



**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Sichuan Furong Coal Mine Methane Utilization Project
Version number of the PDD	08
Completion date of the PDD	28/08/2013
Project participant(s)	Sichuan Furong Group's Limited Industrial Company (project owner) Marubeni Corporation (buyer)
Host Party(ies)	People's Republic of China
Sectoral scope and selected methodology(ies)	Sectoral scope 8: Mining / Mineral Production Sectoral scope 10: Fugitive Emission from Fuels (solid, oil and gas) <i>ACM0008 Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction by flaring or catalytic oxidation (version 04)</i>
Estimated amount of annual average GHG emission reductions	215,387tCO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Sichuan Furong Coal Mine Methane Utilization Project (hereinafter referred to as the “project”) will be implemented by the Sichuan Furong Group’s Limited Industrial Company (hereinafter referred to as “Furong Group”). The project is located in Yibin city in Sichuan Province, China. The primary objective of the project is to capture and use coal mine methane (“CMM”) for power generation. This will displace electricity used from the on-site captive power plant¹ and the Central China Power Grid (“CCPG”) for on-site use. Currently, for safety reasons, CMM is extracted from four of Furong Group’s mines, including Baijiao, Shanmushu, Xunchang² and Gongquan coal mines. There is a small portion of residential and commercial use of the extracted CMM in the baseline scenario. The remaining CMM is released directly into the atmosphere. The implementation of the project will not reduce or affect the baseline level of CMM combusted for thermal demand. Therefore, both the scenario existing prior to the start of the implementation of the project activity and the baseline scenario are the same.

The project activity involves the installation of electricity generators with a combined capacity of 15MW for the generation of power using CMM. By the end of year 2012, generation capacity of 6.596MW have been installed in the Baijiao coal mine area, 3.50MW in Gongquan coal mine area and 3.048MW in Shanmushu coal mine area. It is planned that another 3.048MW gas generator will be installed at Shanmushu coal mine. Details about the generation capacity of the three coal mines please refer to the table below.

Table A.1.-1 Generation capacity of the three coal mines

Coal mines	Practical Situation
Baijiao	6.596MW(3.048MW × 2units+0.5MW) On 28/11/2007, four domestic generators each with a 500kW capacity were commissioned in Baijiao coal mine; ^① On 25/05/2009, two sets of 3.048MW gas generator manufactured by GE Jenbacher GmbH were commissioned in Baijiao coal mine.
Shanmushu	6.096MW(3.048MW × 2units) One set of 3.048MW gas generator manufactured by GE Jenbacher GmbH has been installed in Shanmushu coal mine area, but not put into commission yet; It is planned that another 3.048MW gas generator manufactured by GE Jenbacher GmbH will be installed in Shanmushu coal mine at the end of 2015, but now the location is undetermined.
Gongquan	3.50 MW(0.5MW × 7units) On 15/05/2009, four domestic generators each with a 500kW capacity were commissioned in Gongquan coal mine. ^①
Total	16.192MW ^②

¹ The on-site captive power plant was stopped on 11/04/2010 according to the local government requirements, such as the requirements on neatening industrial pollution sources issued by Sichuan Provincial Economic and Information Commission and Sichuan Environmental Protection Agency, shutting down small thermal power generation unit issued by Sichuan Provincial Economic and Information Commission, and eliminating out-of-date productivity in power industry issued by National Energy Administration. So, the electricity generated by the project only displaced the electricity generated by CCPG after 11/04/2010.

² Xunchang coal mine stopped operation since 25/04/2010 because of a water inrush accident. So, CMM is extracted from the other three mines, i.e. Baijiao, Shanmushu and Gongquan coal mines. CMM extracted from three coal mine is prioritized for residential use and the surplus amount is sent for power generation. Details please refer to Fig. 7.3-2.



Note: ^① During 05/2012-06/2012, three domestic generators installed in Baijiao coal mine were moved to Gongquan coal mine.

^② The total named capacity of the project activity will be 16.192MW, but two sets of 500kW domestic generators are used as back-up (one is in Baijiao coal mine and the other is in Gongquan coal mine), because the equipment failure of 500kW domestic generators is frequent, which was approved by local DRC. Thus the total actual capacity of the project activity will be about 15MW.

In addition, other auxiliary equipment and facilities such as gas storage tanks, compressors, and monitoring instruments will be installed accordingly. Waste heat boilers will also be installed to utilize waste heat exhausted from the gas generators to produce hot water for coal miners. At present, eight domestic generators each with a 500kW capacity and three imported generators each with a 3048kW capacity have already been installed at the project site. Another 3048kW gas generator manufactured by GE Jenbacher GmbH will be installed in Shanmushu coal mine.

Through the implementation of the project, an average annual volume of 15.6 million cubic meters of CH₄ will be combusted and destroyed. An amount that, in the baseline scenario, would otherwise be released directly into the atmosphere. Furthermore, a total of 877,800 MWh electricity derived from CMM will be delivered to the Furong coal mines for self-use, which will displace electricity from both the on-site captive power plant and the CCPG. Waste heat from the power generation process is recovered and utilized for coal miners. However, CERs will not be claimed for this component in order to be conservative. Consequently, through CMM combustion and displacement of fossil fuel-fired electricity from the captive power plant and the CCPG, the project will reduce 2,153,870 tCO₂ equivalents of greenhouse gas emissions during the 10-year crediting period.

The project activity will promote local sustainable development through the following aspects:

- Promote CMM utilization by eliminating the release of methane into the atmosphere;
- Promote the technology transfer of advanced gas generator;
- Provide a guarantee for safe coal mine production;
- Create job opportunities during the project construction and operation periods;
- Reduce the emission of pollutants such as SO_x, NO_x, etc. from coal-fired captive power plants and the power plants connected to the CCPG.

A.2. Location of project activity

A.2.1. Host Party(ies)

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People's Republic of China

A.2.2. Region/State/Province etc.

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Sichuan Province

A.2.3. City/Town/Community etc.

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Xunchang town, Yibin City

A.2.4. Physical/Geographical location

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The proposed project is located in Furong coal mine of Xunchang town in Yibin city of southern Sichuan province, China. The Furong coal mine consists of four mines (Baijiao, Shanmushu, Xunchang³ and

³ Please refer to footnote 2.

Gongquan). It is located 5km from the center of Xunchang town, 50km from Yibin city, and at a coordinate of 104°39'~104°41' east longitude and 28°25'~28°28' north latitude.

The power generators will be installed at Baijiao, Shanmushu and Gongquan coal mines.

The geographic location of the project is shown in the figure below.



Fig.A.2.4.-1 Project Location

A.3. Technologies and/or measures

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The project activity includes the delivery of captured CMM to a power plant at which a total of 15MW CMM-fuelled generators will be installed to produce electricity for on-site use. In doing so, the electricity consumption by the coalmines from the captive power plant and from the CCPG will be displaced. The surplus captured CMM will continue to be directly released to the atmosphere and for residential use. The concentration of CMM utilized by the proposed project ranges from 30% to 40%, with the average being around 33%.

Prior to the implementation of the project activity, a waste coal-fired captive power plant with the installed capacity 24MW and two waste coal boilers with the capacity of 1T/h and 2T/h respectively are operating at the project site. There is a small portion of residential and commercial use of extracted CMM in the existing scenario. The rest is released directly into the atmosphere. The implementation of the project will not reduce or affect the existing level of CMM combusted for thermal demand.

But the on-site captive power plant was stopped on 11/04/2010 according to the local policy requirements, so the electricity generated by the project only displaced the electricity generated by CCPG after 11/04/2010.

At present, eight domestic generators each with a 500kW capacity and three imported generators each with a 3048kW capacity have already been installed at the project site, and another 3.048MW gas generator will be installed. The technical parameters of gas generators please refer to Table A.3.-1 and A.3.-2.

Table A.3.-1 Technical parameters of 3.048MW gas generators

Items	Value
	Imported Units
Model	JMS620GS-S.L
Rated power	3048 kW
Power factor	1
Rated voltage	6300 V
Rate speed	1500
Weight	22200 kg
Technical lifetime	20years
Amount	4
Location	2 at Baijiao coal mine, 1 at Shanmushu coal mine and 1 is undetermined at Shanmushu coal mine.

Table A.3.-2 Technical parameters of 500KW gas generators

Items	Value
	Domestic Units
Model	500GF1-2RW
Rated Power	500 kW
Power factor	0.8
Rated voltage	400V
Rate Speed	1000r/min
Weight	13350kg
Technical lifetime	20years
Amount	8
Location	By the end of 2012, 7 sets at Gongquan coal mine and 1 set at Baijiao coal mine.
Remark	Among the 8 sets gas generators, 2 sets will be used as back-up for hardware replacement, by now, one is at Baijiao coal mine and the other one is at Gongquan coal mine.

Four waste heat boilers were installed at Baijiao area in March 2008 and four waste heat boilers were installed at Gongquan area in January 2009. The specifications of these waste heat boilers are shown in the table below.

Table A.3.-3 Technical parameters of waste heat boilers for 500KW gas generator

Items	Baijiao	Gongquan
Model	Q2/500/0.28-5.5-115/60	Q2/500-0.28-1.0/120/60
Rated heat output	0.28 MW	0.28 MW
Rated outflow pressure	5.5 Mpa	1.0 Mpa
Rated outflow temperature	115 °C	120 °C
Backwater temperature	60 °C	60 °C

Two waste heat boilers for 3.048MW gas generators were installed at Baijiao area in December 2012, and one waste heat boiler for the 3.048MW gas generator is under installation at Shanmushu area at the end of 2012. The specifications of these waste heat boilers are shown in the table below.

Table A.3.-4 Technical parameters of waste heat boilers for 3048KW gas generator

Items	Baijiao	Shanmushu
Model	QC12/500-2.4-1.0-200	Q12.4/493-1.75-0.8
Rated heat output	2.4t/h	1.75t/h
Rated outflow pressure	1.0Mpa	0.8Mpa
Rated outflow temperature	200 °C	175 °C
Backwater temperature	10 °C	20 °C

The electric power voltage of the domestic gas generator will be boosted to 6kV by an efficient transformer. Then electricity will be transmitted to the end users via an internal captive distribution network in the existing captive power plant.

In addition, to secure a steady supply of CMM to the gas power plant, a new gas storage tank of 20,000 m³ and a booster pump station will be constructed near Shanmushu coal mine. Moreover, the existing old storage tank of 20,000 m³ which is located in Baijiao coal mine will be upgraded and used in the project activity. Another existing storage tank of 5,000 m³ is located in Gongquan coal mine will be upgraded and used in the project activity. Main and branch gas pipelines will be renovated and expanded. Existing booster pumps at gas stations will be replaced with the newest product.

The gas grid will become complicated with the addition of a new and large storage tank and a CMM power plant compared with the existing network. Therefore, to efficiently and effectively manage and control the stable operation of the project, a modern and advanced computer system will be employed by the project owner.

Table A.3.-4 Technical parameters of gas supply related equipment

Items	Specification	Quantity	Remarks
Storage tank	GL20000—75	1	Repaire (Baijiao)
Storage tank	GL5000	1	Gongquan
Storage tank	GL20000—75	1	Newly built (Shanmushu)
Roots blower	L72WD	3	Pressurization workshop
Roots blower	L41—40/0.5	4	Pressurization workshop
Roots blower	L32—15/0.5	1	Pressurization workshop
Gas flow meter	JLQD—1000/250	5	Measuring room
Gas flow meter	JLQD—350/150	1	Measuring room

The monitoring equipment involved in the project will include gas flow meters (adjusting temperature and pressure), methane concentration meters, electricity meters, etc. Please refer to Fig.7.3.-2 for the details of the monitoring equipment and their installation locations.

The emissions sources and GHG gases involved in the project activity are: electricity consumption by the gas pump stations, emissions from methane combustion and small amounts of methane that remain unburned during power generation. The details are shown in Table B.3.-1 in section B.3.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
P.R. China (host)	Sichuan Furong Group's Limited Industrial Company	No
Japan	Marubeni Corporation	No

A.5. Public funding of project activity

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There are no public funds from parties included in Appendix I of the UNFCCC involved in this project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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- ACM0008 *Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction by flaring or catalytic oxidation* (version 04)
- *Tool to calculate the emission factor for an electricity system* (version 01.1)
- *Tool for the demonstration and assessment of additionality* (version 05.2)

Above methodology and Tools are available at:

<http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

B.2. Applicability of methodology

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ACM0008 defines the applicability criteria of the methodology. The following tables explain the reasons why this methodology is applicable to the project.

Table B.2-1 Comparison of proposed extraction activities with applicability criteria

ACM0008 Applicability	Proposed extraction activities
Surface drainage wells to capture CBM associated with mining activities.	No. The project activities do not include CBM.
Underground boreholes in the mine to capture pre-mining CMM.	Yes.
Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM.	Yes. Underground boreholes, or other goaf gas capture techniques, including gas from sealed areas, to capture post mining CMM are and will be adopted to capture post mining CMM.
Ventilation air methane that would normally be	Yes.

vented.	
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Table B.2-2 Comparison of proposed utilization activities with applicability criteria

ACM0008 Applicability	Proposed CMM utilization activities
The methane is captured and destroyed through flaring.	No. The project activities do not include flaring.
The methane is captured and destroyed through catalytic oxidation with or without utilization of the thermal energy.	No. The project activities do not include catalytic oxidation.
The methane is captured and destroyed through utilization to produce electricity, motive power and/or thermal energy; emission reductions may or may not be claimed for displacing or avoiding energy from other sources.	Yes. The methane will be captured and destroyed by gas generators and by residential use. And the emission credits will be claimed for displacing the electricity from on-site captive power plant and CCPG.
The remaining share of the methane, to be diluted for safety reason, may still be vented.	Yes.
All the CBM or CMM captured by the project should either be used or destroyed, and cannot be vented.	Yes. The project activities do not include the capture of CBM. Captured CMM will be destroyed by gas generators and by residential use and will not be vented.

Besides the applicability, ACM0008 also defines the types of activities that could not be applied for this methodology. The proposed project does not involve any such activities.

Table B.2-3 Comparison of proposed project with inapplicable activities

ACM0008 Inapplicability	Proposed project activities
Operate in open cast mines.	No. All coal mines ⁴ included in the project are underground working coal mines.
Capture methane from abandoned/decommissioned coalmines.	No. All coal mines ⁵ included in the project are underground working coal mines. Both coal production and CMM extraction are undertaken in these coal mines.
Capture/use of virgin coal-bed methane, e.g. methane of high quality extracted from coal seams independently of any mining activities.	No. CBM extraction activities are not involved in the project.
Use CO ₂ or any other fluid/gas to enhance CBM drainage before mining takes place.	No. CBM extraction activities are not involved in the project.

It can be concluded from the above comparative analysis that the proposed project fulfills the applicability criteria of the methodology ACM0008.

B.3. Project boundary

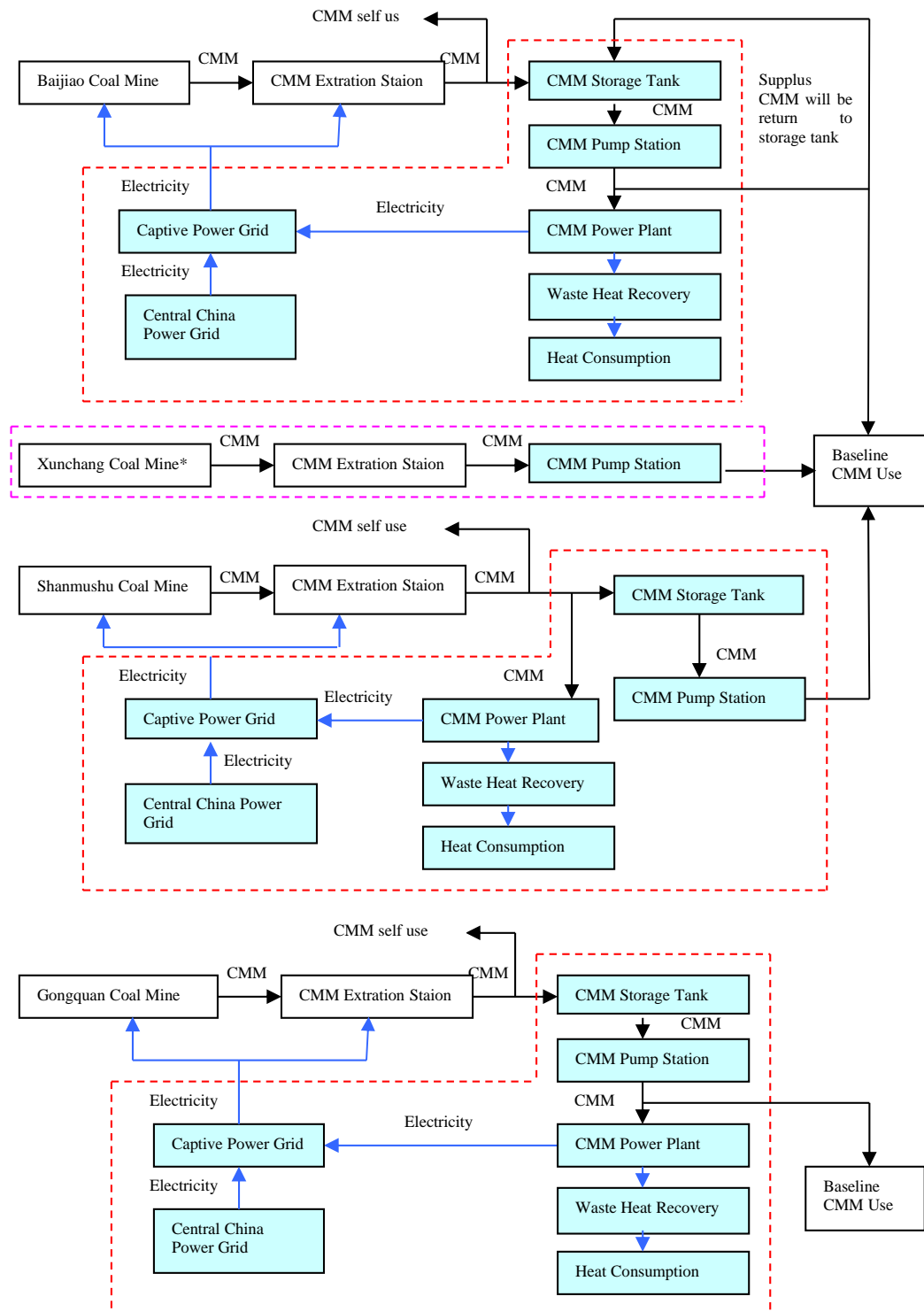
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The project boundary includes gas storage tanks, gas pump stations, CMM power plants and power grid connection system, gas grid and delivery systems. It also includes all power plants connected to the CCPG, which covers Henan, Hubei, Hunan, Jiangxi, Sichuan and Chongqing provincial power grids.

⁴ Xunchang coal mine stopped operation since 25/04/2010.

⁵ Xunchang coal mine stopped operation since 25/04/2010.

A conceptual diagram of the project boundary and the components included in the project activities are shown in the figure below.



* Xunchang coal mine stopped operation since 25/04/2010.

Fig.B.3.-1 Project boundary

Table B.3-1 Emissions sources included or excluded from the project boundary



	Source	GHGs	Included?	Justification/Explanation
Baseline scenario	Emissions of methane as a result of venting	CH ₄	Included	Main emission source. A small portion of extracted CMM is supplied through gas grid for residential use in the baseline scenario. The remaining large portion is released into the atmosphere directly.
	Emissions from destruction of methane in the baseline	CO ₂	Included	Taking account of residential use of extracted CMM in the baseline.
		CH ₄	Excluded	Excluded for simplification. This is conservative.
		N ₂ O	Excluded	Excluded for simplification. This is conservative.
	Grid electricity generation (electricity provided to the grid)	CO ₂	Included	Only CO ₂ emissions associated with the same quantity of electricity than electricity generated as a result of the use of methane included as baseline emission is counted.
		CH ₄	Excluded	Excluded for simplification. This is conservative.
		N ₂ O	Excluded	Excluded for simplification. This is conservative.
	Captive power and/or heat, and vehicle fuel use	CO ₂	Included	A portion of electricity from on-site captive power will be replaced with electricity supplied by the project activity. Vehicle fuel use has been accounted together with residential use as it is supplied through the common gas grid.
		CH ₄	Excluded	Excluded for simplification. This is conservative
		N ₂ O	Excluded	Excluded for simplification. This is conservative
Project scenario	Emission of methane as a result of continued venting	CH ₄	Excluded	Only the change in CMM emission release will be taken into account, by monitoring the methane used or destroyed by the project activity. For ex ante estimation, this emission source is not taken into account.
	On-site fuel consumption due to the project activity, including transport of the gas	CO ₂	Included	Energy consumption from gas pump stations will be accounted for.
		CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N ₂ O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from methane destruction	CO ₂	Included	Emissions from methane combustion in power generation.
	Emissions from NMHC destruction	CO ₂	Included	NMHC content will be monitored annually. If NMHC is less than 1%, emission from NMHC destruction can be ignored. Otherwise, the emissions should be accounted for.
	Fugitive emissions of unburned methane	CH ₄	Included	Small amount of methane will remain unburned in power generation.
	Fugitive methane emissions from on-site equipment	CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small.
Fugitive methane emissions from gas supply pipeline or	CH ₄	Excluded	Excluded for simplification	

	in relation to use in vehicles			
	Accidental methane release	CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small.

B.4. Establishment and description of baseline scenario

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Step 1. Identify technically feasible options for capturing and/or using CMM

Since the project only utilizes CMM but not CBM or VAM, the possible options are identified below.

Step 1a: Options for CMM extraction

- A. Pre mining CMM extraction;
- B. Post mining CMM extraction;
- C. Possible combinations of options A and B, with the relative shares of gas specified.

All options above are technically feasible. However, the methane concentration in the air at coalmine needs to be controlled according to the regulatory requirement. It is discussed further in Step 2.

Step 1b: Options for extracted CMM treatment

According to the methodology, the baseline scenario alternatives should include all possible options that are technically feasible to use CMM. These options could include:

- i. Venting. This is the continuation of existing CMM treatment practices;
- ii. Using/destroying ventilation air methane rather than venting it;
- iii. Flaring of CMM;
- iv. Use for additional grid power generation;
- v. Use for additional captive power generation; this is the proposed project activity not undertaken as a CDM project;
- vi. Use for additional heat generation;
- vii. Feed into gas pipeline (to be used as fuel for vehicles or heat/power generation);

All of the above are technically feasible options to use CMM. Alternative v is the proposed project activity not implemented as a CDM project.

Step 1c. Options for energy production

The alternatives for power generation include:

1. Continuation of the current practice: electricity from existing on-site captive power plant and from the CCPG.
2. Building electricity from coal-fired power plant with the same installed capacity as the proposed project.
3. Building CMM power generation plant. This is the proposed project activity not undertaken as a CDM project.

The alternatives for heat production include:

4. Continuation of current heat supply by waste coal-fired boilers.
5. Heat supply by CMM fired boilers.

6. Waste heat recovery from CMM-fuelled generators. This is the proposed project activity not undertaken as a CDM project.

All energy production options listed above are technically feasible. Option 1 and 4 are the current practice and Option 3 and 6 are the proposed project activity not undertaken as a CDM project.

The heat generated by recovering waste heat from CMM-fuelled generators will replace the heat from existing waste coal-boilers. However, no emission reductions are claimed for this element of the project.

Step 2. Eliminate baseline options that do not comply with legal or regulatory requirements

Options for CMM extraction:

Currently, methane control measures only come under the requirements of health and safety regulations governing the maximum methane concentration at various sites within an underground coal mine. It is only required that methane concentrations in the air must be below 1% to avoid the risk of explosion⁶. In the CMM drainage process, solely adopting pre-mining or post-mining extraction may not meet the underground safety requirement. Usually they are combined with ventilation. Thus, separately, alternative A and alternative B do not comply with the legal requirements. Alternative C is in compliance with legal and regulatory requirements.

The methane at the Furong coal mines currently includes pre-mining CMM (A) and post-mining CMM (B). Indeed it is not possible or logical to just rely on any one technology to manage methane release from mining safely. Both pre-mining and post-mining CMM are drawn out of each mine via a common drainage system for safety purposes and so breakdown will not occur for the split between A+B and these are combined and referred to in this PDD as “CMM”. The baseline will be the continued operation of the gas drainage equipment currently employed as required to meet safety considerations as the coal production in the mines is maintained / expanded in response to market conditions.

The shares of pre-mining CMM and post-mining CMM, about 70%~90% and 10%~30% respectively, will not be changed before or after the implementation of the project activity due to the existence of the CMM extraction system prior to the project.

Options for extracted CMM treatment:

In terms of extracted CMM treatment, all options listed under Step 1b are in compliance with legal or regulatory requirements.

Options for extracted energy production:

In the energy production process, according to the Chinese power regulations, the construction of a coal-fired power plant with a capacity of 135 MW or below is prohibited in the national grid coverage area⁷. Also, the construction of coal-fired generations with a unit capacity of less than 100MW⁸ is strictly controlled. In addition, according to Article 2 of the Notice issued by the Office of National Development and Reform Commission on Strengthening Waste Coal-fired Power Generation Project Planning and Construction Management⁹, when waste coal resource and technology becomes available and suitable, only construction of large capacity units with high efficiency of circulating fluidized bed power

⁶ National Coalmine Safety Regulation 2005, section two, item 100-150.

⁷ Notice on strictly prohibiting the installation of fossil fuel-fired generators with capacity of 135MW or below issued by the General Office of the State Council, decree no.2002-6.

⁸ Temporary regulation of small scale coal fired units construction management (Aug.1997)

⁹ <http://www.gsyjmd.com/zcfg/ShowArticle.asp?ArticleID=1008>

generation is encouraged for high voltage and ultra voltage generating units with capacities of 50MW and above. Since the total generation capacity of the project is only 15MW, alternative 2 does not comply with local and regulatory requirements.

Based on above analysis, alternative C, alternative i~vii, alternative 1, alternative 3 and alternatives 4-6 will be analyzed in the following sections.

Step 3. Formulating baseline scenario alternatives

Based on the alternatives identified in the above two steps, all of the baseline alternatives to the project activity are formulated as follows.

Step 3a. Alternative for CMM extraction

Alternative C: Possible combinations of options A and B.

Step 3b. Alternative for CMM treatment

Alternative i: CMM ventilation.

Alternative ii: Using/destroying ventilation air methane rather than venting it.

Alternative iii: Flaring of CMM.

Alternative iv: Use for additional grid power generation.

Alternative v: Use for additional captive power generation.

Alternative vi: Use for additional heat generation.

Alternative vii: Feed into gas pipeline (to be used as fuel for vehicles or heat/power generation).

Step 3c. Alternative for energy production

Alternative 1: Continuation of electricity supply by existing on-site captive power plant and electricity supply by the CCPG.

Alternative 3: CMM power generation.

Alternative 4: Continuation of current heat supply by waste coal-fired boilers.

Alternative 5: Heat supply by CMM-fired boilers.

Alternative 6: Waste heat recovery from CMM-fuelled generators.

The possible combinations of above alternatives are shown in below table.

Table B.4.-1 Possible baseline scenarios

	CMM extraction	CMM treatment	Electricity generation	Heat generation
Scenario 1	C	i. CMM venting	1.captive power and grid power	4.heat supply by current waste coal-fired boilers
Scenario 2	C	ii. Using/destroying VAM rather than venting it	1. captive power and grid power	4.heat supply by current waste coal-fired boilers
Scenario 3	C	iii. Flaring of CMM	1. captive power and grid power	4.heat supply by current waste coal-fired boilers
Scenario 4	C	iv. Use for additional grid power generation	3.generate electricity from the extracted CMM	6.waste heat recovery from CMM-fuelled generators

Scenario 5	C	v. Use for additional captive power generation	3.generate electricity from the extracted CMM	6.waste heat recovery from CMM-fuelled generators
Scenario 6	C	vi. Use CMM for additional heat generation	1.captive power and grid power	5. heat supply by CMM-fired boilers
Scenario 7	C	vii. Feed into gas pipeline	1.captive power and grid power	4.heat supply by current waste coal-fired boilers

Step 4. Eliminate baseline scenario alternatives that face prohibitive barriers

There are barriers that could prevent the implementation of the identified baseline scenario alternatives in the absence of the CDM. In the following steps, the identified baseline alternative scenarios in CMM extraction, CMM treatment and energy production phases will be assessed.

Scenario 1:

This scenario does not face any barriers as it is the current practice.

Scenario 2:

From the time of the investment decision until now, the use of VAM is still in its pilot stage and the technology is immature¹⁰. In China, the commercial use of VAM technologies is just in its infancy, even globally only a few VAM technologies up till now have been undertaken as pilot or demonstration projects. Therefore, this alternative faces serious technical and prevailing practice barriers and is eliminated.

Scenario 3:

Flaring is currently not standard practice in the mining industry in China as no regulatory requirements exist to mandate flaring of captured CMM. As a result, Chinese coal mine groups are very unfamiliar with flaring equipment, and its usage in China is rare¹¹. Some mines interested in exploring this option were obliged to obtain special permission from the relevant safety authorities, creating additional barriers to its implementation¹². In addition, this option does not utilize the energy potential of CMM, so it does not address the energy shortage issues that exist in China, particularly with the use of clean burning gas. Thus this alternative faces technological barriers, barriers due to prevailing practice etc., and is eliminated as the baseline scenario.

Scenario 4:

However, considering the Notice on Implementation of CBM/CMM Power Generation Project¹³, power generated from CBM/CMM power generation has the priority to be used for self consumption in its mining area. Furthermore, Yibin Economic Commission issued a Letter for Utilization of CMM for Displacement of Captive Power to the project owner. It demonstrates that the local government recommends Furong Group to utilize CMM for power generation to displace the existing on-site captive power as much as possible due to the high energy consumption and environmental pollution of the existing captive power plant. In addition, the commission further issued the clarification responding to the query from Sichuan Furong Group's Limited Industrial Company on 8 December 2009 that the suggestion was not mandatory and the intent of the suggestion was to accelerate the development and implementation of the CMM power generation project as a model for energy saving, emission reduction

¹⁰ <http://www.gzcmm.org/m2mmaterials/S.pdf>.

¹¹ Westlake A, Creedy D P, Hu Yulong, CDM, a Trigger for Coal Mine Methane Emission Reductions in China, 2003. Available at: <http://www.coalinfo.net.cn/coalbed/meeting/2203/papers/coal-mining/005.pdf>

¹² Vrolijk, C. et al. Enhancing Coal Mine Methane Utilisation in China, Report No. COAL R298

DTI/PubURN05/1816, 2005. Available at: www.berr.gov.uk/files/file29223.pdf

¹³ http://www.gov.cn/zwgk/2007-04/16/content_583702.htm



and environmental protection in the city. Thus, this alternative faces the barrier due to the recommendation from Yibin City Government.

Scenario 5:

This alternative does not face barriers.

Scenario 6:

The existing boiler can meet the heat demand including cooking in the dining rooms and providing hot water for the miners' bathroom. Furong coalmine has started operation since 1970s. The youngest mine, Gongquan, started operation in December 1988. All mines are currently are in full operation. The domestic heat use has been sufficiently supplied. The number of the coal miners will not increase in the future according to Furong coalmine's development plan, especially considering that more and more mechanical equipment will be used. The direct release of surplus gas will continue in the future. There is no additional demand for heating within the mining facilities. Additional heat generation will not an option to treat all the extracted CMM. Therefore this alternative faces prohibitive barrier due to lacking in the demand for additional heat generation, and it is eliminated.

Scenario 7:

There is an existing CMM pipeline grid and this is a technically feasible option that needs to be considered. However, in recent times more and more households are using natural gas instead of CMM, and there are no other major population centers close to Furong coal mine areas. According to data on residential use of extracted CMM in most recent years (2000~2007), the trend shows that the use of extracted CMM is almost constant. Moreover, in accordance with the project Environmental Impact Assessment Report¹⁴, the residential use of CMM in Furong coal mine area is almost to a maximum. The population and vehicle numbers in the Furong town has not varied greatly in recent years. The current pipeline system and vehicles already satisfy the local demand and use. In addition, the population of Furong town is predicted not to greatly change in the future. Therefore, it is rational to assume that the increase in the vehicle quantity and CMM requirements for vehicle fuel and residential use are unlikely to occur. Therefore, no additional CMM demand for vehicles and households exists and this alternative is eliminated.

Therefore, based on above analysis, there are two alternatives of this project that face no barriers:

Scenario 1: Combination of options: C+i+1+4. This is the continuation of current practice.

Scenario 5: Combination of options: C+v+3+6. This is project activity not undertaken as a CDM project.

Step 5. Identify the most economically attractive baseline scenario alternative

Step 5b.- Option II. Apply investment comparison analysis

Among the possible baseline scenarios, scenario 1 generates no financial benefits while also needs no investment; scenario 5 generates the revenues from saving the cost of electricity generation at the captive power plant and of electricity purchase from the CCPG. Therefore, the financial indicator NPV is selected to compare these scenarios.

In addition, although scenario 4 is eliminated in Step 4 above, the financial analysis for this scenario is also carried out here to further strengthen that scenario 4 is not the baseline.

Scenario 4 will generate the revenues from selling electricity to the CCPG; The investment costs for scenario 4 and scenario 5 are the same, but the tariff for scenario 4 is 0.3478CNY/kWh by referring to

¹⁴ The Project Environmental Impact Assessment Report, page 4.

another CMM grid-power generation CDM project in Sichuan province¹⁵ while the tariff for scenario 5 is 0.286CNY/kWh as mentioned in section B.5. below.

Table B.4.-1 Baseline scenarios comparison

	NPV (10 ³ CNY)	IRR (%)
<u>Scenario 1</u> : combination of options: C+i+1+4 This is the continuation of current practice.	0	-
<u>Scenario 5</u> : combination of options: C+v+3+6 This is project activity not undertaken as a CDM project.	-460,022	Negative
<u>Scenario 4</u> : combination of options: C+iv+3+6	-359,424	0.44%

Step 5c. Sensitivity analysis

When the IRRs of scenario 4 and scenario 5 are equal to the investment hurdle rate of 13%, the change of investment costs, operation and maintenance costs, electricity generation and electricity tariff are shown in Table B.4.-2 below. However, these situations are most unlikely to occur as for the reasons mentioned below in section B.5.

Table B.4.-2 Sensitivity analysis

Change of parameters when Project IRR = Benchmark	Investment	Operation and maintenance costs	Elec. Generation	Elec. Tariff
Scenario 4	-64.5%	-53.3%	120.7%	47.8%
Scenario 5	-88.5%	-82.1%	300%	79.8%

From the above analysis, the NPVs of scenario 4 and scenario 5 are all negative. Therefore, scenario 1 is the most economically attractive scenario and is identified as the baseline scenario¹⁶.

B.5. Demonstration of additionality

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The proposed project activity will not be implemented without CDM assistance. A timeline of the main events involved in the implementation of the proposed project is described below.

- ◆ Since the beginning of 2006, Marubeni Corporation contacted the project owner to introduce CDM. After a longterm negotiation, finally, on November 10th 2006, the project owner and the CER buyer Marubeni Corporation signed the Emission Reduction Purchase Agreement, upon which the two parties agreed to jointly develop the proposed project as a CDM project.
- ◆ In January 2007, the project Feasibility Study Report (FSR) was completed by Yibin Furong Geological Design Corporation in which the CDM was seriously considered.
- ◆ Between May 17th and June 15th 2007, the PDD (version 1) was available on the UNFCCC website for global stakeholders' comments.
- ◆ On July 30th 2007, Furong Group and the generator supplier signed the generator procurement contract. This is determined as the starting date of the project activity.

¹⁵ <http://www.scpi.gov.cn/newzcfg/zcfg-content.asp?id=2877>

¹⁶ Because the on-site captive power plant was stopped on 11/04/2010 according to the local policy requirements, the electricity generated by the project only displaced the electricity generated by power grid. For conservative calculations, the baseline emission factor for the part of electricity replacement is equal to the power grid emission factor.



- ◆ On August 28th 2007, the FSR was approved by Sichuan Development and Reform Commission (SDRC).
- ◆ In September 2007, the project Environmental Impact Assessment (EIA) was completed by Environmental Science and Engineering School of Southwest Jiaotong University.
- ◆ On September 10th 2007, the EIA was approved by Yibin City Environment Protection Bureau.
- ◆ Between October 20th and November 18th 2007, the PDD (version 2) was available on the UNFCCC website for global stakeholders' comments.
- ◆ On November 20th 2007, the Japanese DNA issued the Letter of Approval for the proposed project.
- ◆ Between April 23rd and May 22nd 2008, the PDD (version 3) was available on the UNFCCC website for global stakeholders' comments.
- ◆ On June 25th 2008, the Chinese DNA issued the Letter of Approval for the proposed project.

The PDD started publication for global stakeholders' comments on May 17th 2007, which was earlier than the start date of the project activity, July 30th 2007, upon which the project owner signed the generators procurement contract. The details in the above timeline clearly demonstrate that the project participants took CDM into serious consideration before commencing the project construction.

The *Tool for the Demonstration and Assessment of Additionality* (version 05.2) will be used to test the additionality of the proposed project.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

As per ACM0008, this step can be ignored.

There are two possible scenarios:

Scenario 1: Combination of options: C+i+1+4

Scenario 5: Combination of options: C+v+3+6

Step 2. Investment Analysis

Sub-Step 2a. Determine appropriate analysis method

The proposed project generates financial and economic benefits other than CDM related revenues, therefore the simple cost analysis (Option I) is not applicable.

Option II is based on the comparison of returns of the project investment with the investment required for an alternative to the project. The alternative baseline scenario of the proposed project is the continuation of current practices rather than new investment projects. So the investment comparison analysis (Option II) is not suitable for this project. In this case, only benchmark analysis (Option III) is selected.

Sub-step 2b. Option III. Apply benchmark analysis

According to the *Economical Assessment and Parameters for Construction Projects* (edition 3)¹⁷, the benchmark rate of return of total investment before income tax is 13% for coal mining industry in China. This is widely applied in the coal mine industry in China. In addition, according to the reference, when a project owner invests in a project based on another sector rather than its own core business base, and has little experience in characteristics and the project and risk, the sectoral benchmark IRR of its own core business will be applied.

¹⁷ China Planning Press, 2006, page 204

There is another possible target IRR hurdle rate that could be considered by the investor. The Confederation of British Industry (CBI) polled 337 industrial investors in the year 2001 and found that the average large industry used 13.5% for its hurdle rate. However, this benchmark was based on a survey of foreign investors and, on the other hand, the IRR benchmark of coal mining industry was approved by the Chinese government. Therefore, 13% as the IRR benchmark for the project is appropriate and conservative.

Table B.5.-1 Main financial parameters for the project

Parameters	Value	Unit	Data source
Total static investment	84.4	million CNY	Based on FSR
Mean annual operation and maintenance costs in the project operational lifetime	11.057*	million CNY	Based on FSR
Mean annual electricity generation in the project operational lifetime	43,890**	MWh	Based on FSR
Electricity tariff	0.286***	CNY/kWh	Based on FSR
Project operational lifetime	20	years	Based on FSR
Residual value (5% of total static investment cost)	4.22	million CNY	Based on FSR

Note: * 11.057 mCNY of O&M cost is the average value during the project lifetime (20 years). The breakdown of O&M cost is shown in table below.

** 43,890MWh of electric generation is the average value during the project lifetime (20 years). For 10 crediting years, the average value is 39,780MWh.

*** 0.286CNY/kWh is the weighted tariff between captive power cost of 0.229CNY/kWh and grid power purchase price 0.480CNY/kWh by the share of 77.2% and 22.8%, respectively, based on the most recent 3 years (2003-2005) data of electricity consumption available at the consideration of the CDM for the project. This tariff is in line with the FSR formally approved. The calculation is shown in Appendix 4.

Cost	Annual cost for 40GWh/year for 10 crediting years	Remarks
CMM compression and delivery cost	4.800 million CNY	Proportional (0.12 CNY/kWh * 40GWh)
Lubricant cost	1.200 million CNY	Proportional (0.03CNY/kWh * 40GWh) 0.002kg/kWh * 15 CNY/kg
Maintenance cost	2.400 million CNY	Proportional (0.06 CNY/kWh * 40GWh)
Labor cost	0.640 million CNY	Fixed (40,000CNY/person * 16 person)
Contingency cost	1.200 million CNY	Fixed
Total O&M cost	10.240 million CNY for 10 crediting years (11.057 million CNY for 20 operational years)	(by multiplying 43,890MWh for the proportional parts)

Sub-step 2c. Calculation and comparison of financial indicators

IRR for the proposed project without CDM assistance is negative. With CDM assistance, assuming the CER price is US\$10/tCO₂e, the project IRR will reach 15.11%, which is well over the benchmark. Therefore, it is concluded that the proposed project is not financially attractive without revenue from CDM.

Table B.5-2 Project IRR with and without CDM

IRR without CDM	IRR with CDM
Negative	15.11%

Sub-step 2d. Sensitivity analysis

The following key parameters have been selected as sensitive elements to test the financial attractiveness for the proposed project:

- ◆ Total investment
- ◆ Operation and maintenance costs (O&M)
- ◆ Electricity generation
- ◆ Electricity tariff

Financial analysis is performed by altering investment, operation and maintenance costs, electricity supply and electricity tariff by +10%/-10%, respectively, and assessing the impact on the project IRR. For the proposed project, no matter whether there is an increase in electricity generation or tariff, or a decrease in investment or operation and maintenance costs, the project IRR without CDM remains negative.

Alternatively, when the project IRR is equal to the benchmark, the resultant changes to the critical parameters can be seen in the table below.

Table B.5.-3 Parameter changes when project IRR is equal to the benchmark

Change of parameters	Investment	Operation and maintenance costs	Elec. Generation	Elec. Tariff
Project IRR = Benchmark	-88.5%	-82.1%	300%	79.8%

It shows that when the project IRR is equal to the benchmark 13%, the operation and maintenance costs need to decrease by 82.1% or the investment decrease by 88.5%, or electricity generation or electricity tariff increase by 300% and 79.8%, respectively. These are situations that are very unlikely to occur.

A decrease in investment by 88.5% or O&M costs by 82.1% is unlikely to occur due to the continuous increase in material and labour costs etc. in the host country of the proposed project. According to the National Bureau of Statistics of China, the procurement price index for material, fuel and power increased by 8.3%¹⁸, 6.0%¹⁹ and 4.4%²⁰ nationwide, during 2005, 2006, and 2007 respectively. In Sichuan province the procurement price index rose to levels of 9.3%²¹, 4.3%²² and 5.7%²³.

Electricity generation is unlikely to increase by 300%. The project was designed based on the CMM quantity of to be extracted and utilized for power generation. A maximum 15MW generation capacity was approved by the government including the standby capacities. Therefore, based on the determined generation capacity and CMM quantity, a more than three times of the electricity supply by the project activity is unlikely to occur.

As for electricity tariff, if it increases by 79.8% the project IRR would be equal to the benchmark 13%. However, according to the procurement price index for power during the most recent years 2005~2007

¹⁸ http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20060227_402307796.htm

¹⁹ http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20070228_402387821.htm

²⁰ http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20080228_402464933.htm

²¹ http://www.stats.gov.cn/was40/gjtjj_detail.jsp?channelid=4362&record=101

²² http://www.stats.gov.cn/was40/gjtjj_detail.jsp?channelid=4362&record=72

²³ http://www.stats.gov.cn/tjgb/ndtjgb/dfndtjgb/t20080219_402468477.htm

mentioned above, it increased by only 8.3%, 6.0% and 4.4% nationwide, and 9.3%, 4.3% and 5.7% in Sichuan province. Therefore, an increase of 79.8% in electricity tariff is also most unlikely to occur.

In such extreme cases when the project totally displaces electricity consumption from the public power grid (CCPG), the purchase price of 0.480 CNY/kWh will be avoided and this cost therefore saved, which is 68% higher than the tariff 0.286 CNY/kWh. In such a case, the project IRR would reach 10.63% without CER revenue. However, it is still below the benchmark IRR 13%.

In sum, the above sensitivity analysis strongly demonstrates that the scenario 5 is not the baseline to the project activity.

Based on the above analysis, the baseline scenario of the project is the scenario 1: combination of alternatives C+i+1+4. This means the continuation of the current CMM extraction practice with most extracted CMM being released into the atmosphere, and electricity being supplied by the on-site captive power plant and by the CCPG, heat being supplied by the existing waste coal-fired boilers.

Post registration change assessment

Because the total named capacity of the project activity will be 16.192MW and two sets of 500kW domestic generators are used as back-up, the change of installed capacity may affect the investment and revenues of the Project. Base on the change of investment and revenues of the Project, the IRR was re-done.

The main factors considered are as following:

- (1) The total named capacity of the project activity will be 16.192MW and two sets of 500kW domestic generators are used as back-up;
- (2) The total static investment will be 109.4million (for 8 sets of 500kW domestic generators and 4 sets of 3048kW generators), which is 29.62% higher than that in the registered PDD;
- (3) The coal-fired captive power plant was closed as per the government requirement, which is out of the project owner's control and occurred more than 2 years after the real investment, so, the tariff will not be changed;
- (4) The actual annual installed capacity and electricity generation are as following:

For 500kW domestic generators

Year	Actual installed capacity (KW)	Actual annual electricity generation (KWh)	Actual operation hours (h)
2008	2000	8800001	4400
2009	4000	7742087	1936
2010	4000	8961929	2240
2011	4000	12359901	3090
2012	4000	12529352	3132

For 3048kW generators

Year	Actual installed capacity (KW)	Actual annual electricity generation (KWh)	Actual operation hours (h)
2009	6096	7807235	1281
2010	6096	22285824	3656
2011	6096	22785631	3738
2012	6096	18279075	2999

So, the highest annual operation hour for 500kW domestic generator is 4400h, while the highest annual operation hour for 3048kW generator is 3738h. Base on the highest annual operation hour, the estimated annual electricity generation is 58774MWh for six sets of 500kW domestic generators and four sets of 3048kW generators, which is 33.91% higher than that in the registered PDD. The IRR is negative, still lower than the benchmark 13%.

For most conservative assessment of the additionality of the Project due to the post registration change, assuming

- (1) the installed capacity is 16.192MW;
- (2) the operation hour is 8760h;
- (3) other parameters keep unchanged.

The IRR is 10.49%, still lower than the benchmark.

So, the additionality of the Project is very robust, and not changed due to the post registration change.

Step 3 : Barrier analysis.

No barrier analysis is chosen, therefore this step is skipped.

Step 4: Common Practice Analysis

Sub-step 4a. Analyze other activities similar to the proposed project activities

CMM Utilization

In 2004, coal mines in China released about 12 billion cubic meters of CMM. A total of 1.8 billion cubic meters were extracted, of which 1.1 billion were vented directly, only 0.7 billion were used²⁴. In China, the utilization of CMM is not widely recognized as common practice.

CMM Power Plant

Recently, many CMM power plants with CDM support have been installed in major coal mines in China. CMM power plants encounter many barriers within commercial plants due to high costs, low reliability, immature gas generator technology, and the low and variable nature of methane concentration and production amount of CMM.

In China, coal resources are mainly distributed in Shanxi province, Inner Mongolia and Uygur Autonomous Region²⁵. Sichuan province has a share of only about 1% of total coal reserves in China, and which are mainly located in Yibin and Luzhou cities, and the main coal products are anthracite coal (69.3%) and bituminite (24.5%)²⁶. At present, Sichuan province has a total of 68 towns-own coal mines²⁷. The first CMM power generation project in Sichuan province²⁸, which started operating on October 1st 2007, was also undertaken as a CDM project²⁹.

Sub-step 4b. Discuss any similar options that are occurring

²⁴ China Coal Information Institute (CCII) & State Administration of Coal Mine Safety, Beijing 2005, 5th International Symposium on CBM/CMM in China

²⁵ <http://www.qqkqw.com/News/V3067.aspx>

²⁶ <http://www.scsafety.gov.cn/html/2008/11/20081124175612-1.htm>

²⁷ http://www.coal.com.cn/Gratis/2007-12-24/ArticleDisplay_150232.shtml

²⁸ <http://www.verypower.cn/news/neirong.asp?newsid=6044&id=0302>

²⁹ <http://cdm.unfccc.int/Projects/Validation/DB/7RK18I462TY5Z9TFTITP8A61OX5KN3/view.html>

Currently, similar projects that are being proposed at coalmines in China as shown in Table B.5.-4 are only with CDM incentives³⁰. So a conclusion can be made that the proposed project activity is not a common practice in China and it could be carried out only with CDM assistance.

Table B.5.-4 Analysis of other CMM projects under construction / operated in China

Coal Mining Company	Location	CDM Status
Jiangxi Fengcheng Coal Mining Group	Jiangxi province	Approved by Chinese DNA
Ningxia Shizuishan Coal Mine	Ningxia province	Approved by Chinese DNA
Guizhou Shuicheng Coal Mine Group	Guizhou province	Approved by Chinese DNA
Yangquan Coal Mine Group	Shanxi province	Registered
Liaoning Fuxin Coal Mine Group	Liaoning province	Approved by Chinese DNA
Huainan Coal Mine Group Pansan Coal Mine	Anhui province	Approved by Chinese DNA
Shanxi Jincheng Coal Mine Group	Shanxi province	Approved by Chinese DNA
Huaibei Coal Mine Group Haizi Luling Coal Mine	Anhui province	Registered
Songzao Coal and Electricity Group	Chongqing city	Approved by Chinese DNA
Tiefa Coal Mine Group	Liaoning province	Approved by Chinese DNA
Shanxi Liulin Coal Mine	Shanxi province	Registered
Shanxi Yangcheng Coal Mine Group	Shanxi province	Registered
Huainan Coal Mine Group Panyi Xieqiao Coal Mine	Anhui province	Approved by Chinese DNA
Henan Anyang Xinlong Coal Mine Group	Henan province	Approved by Chinese DNA
Shanxi Coal Transport Company Yangquan	Shanxi province	Registered
Jilin Liaoyuan Coal Mine Group Meihe Coal Mine	Jilin province	Approved by Chinese DNA
Guizhou Qianxi Qinglong Coal Mine	Guizhou province	Approved by Chinese DNA
Chongqing Zhongliangshan Coal Mine	Chongqing city	Approved by Chinese DNA
Chongqing Nantong Coal Mine	Chongqing city	Approved by Chinese DNA
Chongqing Tianfu Coal Mine	Chongqing city	Approved by Chinese DNA
Pingdingshan Coal Mine Group	Henan province	Approved by Chinese DNA
Yima Coal Mining Group	Henan province	Approved by Chinese DNA
Zhengzhou Coal Mining Group	Henan province	Approved by Chinese DNA
Jiaozuo Group Company	Henan province	Approved by Chinese DNA
Guangxian Company Xinfeng Mine	Henan province	Approved by Chinese DNA
Lubanshan North and South Coal Mine Methane Utilization Project, China	Sichuan province	Approved by Chinese DNA

Since no CMM utilization power generation projects are implemented in Sichuan province and even in China without CDM support, the proposed project is not common practice.

In sum, the proposed project is additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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According to methodology ACM0008, the project emissions, baseline emissions, leakage and emission reductions are calculated using the following steps.

1. Project Emissions

³⁰ China Coal Information Institute, New Development of CMM Projects in China, page 295, the proceeding of 2007 Methane to Markets Partnership Expo, October – November 2007.

Project emissions are defined by the following equation:

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM} \quad (1)$$

Where:

PE_y : Project emissions in year y (tCO₂e)

PE_{ME} : Project emissions from energy use to capture and use methane (tCO₂e)

PE_{MD} : Project emissions from methane destroyed (tCO₂e)

PE_{UM} : Project emissions from un-combusted methane (tCO₂e)

1.1 Combustion emissions from additional energy required for CMM capture and use

The project needs no additional heat or fossil fuel consumption for the capture and use or destruction of methane. In this project activity, only additional electricity will be used for pumping CMM to the gas generators. Therefore, emissions from this energy (electricity) consumption will be simply calculated according to the following formula:

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC} \quad (2)$$

Where:

$CONS_{ELEC,PJ}$: Additional electricity consumption for capture and use of methane (MWh)

CEF_{ELEC} : Carbon emissions factor of electricity used by Furong coal mines (tCO₂/MWh)

The parameters in the Equation (2) in the ACM0008 (version 04), including $CONS_{HEAT,PJ}$, CEF_{HEAT} , $CONS_{FossilFuel,PJ}$, $CEF_{FossilFuel,PJ}$ are therefore not considered.

For the electricity emission factor, the same formulae are used as the calculations for baseline emissions. The combined emission factor is applicable to this project activity. Please refer to Appendix 4 for details.

1.2 Combustion emissions from use of captured methane

When the captured methane is burned for heat and in CMM power plant, combustion emissions are released. In addition, if NMHC accounts for more than 1% by volume of the extracted CMM, combustion emission from these gases should also be included.

The project activity includes supplying CMM to power plant, no other technologies such as flaring, catalytic oxidation, etc., are being applied. Although the CMM directly used for heat generation is not included in the project activity, it will be monitored if any CMM destroyed through heat generation occurs in the crediting period. In addition, CMM supplied to gas grid or vehicle use will be monitored too. If the overlap occurs between CMM used for power generation and baseline use of CMM for households and vehicles, it will be used for calculating the project emissions. If total annual CMM volumes are more than enough to cover annual thermal energy and power requirements, no project emissions will be accounted for. Therefore, the formula is expressed as follows:

$$PE_{MD} = (MD_{ELEC} + MD_{HEAT} + MD_{GAS}) \times (CEF_{CH_4} + r \times CEF_{NMHC}) \quad (3)$$

$$r = PC_{NMHC} / PC_{CH_4} \quad (4)$$

where:

MD_{ELEC} : Methane destroyed through power generation (tCH₄)

MD_{HEAT} : Methane destroyed through heat generation (tCH₄)

MD_{GAS}	Methane destroyed after being supplied to gas grid or for vehicle use (tCH ₄)
CEF_{CH_4}	Carbon emission factor for combusted methane (2.75 tCO ₂ /tCH ₄)
CEF_{NMHC}	Carbon emission factor for combusted non methane hydrocarbons (the concentration varies and, therefore, to be obtained through periodical analysis of captured methane) (tCO ₂ /tNMHC)
r	Relative proportion of NMHC compared to methane
Pc_{CH_4}	Concentration (in mass) of methane in extracted gas (%)
Pc_{NMHC}	NMHC concentration (in mass) in extracted gas (%)

The methane that is still vented in the project scenario is not accounted for in the project emissions or in the baseline emissions, since it is vented in both scenarios.

The parameters in the Equation (3) in the ACM0008 (version 04), including MD_{FL} , MD_{OX} are therefore not considered.

The recent test shows that the concentration of NMHC in extracted CMM from Furong coal mines only accounts for 0.016% in volume, which is much lower than 1%. Therefore, combustion emissions from non-methane hydrocarbons are ignored in ex ante emission calculations. When the project has begun operating, the concentration of NMHC will be monitored annually.

Methane destroyed through power generation

$$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC} \quad (5)$$

Where:

MM_{ELEC} : Methane measured sent to power plant (tCH₄)

Eff_{ELEC} : Efficiency of methane destruction in power plant (taken as 99.5% from IPCC)

Methane destroyed through heat generation

$$MD_{HEAT} = MM_{HEAT} \times Eff_{HEAT} \quad (6)$$

Where:

MM_{HEAT} : Methane measured sent to heat generation (tCH₄)

Eff_{HEAT} : Efficiency of methane destruction/oxidation in heat plant (taken as 99.5% from IPCC)

The project activity don't supply CMM for heat generation, so $MD_{HEAT} = 0$, MM_{HEAT} and Eff_{HEAT} are not needed to be monitored.

Methane destroyed after being supplied to gas grid or for vehicle use

$$MD_{GAS} = MM_{GAS} \times Eff_{GAS} \quad (7)$$

Where:

MM_{GAS} : Methane measured supplied to gas grid for vehicle use or heat/power generation off-site (tCH₄)

Eff_{GAS} : Overall efficiency of methane destruction/oxidation through gas grid to various combustion end uses, combining fugitive emissions from the gas grid and combustion efficiency at end user (taken as 98.5% from IPCC)

The project activity don't supply CMM to gas grid for vehicle use or heat/power generation off-site, so $MD_{GAS}=0$, MM_{GAS} and Eff_{GAS} are not needed to be monitored.

1.3 Un-combusted methane from end uses

Not all of the methane used to generate electricity will be combusted: a small amount will escape into the atmosphere. No other technologies such as flaring, catalytic oxidation, heat generation and supply to gas grid etc. other than electricity generation are involved in the project. These emissions are calculated using the following formula:

$$PE_{UM} = GWP_{CH_4} \times MM_{ELEC} \times (1 - Eff_{ELEC}) \quad (8)$$

where:

GWP_{CH_4} : Global Warming Potential of methane (21tCO₂/tCH₄)

The parameters in the Equation (10) in the ACM0008 (version 04), including PE_{flare} , PE_{OX} are therefore not considered.

2. Baseline Emissions

Baseline emissions are given by the following equation:

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y} \quad (9)$$

Where:

BE_y : Baseline emissions in year y (tCO₂e)

$BE_{MD,y}$: Baseline emissions from destruction of methane in the baseline scenario in year y (tCO₂e)

$BE_{MR,y}$: Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO₂e)

$BE_{Use,y}$: Baseline emissions from the production of power and supply to gas grid replaced by the project activity in year y (tCO₂e)

2.1 Methane destruction in the baseline

In the baseline scenario, a small portion of the extracted CMM is destroyed by the supply to the gas grid for end-use by residents and vehicles. Therefore, baseline emissions should be calculated using the following formula:

$$BE_{MD,y} = (CEF_{CH_4} + r \times CEF_{NMHC}) \times CMM_{BL,GAS,y} \quad (10)$$

where:

$CMM_{BL,GAS,y}$: CMM that would have been captured, sent to gas grid and destroyed by combustion end use in the baseline scenario in the year y (tCH₄)

Calculation of the mean annual thermal demand (TH_y) for each year of the crediting period

The following equations are used to calculate baseline thermal demand. Because no daily data is available for estimating the scalar factor d_k , so monthly data is used in the calculation:

$$CMM_{BL,GAS,y} = \sum_{k=1}^{12} TH_{BL,k} \quad (11)$$

where:

$TH_{BL,k}$: Methane used to serve estimated thermal energy demand in the baseline for month k of year y (tCH₄)

The quantity $TH_{BL,k}$ should be determined for each month k of the annual reporting period. For each month k , in a future year y the formula is:

$$TH_{BL,k} = \frac{TH_{BL,y}}{12} \times m_k^{\max} \quad (12)$$

Where:

$TH_{BL,y}$: Projected annual baseline thermal demand for year y (tCH₄)

m_k : Scalar adjustment factor for month k to reflect seasonal variations, such that $\sum m_k = 12$.

m_k^{\max} : Maximum scalar adjustment factor for month k over the 5 years prior to the start of the project activity (i.e., $\sum m_k^{\max} > 12$)

2.2 Methane released into the atmosphere

The methane would have been emitted directly into the atmosphere in the baseline scenario, unless some capture and use activities form part of the baseline.

$$BE_{MR,y} = GWP_{CH_4} \times MM_{ELEC,y} \quad (13)$$

2.3 Emissions from power and heat generation replaced by the project

$$BE_{Use,y} = GEN_y \times CEF_{ELEC} \quad (14)$$

Where:

GEN_y : Electricity generated by project activity in year y (MWh)

The electricity generated by the proposed project will displace the electricity from both the on-site captive plant and the CCPG in the baseline scenario. Because the on-site captive plant was closed as per the government requirement, only considering the electricity from the CCPG is displaced. So the combined CEF_{ELEC} will be CCPG emissions factor, this is conservative. Please see Appendix 4 for details.

2.3.1 CCPG emissions factor

The baseline scenario includes the grid power supply that will be replaced by the project activity; the Emission Factor for displaced electricity is calculated according to the latest version of the *Tool to calculate the emission factor for an electricity system*.

1) Identify the relevant electric power system

The project will be connected to the CCPG, which covers Henan, Hubei, Hunan, Jiangxi, Sichuan and Chongqing provincial grids. Therefore, the CCPG is identified as the relevant electric power system.

2) Select an operating margin (OM) method

According to this Tool, the four following methods can be applied to calculate the Operating Margin emission factor ($EF_{grid,OM,y}$):

- (a) Simple OM, or
- (b) Simple adjusted OM, or
- (c) Dispatch Data Analysis OM, or
- (d) Average OM.

For recent years (2001-2005) where data is available, the low-cost/must-run resources constituted less than 50% of total power generation of the CCPG and the relevant ratios are respectively 36.8%, 35.9%, 34.4%, 38.5% and 38.6% for the year 2001, 2002, 2003, 2004 and 2005³¹. In this case, method (a) Simple OM is adopted for the project.

Under method (a), ex ante option is selected. A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

3) Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂e/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants. It may be calculated:

- Based on data on fuel consumption and net electricity generation of each power plant/unit (Option A), or
- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit (Option B), or
- Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option C).

The project adopts Option C for the following reasons:

- a) The necessary data for option A and option B is not available;
- b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources;
- c) The quantity of electricity supplied to the grid by nuclear and renewable sources is known.

Where Option C is used, the simple OM emission factor is calculated as follows

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (15)$$

Where:

$EF_{grid,OMsimple,y}$: Simple operating margin CO₂ emission factor in year y (tCO₂/MWh).

³¹ China Electric Power Yearbook (2002~2006)

- $FC_{i,y}$: Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit); Using country specific data from China Energy Statistical Yearbook 2004~2006.
- $NCV_{i,y}$: Net calorific value (energy content) of fuel i in year y (GJ/ mass or volume unit); Using country specific data from China Energy Statistical Yearbook 2006.
- $EF_{CO_2,i,y}$: CO_2 emission factor of fossil fuel type i in year y (tCO₂/GJ); Using 2006 IPCC Guidelines for National Greenhouse Gas Inventories for default values.
- EG_y : Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh).
- i : All fossil fuel types combusted in power sources in the project electricity system in year y .
- y : Three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation.

4) Identify the cohort of power units to be included in the build margin (BM)

The sample group of power units m used to calculate the build margin consists of either:

- The set of five power units that have been built most recently, or
- 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.

Project participants should use the set of power units that comprises the larger annual generation.

According to the *Tool to calculate the emission factor for an electricity system*, in terms of vintage of data, two options can be used. Here we choose Option 1, ex-ante for this project. This includes 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.

5) Calculate the build margin emission factor

5) Calculate the build margin emission factor

The build margin emission factor is the generation-weighted average emission factor (tCO₂e/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{BL,m,y}}{\sum_m EG_{m,y}} \quad (16)$$

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).

$EF_{BL,m,y}$: 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.

In China, data on either the five power plants that have been built most recently or the power plants capacity additions in the electricity system that comprise 20% of the system generation are classified as ‘business confidential’ and are not publicly available. Therefore, the EB accepted the following deviations³².

- Use of capacity additions during last 1~3 years for estimating the build margin emission factor for grid electricity.
- Use of weights estimated using installed capacity in place of annual electricity generation.

To estimate the build margin (BM), the EB also suggests using the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy, for each fuel type in estimating the fuel consumption.

According to the data published by the Chinese DNA³³, the subcritical generating system with a capacity of 600MW represents the most advanced technology commercially used in domestic coal-fired plants. The combined cycle technology with a capacity of 200MW stands for the most advanced technology used in thermal plants fired by gas or oil in China. Therefore, the BM emission factor of the CCPG is calculated using the data from 2002~2005, based on the above best technology commercially available at the time of this PDD submission.

The calculation procedures are shown below.

$$\lambda_{coal} = \frac{\sum_{i \in COAL, y} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,y} F_{i,j,y} \times COEF_{i,j}} \quad (17)$$

$$\lambda_{oil} = \frac{\sum_{i \in OIL, y} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,y} F_{i,j,y} \times COEF_{i,j}} \quad (18)$$

$$\lambda_{gas} = \frac{\sum_{i \in GAS, y} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,y} F_{i,j,y} \times COEF_{i,j}} \quad (19)$$

Where:

$\lambda_{Coal,y}$, $\lambda_{Oil,y}$ and $\lambda_{Gas,y}$ represent the proportion of CO₂ emission of the solid, liquid and gas fuel in the total emission, respectively.

$F_{i,j,y}$ is the amount of fuel i consumed by relevant power sources j in year y (mass or volume).

$COEF_{i,j,y}$ is the CO₂ emission coefficient of fuel i (tCO₂ /mass or volume), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year y . COAL, OIL and GAS are the mark aggregation of solid fuel, liquid fuel and gas fuel, respectively.

$$EF_{thermal} = \lambda_{coal} \times EF_{coal,Adv} + \lambda_{oil} \times EF_{oil,Adv} + \lambda_{gas} \times EF_{gas,Adv} \quad (20)$$

³² http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ

³³ <http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=2184>

$EF_{thermal}$ is the emission factor of thermal power plant. $EF_{coal,Adv}$, $EF_{oil,Adv}$ and $EF_{gas,Adv}$ represent the CO₂ emission factor of the most advanced technology commercially used in coal-, oil- and gas-fired plants in China, respectively.

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (21)$$

Where:

CAP_{Total} : Total newly capacity addition on different power sources connected to the CCPG.

$CAP_{Thermal}$: Newly capacity addition on thermal power sources connected to the CCPG.

6) Calculate the combined margin emission factor

$EF_{grid,CM,y}$ as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$) is expressed as:

$$EF_{ELEC,y} = EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y} \quad (22)$$

Where:

w_{OM} : Weighting of operating margin emission factor (%);

w_{BM} : Weighting of build margin emission factor (%)

Please refer to Appendix 4 for details.

3. Leakage

The formula for leakage is given as follows:

$$LE_y = LE_{d,y} + LE_{o,y} \quad (25)$$

Where:

LE_y Leakage emissions in year y (tCO₂e)

$LE_{d,y}$ Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y (tCO₂e)

$LE_{o,y}$ Leakage emissions due to other uncertainties in year y (tCO₂e)

3.1 Displacement of baseline thermal energy uses

According to the thermal demand analysis as stated in Appendix 4, after the project activity is implemented, the CMM which is used for thermal energy in the baseline scenario won't be used for power generation in the project activity. No overlap will occur. Therefore this leakage can be ignored.

3.2 CBM drainage from outside the de-stressed zone

As mentioned above, no CBM drainage is involved in the proposed project. So that no leakage would occur.

3.3 Impact of CDM project activity on coal production

In the case of the proposed project activity at Furong coal mines, drainage and extraction systems have been functioning since 2001 and present in the baseline scenario. So this leakage can be ignored.

3.4 Impact of CDM project activity on coal prices and market dynamics

While this impact is theoretically possible, reliable scientific information is not currently available to assess this risk and to determine if the phenomenon would be negligible or not. Moreover, it is difficult to assess ex-ante the contribution of any particular project given the dynamic nature of local and global coal markets. Therefore, the leakage due to the impact of CDM project activity on coal prices and market dynamics is not taken into account.

More than 400 kilo tons of waste coal are produced by the Furong coalmine every year and less than half of it is used in the captive power plant. The unused waste coal is dumped. After the implementation of the project, the waste coal will continue to be dumped. No great changes and impacts occurs.

4. Emission Reductions

The emission reduction ER_y by the project activity during a given year y is the deference between the baseline emissions (BE_y) and project emissions (PE_y) and leakage as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (26)$$

Where:

ER_y : emissions reductions of the project activity during the year y (tCO₂e)

BE_y : baseline emissions during the year y (tCO₂e)

PE_y : project emissions during the year y (tCO₂e)

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	$TH_{BL,y}$
Unit	tCH ₄
Description	Projected annual baseline CMM demand for thermal energy uses
Source of data	Calculated ex-ante
Value(s) applied	See Appendix 4, Table 2.1, Table 2.2, Table 2.3 and Table 2.4
Choice of data or Measurement methods and procedures	According to the statistics over the past 5 years
Purpose of data	-
Additional comment	-

Data / Parameter	m_k^{\max}
Unit	-



Description	Scalar adjustment factor for month k, based on the seasonal load shape ($\sum m_k^{\max} > 12$)
Source of data	Calculated
Value(s) applied	See Appendix 4, Table 2.1 and Table 2.2
Choice of data or Measurement methods and procedures	Ex ante calculated according to the statistics over the past 5 years
Purpose of data	-
Additional comment	-

Data / Parameter	$CMM_{BL,y}$
Unit	tCH ₄
Description	Baseline extracted CMM for end uses
Source of data	Recorded data provided by the project owner
Value(s) applied	See Appendix 4, Table 2.1 and Table 2.2
Choice of data or Measurement methods and procedures	Statistics over the past 5 years (2003~2007)
Purpose of data	-
Additional comment	-

Data / Parameter	Eff_{ELEC}
Unit	-
Description	Efficiency of methane destruction in power plant
Source of data	IPCC
Value(s) applied	99.5%
Choice of data or Measurement methods and procedures	To be updated according to the latest information from IPCC.
Purpose of data	-
Additional comment	-

Data / Parameter	GWP_{CH_4}
Unit	tCO ₂ e/tCH ₄
Description	Global warming potential of methane
Source of data	IPCC
Value(s) applied	21



Choice of data or Measurement methods and procedures	To be updated according to the latest information from IPCC.
Purpose of data	-
Additional comment	-

Data / Parameter	CEF_{CH_4}
Unit	tCO ₂ e/tCH ₄
Description	Carbon emission factor for combusted methane
Source of data	Methodology ACM0008 (ver.04)
Value(s) applied	2.75
Choice of data or Measurement methods and procedures	To be updated according to the latest version of ACM0008.
Purpose of data	-
Additional comment	-

Data / Parameter	D_{CH_4}
Unit	tCH ₄ /m ³
Description	Density of methane under normal conditions (20°C and 101.325kPa) in the exhaust gases
Source of data	IPCC default value
Value(s) applied	0.00067
Choice of data or Measurement methods and procedures	
Purpose of data	Used to calculate the baseline emission and the project emission from methane delivered to the power plant.
Additional comment	-

Data / Parameter	$FC_{i,y}$
Unit	mass or volume unit
Description	Amount of fossil fuel type i consumed by power plants connected to the CCPG in year y
Source of data	<i>China Energy Statistical Yearbooks, 2005-2007</i>
Value(s) applied	See Appendix 4, Table 3.1.1, Table 3.1.3, Table 3.1.5 and Table 3.2.2



Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China Energy Statistical Yearbook</i> , satisfying the requirement of <i>Tool to calculate the emission factor for an electricity system</i> .
Purpose of data	-
Additional comment	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

Data / Parameter	NCV_i
Unit	GJ/mass or volume unit
Description	net calorific value (energy content) of fossil fuel type i in year y
Source of data	China Energy Statistical Yearbook
Value(s) applied	see Appendix 4 for details
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China Energy Statistical Yearbook</i> , satisfying the requirement of <i>Tool to calculate the emission factor for an electricity system</i> .
Purpose of data	-
Additional comment	-

Data / Parameter	$EF_{CO_2,i,y}$
Unit	tCO ₂ /GJ
Description	CO ₂ emission factor of fossil fuel type i in year y
Source of data	Default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Appendix 4, Table 3.1.1, Table 3.1.3, Table 3.1.5 and Table 3.2.2
Choice of data or Measurement methods and procedures	Regional or national average default values are unavailable, so IPCC default values at the lower limit of the uncertainty at a 95% confidence interval are used, satisfying the requirement of latest version of <i>Tool to calculate the emission factor for an electricity system</i> .
Purpose of data	-
Additional comment	-

Data / Parameter	EG_y
Unit	MWh/year
Description	Electricity generation of each power source/plant connected to the CCPG
Source of data	China Electric Power Yearbook
Value(s) applied	See Appendix 4, Table 3.1.2, Table 3.1.4, Table 3.1.6 and Table 3.1.7
Choice of data or Measurement methods and procedures	The data obtained from the official publication <i>China Power Electric Yearbook</i> , satisfying the requirement of <i>Tool to calculate the emission factor for an electricity system</i> .

Purpose of data	-
Additional comment	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation.

B.6.3. Ex ante calculation of emission reductions

>>

1. Project Emissions

The project emissions are calculated based on the formula (1)~(6) in section B.6.1.

1.1 Combustion emissions from additional energy required for CMM capture and use

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC}$$

Furong Group uses electricity from the CCPG, so that the combined CEF_{ELEC} , 0.9745tCO₂e/MWh (See Appendix 4 for details), will be applied as the same as that of the baseline emission factor. Please refer to Appendix 4 for details on the calculation of the combined emission factor.

Consequently, the result of PE_{ME} is shown in the table below.

Table B.6.3-1 Project emissions from additional energy use

Years	$CONS_{ELEC,PJ}$ (MWh)	PE_{ME} (tCO ₂ e)
	A	B=A * CEF_{ELEC}
2009 (Sept. 1 st – Dec. 31 st)	472	460
2010	1,608	1,567
2011	1,880	1,832
2012	1,910	1,861
2013	2,021	1,969
2014	2,091	2,038
2015	2,222	2,166
2016	2,283	2,224
2017	2,293	2,234
2018	2,293	2,234
2019 (Jan. 1 st – Aug. 31 st)	1,529	1,490
Total	20,601	20,076

1.2 Combustion emissions from use of captured methane

When the captured methane is burned in a CMM power plant, combustion emissions are released. The recent test shows that the concentration of NMHC in extracted CMM from Furong coal mines only accounts for 0.016% in volume, which is much lower than 1%. Therefore, the combustion emission from NMHC is ignored in ex ante emission calculations.

$$PE_{MD} = MD_{ELEC} \times CEF_{CH4}$$

$$MD_{ELEC} = MM_{ELEC} \times Eff_{ELEC}$$

The IPCC default value of Eff_{ELEC} , 99.5%, is applied to the proposed project. With CEF_{CH_4} value of 2.75 tCO₂/tCH₄, PE_{MD} is calculated and shown in the table below.

Table B.6.3-2 Combustion emissions from use of captured methane

Years	MM_{ELEC} (tCH ₄)	MD_{ELEC} (tCH ₄)	PE_{MD} (tCO ₂ e)
	C	$D=C * Eff_{ELEC}$	$E=D * CEF_{CH_4}$
2009 (Sept. 1 st – Dec. 31 st)	2,278	2,267	6,233
2010	7,504	7,466	20,533
2011	8,978	8,933	24,566
2012	8,978	8,933	24,566
2013	9,380	9,333	25,666
2014	9,715	9,666	26,583
2015	10,385	10,333	28,416
2016	10,720	10,666	29,333
2017	10,720	10,666	29,333
2018	10,720	10,666	29,333
2019 (Jan. 1 st – Aug. 31 st)	7,147	7,111	19,555
Total	96,525	96,042	264,116

1.3 Un-combusted methane from end uses

No all of the methane used to generate electricity will be combusted, and a small amount will escape into the atmosphere.

$$PE_{UM} = GWP_{CH_4} \times MM_{ELEC} \times (1 - Eff_{ELEC})$$

Table B.6.3-3 Un-combusted methane from end uses

Year	MM_{ELEC} (tCH ₄)	Total CH ₄ emissions (tCH ₄)	PE_{UM} (tCO ₂ e)
	C	$F=C*(1 - Eff_{ELEC})$	$G=F*GWP_{CH_4}$
2009 (Sept. 1 st – Dec.31 st)	2,278	11	239
2010	7,504	38	788
2011	8,978	45	943
2012	8,978	45	943
2013	9,380	47	985
2014	9,715	49	1,020
2015	10,385	52	1,090
2016	10,720	54	1,126
2017	10,720	54	1,126
2018	10,720	54	1,126
2019 (Jan. 1 st – Aug. 31 st)	7,147	36	750
Total	96,525	483	10,135

Total Project Emissions

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM}$$

Table B.6.3-4 Project emissions

Year	PE_{ME} (tCO ₂ e)	PE_{MD} (tCO ₂ e)	PE_{UM} (tCO ₂ e)	PE_y (tCO ₂ e)
	B	E	G	H=B+E+G
2009 (Sept. 1 st – Dec. 31 st)	460	6,233	239	6,933
2010	1,567	20,533	788	22,888
2011	1,832	24,566	943	27,341
2012	1,861	24,566	943	27,370
2013	1,969	25,666	985	28,620
2014	2,038	26,583	1,020	29,641
2015	2,166	28,416	1,090	31,672
2016	2,224	29,333	1,126	32,683
2017	2,234	29,333	1,126	32,693
2018	2,234	29,333	1,126	32,693
2019 (Jan. 1 st – Aug. 31 st)	1,490	19,555	750	21,795
Total	20,076	264,116	10,135	294,327

2. Baseline Emissions

The baseline emissions are calculated based on the formula (7)~(22) in section B.6.1.

2.1 Methane destruction in the baseline

In the baseline scenario, a small portion of the extracted CMM is utilized by residential users through the gas grid. The thermal demand in the baseline scenario is calculated following the formula below.

$$CMM_{BL,GAS,y} = \sum_{k=1}^{12} TH_{BL,k}$$

$$TH_{BL,k} = \frac{TH_{BL,y}}{12} \times m_k^{\max}$$

According to the thermal demand analysis (See Appendix 4, Table 2.1-2.4), the maximum thermal demand in the baseline scenario ($TH_{BL,y}$) calculated ex ante are 3.89 million m³CH₄ for Baijiao, Shanmushu and Xunchang coal mines, and 0.83 million m³CH₄ for Gongquan coal mine. According to this analysis, the overlap between CMM usage in the baseline and power generation in the project activity would not occur. Therefore, $BE_{MD,y}$ is assumed to be zero.

2.2 Methane released into the atmosphere

$$BE_{MR,y} = GWP_{CH_4} \times MM_{ELEC,y}$$

Table B.6.3-5 Methane released into the atmosphere

Year	$MM_{ELEC,y}$ (tCH ₄)	$BE_{MR,y}$ (tCO _{2e})
	C	I=C* GWP_{CH_4}
2009 (Sept. 1 st – Dec. 31 st)	2,278	47,838
2010	7,504	157,584
2011	8,978	188,538
2012	8,978	188,538
2013	9,380	196,980
2014	9,715	204,015
2015	10,385	218,085
2016	10,720	225,120
2017	10,720	225,120
2018	10,720	225,120
2019 (Jan. 1 st – Aug. 31 st)	7,147	150,080
Total	96,525	2,027,018

2.3 Emissions from power and heat generation replaced by the project

$$BE_{Use,y} = GEN_y \times CEF_{ELEC}$$

The combined emission factor, CEF_{ELEC} is 0.9745 tCO_{2e}/MWh.

Table B.6.3-6 Emissions from electricity displaced by the project

Year	GEN_y (MWh)	$BE_{Use,y}$ (tCO _{2e})
	J	K=J* CEF_{ELEC}
2009 (Sept. 1 st – Dec. 31 st)	10,200	9,940
2010	33,600	32,743
2011	40,200	39,175
2012	40,200	39,175
2013	42,000	40,929
2014	43,500	42,391
2015	46,500	45,314
2016	48,000	46,776
2017	48,000	46,776
2018	48,000	46,776
2019 (Jan. 1 st – Aug. 31 st)	32,000	31,184
Total	432,200	421,179

Total Baseline Emissions

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$$

Table B.6.3-7 Baseline emissions of Furong coal mines

Year	$BE_{MD,y}$ (tCO ₂ e)	$BE_{MR,y}$ (tCO ₂ e)	$BE_{Use,y}$ (tCO ₂ e)	BE_y (tCO ₂ e)
	L	I	K	M=L+I+K
2009 (Sept. 1 st – Dec. 31 st)	0	47,838	9,940	57,778
2010	0	157,584	32,743	190,327
2011	0	188,538	39,175	227,713
2012	0	188,538	39,175	227,713
2013	0	196,980	40,929	237,909
2014	0	204,015	42,391	246,406
2015	0	218,085	45,314	263,399
2016	0	225,120	46,776	271,896
2017	0	225,120	46,776	271,896
2018	0	225,120	46,776	271,896
2019 (Jan. 1 st – Aug. 31 st)	0	150,080	31,184	181,264
Total	0	2,027,018	421,179	2,448,197

3. Leakage

The leakage of the project is zero.

B.6.4. Summary of ex ante estimates of emission reductions

Based on the calculation in section B.6.3, the emission reductions to be achieved by the proposed project are shown in the table below.

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
2009 (Sept. 1 st – Dec. 31 st)	57,778	6,933	0	50,845
2010	190,327	22,888	0	167,439
2011	227,713	27,341	0	200,372
2012	227,713	27,370	0	200,343
2013	237,909	28,620	0	209,289
2014	246,406	29,641	0	216,765
2015	263,399	31,672	0	231,727
2016	271,896	32,683	0	239,213
2017	271,896	32,693	0	239,203
2018	271,896	32,693	0	239,203
2019 (Jan. 1 st – Aug. 31 st)	181,264	21,795	0	159,469
Total	2,448,197	294,327	0	2,153,870
Total number of crediting years	10			
Annual average over the crediting period	244,820	29,433	0	215,387

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter	$CONS_{ELEC,PJ}$
Unit	MWh
Description	Additional electric power consumption by the project in year y
Source of data	On-site continuous measurements by electricity meters
Value(s) applied	Data from Project Feasibility Study Report Refer to Section B.6.3, Table B.6.3-1
Measurement methods and procedures	Continuously monitored by on-site electricity meters. The data will be daily recorded.
Monitoring frequency	Continuously monitored
QA/QC procedures	Electricity meters will be maintained and calibrated for accuracy (0.5) according to manufacturer's specifications and relevant national or sectoral regulations. The calibration will be carried out annually by an independent certified party.
Purpose of data	-
Additional comment	-

Data / Parameter	MM_{ELEC}
Unit	tCH ₄
Description	Methane sent to CMM power plant(minus the vented methane)
Source of data	Automatically calculated by the installed monitoring system with monitored data by gas flow meters (installed at the inlet pipeline and the pipeline emergency vent valve located) and methane concentration meters (installed at the inlet pipeline).
Value(s) applied	Data from Project Feasibility Study Report Refer to Section B.6.3, Table B.6.3-2
Measurement methods and procedures	Continuously monitored gas flow, temperature and pressure by gas flow meters, and methane concentration by methane concentration meters. MM_{ELEC} will be calculated as the input methane minus the vented methane. The monitored data will be daily recorded.
Monitoring frequency	Continuously monitored
QA/QC procedures	Monitoring instruments will be maintained and calibrated according to manufacturer's specifications and relevant national or sectoral regulations. The calibration will be carried out by an independent certified party annually.
Purpose of data	-
Additional comment	-

Data / Parameter	PC_{CH4}
Unit	%



Description	Concentration (in volume) of methane in extracted gas (%), measured on wet basis.
Source of data	Measured by the on-site infrared methane concentration meters, optical
Value(s) applied	33%
Measurement methods and procedures	Methane concentration can be measured real-time by infrared methane concentration meters mounted on the gas pipelines using nondispersive infrared gas analysis technique. The monitored data will be recorded daily. The continuously monitored methane concentration meter with accuracy of 0.5 will be installed.
Monitoring frequency	Continuously monitored
QA/QC procedures	Monitoring instruments will be maintained and calibrated according to manufacturer's specifications. The calibration will be carried out by an independent certified party annually.
Purpose of data	-
Additional comment	-

Data / Parameter	$P_{C_{NMHC}}$
Unit	%
Description	Concentration (in volume) of NMHC in extracted gas
Source of data	Analyzed by Sichuan Quality Supervision and Inspection Institute for Gaseous Product, a nationally certified entity. Measured by hydrogen flame ionization detector using gas phase chromatography, optical
Value(s) applied	0.016%
Measurement methods and procedures	Annual qualified lab analysis with hydrogen flame ionization detector using gas phase chromatography. The lab must be qualified and certified by relevant authorities according to local or national regulations.
Monitoring frequency	at least once a year
QA/QC procedures	The test will be carried out at least once a year in accordance with national standards.
Purpose of data	-
Additional comment	-

Data / Parameter	CEF_{NMHC}
Unit	-
Description	Carbon emission factor for combusted non methane hydrocarbons (various)
Source of data	Will be analyzed by the same qualified institute for $P_{C_{NMHC}}$.
Value(s) applied	To be monitored.
Measurement methods and procedures	Analyzed by the same institute for $P_{C_{NMHC}}$ at the same frequency. The lab must be qualified and certified by relevant authorities according to local or national regulations.
Monitoring frequency	at least once a year
QA/QC procedures	The test will be carried out at least once a year in accordance with national standards.
Purpose of data	-

Additional comment	-
Data / Parameter	GEN_y
Unit	MWh
Description	Electricity generated by gas generators
Source of data	Continuous on-site measurement by electricity meters
Value(s) applied	Data from the Project Feasibility Study Report Refer to Section B.6.3, Table B.6.3-6
Measurement methods and procedures	Electricity meters will be installed at gas power plants to measure the electricity delivered to the on-site electric grid for Furong self-use.
Monitoring frequency	Continuously monitored
QA/QC procedures	Monitoring instruments will be maintained and calibrated for accuracy (0.5S) according to manufacturer's specifications. The calibration will be carried out annually by an independent certified party.
Purpose of data	-
Additional comment	-

B.7.2. Sampling plan

>>

Not applicable, therefore no need for further statement.

B.7.3. Other elements of monitoring plan

>>

The objective of the monitoring plan is to assure the complete, consistent, clear, and accurate monitoring and calculation of the project emission reductions during the entire crediting period. The project owner is responsible for the implementation of the monitoring plan which includes data collection and storage, monitoring instrument calibration, and compiling monitoring report, etc. In addition to this monitoring plan the project owner also prepared Criteria on Safety Operation of Power Station, Criteria on Gas Generator Operation, etc. as the supplementary documents to make sure the full and good performance of the monitoring plan.

1. Monitoring Organization

The monitoring plan will be carried out by a CDM team which consists of the Furong CDM director, general monitoring manager, regional monitoring managers, and monitoring staff. The role and responsibility of the CDM team is to collect, check and archive the data, to maintain and calibrate monitoring instruments, and to coordinate with other departments of the Furong Group, DOE, DNA, CER buyer and CDM consultant etc.

The structure of the CDM team is shown as follows.

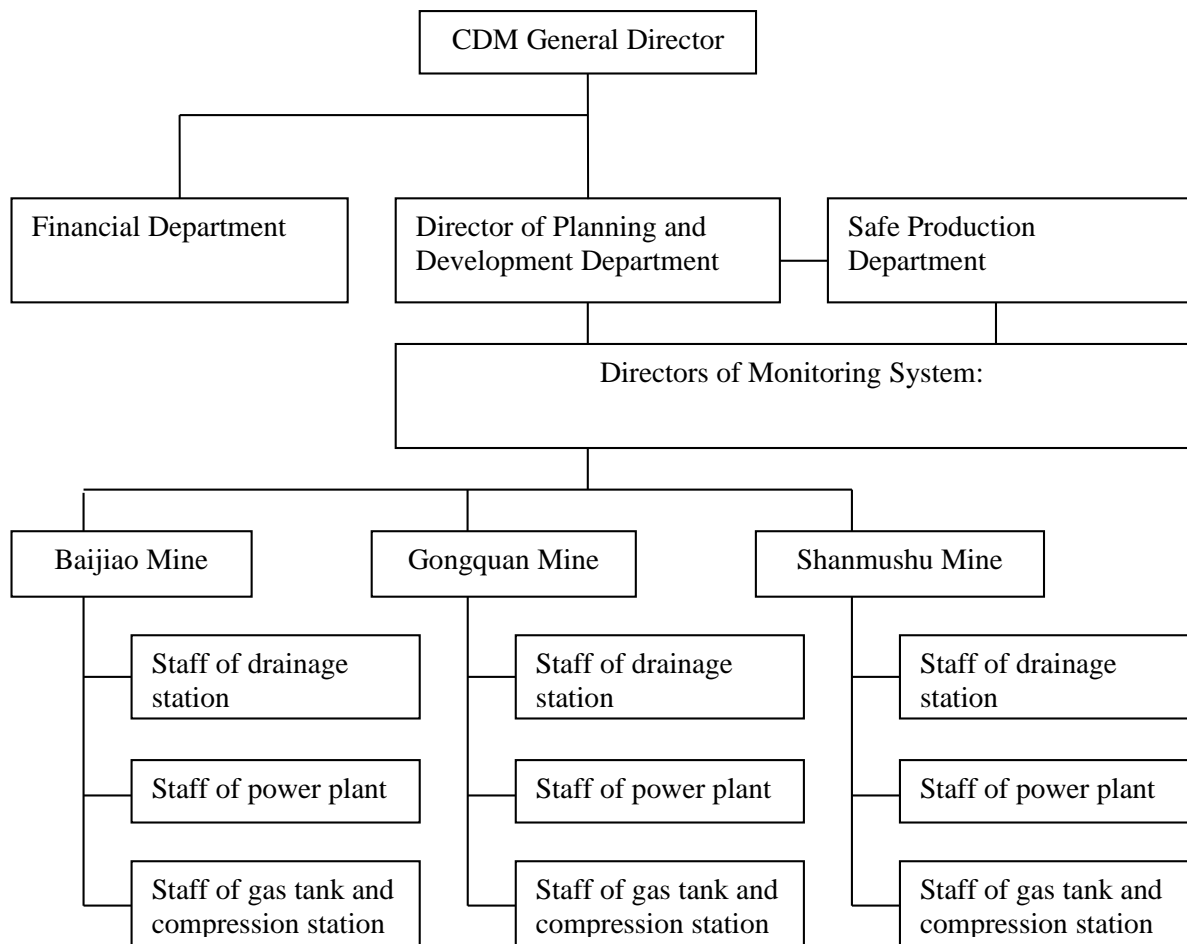


Fig. 7.3-1 Furong Group CDM Team

One competent CDM General Director, who will be designated by the project owner, has the overall responsibility for the monitoring plan and to supervise the collection of data. The CDM General Director designed Director of Planning and Development Department as the leader of monitoring activity. During the crediting period, CDM General Director will be the main contact person for the verifiers, the DNA, as well as relevant local authorities, etc., and Director of Planning and Development Department will responsible the monitoring management.

All other monitoring managers and staff have clearly defined roles and responsibilities to ensure the accurate implementation of the monitoring plan, including:

(1) Directors of Monitoring System

- Provide training for the monitoring staff to ensure high quality of monitoring activities.
- Calculate CERs using collected data.
- Compiling periodical monitoring reports for verification and certification of CERs.
- Reporting to the Director of Planning and Development Department with any issues related to project's performance.

(2) Monitoring staff

- Collect and store monitoring data in a safe manner.
- Maintain monitoring system and equipment under their normal operating conditions.
- Calibrate monitoring devices and instruments in accordance with the manufacturer's specifications and national or sectoral standards and requirements.



The project CDM team will meet at least once a month to discuss the performance of the CDM project. In case of non-conformance, each team member can call in to arrange a CDM project team meeting.

2. Training

For all employees involved in the CDM project, a Training Plan will be created. The training plan provides an overview of the type of training that is necessary and the time schedule of the training. The CDM managers should ensure that for the crediting period, only trained and skilled people work on the CDM project. The training content depends on the trainees' background and how they are involved in the collection/utilization process and the CDM process. Depending on their task, they will be given a comprehensive knowledge of the general and technical aspects of the project. The equipment supplier will provide instructions and training for the personnel on installation, operation, maintenance and calibration of the monitoring equipment.

3. Monitoring Data

The data that needs to be monitored during the crediting period include the additional energy consumption of the project, flow rate of CMM drained, flow rate of CMM sent to gas generators, electricity generation by the project, electricity generation and delivery by on-site waste coal captive power plant, electricity purchased from CCPG of Furong coal mines, concentration of methane and NMHC in extracted gas and all data related to determining the emission factor of the electricity system that the project will be connected to. Please refer to section B.7.1 for details.

4. Monitoring instruments, installation and calibration

The Furong Group has commissioned the Chongqing branch of China Coal Research Institute (CQCCRI) to make a Technical Scheme of Monitoring System for the proposed project, which defines the design principles, system functions and technical standards to be adopted.

The main instruments and devices of the monitoring system include:

(1) On gas delivery pipelines

- ◆ Methane concentration meter and gas flow meters (adjusted by temperature and pressure)
- ◆ Display cabinet for gas drainage (continuously displaying the parameters of pressure, temperature, methane concentration and gas flow rate)

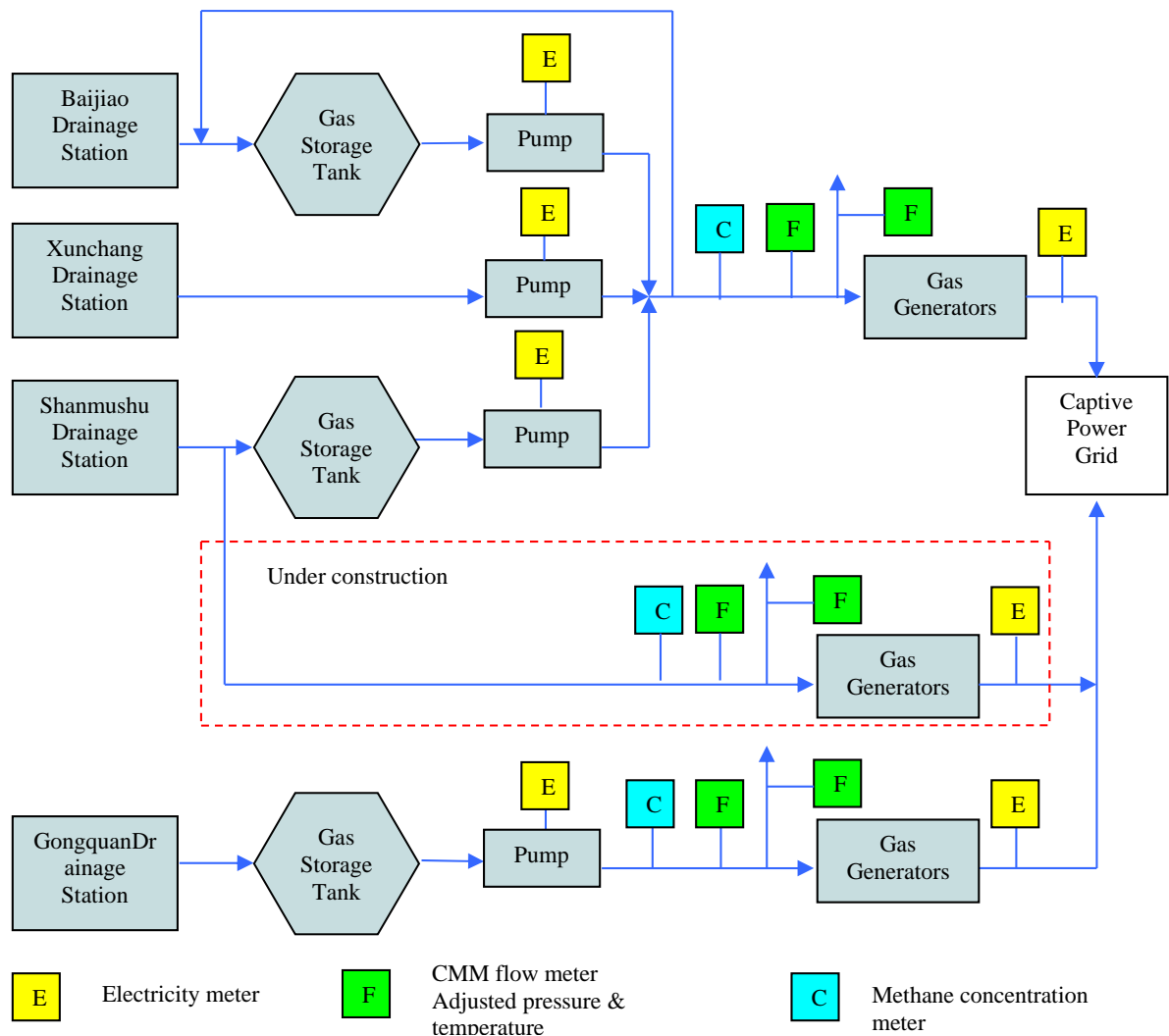
(2) In gas power plants (including Baijiao plant, Gongquan plant and Shanmushu plant)

- ◆ Methane concentration meter and gas flow meters (adjusted by temperature and pressure) installed at the inlet of the power plant to monitor the gas sent to the generators;
- ◆ Display cabinet installed indoors; in addition, methane concentration meter installed to monitor indoor methane content to ensure the safety operation of the power plant;
- ◆ Gas flow meters (adjusted by temperature and pressure) installed at the pipeline emergency vent valve located which is in front of the generators of the power plants;
- ◆ Electricity meters installed in accordance with the generator manufacturer's requirements.

(3) In central control room

- ◆ In the control room, all data relating to the project activity will be monitored continuously and stored in a computer automatically. All stored data can be easily printed out to make a hard copy.

The main monitoring instruments and installation points are shown in the figure below.



* Xunchang coal mine stopped operation since 25/04/2010

Fig. 7.3-2 Monitoring Instruments and Installation³⁴

CMM flow meters, methane concentration meters (temperature and pressure can be monitored simultaneously) and a modern display cabinet will be supplied by CQCCRI, which is responsible for the instrument installation and will provide the training for the operation and maintenance of these instruments by the operating staff.

The accuracy and applicable standards of these meters are shown in the table below.

Table B.7.3.-1 Main Monitoring Instruments

Symbol	Instrument	Function	Applied Standards	Model	Accuracy
C	Methane concentration meter	Measuring CH ₄ concentration of the drained CMM sent to the gas generators	AQ 6211-2008 JJG 678-2007	GJG100H(B) Infra red	0.5

³⁴ Because MM_{GAS} and MM_{HEAT} are not need to be monitored, the Fig. 7.3-2 Monitoring Instruments and Installation is simplified and only used for monitoring the emission reductions, and the details please refer to Appendix 5.



F	Gas flow meter	Measuring the CMM volume sent to the gas generators	JJG 640-1994	GLY series	0.5
E	Electricity meter	Measuring electricity delivered by the project	JJG 307-2006 JJG 596-1999	N/A	0.5

5. Quality control and quality assurance procedures

The project CDM team will establish a quality management system, which ensures the quality and accuracy of the measured data, including corrective actions in case of non-conformity. The quality management system will include:

(1) Data collection and handling

The parameters including CMM flow, methane concentration, temperature, pressure, and electricity generated and delivered to the Furong captive power grid, will be continuously measured and daily recorded.

The other parameters, such as NMHC in the CMM will be measured annually by a qualified institute independent of the Furong Group in terms of personnel and financial management. Effective data will be recorded every day and archived in electronic spreadsheet at the end of each month. The electronic files will be stored on hard disk or other media. In addition, a hard copy printout will be archived in a designated documents storage room.

(2) Reporting

The monitoring staff will report to the Directors of Monitoring System about the daily monitored data and the project performance every day.

Directors of Monitoring System will report the monthly data on the project's CERs monitoring to Director of Planning and Development Department.

The Director of Planning and Development Department will report to CDM General Director accumulated emission reductions generated. CDM General Director will decide when the verification will be conducted.

(3) Equipment calibration and maintenance

Flow meters, methane concentration meters, and other critical CDM project equipment will be subject to regular maintenance and testing according to technical specifications from the manufacturers to ensure accuracy and good performance.

Calibration of equipment will be conducted periodically according to their technical specifications. Electricity meter will be subject to annual checkups and calibration for accuracy with the *Electromechanical Meters for Measuring Alternating-current Electrical Energy (JJG 307-2006)* and *Verification Regulation of Electrical Energy Meters with Electronics (JJG 596-1999)*.

(4) Internal inspection



The monitoring plan including all defined procedures, reports, data and personnel will be regularly inspected internally to ensure the monitoring activities and to minimize the uncertainties of emission reductions. Particularly in the beginning of the crediting period, these internal inspections should take place, to guarantee the monitoring procedures.

Following the main criteria such as use and strict adherence to recognized standard methods, use of standard reporting forms including process measures as well as emission data, etc., to guarantee the data reliable and accurate.

(5) Site audits

CDM team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the monitoring plan.

(6) Corrective actions

Actions to correct deviations from the monitoring plan will be taken as these deviations are observed either by the operator or during internal audits.

Except for periodic meetings, additional technical meetings among the CDM team and the MB of the Furong group will be held, if necessary, in order to define the corrective actions to be carried out.

Any corrective actions taken will be documented in case of equipment or systems malfunction or breakdown.

(7) Document storage

Hard copy documentation such as paper maps, diagrams and environmental assessment will be collated in a documents storage room together with the monitoring plan. In addition, the following documents will be stored.

- ◆ List of monitoring equipment (flow meter, methane concentration meter, electricity meter, etc.), including their numbers, names, manufacturers, specifications, use requirements, etc.
- ◆ Calibration lists and reports, including equipment or parts calibrated, date, method and procedures of calibration, their precision after these procedures, personnel, devices needed, etc.
- ◆ Maintenance lists and reports, including equipment or parts maintained, date, method and procedures of maintenance, their performance after these procedures, personnel, devices needed, etc.
- ◆ Operation manual of the project
- ◆ Meeting minutes of CDM project team meetings
- ◆ Non-conformance reports
- ◆ Worksheets: monthly and yearly
- ◆ Training programme
- ◆ Internal audit/inspection reports, including personnel, time, findings, corrective actions, follow-up inspections
- ◆ Annual monitoring review

All hard copy information will be stored by the project owner with at least one copy. All data records will be kept for two years after the end of the crediting period.

(8) Emergency preparedness for unintended emissions



In case of equipment malfunction or breakdown, timely corrective actions will be carried out to minimize the unintended emissions. Working staff will be trained to react and cope with emergent situations appropriately. They will effectively judge the abnormal situation and make prompt responses such as fixing malfunctioned equipment, recording and reporting to the CDM director, managers and the MB in time. The plant operator must frequently inspect, at least once a week, all methane-containing parts of the plant.

All findings have to be documented. In cases leakages are found, the leakages must be reduced and repaired according to the plant operation manual and the manufacturers' recommendations.

6. Verification of monitoring results

The responsibilities for verification of the project are as follows:

- ◆ The Furong CDM team will make the arrangements for the verification and will prepare for the audit and verification process to the best of their abilities.
- ◆ The Furong CDM team will facilitate the verification by providing the DOE with all required information, before, during and in the event of queries, after the verification.
- ◆ The Furong CDM team will cooperate fully with the DOE and instruct its staff and management to be available for interviews and respond honestly to all questions from the DOE.
- ◆ The periodic verification will be carried out annually or in another realistic interval which will be decided after the project registration.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

30/07/2007

(date when the generator procurement contract was signed)

C.1.2. Expected operational lifetime of project activity

>>

20 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

The project chose the fixed crediting period.

C.2.2. Start date of crediting period

>>

01/09/2009 or registration date, whichever comes later.

C.2.3. Length of crediting period

>>

10 years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

The project owner commissioned the Environmental Science and Technology School of Southwest Jiaotong University to perform an environmental impact assessment of the proposed project. In the



assessment, the proposed project has been considered to have few potential impacts on air, water quality, sound environment, etc. The Environmental Impact Assessment (EIA) Report was approved by Yibin Environmental Protection Bureau (EPB) on September 10th 2007.

In addition, the EIA report on the newly built 20,000 m³ gas tank was completed by Chongqing Dehe Environmental Engineering Co., Ltd. in July 2007, and approved by Yibin EPB on August 29th 2007.

The results of this evaluation are summarized as follows.

Air Pollution

During the project construction period, the main air pollutant is particulates (dust) which are released from construction activities and transportation and the emission from vehicles and construction machinery. Measures will be taken to mitigate this pollutant, such as spraying water at construction sites and on dusty roads, controlling vehicle speeds and operating with proper maintenance and in compliance with relevant emission standards.

During the operation period, the main air pollutant is exhaust gas from gas generators, which containing mainly NO_x. With the installation of modern equipment, the NO_x emissions will be in compliance with Chinese standards and limits.

Wastewater

In the project activity, city water will be used as a coolant for the gas generators. This coolant will be circulated in a closed circuit line, and between gas generators and the cooling tower also. Consequently, no effluent will be produced and discharged into the river system from the electricity generation component. Sewage will be treated on-site. After treatment, a portion of treated water will be reused for watering plants on site, and the remaining once having met the discharging standards will be discharged into the river.

Noise

The potential noise source will be gas generators. However, the generators will be housed indoors and the walls will be made of soundproof materials to reduce noise emissions. Through noise protection measures (such as mufflers on exhaust pipes and sound insulation parts) it can be reduced to a level that meets regulation. In addition, since the gas generators are located in the existing captive power plant, which is away from any residence, noise will not be a problem for local residents. Operators will work in the control room outside of the generator house, and they will be protected with ear plugs, if necessary.

Waste

The main forms of solid waste from the proposed project include: refuse generated on the construction site and waste generated by construction workers in the construction period, and by operators in the operation period. These solid wastes will be disposed of in a local landfill.

Gas storage tank

The main environmental impact related to the gas tank is the noise caused by blowers. The following measures will be taken to mitigate the gas tank noise.

- ◆ Adopting low noise equipment;
- ◆ Constructing soundproof walls and mufflers;
- ◆ Applying soft connections between pipes and vibrating equipment;



- ◆ Planting trees around the gas tank area.

In addition, many protective measures are undertaken in order to prevent leakage or the occurrence of explosions. These measures include, but are not limited to:

- ◆ Installing gas leakage detector on the tank;
- ◆ Equipping with automatic cut-out system for emergencies at the inlet and outlet of storage tank and blowers;
- ◆ Installing fire-resistance wall and explosion-proof equipment and devices;
- ◆ Maintaining and inspecting storage tank and all relevant parts on a regular basis;
- ◆ Establishing safety management and operation policies and measures, e.g. Duties for Control Entry to Storage Tank Area, Duties for Routine Inspection, Duties for Maintenance and Repair,

The project has no great potential impact on the local people and environment.

D.2. Environmental impact assessment

>>

The EIA report on the project and individual EIA report on the gas tank were approved by Yibin Environmental Protection Bureau on September 10th 2007 and August 29th 2007, respectively. Strict environmental monitoring and mitigation measures will be carried out during the construction and operation phases. The project will not cause any significant environmental impacts. On the contrary, the project will bring a positive impact on the local environment. By implementing the proposed project, electricity generated by coal-fired captive power plant and from the thermal-power-dominated CCPG will be displaced. Thus, emissions of dust, sulphur oxides and nitrogen oxides, etc. that would be produced by captive power plant and the CCPG will be avoided.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

Although the stakeholder consultation is not necessary for the proposed project according to Chinese laws and regulations, the project owner conducted the stakeholder consultation in December 2006. The project owner sent letters to key local stakeholders and leading residents in Xunchang town to attend the stakeholder consultation of the proposed project. In the letter they enclosed papers explaining the aim and outline of the proposed project. And they televised the project concept and information to the local residents and announced the date of the stakeholder consultation through a local TV channel.

Meanwhile, they posted public announcements on village billboards two weeks before the stakeholder consultation.

The Furong area stakeholder consultation was held on January 11th 2007. Twenty-two people participated, who were representatives of local villagers, local council workers, related local government organizations and project staff.

At the consultation the project manager explained the project's mission and outline. Participants asked questions on the project and Furong project staffs provided responses accordingly as described in the following section.

At the end of the meeting all participants unanimously agreed to implement the project.

E.2. Summary of comments received

>>

Almost all stakeholders who were present during the consultation understood the significant aim of this project, which is to reduce GHG and to use CMM for residential fuel and power generation. Some



stakeholders asked or brought up the following questions or concerns, and project manager answered accordingly.

Q1. We are concerned that if the CMM extracted is converted into electricity, there will be a shortage of residential gas supply.

A1. The principle of the CMM project is to give high priority to residential use. We will make sure that the residential gas will never be in short supply after the project begins operation.

Q2. Recently shortage of household gas fuel has been occurred especially in winter. In the proposed project CMM will be used for gas generator too. We are very concerned about more frequent occurrences of gas shortage.

A2. In the proposed project the existing gas grid will be restructured on a massive scale. A new gas storage tank which has 20,000 cubic meter capacity will be installed at Shanmushu coal mine. Only a part of Shanmushu CMM could be used by the gas grid up to now, but after the new storage tank is installed we can fully use the CMM of Shanmushu. So residential gas will be supplied sufficiently also in winter. Residents can use plenty of gas, more than before.

Q3. How will you reduce the noise pollution from the gas power plant?

A3. All gas generators will be installed in houses that will be constructed with soundproof materials. Also, exhaust pipe noise protection measures (such as muffler/silencer) will be installed. It can be reduced to a level that meets regulation. Therefore, outside of the house the noise level will be lower than relevant Chinese regulation.

Also the gas generators are located away from residential streets, schools, and sensitive receptors. It is expected that the project will have few acoustic impacts on the existing amenity.

Q4. Is there any concern over the environmental impact after the operation of the gas power plant?

A4. There is little toxic material contained in the exhaust gas and wastewater of the project. Moreover the electricity from gas generators will displace the electricity from the captive power plant and the CCPG, so SO_x and NO_x and dust will be lower than present level.

Q5. Is it possible to use CMM for the nearby small coal mines under this proposed project?

A5. It would be possible theoretically, but we did not consider this possibility due to limited time on the project construction. Currently, there is another methodology for small-scale CDM that is available to small coal mines, which can be easily developed as a CDM project.

E.3. Report on consideration of comments received

>>

The project owner explained that participants have a lot of concerns for the project period, both over construction stage and operation stage; they were informed that the proposed project will be implemented in accordance with national and local environmental rules and regulations.

SECTION F. Approval and authorization

>>

The LOA of both project participants were issued.

**Appendix 1: Contact information of project participants**

Organization name	Sichuan Furong Group's Limited Industrial Company
Street/P.O. Box	Xunchang town, xinqiao road
Building	
City	Yibin City, Gong Country
State/Region	Sichuan Province
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Country	P. R. China
Telephone	86-(0)831-2333531
Fax	86-(0)831-2379429
E-mail	yu6655@126.com
Website	http://www.fijt.com/Index.aspx
Contact person	
Title	Chief Engineer
Salutation	Mr.
Last name	Yu
Middle name	
First name	Xueping
Department	
Mobile	
Direct fax	86-(0)831-2379429
Direct tel.	86-(0)831-2333531
Personal e-mail	yu6655@126.com



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Country	Japan
Telephone	81-3-3282 3166
Fax	81-3-3282 4834
E-mail	toh-k@marubeni.com
Website	http://www.marubeni.com
Contact person	TOH Kaname
Title	General Manager
Salutation	Mr.
Last name	Toh
Middle name	
First name	Kaname
Department	GHG Project Team, Energy & Natural Resources Projects Dept.-I
Mobile	81-80-3489 3016
Direct fax	81-3-3282 4834
Direct tel.	81-3-3282 3166
Personal e-mail	toh-k@marubeni.com



Appendix 2: Affirmation regarding public funding

No public funding has been provided for this CDM project.



Appendix 3: Applicability of selected methodology

Please refer to section B.3. above.

Appendix 4: Further background information on ex ante calculation of emission reductions

1. Combustion emissions from additional energy required for CMM capture and use

In the proposed project activity, the additional electricity is used by delivering the extracted CMM to the gas power plant. PE_{ME} is calculated as follows.

$$PE_{ME} = CONS_{ELEC,PJ} \times CEF_{ELEC}$$

For ex-ante calculation $CONS_{ELEC,PJ}$ is estimated by following formula.

$$CONS_{ELEC,PJ} = Q_{CMM,y} \times \eta_{SNT}$$

$Q_{CMM,y}$: Additional delivery of CMM amount in year y (tCH₄).

η_{SNT} : Mean electricity consumption coefficient of CMM delivery (kWh/ tCH₄).

The historical data of electricity consumption for delivery of CMM are available from Baijiao pump station, and are used for ex-ante calculation of project emissions.

η_{SNT} is calculated as follow formula using Baijiao data.

$$\eta_{SNT} = \frac{\sum_{y=1}^n \frac{E_{PUMP,y}}{Q_{SNT,y}}}{n}$$

Where:

$E_{PUMP,y}$: Electricity consumption of pump station in year y (kWh).

$Q_{SNT,y}$: CMM amount delivered to gas grid in the baseline in year y (tCH₄).

Table 1.1 Historical data of electricity consumption of pump station

Year	$Q_{SNT,y}$ tCH ₄	$E_{PUMP,y}$ kWh	η_{SNT} kWh/tCH ₄
2001	3,906	689,913	176.6
2002	3,819	724,126	189.6
2003	3,133	418,034	133.4
2004	3,457	436,096	126.1
2005	2,891	363,432	125.7
Total	3441	526320	150.3

The results of $CONS_{ELEC,PJ}$ is shown following table.

Table 1.2 Additional electricity consumption by the project activity



Year	$Q_{CMM,y}$ (tCH ₄)	η_{SNT} (kWh/tCH ₄)	$CONS_{ELEC,PI}$ (MWh)
2009 (Sep.1 st -Dec. 31 st)	3,141	150.3	472
2010	10,698		1,608
2011	12,507		1,880
2012	12,708		1,910
2013	13,445		2,021
2014	13,914		2,091
2015	14,785		2,222
2016	15,187		2,283
2017	15,254		2,293
2018	15,254		2,293
2019 (Jan.1 st - Aug.31 st)	10,173		1,529



2. Thermal demand analysis in the baseline scenario

Table 2.1 Baseline Thermal Demand of Baijiao, Shanmushu and Xunchang coal mines

m ³ CMM	1	2	3	4	5	6	7	8	9	10	11	12	Total
2003	966,091	969,243	1,177,250	941,727	964,643	823,158	771,950	731,102	700,641	792,646	764,901	1,038,665	10,642,016
2004	850,467	1,103,216	992,725	919,816	843,097	926,866	915,836	770,075	893,116	823,068	873,503	870,434	10,782,216
2005	948,250	1,090,055	785,915	838,574	843,163	837,236	827,355	813,757	789,952	894,709	848,014	1,077,976	10,594,955
2006	875,984	878,427	967,161	752,891	694,879	742,086	774,013	736,585	712,861	777,003	779,783	992,976	9,684,650
2007	1,012,729	880,081	1,066,794	903,544	827,905	788,285	803,283	813,245	885,170	936,049	1,022,940	1,088,017	11,028,041
Total	4,653,520	4,921,022	4,989,845	4,356,552	4,173,687	4,117,630	4,092,437	3,864,763	3,981,740	4,223,474	4,289,141	5,068,067	52,731,879
Average	930,704	984,204	997,969	871,310	834,737	823,526	818,487	772,953	796,348	844,695	857,828	1,013,613	10,546,376
m_k													
2003	1.04	0.98	1.18	1.08	1.16	1.00	0.94	0.95	0.88	0.94	0.89	1.02	
2004	0.91	1.12	0.99	1.06	1.01	1.13	1.12	1.00	1.12	0.97	1.02	0.86	
2005	1.02	1.11	0.79	0.96	1.01	1.02	1.01	1.05	0.99	1.06	0.99	1.06	
2006	0.94	0.89	0.97	0.86	0.83	0.90	0.95	0.95	0.90	0.92	0.91	0.98	
2007	1.09	0.89	1.07	1.04	0.99	0.96	0.98	1.05	1.11	1.11	1.19	1.07	
m_max_k	1.09	1.12	1.18	1.08	1.16	1.13	1.12	1.05	1.12	1.11	1.19	1.07	
CMM _{BL,y}													Total
m ³ CMM	1,012,729	1,103,216	1,177,250	941,727	964,643	926,866	915,836	813,757	893,116	936,049	1,022,940	1,088,017	11,796,146
m ³ CH ₄	334,201	364,061	388,493	310,770	318,332	305,866	302,226	268,540	294,728	308,896	337,570	359,046	3,892,728
t CH ₄	224	244	260	208	213	205	202	180	197	207	226	241	2,608

Table 2.2 Baseline Thermal Demand of Gongquan coal mine

m ³ CMM	1	2	3	4	5	6	7	8	9	10	11	12	Total
2003	197,874	184,618	191,645	128,417	83,882	180,693	158,110	194,344	286,177	108,088	191,225	141,636	2,046,710
2004	150,082	194,685	148,338	175,203	210,774	292,694	161,618	135,896	145,391	101,727	75,957	118,695	1,911,062
2005	208,152	255,692	138,691	147,984	104,211	147,747	123,628	178,629	173,404	99,412	126,715	190,231	1,894,497



2006	179,418	167,320	157,445	102,667	152,535	162,897	158,533	195,801	189,495	137,118	194,946	175,231	1,973,405
2007	178,717	155,308	159,406	172,104	206,976	248,932	141,756	143,514	144,097	127,643	88,951	148,366	1,915,771
Total	914,244	957,623	795,525	726,375	758,378	1,032,964	743,645	848,184	938,564	573,989	677,794	774,160	9,741,444
Average	182,849	191,525	159,105	145,275	151,676	206,593	148,729	169,637	187,713	114,798	135,559	154,832	1,948,289
m_k													
2003	1.08	0.96	1.20	0.88	0.55	0.87	1.06	1.15	1.52	0.94	1.41	0.91	
2004	0.82	1.02	0.93	1.21	1.39	1.42	1.09	0.80	0.77	0.89	0.56	0.77	
2005	1.14	1.34	0.87	1.02	0.69	0.72	0.83	1.05	0.92	0.87	0.93	1.23	
2006	0.98	0.87	0.99	0.71	1.01	0.79	1.07	1.15	1.01	1.19	1.44	1.13	
2007	0.98	0.81	1.00	1.18	1.36	1.20	0.95	0.85	0.77	1.11	0.66	0.96	
m_max_k	1.14	1.34	1.20	1.21	1.39	1.42	1.09	1.15	1.52	1.19	1.44	1.23	
CMM _{BL,y}													Total
m ³ CMM	208,152	255,692	191,645	175,203	210,774	292,694	161,618	195,801	286,177	137,118	194,946	190,231	2,500,051
m ³ CH ₄	68,690	84,378	63,243	57,817	69,555	96,589	53,334	64,614	94,438	45,249	64,332	62,776	825,017
t CH ₄	46	57	42	39	47	65	36	43	63	30	43	42	553

Therefore, in the crediting period, the baseline thermal demand of Baijiao, Shanmushu and Xunchang coal mines is not more than 3.89 million m³CH₄, namely, 2,608 tCH₄, while the baseline thermal demand of Gongquan coal mine is not more than 0.83 million m³CH₄, namely, 553 tCH₄. So, the baseline thermal demand of the project is not more than 4.72 million m³CH₄, namely, 3,161 tCH₄.

Table 2.3 Comparison of CMM extraction, CMM destroyed for power generation and max thermal demand in the baseline of Baijiao, Xunchang and Shanmushu coal mines

Crediting period	CMM extraction (million m ³ CH ₄)	CMM destroyed for power generation, MM_{ELEC} (million m ³ CH ₄)	CMM extracted but not used in the project activity (million m ³ CH ₄)	Max. thermal demand in the baseline (million m ³ CH ₄)
2009	14	7.14	6.86	3.89
2010	14.6	7.46	7.14	3.89
2011	16.4	8.93	7.47	3.89
2012	16.6	8.93	7.67	3.89
2013	17.3	9.31	7.99	3.89



2014	17.8	9.66	8.14	3.89
2015	18.7	10.35	8.35	3.89
2016	19	10.62	8.38	3.89
2017	20	10.66	9.34	3.89
2018	20	10.66	9.34	3.89
2019	20	10.66	9.34	3.89

Table 2.4 Comparison of CMM extraction, CMM destroyed for power generation and max thermal demand in the baseline of Gongquan coal mine

Crediting period	CMM extraction (million m ³ CH ₄)	CMM destroyed for power generation, <i>MM_{ELEC}</i> (million m ³ CH ₄)	CMM extracted but not used in the project activity (million m ³ CH ₄)	Max. thermal demand in the baseline (million m ³ CH ₄)
2009	6	3.06	2.94	0.83
2010	7.3	3.74	3.56	0.83
2011	8.2	4.47	3.73	0.83
2012	8.3	4.47	3.83	0.83
2013	8.7	4.69	4.01	0.83
2014	8.9	4.84	4.06	0.83
2015	9.3	5.15	4.15	0.83
2016	9.6	5.38	4.22	0.83
2017	10	5.34	4.66	0.83
2018	10	5.34	4.66	0.83
2019	10	5.34	4.66	0.83

Based on the above comparison, the thermal energy demand in the baseline will not be overlapped by the project activity.

3. Calculation of emission factor of the CCPG

3.1 Operating Margin

Table 3.1.1 Fuel consumed by the CCPG in year 2003

Fuel Type	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Subtotal	Emission factor	Oxidation	LHV	CO ₂ emission (tCO ₂ e)
									(tc/TJ)	(%)	(MJ/t,km ³)	$K=G*H*I*J*44/12/10000$ (mass)



		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J*44/12/1000 (volume)
Raw coal	10 ⁴ t	1427.41	5504.94	2072.44	1646.47	769.47	2430.93	13851.66	25.8	100	20908	273971540
Clean coal	10 ⁴ t							0	25.8	100	26344	0
Other washed coal	10 ⁴ t	2.03	39.63			106.12		147.78	25.8	100	8363	1169146
Coke oven	10 ⁴ t				1.22			1.22	25.8	100	28435	32817
Coke oven gas	10 ⁷ m ³			0.93				0.93	12.1	100	16726	69013
other gas	10 ⁷ m ³							0	12.1	100	5227	0
Crude oil	10 ⁴ t		0.5	0.24			1.2	1.94	20	100	41816	59490
Gasoline	10 ⁴ t							0	18.9	100	43070	0
Diesel	10 ⁴ t	0.52	2.54	0.69	1.21	0.77		5.73	20.2	100	42652	181016
Fuel oil	10 ⁴ t	0.42	0.25	2.17	0.54	0.28	1.2	4.86	21.1	100	41816	157229
PLG	10 ⁴ t							0	17.2	100	50179	0
Refinery gas	10 ⁴ t	1.76	6.53		0.66			8.95	18.2	100	46055	275070
Natural gas	10 ⁷ m ³					0.04	2.2	2.24	15.3	100	38931	489223
Other petroleum product	10 ⁴ t							0	20	100	38369	0
Other coking products	10 ⁴ t							0	25.8	100	28435	0
Other energy	10 ⁴ tce		11.04			16.2		27.24	0	100	0	0
											Subtotal	276404544

Table 3.1.2 Electricity generation and supply by the CCPG in year 2003



Province	Generation (MWh)	On-site Use (%)	Supply (MWh)
Jiangxi	27,165,000	6.43	25,418,291
Henan	95,518,000	7.68	88,182,218
Hubei	39,532,000	3.81	38,025,831
Hunan	29,501,000	4.58	28,149,854
Chongqing	16,341,000	8.97	14,875,212
Sichuan	32,782,000	4.41	31,336,314
Total			225,987,719
<i>China Electric Power Yearbook 2004</i>			

Table 3.1.3 Fuel consumed by the CCPG in year 2004

Fuel Type	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Subtotal	Emission factor (tc/TJ)	Oxidation (%)	LHV (MJ/t,km ³)	CO ₂ emission (tCO ₂ e)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J*44/12/10000 (mass)
												K=G*H*I*J*44/12/1000 (volume)
Raw coal	10 ⁴ t	1863.8	6948.5	2510.5	2197.9	875.5	2747.9	17144.1	25.8	100	20908	3309092605
Clean coal	10 ⁴ t		2.34					2.34	25.8	100	26344	58316
Other washed coal	10 ⁴ t	48.93	104.22			89.72		242.87	25.8	100	8363	1921441
Coke oven	10 ⁴ t		109.61					109.61	25.8	100	28435	2948455
Coke oven gas	10 ⁷ m ³			1.68		0.34		2.02	12.1	100	16726	149900
other gas	10 ⁷ m ³					2.61		2.61	12.1	100	5227	60527
Crude oil	10 ⁴ t		0.86	0.22				1.08	20	100	41816	33118
Gasoline	10 ⁴ t		0.06			0.01		0.07	18.9	100	43070	2089
Diesel	10 ⁴ t	0.02	3.86	1.7	1.72	1.14		8.44	20.2	100	42652	266627



Fuel oil	10 ⁴ t	1.09	0.19	9.55	1.38	0.48	1.68	14.37	21.1	100	41816	464893
PLG	10 ⁴ t							0	17.2	100	50179	0
Refinery gas	10 ⁴ t	3.52	2.27					5.79	18.2	100	46055	177950
Natural gas	10 ⁷ m ³						2.27	2.27	15.3	100	38931	495775
Other petroleum product	10 ⁴ t							0	20	100	38369	0
Other coking products	10 ⁴ t							0	25.8	100	28435	0
Other energy	10 ⁴ tce		16.92		15.2	20.95		53.07	0	100	0	0
											Subtotal	345671697

Table 3.1.4 Electricity generation and supply by the CCPG in year 2004

Province	Generation (MWh)	On-site Use (%)	Supply (MWh)
Jiangxi	30,127,000	7.04	28,006,059
Henan	109,352,000	8.19	100,396,071
Hubei	43,034,000	6.58	40,202,363
Hunan	37,186,000	7.47	34,408,206
Chongqing	16,520,000	11.06	14,692,888
Sichuan	34,627,000	9.41	31,368,599
Total			249,074,186
<i>China Electric Power Yearbook 2005</i>			

Table 3.1.5 Fuel consumed by the CCPG in year 2005

Fuel Type	Unit	Jiang xi	Hena n	Hube i	Hun an	Chongq ing	Sichu an	Subtotal	Emission factor	Oxidat ion	LHV	CO ₂ emission (tCO ₂ e)
									(tc/TJ)	(%)	(MJ/t,k m ³)	$K=G*H*I*J*44/12/10000$ (mass)



		A	B	C	D	E	F	G=A+B+C+D +E+F	H	I	J	K=G*H*I*J*44/12/1000 (volume)
Raw coal	10 ⁴ t	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	17827.75	25.8	100	20908	35261449
Clean coal	10 ⁴ t	0.02						0.02	25.8	100	26344	498
Other washed coal	10 ⁴ t		138.12			89.99		228.11	25.8	100	8363	1804669
Coke oven	10 ⁴ t		25.95		105			130.95	25.8	100	28435	3522491
Coke oven gas	10 ⁷ m ³			1.15		0.36		1.51	12.1	100	16726	112054
other gas	10 ⁷ m ³		10.2			3.12		13.32	12.1	100	5227	308897
Crude oil	10 ⁴ t		0.82	0.36				1.18	20	100	41816	36185
Gasoline	10 ⁴ t		0.02			0.02		0.04	18.9	100	43070	1194
Diesel	10 ⁴ t	1.3	3.03	2.39	1.39	1.38		9.49	20.2	100	42652	299798
Fuel oil	10 ⁴ t	0.64	0.29	3.15	1.68	0.89	2.22	8.87	21.1	100	41816	286959
PLG	10 ⁴ t							0	17.2	100	50179	0
Refinery gas	10 ⁴ t	0.71	3.41	1.76	0.78			6.66	18.2	100	46055	204689
Natural gas	10 ⁷ m ³						3	3	15.3	100	38931	655209
Other petroleum product	10 ⁴ t							0	20	100	38369	0
Other coking products	10 ⁴ t				1.5			1.5	25.8	100	28435	40349
Other energy	10 ⁴ tce		2.88		1.74	32.8		37.42	0	100	0	0
											Subtotal	359887488

Table 3.1.6 Electricity generation and supply by the CCPG in year 2005

Province	Generation (MWh)	On-site Use (%)	Supply (MWh)
Jiangxi	30,000,000	6.48	28,056,000
Henan	131,590,000	7.32	121,957,612



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Hubei	47,700,000	2.51	46,502,730
Hunan	39,900,000	5	37,905,000
Chongqing	17,584,000	8.05	16,168,488
Sichuan	37,202,000	4.27	35,613,475
Total			286,203,305
<i>China Electric Power Yearbook 2006</i>			

Therefore, OM emission factor of the CCPG is the average value of 2003~2005.

$$EF_{OM} = \sum F_{i,m,y} \times COEF_{i,m} / \sum GEN = (276,404,544 + 345,671,697 + 359,887,488) / (225,987,719 + 249,074,186 + 286,203,305)$$

$$= 1.2899 \text{ tCO}_2\text{e/MWh}$$

3.2 Build Margin

According to the recent research undertaken by the National Development and Reform Commission (“NDRC”, Chinese DNA), the subcritical generating system with a capacity of 600MW represents the most advanced technology commercially used in domestic coal-fired plants. The weighted value based on the coal consumption by 15 sets of 600MW subcritical generating units installed in 2005 is calculated as 343.33 gce/kWh, which also means the power supply efficiency of these plants is weighted as 35.82%.

The combine cycle technology with a capacity of 200MW stands for the most advanced technology used in thermal plants fired by gas or oil in China. Based on the statistics in 2004, the thermal plant with the maximum power supply efficiency 47.67% consumed the equivalent fuel of 258 gce/kWh.

Table 3.2.1 Emission factor of most advanced technology commercially used in China’s domestic thermal power plants

	Parameters	Power supply efficiency (GENE)	EF of fuel (tC/TJ)	Oxidation	Emission Factor (tCO ₂ e/MWh)
		A	B	C	D=3.6/A/1000*B*C*44/12
Coal fire plant	$EF_{Coal,Adv}$	35.82%	25.8	1	0.9508
Gas fire plant	$EF_{Gas,Adv}$	47.67%	15.3	1	0.4237
Oil fire plant	$EF_{Oil,Adv}$	47.67%	21.1	1	0.5843

Table 3.2.2 Fuel consumption and emissions on the CCPG in 2005

Fuel Type	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Sub-total	Emission n	Oxidation	LHV	CO ₂ emissions (tCO ₂ e)
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		A	B	C	D	E	F	G=A+B+C +D+E+F	Factor (tc/TJ)	(%)	(MJ/t,m ³)	K=C*H*I*J*44/12/10000(mass)
								H	I	J		K=C*H*I*J*44/12/1000 (volume)
Raw coal	10 ⁴ t	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	17827.75	25.8	100	20908	352,614,497
Cleaned coal	10 ⁴ t	0.02						0.02	25.8	100	26344	498
Other washed coal	10 ⁴ t		138.12			89.99		228.11	25.8	100	8363	1,804,669
Coke oven	10 ⁴ t		25.95		106.5			132.45	25.8	100	28435	3,562,840
Sub-Total												357,982,504
Crude oil	10 ⁴ t		0.82	0.36				1.18	20	100	41816	36,185
Gasoline	10 ⁴ t		0.02			0.02		0.04	18.9	100	43070	1,194
Diesel oil	10 ⁴ t	1.3	3.03	2.39	1.39	1.38		9.49	20.2	100	42652	299,798
Fuel oil	10 ⁴ t	0.64	0.29	3.15	1.68	0.89	2.22	8.87	21.1	100	41816	286,959
Other petroleum product	10 ⁴ t							0.00	20	100	38369	0
Sub-Total										100		624,136
Natural gas	10 ⁸ m ³						3	3.00	15.3	100	38931	655,209
Coke oven gas	10 ⁸ m ³			1.15		0.36		1.51	12.1	100	16726	112,054
Other gas	10 ⁸ m ³		10.2			3.12		13.32	12.1	100	5227	308,897
PLG	10 ⁴ t							0.00	17.2	100	50179	0
Refinery gas	10 ⁴ t	0.71	3.41	1.76	0.78			6.66	18.2	100	46055	204,689
Sub-Total												1,280,848
Total												359,887,488

$$\lambda_{coal} = \frac{\sum_{i \in COAL, y} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,y} F_{i,j,y} \times COEF_{i,j}}$$

$$\lambda_{coal} = 357,982,504 / 359,887,488 = 99.47\%$$

$$\lambda_{oil} = \frac{\sum_{i \in OIL, y} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,y} F_{i,j,y} \times COEF_{i,j}}$$

$$\lambda_{oil} = 624,136 / 359,887,488 = 0.17\%$$

$$\lambda_{gas} = \frac{\sum_{i \in GAS, y} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,y} F_{i,j,y} \times COEF_{i,j}}$$

$$\lambda_{gas} = 1,280,848 / 359,887,488 = 0.36\%$$

$$EF_{thermal} = \lambda_{coal} \times EF_{coal,Adv} + \lambda_{oil} \times EF_{oil,Adv} + \lambda_{gas} \times EF_{gas,Adv}$$

$$= 99.47\% \times 0.9508 + 0.17\% \times 0.5843 + 0.36\% \times 0.4237 = 0.9482 \text{ (tCO}_2\text{e/MWh)}$$

**Capacity addition during the 2002~ 2005 on the CCPG**

Table 3.2.3 Generation capacity of the CCPG installed in year 2002

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal	MW	5,128.8	15,904.5	8,147.8	4,975.6	3,004.5	6,142.0	43,303.2
Hydro	MW	2,197.4	2,438.0	7,213.9	6,135.3	1,195.5	11,854.6	31,034.7
Nuclear	MW							0.0
Wind and Other	MW							0.0
Total	MW	7,326.2	18,342.5	15,361.7	11,110.9	4,200.0	17,996.6	74,337.9

Table 3.2.4 Generation capacity of the CCPG installed in year 2003

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal	MW	5,407.8	17,635.5	8,173.3	6,446.7	3,126.2	6,104.0	46,893.5
Hydro	MW	2,307.4	2,438.0	7,337.2	6,603.1	1,329.8	12,341.5	32,357.0
Nuclear	MW	0	0	0	0	0	0	0.0
Wind and Other	MW	0	0	0	0	0	0	0.0
Total	MW	7,715.2	20,073.5	15,510.5	13,049.8	4,456.0	18,445.5	79,250.5

Table 3.2.5 Generation capacity of the CCPG installed in year 2005

Power type	unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal	MW	5,906.0	26,267.8	9,526.3	7,211.6	3,759.5	7,496.0	60,167.2
Hydro	MW	3,019.0	2,539.9	8,088.9	7,905.1	1,892.7	14,959.6	38,405.2
Nuclear	MW	0	0	0	0	0	0	0
Wind and Other	MW	0	0	0	0	24	0	24
Total	MW	8,925.0	28,807.7	17,615.2	15,116.7	5,676.2	22,455.6	98,596.4

Therefore, the Build Margin of the CCPG is calculated as shown in the table below:

Table 3.2.6 Capacity addition of the CCPG during 2002~2005

Capacity	2002	2003	2005	Capacity Addition 2002-2005	Share in the Capacity Addition
	A	B	C	D=C-A	E



1	Thermal	(MW)	43,303.2	46,893.5	60,167.2	16,864	69.52%	D1/D5
2	Hydro	(MW)	31,034.7	32,357	38,405.2	7,370.5	30.38%	D2/D5
3	Nuclear	(MW)	0	0	0	0	0.00%	D3/D5
4	Other	(MW)	0	24	24	24	0.10%	D4/D5
5	Total	(MW)	74,337.9	79,250.5	98,596.4	24,258.5	100%	D5/D5
6	Share in the capacity of 2005		75.40%	80.38%	100%			
			A5/C5	B5/C5	C5/C5			

$$EF_{BM} = 0.9482 * 69.52\% = 0.6592 \text{ tCO}_2\text{e/MWh}$$

Taking the default value of weights w_{OM} and w_{BM} , 50% respectively, the emission factor of the CCPG is calculated as follows.

For more details, please refer to <http://cdm.ccchina.gov.cn/Detail.aspx?newsId=3526&Tid=3>, on which all data are published by the Chinese DNA.

Table 3.2.7 Emission factor of the CCPG

	OM (tCO ₂ e/MWh)	BM (tCO ₂ e/MWh)	EF (tCO ₂ e/MWh)
Central China Power Grid	1.2899	0.6592	0.9745

Appendix 5: Further background information on monitoring plan

The interconnections of the gas supply / storage and consumption points are shown in the figure below.

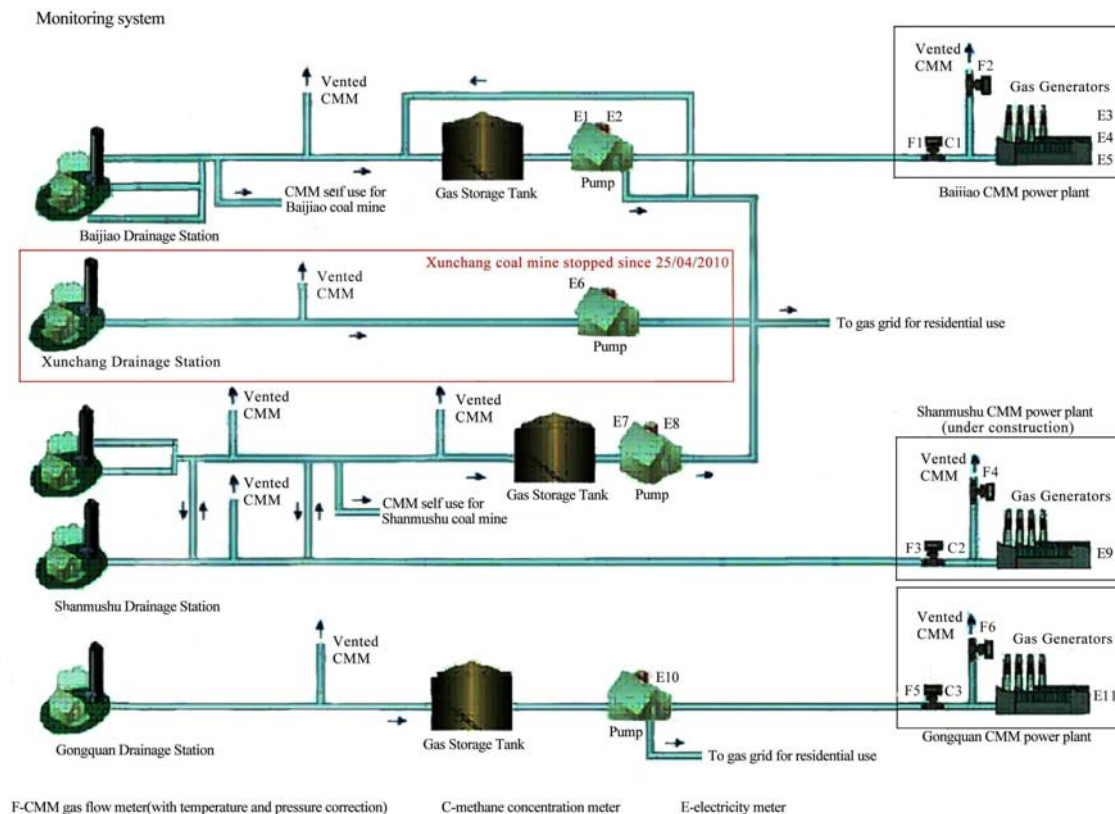


Fig A5.1 Gas distribution network

The Fig. 7.3-2 in section B.7.3 is only for emission reduction monitoring and was prepared based on Fig A5.1.

Fig.A5.1. fully reflects gas supply/storage and consumption points and the installation of measurement meters. Many meters shown in Fig A5.1 are for performance assessment and the CMM sale measurement, not for mission reduction monitoring.

There are three pipelines in Baijiao Drainage Station. And then a portion of CMM from Baijiao Drainage Station is used for self consumption, and the other portion is send to gas storage tank and the pump station, and then a portion is send to gas grid for residential use, and the other is send to Baijiao CMM power plant.

Xunchang coal mine was stopped on 25/04/2010, before that there was one pipeline in Xunchang Drainage Station, and the CMM from it is send to the pump station and then send to the gas grid for residential use.

There are also three pipelines in Shanmushu Drainage Station. And then a portion of CMM from Shanmushu Drainage Station is used for self consumption, and the other portion is send to gas grid for residential use through gas storage tank and the pump station. In addition, redundant CMM is send

back to gas storage tank in Baijiao coal mine. Now, the Shanmushu CMM power plant is under construction, when it be finished, a portion of CMM from Shanmushu Drainage Station will be send to gas grid for residential use, and the other will be send to Shanmushu CMM power plant.

There is only one pipeline in Gongquan Drainage Station, and the CMM from Gongquan Drainage Station is send to gas storage tank and the pump station, and then a portion is send to gas grid for residential use, and the other is send to Gongquan CMM power plant.

Gas flow meters and methane concentration meters have been installed at the inlet pipeline and the emergency vent valves, and electricity meters have been installed for the pump stations and CMM power plants. The main parameters of these meters are shown in the Table A5.1 below.

Table A5.1 Main Parameters of Monitoring Instruments

No.	Instrument	Function	Location	Accuracy
F1	Gas flow meter	Measuring the CMM volume	Gas pipeline of Baijiao CMM power plant (the value of the CMM send to Baijiao CMM power plant is equal to the reading of F1 minus the reading of F2)	0.5
F2	Gas flow meter	Measuring the CMM volume	The emergency evacuation valve of Baijiao CMM power plant	0.5
F3	Gas flow meter	Measuring the CMM volume	Gas pipeline of Shanmushu CMM power plant (the value of the CMM send to Shanmushu CMM power plant is equal to the reading of F3 minus the reading of F4)	0.5
F4	Gas flow meter	Measuring the CMM volume	The emergency evacuation valve of Shanmushu CMM power plant	0.5
F5	Gas flow meter	Measuring the CMM volume	Gas pipeline of Gongquan CMM power plant (the value of the CMM send to Gongquan CMM power plant is equal to the reading of F5 minus the reading of F6)	0.5
F6	Gas flow meter	Measuring the CMM volume	The emergency evacuation valve of Gongquan CMM power plant	0.5
C1	Methane concentration meter	Measuring CH ₄ concentration of the drained CMM	Gas pipeline of Baijiao CMM power plant	0.5
C2	Methane concentration meter	Measuring CH ₄ concentration of the drained CMM	Gas pipeline of Shanmushu CMM power plant	0.5
C3	Methane concentration meter	Measuring CH ₄ concentration of the drained CMM	Gas pipeline of Gongquan CMM power plant	0.5
E1	Electricity meter	Measuring electricity delivered by the project	Baijiao Pump station	0.5S



E2	Electricity meter	Measuring electricity delivered by the project	Baijiao Pump station	0.5
E3	Electricity meter	Measuring electricity delivered by the project	500kW domestic generators in Baijiao CMM power plant	0.5
E4	Electricity meter	Measuring electricity delivered by the project	As the main meter of 3.048MW generators in Baijiao CMM power plant	0.5
E5	Electricity meter	Measuring electricity delivered by the project	As the back meter of 3.048MW generators in Baijiao CMM power plant	0.2
E6	Electricity meter	Measuring electricity delivered by the project	Xunchang Pump station	0.5
E7	Electricity meter	Measuring electricity delivered by the project	Shanmushu Pump station	0.5
E8	Electricity meter	Measuring electricity delivered by the project	Shanmushu Pump station	0.5
E9	Electricity meter	Measuring electricity delivered by the project	The main meter of 3.048MW generators in Sanmushu CMM power plant	0.5
E10	Electricity meter	Measuring electricity delivered by the project	Gongquan Pump station	0.5S
E11	Electricity meter	Measuring electricity delivered by the project	The main meter of 500kW domestic generators in Gongquan CMM power plant	0.5



Appendix 6: Summary of post registration changes

1. The on-site captive power plant was stopped on 11/04/2010 according to the local government requirements, and the ex-post mission factor was changed to the ex-ante mission factor and the combined mission factor was changed to CCPG emissions factor;
2. Xunchang coal mine stopped operation since 25/04/2010 because of water inrush accident, so, CMM is extracted from the other three coal mines, i.e. Baijiao, Shanmushu and Gongquan coal mines;
3. Generation capacity of coal mines was detailed changed respectively based on real practice;
4. The technical parameters of the imported gas generator was added based on real practice;
5. The project boundary was changed based on practical situation, and Xunchang coal mine was excluded from the project boundary;
6. The monitoring plan was changed based on real practice;
7. The electricity meters calibration standards was changed based on the standards the project complied;
8. The organization and management structure was changed based on real practice;
9. Thermal demand analysis in the baseline scenario in Appendix 4 was re-done.

Because clean development mechanism project design document form (CDM-PDD) (version 03) was changed to CDM-PDD (version 04.1), some sections was changed.



History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Appendix 06 to Appendix 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Appendix 8).
03	EB 25, Appendix 15 26 July 2006	
02	EB 14, Appendix 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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