consumed in project activity in year ‘y’.				
Source of data	Fuel flow meter readings at the project boundary				
Description of measurement methods and procedures to be applied	Measured				
Frequency of monitoring/recording	The natural gas consumed by the project are monitored continuously and recorded the readings daily, and weekly records are prepared by the project owner and the gas supplier.				
Value monitored	1,226,545,814				
Monitoring equipment	Title	Serial No.	Accuracy	Calibrations Date	Validity
	Gas Ultrasonic Flowmeter1	3314	1.0	21/07/2014	Yes
				20/07/2015	
				20/07/2016	
		3317	1.0	21/07/2014	Yes

	Gas Ultrasonic Flowmeter2			20/07/2015	
				20/07/2016	
	Gas Ultrasonic Flow meter at plant (Daniel)	11296566	0.5	30/12/2014	Yes
				20/07/2015	
				20/07/2016	
QA/QC procedures to be applied	Nature gas metering to the project is subject to regular maintenance and testing in accordance with stipulation of the meter supplier, applicable industry and national standards and relevant agreements to ensure accuracy. The readings will be double checked by the gas supply company.				
Purpose of the data	Project emissions and leakage calculation				
Calculation method	-				
Comments	-				

Data / Parameter	NCV_{natural gas,y}
Data unit	GJ/m ³
Description	Net calorific value of nature gas consumed by the project plant in year y. The values are recorded fortnightly
Source of data	Natural gas supplier
Description of measurement methods and procedures to be applied	Measured
Frequency of monitoring/recording	The calorific value of the gas is provided daily by the supplier according to fuel purchase agreement, and recorded by the Project owner.
Value monitored	0.033353 (2015 year) (weighted average) 0.033804 (2016 year) 0.033548 (2017 year)
Monitoring equipment	-
QA/QC procedures to be applied	-

Purpose of the data	Project emissions and leakage calculation
Calculation method	-
Comments	Data will be archived by electronic/paper

Data / Parameter	EF_{CO₂,natural gas,y}
Data unit	tCO ₂ /TJ
Description	The CO ₂ emission factor per unit of energy of nature gas in year y
Source of data	Local/ Regional / Global (IPCC)
Description of measurement methods and procedures to be applied	Use supplier-provided data, local data, country-specific values, that order of preference. The data will be recorded annually.
Frequency of monitoring/recording	Recording annually
Value monitored	58.3
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Project emissions calculation
Calculation method	-
Comments	Data will be archived by electronic/ paper

Data / Parameter	OXID_{natural gas,}
Data unit	%
Description	Oxidation factor of natural gas used by the project plant
Source of data	IPCC
Description of measurement methods and procedures to be applied	Use IPCC current default

Frequency of monitoring/recording	Recording annually
Value monitored	-
Monitoring equipment	100
QA/QC procedures to be applied	-
Purpose of the data	Project emissions calculation
Calculation method	-
Comments	Data will be archived by electric/ paper

Data / Parameter	FC _y
Data unit	m ³
Description	Net quantity of fuel other than combusted by project activity in year y
Source of data	Fuel flow meter reading at project boundary
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	-
Value monitored	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Project emissions calculation
Calculation method	According to the feasibility study report, the only type of fuel used in the project is natural gas. During the actual operation, no other auxiliary fuels were used in electricity generation. So, this parameter is 0.
Comments	Data will be archived by electronic paper

Data / Parameter	NCV _y
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Data unit	GJ/m ³
Description	Net calorific value of fuel other than natural gas consumed in the project plant in year y. The values will be recorded fortnightly.
Source of data	Fuel supplier, Local Authority, Country specific, IPCC
Description of measurement methods and procedures to be applied	Use supplier-provided data, local data, country-specific values, that order of preference. IPCC values can be used for startup fuel. According to the feasibility study report, the only type of fuel used in the project is natural gas. There is no other fuel used. This data is monitored in case that fuel other than natural gas is used.
Frequency of monitoring/recording	Recording annually
Value monitored	0
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Project emissions calculation
Calculation method	-
Comments	-

Data / Parameter	EF_{CO₂, y}
Data unit	tCO ₂ /TJ
Description	The CO ₂ emission factor of the fuel other than natural gas in year y
Source of data	Local/ Regional / Global (IPCC)
Description of measurement methods and procedures to be applied	According to the feasibility study report, the only type of fuel used in the project is natural gas. During the actual operation, no other auxiliary fuels were used in electricity generation
Frequency of monitoring/recording	-
Value monitored	-
Monitoring equipment	-
QA/QC procedures to be applied	-

Purpose of the data	Project emissions calculation
Calculation method	-
Comments	-

Data / Parameter	OXID_y
Data unit	%
Description	Oxidation factor of the fuel other than natural gas used by the project plant
Source of data	IPCC
Description of measurement methods and procedures to be applied	According to the feasibility study report, the only type of fuel used in the project is natural gas. During the actual operation, no other auxiliary fuels were used in electricity generation.
Frequency of monitoring/recording	Recording annually
Value monitored	-
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Project emissions calculation
Calculation method	-
Comments	-

Data / Parameter	GWP_{CH4}
Data unit	tCO ₂ /tCH ₄
Description	Global Warming Potential for CH ₄
Source of data	IPCC default value
Description of measurement methods and procedures to be applied	-

Frequency of monitoring/recording	Annually
Value monitored	25
Monitoring equipment	-
QA/QC procedures to be applied	The latest value available at the DNA website of the crediting year has been used for the calculation.
Purpose of the data	Leakage Emission calculation
Calculation method	-
Comments	-

The primary parameters to be monitored for baseline emissions during the crediting period are listed below:

Data / Parameter	EG _y				
Data unit	MWh				
Description	Net electricity delivered to the grid by the project activity in year ‘y’				
Source of data	Reading of the meters installed at project activity				
Description of measurement methods and procedures to be applied	Measured and calculated				
Frequency of monitoring/recording	Power exported to the grid and imported from the grid is measured continuously and recorded the readings daily. A monthly record will be prepared by the project owner at beginning of the month, and sent to the grid company for cross-check.				
Value monitored	5,704,508.040				
Monitoring equipment					
	Title	Serial No.	Accuracy	Calibration date	Validity
	#02 main meter	211298428	0.2S	22/01/2015	Yes
				20/01/2016	
			16/01/2017		
	#02 back-up meter	211298434	0.2S	22/01/2015	Yes
			20/01/2016		

				16/01/2017	
	#3 main meter	211299224	0.2S	22/01/2015 20/01/2016 16/01/2017	Yes
	#3 back-up meter	3060045996	0.2S	22/01/2015 20/01/2016 16/01/2017	Yes
	#4 main meter	211298437	0.2S	22/01/2015 20/01/2016 16/01/2017	Yes
	#4 back-up meter	211298427	0.2S	22/01/2015 20/01/2016 16/01/2017	Yes
QA/QC procedures to be applied		Meters will be remained for regular maintenance and testing services for an ensured accuracy (0.2S). All the calibration tests records will be maintained for DOE's verification. Double check by receipt of sales.			
Purpose of the data		For Baseline Emission calculation			
Calculation method		$EG_y = EG_{\text{export}} - EG_{\text{import}}$ EG_{export} is electricity supplied to the grid (MWh) EG_{import} is electricity imported from the grid (MWh)			
Comments		-			

Data / Parameter	EF_{BM,y}
Data unit	tCO ₂ /MWh
Description	Build margin emission factor
Source of data	China's DNA CDM official data
Description of measurement methods and procedures to be applied	Calculated based on the standard procedures approved by EB

Frequency of monitoring/recording	Annually
Value monitored	0.4923
Monitoring equipment	-
QA/QC procedures to be applied	The latest value available at the DNA website of the crediting year has been used for the calculation.
Purpose of the data	Calculation of baseline emissions
Calculation method	-
Comments	-

Data / Parameter	BTCA
Data unit	g/kWh
Description	Fuel consumption for best technology commercially available
Source of data	China's DNA CDM official data
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually
Value monitored	290.7857 for coal fired power generation 232.3 for oil and natural gas power generation
Monitoring equipment	-
QA/QC procedures to be applied	The latest value available at the DNA website of the crediting year has been used for the calculation.
Purpose of the data	Baseline Emission calculation
Calculation method	-
Comments	-

Data / Parameter	CAP_{fire-y}
Data unit	MW

Description	Installed capacity of fuel-fired power in year y within the ECPG.
Source of data	China Electric power Yearbook
Description of measurement methods and procedures to be applied	According to the requirements of methodology, applying the data in China Electric Power Yearbook
Frequency of monitoring/recording	Annually
Value monitored	243,750
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Baseline Emission calculation
Calculation method	-
Comments	-

Data / Parameter	CAP_y
Data unit	MW
Description	Tool installed capacity of various power in year y within the ECPG.
Source of data	China Electric power Yearbook
Description of measurement methods and procedures to be applied	According to the requirements of methodology, applying the data in China Electric Power Yearbook
Frequency of monitoring/recording	Annually
Value monitored	300,680
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Baseline Emission calculation

Calculation method	-
Comments	-

Data / Parameter	Fuel Energy Value
Data unit	GJ/tSCE
Description	Fuel energy value of Standard Coal Equivalent
Source of data	China's DNA CDM official data
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually
Value monitored	29.27
Monitoring equipment	-
QA/QC procedures to be applied	The latest value available at the DNA website of the crediting year has been used for the calculation.
Purpose of the data	Baseline Emission calculation
Calculation method	-
Comments	-

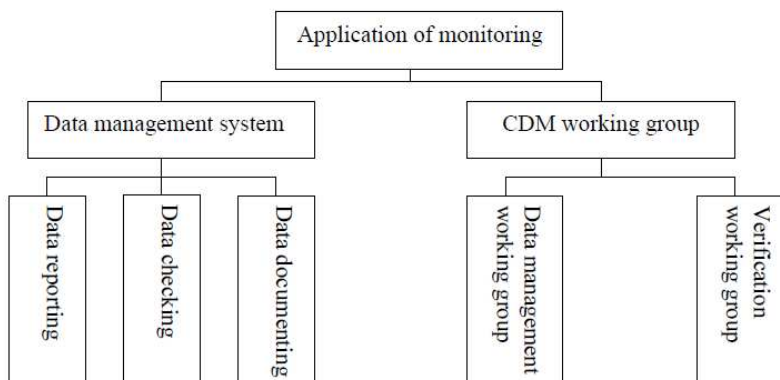
Data / Parameter	η_{BL}
Data unit	%
Description	Energy efficiency of the technology
Source of data	Chinese DNA
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually

Value monitored	42.27%, Refer to ER calculation spreadsheet
Monitoring equipment	-
QA/QC procedures to be applied	The latest value available at the DNA website of the crediting year has been used for the calculation.
Purpose of the data	Baseline Emission calculation
Calculation method	-
Comments	-

Data / Parameter	OXID_f
Data unit	%
Description	Oxidation rate of the fuel y
Source of data	IPCC default value
Description of measurement methods and procedures to be applied	-
Frequency of monitoring/recording	Annually
Value monitored	1
Monitoring equipment	-
QA/QC procedures to be applied	IPCC default value
Purpose of the data	Project emissions calculation
Calculation method	-
Comments	-

4.3 Monitoring Plan

Monitoring plan for the project activity includes the details of the operation and management of the project activity during the crediting period and the measurement of the parameters in baseline and project emission scenarios that will be used to calculate actual emission reductions. The main framework is shown in the below figure. The monitoring plan of the project activity is organized as per the statement presented below.



Introduction

The Xiaoshan Power Plant's NG Power Generation Project of Zhejiang Southeast Electric Power Co., Ltd. adopts the approved monitoring methodology to determine the emission reductions from the net electricity generation from the project.

Organizational structure & procedures during project implementation

The host entity of this project is Zhejiang Southeast Electric Power Co., Ltd. An independent institution of operation and management for project will be formed, and directed by the general manager of Zhejiang Southeast Electric Power Co., Ltd. Its operation and management framework is described below:

Project Director:

Part-time by the General Director or Deputy General Director of ZheJiang Southeast Electric Power Co., Ltd, who will take charge of the management of the the project, take responsibility for Chinese DNA and stakeholders, meanwhile, take charge of the coordination with buyer countries and DOE;

Manager:

He/she will take charge of the operation and management of the project, monitoring and statistics of material supply and utilization, project production, and cooperate with validation and verification, etc;

Operation Team:

They will take charge of the regular monitor works, including monitoring of raw data, data aggregation and processing, statistic and storage of the processed data, calibration and maintenance of the measurement equipments, and cooperate with validation and certification, etc.

Training

All staff involved in any of the procedures related with the project activity will be trained before the start of the crediting period in order to perform the tasks specified in the monitoring plan.

Calibration, testing and maintenance for measurement equipments

The detailed calibration, testing and maintenance procedure for the measurement equipments used to monitor data of the project activity shall be prepared by the Manager based on the agreements with the nature gas supplier, equipment manufacturer's recommendations and the industry and national standards as applicable.

Data monitoring

The main data monitoring of the project activity within the crediting period include:

Monitoring of net electricity generated by the project activity:

The net electricity generated by the project will be monitored through the electric meters within the project boundary. This data should be monitored and recorded daily by the computer system. There should be main and backup metering system in the control centre. The recorded readings should be readily accessible for DOE in verification. The records for calibration, testing and maintenance of the electric meters should be also readily accessible for DOE in verification.

Monitoring of quantity of nature gas combusted by the project activity:

Quantity of nature gas combusted will be monitored through the gas flow meters both at the project end and nature gas supplier for cross-verification. This data should be monitored and recorded daily by the computer system. The detailed monitoring procedure of this data should be established in accordance with the agreements with the nature gas supplier. The recorded readings should be readily accessible for DOE in verification. The records for calibration, testing and maintenance of the gas flow meters should be also readily accessible for DOE in verification.

Monitoring of NCV of natural gas combusted by the project activity:

The detailed monitoring procedure of NCV of nature gas combusted by the project activity should be established in accordance with the agreements with the nature gas supplier. This data should be monitored and recorded fortnightly by the computer system. The recorded readings should be readily accessible for DOE in verification. The records for calibration, testing and maintenance of the gas flow meters should be also readily accessible for DOE in verification. $OXID_f$ and $EF_{CO_2,f,y}$ will also be monitored.

Monitoring of relevant data used to calculate the baseline emission factor of BM:

According the approved monitoring methodology AM0029, the relevant baseline emission parameters will be monitored. In this PDD, the baseline emission factor has been selected to BM, so the relevant parameters used to calculate BM should be publicly available (e.g. raw data of *China Electric Power Yearbook*, IPCC, etc.) in China and monitored and recorded annually by the computer system. The recorded data and revised ex-post calculation should be readily accessible for DOE in verification.

Recording and archiving of data

The on-site control centre will be established from where all electronic data will be remotely monitored and recorded. Staff working at the control centre will prepare a daily report on the operations of the project activity and this daily report will record data readings and equipment

defects, outages, repairs and maintenance activities. All relevant information, notes of meetings, data files, maintenance records, defect reports, hard copy and computerised records of monitoring will be kept at the control centre or other designated location, and arranged in an orderly and transparent manner to facilitate audit as and when required. All monitored data required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs, for this project activity, whichever occurs later.

Meters failure

Should any reading of the main meters be inaccurate by more than the allowable error, or otherwise functioned improperly, the monitored parameters will be determined by:

- (a) First, by reading backup meter installed, unless a test by either party reveals it is inaccurate;
- (b) If the backup system is not within acceptable limits of accuracy or is otherwise performing improperly, the developer, the Grid Company and the natural gas supply company will jointly prepare an estimate of the correct reading;
- (c) If the developer, the Grid Company and the natural gas supply company fail to agree then the matter will be referred for arbitration according to agreed procedures.

Emergency preparedness

Disposal of Emergency will be implemented according to the stipulations in the Management Regulations of the Xiaoshan Power Plant of Zhejiang Southeast Electric Power Co., Ltd.

Review of monitored data

Monitored data will be reviewed by responsible personnel. This audit will check compliance with operational procedures in this monitoring plan.

This internal audit will also identify potential improvements to procedures to improve monitoring and reporting in future years. If such improvements are proposed these will be reported to the DOE and only operated after approval from the DOE.

Verification of monitoring results

The verification of the monitoring results of the project activity is a mandatory process required for the project. The main objective of the verification is to independently verify that the project has achieved the emission reductions as reported and projected in the PDD. It is expected that the verification will be done annually.

The responsibilities for verification of the projects are as follows:

- Manager will take charge of the arrangements for the verification and will prepare for the audit and verification process to the best of his/her abilities.
- Manager will provide the DOE with all required necessary information, before, during and, in the event of queries, after the verification due to facilitate verification.
- Manager will fully cooperate with the DOE, instruct other relevant staff, management to be available for interviews and respond honestly to all questions from the DOE.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Baseline emissions are calculated by multiplying the electricity generated in the project plant (EG_y) with a baseline CO_2 emission factor ($EF_{BL,CO_2,y}$), the formulae can be described as follows:

$$BE_y = EG_y * EF_{BL,CO_2,y}$$

Where, EG_y : Net electricity supplied to the grid in year y (MWh)

According to the methodology AM0029, the baseline emission factor is chosen as the minimum of the following three options:

Option 1: The build margin, calculated according to ACM0002; and

Option 2: The combined margin, calculated according to ACM0002, using a 50/50 OM/BM weight.

Option 3: The emission factor of the technology (and fuel) identified as the most likely baseline scenario under “Identification of the baseline scenario” above, and calculated as follows:

$$EF_{BL,CO_2,y} (tCO_2 / MWh) = \frac{COEF_{BL}}{\eta_{BL}} \times 3.6 GJ / MWh \quad (2)$$

$COEF_{BL}$ = the fuel emission coefficient (tCO_2e/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used;

η_{BL} = the energy efficiency of the technology, as estimated in the baseline scenario analysis.

Based on the registered PDD, for the project, Option 1 was chosen as the baseline emission factor and should be updated by ex-post calculation during the crediting period.

EX post calculation of baseline emission:

The build margin emission factor of the ECPG issued in the year 2017 is calculated as 0.4923 tCO_2/MWh .

Where:

The EG_y is calculated below:

Item	$COEF_{BL}(tCO_2/GJ)$	η_{BL}	$EF_{BL,CO_2,option3}(tCO_2/MWh)$	EG_y (MWh)
	A	B	C	D
Data	0.0946	42.27%	0.81086	5,704,508.040
Data source	$25.8tC/TJ*(44/12)/1000$	DNA of China	$C=(A/B)*3.6GJ/MWh$	ER sheet

Item	$EF_{BM,y}(tCO_2/MWh)$	$EF_{OM,y}(tCO_2/MWh)$	$EF_{CM,y}(tCO_2/MWh)$	$EF_{BM}(tCO_2/MWh)$
	E	F	G	H
Data	0.4923	0.8046	0.5704	0.4923
Data source	China's DNA	China's DNA	$G=0.75*E+0.25*F$	$H=\min(E,G,H)$

During this monitoring period, Net Electricity Supplied to the grid ($EG_{PJ,y}$) and Baseline Emission are calculated as follows:

Monitoring Period	EG_y (MWh)	EF_{BM} (tCO_2/MWh)	BE_y (tCO_2e)
26/03/2015 – 31/12/2015	1,966,957.080	0.4923	968,332
01/01/2016 – 31/12/2016	2,513,613.960	0.4923	1,237,452
01/01/2017 – 08/01/2017	1,223,937.000	0.4923	602,544
Total		0.4923	2,808,328

5.2 Project Emissions

The Project activity is on-site combustion of natural gas to generate electricity and during the actual operation, no other auxiliary fuels were used in electricity generation. The CO₂ emissions from electricity generation (PE_y) are calculated as follows:

$$PE_y = FC_{natural_gas,y} \times COEF_{natural_gas,y} \quad (3)$$

Where:

FC_{natural gas,y}: is the total volume of natural gas combusted in the Project plant in year(s) 'y'

COEF_{natural gas, y}: is the CO₂ emission coefficient (tCO₂/m³ or similar) in year(s) for natural gas and is obtained as:

$$COEF_{natural_gas,y} = \sum NCV_{natural_gas,y} \times EF_{CO_2,natural_gas,y} \times OXID_{natural_gas} \quad (4)$$

Where:

NCV_{natural gas, y}: is the net calorific value (energy content) per volume unit of natural gas in year 'y' (GJ/m³) as determined from the fuel supplier;

EF_{CO₂,natural gas,y}: is the CO₂ emission factor per unit of energy of natural gas in year 'y' (tCO₂/GJ) as determined from the fuel supplier, wherever possible, otherwise from local or national data;

OXID_{natural gas}: is the oxidation factor of natural gas.

Based on the above values, the project emission calculation was described as follows:

Where:

Year	FC (Nm ³)	NCV (GJ/ Nm ³)	EF _{CO₂} (tCO ₂ /GJ)	OXID	PE _y (tCO ₂)
2015	470,820,887	0.033353	0.0583	100%	915,499
2016	501,943,508	0.033804	0.0583	100%	989,210
2017	253,781,419	0.033548	0.0583	100%	496,365
Total	1,226,545,814				2,401,074

Note: Please see the ERs spreadsheet for more details.

5.3 Leakage

Leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the Project boundary. This includes mainly fugitive CH₄ emissions and CO₂ emissions from associated fuel combustion and flaring. In the methodology AM0029, the leakage emission was calculated as follows:

$$LE_y = LE_{CH_4,y} + LE_{LNG,CO_2,y} \quad (5)$$

Where:

LE_y: Leakage emissions during the year y in tCO₂e

LE_{CH₄, y}: Leakage emissions due to fugitive upstream CH₄ emissions in the year y in tCO₂e

LE_{LNG, CO₂, y}: Leakage emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y in tCO₂e

According to the registered PDD, no LNG was used in the project, only take fugitive upstream CH₄ emissions (LE_{CH₄, y: Leakage}) into account due to this project used NG as fuel, i.e. $LE_y = LE_{CH_4,y}$.

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:

$$LE_{CH_4,y} = (FC_{natural_gas,y} \times NCV_{natural_gas,y} \times EF_{NG,upstream,CH_4} - EG_y \times EF_{BL,upstream,CH_4}) \times GWP_{CH_4} \quad (6)$$

FC_{natural_gas,y}: Quantity of natural gas combusted in the Project plant during the year y in m³;

NCV_{natural_gas,y}: Average net calorific value of the natural gas combusted during the year y in GJ/m³;

EF_{NG,upstream,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, in t CH₄ per GJ fuel supplied to final consumers;

EG_y : Electricity generation in the Project plant during the year in MWh;

GWP_{CH_4} : Global warming potential of methane valid for the relevant commitment period, 25tCO₂/CH₄

$EF_{BL,upstream,CH_4}$: Emission factor for upstream fugitive methane emissions occurring in the absence of the Project activity in t CH₄ per MWh electricity generation in the Project plant, as defined below;

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 $EF_{BL,upstream,CH_4}$ in this PDD was calculated as follows:

$$EF_{BL,upstream,CH_4} = \frac{\sum_j FF_{j,k} \times EF_{k,upstream,CH_4}}{\sum_j EG_j} \quad (7)$$

Where:

j: Plants included in the build margin;

$FF_{j,k}$: Quantity of fuel type 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 or oil type) in t CH₄ per MJ fuel produced;

EG_j : Electricity generation in the plant j included in the build margin in MWh/a.

Based on the calculation method of BM, the formula (7) could be converted to:

$$EF_{BL,upstream,CH_4} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{fossil,upstream,CH_4}$$

$$EF_{fossil,upstream,CH_4} = \lambda_{Coal} \times EF_{Coal,upstream,CH_4} + \lambda_{Oil} \times EF_{Oil,upstream} + \lambda_{Gas} \times EF_{Gas,upstream}$$

$$EF_{BL,upstream,CH_4} = \frac{CAP_{Thermal}}{CAP_{Total}} \times (\lambda_{Coal} \times EF_{Coal,upstream,CH_4} + \lambda_{Oil} \times EF_{Oil,upstream} + \lambda_{Gas} \times EF_{Gas,upstream})$$

Where:

CAP_{Total} is the total change in installed capacity of the Grid (MW);

$CAP_{Thermal}$ is the incremental capacity of fuel-fired power of the Grid (MW);

$EF_{coal,upstream,CH_4}$, $EF_{oil,upstream,CH_4}$, $EF_{gas,upstream,CH_4}$ is emission factor of coal, oil, gas-fired power with the most efficiency level of the best technology commercially available in China was selected;

λ_{Coal} , λ_{Oil} and λ_{Gas} are the proportions of the corresponding CH₄ emissions of the solid fuel, liquid fuel and gas fuel to the total emission.

For the project, the leakage calculation is described as follows:

Year	FC (Nm ³)	NCV (MJ/Nm ³)	$EF_{NG,upstream,CH_4}$ (tCH ₄ /GJ)	$EG_{PJ,grid,y}$ (MWh)	$EF_{BL,upstream,CH_4}$ (tCH ₄ /MWh)	GWP_{CH_4}	$LE_{CH_4,y}$ (tCO ₂ e)
2015	470,820,887.00	33.353	0.000296	1,966,957.08	0.003503	25	-172,159
2016	501,943,508.00	33.804	0.000296	2,513,613.96	0.003503	25	-220,029
2017	253,781,419.00	33.548	0.000296	1,223,937.00	0.003503	25	-107,135

	$LE_{CH_4,y}$ (tCO ₂ e)	LE_{LNG,CO_2} (tCO ₂ e)	LE (tCO ₂ e)	LE_y (tCO ₂ e)*
2015	-172,159	0	-172,159	0
2016	-220,029	0	-220,029	0
2017	-107,135	0	-107,135	0

According to the AM0029, when the total net leakage effects are negative, the Project should assume $LE_y = 0$.

5.4 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)
Year 2015	968,332	915,499	0	52,833
Year 2016	1,237,452	989,210	0	248,242

Year 2017	602,544	496,365	0	106,179
Total	2,808,328	2,410,074	0	407,254

The estimated annual emission reductions are 454,378 tCO₂e as per registered PDD.

However, the value of $EF_{BM,y}$ gradually decreases, that makes the value of baseline emission accordingly decrease. In order to fairly compare the estimated annual emission reductions and actual emission reductions, we calculate the estimated annual emission reductions using the value of $EF_{BM,y}$ in year 2017.

Item	EG_y	$EF_{BM,y}$	BE_y	PE_y	LE_y	ER_y
Data	2,525,250	0.4923	1,243,180	1,007,377	0	235,803
Data source	FSR of project	China DNA	$BE_y = EG_y * EF_{BM,y}$	PDD of project	PDD of project	$ER_y = BE_y - PE_y - LE_y$

The new value of estimated annual emission reductions are 235,803 tCO₂e. The monitoring period covers 655 days, $235,803 \text{ tCO}_2\text{e} * 825\text{days} / 365\text{days} = 532,979 \text{ tCO}_2\text{e}$.

According to the data in the above table, the actual emission reductions are 407,254 tCO₂e during this monitoring period. And, actual emission reductions are less than the estimated emission reductions in the registered PDD.