Guangdong Huizhou LNG Power Generation Project

[Date of the VCS PD]
26 June 2009

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1 Description of Project:

1.1 Project title

Guangdong Huizhou LNG Power Generation Project
Version number of the document: 01

1.2 Type/Category of the project

Guangdong Huizhou LNG Power Generation Project in the Daya Bay Economic and Technical Development Zone, Huizhou City, Guangdong Province. (hereafter referred to as the Project) satisfies the requirement of UNFCCC Clean Development Mechanism which is a program approved under the VCS 2007.

This category of the Project would fall within sectoral scope 1: energy industries. (non-renewable sources)

- The Project is not a Grouped project.

1.3 Estimated amount of emission reductions over the crediting period including project size:

It is expected that the Project activities will generate emission reductions for about 1,096,728tCO_2e per year over the first maximum10-year crediting period from August 21 2006 to July 31 2016.

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
2006 (August-December)	456,970
2007	1,096,728
2008	1,096,728
2009	1,096,728
2010	1,096,728
2011	1,096,728
2012	1,096,728
2013	1,096,728
2014	1,096,728
2015	1,096,728
2016(January-March)	639,758
Total estimated reductions (tonnes of CO_2e)	10,967,280
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	1,096,728

The project belongs to mega project as the annual CO_2 equivalent emissions reductions are 1,096,728t which is more than 1,000,000t.

1.4 A brief description of the project:

Huizhou LNG Power Generation Project (HLPGP) has constructed a highly efficient Natural Gas (NG) fired Combined-Cycle Gas Turbine (CCGT) power plant. The proposed project has a capacity of 1083.09 MW (3×361.03 MW) with annual output of 3703.5 GWh. All three units are now in operation. The proposed project will have an annual consumption of 506,100 tons of Liquefied Natural Gas (LNG), which will be regasified at the LNG terminal and transport to the power station via pipeline.

Electricity to be generated by HLPGP will be subsequently supplied to the Guangdong

Provincial Power Grid (GPPG), which is a part of the China Southern Power Grid (CSPG), consequently displacing power generation from the Southern China Power Grid (CSPG) where more than 50 percent of the power comes from coal fired power plants. The estimated annual greenhouse gas (GHG) emission reductions will be 1,096,728 tCO_2e.

By using LNG and CCGT, the HLPGP will offer the least environmental damaging form of fossil-fuelled electricity generation, produce positive environmental and economic benefits and contribute to the local sustainable development. The specific sustainable development benefits of the proposed project include:

- Consistence with China's national energy policy aiming at optimization of energy structure, improvement of energy security and diversification of energy mix.
- Supply of less GHG-intensive electricity to the Guangdong Provincial Power Grid (GPPG) which is a part of the CSPG.
- Improvement of reliability of power supply in GPPG.
- Successful demonstration to other planned or scheduled NG CCGT plants in Guangdong and other provinces of China.
- Promote and strengthen technology and knowledge transfer of CCGT

1.5 .Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

The proposed project is located in the Daya Bay Economic and Technical Development Zone, Huizhou City, Guangdong Province. The position is longitude 114°36′16″degrees east and latitude 22°45′34″ degrees north. The project site is 214 km away from Guangzhou and 48 km from Huizhou and 4 km east of Huiyang Town. The map below shows the location of the proposed project.

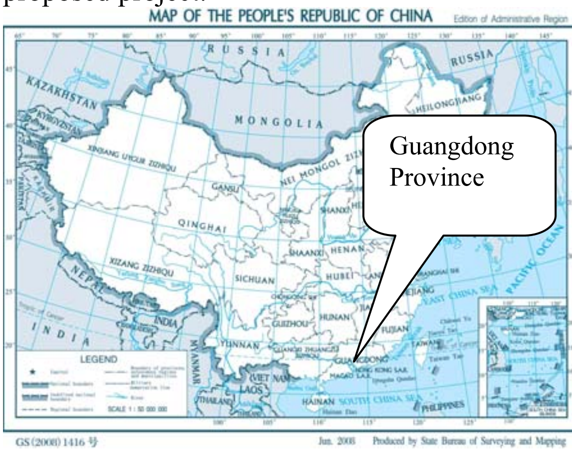

Figure 1.The location of Guangdong Province

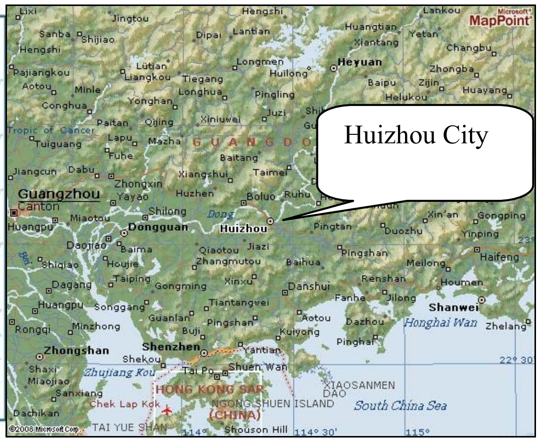

Figure 2.The location of Jieyang City

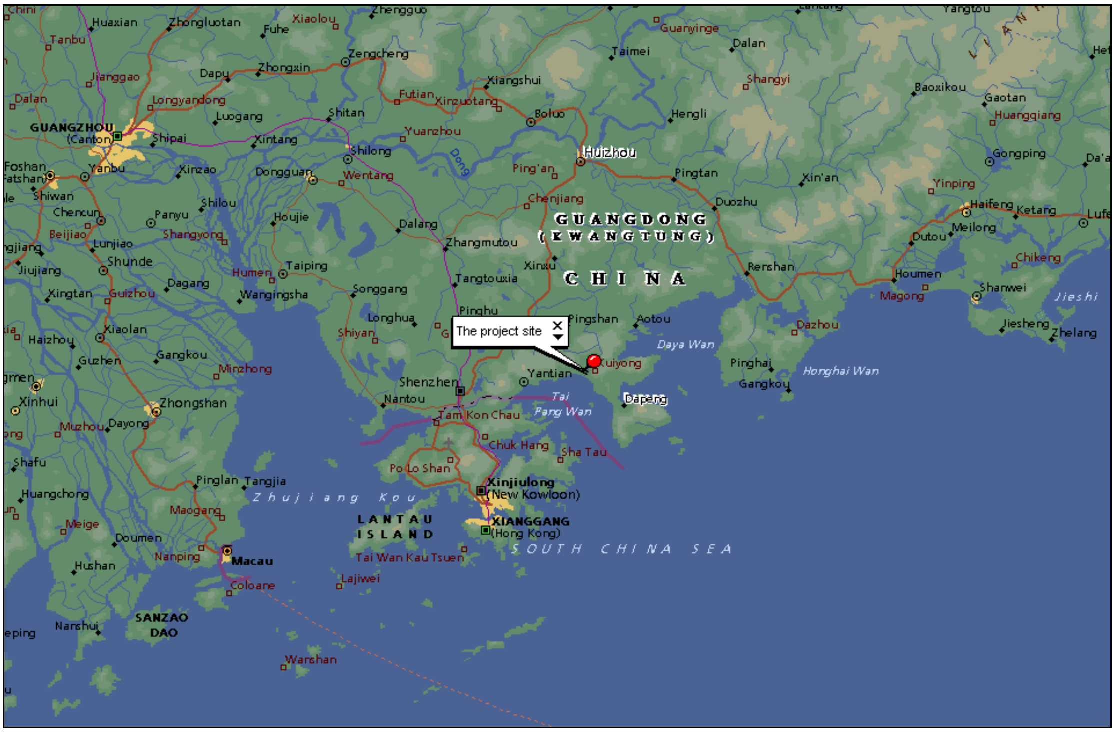

Figure 3. The location of the Project

1.6 Duration of the project activity/crediting period:

- Project start date: August 21th 2006 on which the project activity began reducing or removing GHG emission.
- Crediting period start date: August 21st 2006 on which the first monitoring period commenced.

10 ×3 years was selected as the crediting period of the Project. That is, the length of the first crediting period is 10 years which will be renewed two times.

1.7 Conditions prior to project initiation:

The Project is located in Daya Bay Economic and Technical Development Zone, Huizhou City, Guangdong Province. In order to optimize the structure of energy, alleviate the conflict between demands for energy and protection of environment, the local government start to discuss the possibility of using LNG and CCGT. The testing engineering integrated LNG project of Guangdong Province was approved by government. The Project is part of the testing engineering integrated LNG project of Guangdong Province.

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

The project will achieve GHG emission reductions by using LNG and CCGT. The project can supply less GHG-intensive electricity to the Guangdong Provincial Power Grid (GPPG) which is a part of the CSPG.

1.9 Project technologies, products, services and the expected level of activity:

LNG is natural gas that has been processed to remove impurities and heavy hydrocarbons and then compressed to liquid. LNG is about 1/600th the volume of natural gas at Standard Temperature and Pressure (STP), making it more convenient to transport by vessel. The LNG is liquefied (-163℃) and imported from Australia's Northwest shelf gas development project by LNG tankers. In receiving terminal, the imported LNG is be heated to convert it to its initial gaseous form and supplied to the users in Pearl River Delta region and Hong Kong (including the proposed CCGT power plant). A LNG terminal is in operation near Shenzhen to receive the LNG from Australia and the first shipment has landed in China in June 28, 2006.

The CCGT process includes two parts: the first phase of the process takes place in the gas turbine which burns natural gas to rotate a coupled AC generator to generate electricity. After the fuel is burnt and passes through the gas turbine, the second phase will utilises the additional heat remaining in the exhausted gas through a heat recovery steam to produce steam to power a steam turbine. These "combined cycle" will result in cycle thermal efficiencies of over 50% since they're used with the most recent gas turbine technology.

The gas turbines and steam turbines in the HLPGP are produced jointly by Dongfang Steam Turbine Works (DSTW) and MITSUBISHI Heavy Industries. These gas turbines are the domestic made F-class gas turbine in China by local turbine manufacturers, which is first-of-kind technology introduced by domestic companies. The heat recovery boilers are produced by Hangzhou Boiler Group, Therefore, the successful implementation the proposed project will greatly contribute to transfer of advanced clean power generation technology to China.

1.10 Compliance with relevant local laws and regulations related to the project:

With the purpose of enhancing the development of renewable resources, increasing energy supply, improving the structure of energy resources, ensuring the security of energy resources, and achieving the economical and social sustainable development, the Chinese Renewable Energy Law was put into force on 1st June, 2006[1]. As a LNG Power Generation Project, the Project is compliant with Chinese Renewable Energy Law.
In addition, the project is also compliant with construction procedure and approval regulation published by State Planning Commission on 29 July 1999[2]. Hence, the project is in compliance with the Chinese relevant laws and regulations. The detailed laws and regulations related to the Project are explained in table 1.

Table 1 Description of the laws and regulations to the project

Item	Requirement by laws and regulations(Yes/No)	The real action of the project
Environmental Impact Assessments (EIA)	Yes	The EIA was approved by National Environment Protection Bureau on October 11th 2001.
Feasibility Study Reports (FSR)	Yes	The FSR was approved by NDRC on July 13th 2004.

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

There are some risks that may substantially affect the project's GHG emission reduction or removal enhancement:

[1] http://www.sepa.gov.cn/law/law/200802/t20080202_117982.htm.

[2] ttp://www.zhuhai.gov.cn/xxfw/zzjg/srmzf/sxzfwzx/bsfw/bsdt/fgj/yjwj/200711/t20071117_35701.html

Financial risk

According to the demonstration and assessment of additionality, the project faced investment and technical barriers and was economically unattractive, which showed it was an additional project. Therefore, risks that may substantially affect the project's CO_2 emission reductions will result from insufficient investment.

Natural disasters

Besides the risks mentioned above, the project's GHG emission reduction or removal enhancement may be affected by natural disasters, such as flood, typhoon, earthquake and snow or ice storm.

Conclusion

The VCU revenues will reduce the risks from financial risk and natural disasters, and improve the financial attraction. Therefore, the application of VCU provides a financial guarantee for achieving GHG emission reduction of the Project.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The Projects can supply less GHG-intensive electricity to the Guangdong Provincial Power Grid (GPPG) and CSPG. It generates less emission in operation period. Thus, the Project doesn't fall into categories that creating GHG emissions primarily for the purpose of its subsequent removal or destruction

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

The project developer confirmed that the project has not created another form of environmental credit.

1.14 Project rejected under other GHG programs (if applicable):

Not applicable.

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants:

The Project Developer, Guangdong Huizhou LNG Power Co., Ltd, is the Project Proponent. The roles and responsibilities of the Project proponent are explained in Table 2:

Table 2 Description of the roles and responsibilities of the Project proponent

Project proponents	Roles and responsibilities
Guangdong Huizhou LNG Power Co., Ltd.	- Construct and operate the Project - Apply VCU of the Project - Provide proof of title for validation and verification - Provide this VCS PD - Provide monitoring plan and report

	- Possess VCU

In the following table 3, the contact information of all project participants is shown.

Table 3 Contact information of the Project proponent

Organization:	Guangdong Huizhou LNG Power Co. Ltd
Street/P.O.Box:	Petrochemical Industrial Park of Daya Bay E & T Development Zone, Huizhou, PRC
Building:	Huizhou LNG Power Plant administration building
City:	Huizhou
State/Region:	Guangdong Province
Postfix/ZIP:	516082
Country:	P.R.China
Telephone:	+86752-5587058
FAX:	+86752-5587059
E-Mail:	wanghui@upperhorn.com
URL:	http://www.lngphz.cn
Represented by:	Huang Zhanxun
Title:	Manager of Production and Business Department
Salutation:	Ms.
Last Name:	Huang
Middle Name:	-
First Name:	Zhanxun
Department:	Dept.of General Affairs
Mobile:	+86-13927370891
Direct FAX:	+86752-5587058
Direct tel:	+86752-5587059
Personal E-Mail:	wanghui@upperhorn.com

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.):

Table 4 Key documents needed to be approved before construction of the Project:

Completing date	Title of the Documents needed to be approved before construction
05/2001	Environmental Impact Assessment Report (EIA)
11/10/2001	Approval of EIA
10/2002	Feasibility Study Report(FSR)
13/07/2004	Approval of FSR

1.17 List of commercially sensitive information (if applicable):

Not applicable.

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

Version 01.1 of AM0029: "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" (referred as The Methodology). More information about The Methodology can be found on the website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

The AM0029 also uses the version 06 of ACM0002: "Consolidated Methodology for Grid-connected Electricity Generation from Renewable Sources" and Version 05 of "Tool for the Demonstration and Assessment of Additionality".

2.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The version 01.1 of AM0029: "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" is applicable under the following conditions:

- The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant
- The geographical/physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating baseline emissions is publicly available.
- Natural gas is sufficiently available in the region or country, e.g. future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of natural gas in the project activity.

The Methodology is applicable for the proposed project for the following reasons:

- The proposed project is a new natural gas fired electricity generation plant. The electricity generated by the proposed project will be sold to the Guangdong Provincial Power Grid (GPPG), which is part of the CSPG. The primary fuel in the proposed project is LNG imported from Australia.
- The power grid (the CSPG) which the proposed project is to be connected to is clearly identified and information on the characteristics of this grid is publicly available.
- The LNG used in the proposed project only accounts for 14 percent of the total annual LNG imported from Australia. The terminal will annually import about 3.7 million tons of LNG from Australia's Northwest Shelf gas development project over the next 25 years and mainly supply gas to Shenzhen, Dongguan, Guangzhou, Foshan and Hong Kong and five power plants. The second phase of the LNG terminal is expected to raise the capacity of the LNG import to 6.2 million tons a year.Therefore, the additional natural gas based power capacity would not be constrained by the use of the natural gas in the project activity. All current gas users also signed take-or-pay (ToP) long-term contracts with the Guangdong Dapeng LNG, operator of the LNG project, which has contracted all LNG demand. Such long-term contract along the LNG chain makes sure that there is no supply constrain. Such clause also makes sure that the proposed project will not lead to fuel switch activity, thus no possible leakage.

Based on the aforementioned information, the Methodology is applicable to the proposed project..

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

According to the version 01.1 of AM0029, in the calculation of project emissions, only CO_2 emissions from fossil fuel combustion at the project plant are considered. In the calculation of baseline emission, only CO_2 emissions from fossil fuel combustion in power plants in the baseline are considered.
The GHGs included in or excluded from the project boundary are listed as follows:

	Source	Gas	Included?	Justification/Explanation
Baseline	Power generation in baseline.	CO_2	Yes	Main emission resource.
		CH_4	No	Excluded for simplification. This is conservativ
		N_2O	No	Excluded for simplification. This is conservativ
Project Activity	On-site fuel combustion due to the project activity	CO_2	Yes	Main emission resource
		CH_4	No	Excluded for simplification..
		N_2O	No	Excluded for simplification.

The project boundary of the proposed project includes the HLPGP project site and all power plants connected physically to the baseline grid. According to ACM0002, the baseline grid is defined as the China Southern Power Grid. Guangdong provincial grid is an integral part of the CSPG.

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

According to the version 01.1 of AM0029, the following steps are used to define the baseline scenario:

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

Sub-step 1a. Define alternatives to the project activity

In this step, all possible realistic and credible alternatives that provide outputs or services comparable with the proposed project are identified. The options should also be in compliance with all applicable legal and regulatory requirements. The existing and planned generation technologies within CSPG are listed as follows:

Alternatives	Output and Service	Plausibility
Natural Gas power generation using combined cycle gas turbine (CCGT) without VER.	Generation, full-year peak regulation capacity	Plausible for higher capacities. Meets all eligibility conditions
Natural Gas power generation using single Gas Turbine technology	Generation, full-year peak regulating capacity	Not Plausible. It is not widely used in CSPG because the thermal efficiency is lower than that of the CCGT[3]
Light Oil based power plants using CCGT	Generation, full-year peak regulating capacity	Plausible
Coal based power plant with Sub-critical boilers	Generation, full-year peak regulating capacity	Plausible
Coal based power plant with Supercritical boilers	Generation, full-year peak regulating capacity	Plausible
Wind	Generation	Not plausible. It will not deliver outputs and services

[3] http://www.china5e.com/gasturbine/introduction.php

		for peak load.
Nuclear	Generation	Not plausible. It will not deliver outputs and services for peak load.
Hydro Run-of-river	Generation	Not plausible. It will not deliver outputs and services comparable to the project activity with full-year peak regulation capacity.
Hydro Daily regulating	Generation, Daily peak regulating capacity	Not plausible. It will not deliver outputs and services comparable to the project activity with full-year peak regulation capacity.
Hydro Monthly regulating	Generation, Monthly peak regulating capacity	Not plausible. It will not deliver outputs and services comparable to the project activity with full-year peak regulation capacity.
Hydro Seasonal regulating	Generation, Seasonal peak regulating capacity	Not plausible. It will not deliver outputs and services comparable to the project activity with full-year peak regulation capacity.
Hydro Yearly regulating	Generation, partly peak peak regulating capacity	Not plausible. Given the construction period of hydro project with yearly or multi-yearly regulating capacity is almost 8-12 years in Yunnan province. The long construction period of hydro power makes it impossible to supply peak regulation capacity to meet the peak load of GPPG within 3-5 years.
Hydro Multi year regulating	Generation, full-year peak regulating capacity	Not plausible. Given the construction period of hydro project with yearly or multi-year regulating capacity is almost 8-12 years in Yunnan province. The long construction period of hydro power makes it impossible to supply peak regulation capacity to meet the peak load of GPPG within 3-5 years.
Import	Import from Three Gorgers	Not plausible. It will not deliver outputs and services comparable to the project activity with full-year peak regulation capacity.

According to AM0029, the selected alternatives need not consist solely of power plants of the same capacity, load factor and operational characteristics. It could be several smaller plants, or the share of a larger plant. Thus, from the above analysis, following are the plausible baseline alternatives:

Fuel	**Technology**	**Output**
Natural Gas	CCGT	Generation, full year peak regulating capacity
Light Oil	CCGT	Generation, full year peak regulating capacity
Coal	Sub critical	Generation, full year peak regulating capacity
Coal	Supercritical	Generation, full year peak regulating capacity

The efficiency and technical life time of the previous technologies are listed in the next step.

Step 2: Identify the economically most attractive baseline scenario alternative.

According to the version 01.1 of AM0029, the economically most attractive baseline scenario alternative is identified using levelied cost as a financial indicator. The basic levelised cost methodology used in this PD is based on "Projected Costs of Generation Electricity" published by IEA. The formula applied to calculate the levelised electricity generation cost (EGC) is the following:

$$EGC = \frac{\sum_t \left[(I_t + M_t + F_t)(1+r)^{-t}\right]}{\sum_t \left[E_t\left((1+r)^{-t}\right]}$$

With:
EGC: Average lifetime levelised electricity generation cost per kWh.
I_t: Capital expenditure in the year t.
M_t: Operation and maintenance expenditures in the year t.
F_t: Fuel expenditure in the year t.
E_t: Electricity generation in the year t.
r: Discount rate.

The relevant assumptions and parameters are listed as following:

Table 1 Parameters for Coal-fired, NG and oil-fired CCGT

Item	Unit	300MW Coal-fired sub-critical	600MW Coal-fired supercritical	600MW Coal-fired sub-critical	180 MW Oil fired CCGT	300 MW NG CCGT
Investment Cost	RMB/kW	4515	4074	3938	3137	3106
Material Expenditure	RMB/MWh	6	5	5	16	8
Other O&M Expenditure	RMB/MWh	12	10	10	18	12
Water Expenditur	RMB/MWh	1	1	1	1	1
Annual wage	Million RMB	6.2	10.3	10.3	6	6
Power generation coal consumption (PGCC)	gce/kWh	320	299	312	225	0.1815
Annual generating hours	h	5000	5000	5000	3500	3500

Source: Design reference cost index for thermal power transmit electricity and transformer electricity projects (2004), 2005 April, China Electrical Power Press.

Table2 Fuel expenditure for different technologie

Fuel	Fuel	Cost
Coal	192.64 RMB/tce (including desulphurization cost)	National Economic Operation Anaysis of Coal Enterprises of from Jan. to May, 2004 http://www.chinacoal.gov.cn/jingjiyunxing/node_4623.ht m
NG	1.55 RMB/Nm3	Huizhou LNG Porject's Natural gas sales and purchase contract
Fuel oil	2100 RMB/t	"Notice of electricity price of oil-fire power plants floating with price of fuel oil" issued by the Guangdong Province Price Supervision Bureau on July. 2003. http://www.lawon.cn/law/viewDetail.jsp?id=72965

Table 3 Construction period and technical lifetime

Technology	Construction	Life time
300MW coal fired plant	3 years	20 Years
600 MW coal fired plant subcritical	4 years	20 Years
600 MW coal fired plant supercritical	4 years	20 Years
CCGT (oil fired	2 years	20 Years
NG CCGT	3 years	20 Years

Source: Design reference cost index for thermal power transmit electricity and transformer electricity projects (2004), 2005 April, China Electrical Power Press.

Based on the above parameters and levelised cost calculation formula, the levelised cost of corresponding generation technology can be calculated and listed in the following table.

Table 4 Result and sensitive analysis of Levelised cost

Fuel	Levelised Cost	Load Factor		Fuel Cost	
	RMB/kWh	+10%	-10%	+10%	-10%
300MW coal fired plant	0.2427	0.2280	0.2607	0.2489	0.2365
600 MW coal fired plant subcritical	0.2195	0.2063	0.2358	0.2253	0.2138
600 MW coal fired plant supercritical	0.2173	0.2045	0.2330	0.2233	0.2113
CCGT (oil fired	0.6366	0.6248	0.6510	0.6838	0.5893
NG CCGT	0.4324	0.4206	0.4469	0.4605	0.4043

According to the version 01.1 of AM0029, the baseline alternatives with the best financial indicator, i.e. the lowest levelised cost, can be pre-selected as the most plausible scenario. Then the 600 MW subcritical coal-fired power plant has the lowest levelised cost, then the most plausible scenario. The sensitive analysis in the previous table confirms and supports that the 600 MW subcritical coal-fired power plant is always the least levelised cost alternatives within reasonable variations in the critical assumptions.

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would

have occurred in the absence of the project activity (assessment and demonstration of additionality):

According to the version 01.1 of AM0029, the project proponent is required to demonstrate that the GHG reductions from the project activity are additional to those that would have occurred in absence of the project activity. The assessment of additionality demonstrates that the proposed project activity is unlikely to be financially attractive and is not common practice in the relevant sector by applying two specified steps of the Version 05 of "Tool for the demonstration and assessment of additionality"

The following Timeline provides background information that is helpful in appreciating the barriers the Project has encountered and continues to face. In accordance with the CDM registration process, the Project Company can provide the CDM validator with documentation and access to the responsible persons to substantiate the timeline and assertions made in the PD.

Timeline of the Project Preparation:

August 2002	The project entity acknowledged the CDM and its potential contribution on NG generation project in August 2002[4]
July 2003	The project entity submitted Feasibility Study Report (FSR) to NDRC for approval in July 2003
February 2004	The project entity commissioned a revision of Financial Assessment (FA), taking into account the CDM's contribution in mitigating project risk and improving its financial performance in February 2004[5].
July 2004	The submitted FSR was approved by NDRC in July 2004.

According to the above Timeline, as early as February 2004, the project entity had commissioned a revision of the FA to take the potential CDM revenue into account based on a case study for a similar natural gas-fired power generation project[6] and the latest data on the gas price and quantity. According to the Shareholders Meeting Minutes dated May 26, 2004, to ensure financial viability of the project, the shareholders has also actively got down to the preparation for application of CDM even when the Kyoto Protocol was not yet in force and no relevant methodology was available.

It has been demonstrated in the revision of FA that without the CDM revenue, the Internal Rate of Return (IRR) of the project would be 6.12 percent, which was 2 percent lower than the industry benchmark of 8 percent[7]. With the CDM revenue, the IRR would be 8.18 percent, barely surpassing the industry benchmark.

To meet the high investment cost of the LNG power plant, the project entity has to seek additional financial support from commercial banks. China Industrial and Commercial Bank (CICB)[8] has agreed to extend a loan to the project entity only on the understanding that the project risks would be partially compensated by the potential CDM revenue.

Step 1: Benchmark investment analysis.

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[4] Environmental Development &Carbon Credit Meeting on August 20,2002

[5] Agreement on Finanacial Assessment on Huizhou LNG Power Plant with Guangdong Electric Power Design Institute dated February 17,2004.

[6] *Case Study of Clean Development Mechanism Project of Zhuhai Power Plant Project Phase II*", Energy Research Institute of the NDRC & Global Climate Change Institute, Tsinghua University, November 2003

[7] State Power Corporation of China. "Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects". Beijing: China Electric Power Press, 2003.

[8] 8."*Supplementary statement on loan evaluation report of Guangdong Huizhou LNG project*", China Industrial and

Commercial Bank, Guangdong Branch, January 23, 2006

For determining the financial attractiveness of the proposed project activity, project proponent has taken into consideration all the financial parameters relevant to the project activity and has also conducted sensitivity analysis to reflect the impacts of probable realistic variations of key parameters.

Sub-step 1a. Apply Benchmark Analysis

According to the *"Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects"*[9], the Financial benchmark rate of return (after tax) of Chinese Power Industries is 8% of the total investment IRR[10]. This benchmark is widely used for power project investments in China and all the power projects in China are considered viable by the government only if the guaranteed returns of minimum 8% on the capital are ensured. In line with that, the feasibility study of the proposed project and the benchmark investment analysis in this PDD adopt 8% as benchmark FIRR.

Sub-step 1b. Calculation and comparison of financial indicators.

Table 5 summarizes the data used in the calculation of the project IRR.

Table5 Main parameters for calculation of financial indicators

Basic Parameters	**Value**	**Unit**	**Data Source**
Installed capacity	1083.9	MW	FSR
Electricity generation	3703.5	GWh	Natural gas sales and purchase contract
Fixed assets	3600.17	Million RMB	FSR
Electricity tariff (Excluding VAT)	418.63	RMB/MWh	FSR
Auxiliary electricity consumption rate	2.40%		FSR
Power generation gas consumption	0.1797	m3/kWh	FSR
Water expenditure	0.28	RMB/MWh	FSR
Material expenditure	3.21	RMB/MWh	FSR
Overhaul of equipment	3.35%		FSR
Persons	165	persons	FSR
Annual average wage	60000	RMB/Year	FSR
Welfare	55%		FSR
Operating management expenditure	11.62	RMB/MWh	FSR
Gas price (Including VAT)[11]	1.55	RMB / m3	Natural gas sales and purchase contract
Insurance	0.25%		FSR
Depreciation period	15	Years	FSR
Fixed assets residue	5%		FSR
Income tax	33%		FSR
Construction tax	5%		FSR
Education surcharge	3%		FSR

[9] State Power Corporation of China. "Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects". Beijing: China Electric Power Press, 2003.

[10] Please refer to Article 1.11.,*Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects*. State Power Corporation of China. , Beijing: China Electric Power Press, 2003

[11] The gas price quoted in the financial projection was based on the LNG sales and purchase contract. The gas price is subject to change based on the pricing clause in the contract with a correlation to the price fluctuation of crude oil. The current gas price of 1.5961RMB/m3 was not reflected in the calculation of financial indicator as the project's additionality should be reviewed back in 2004 when the final investment decision was made by the project sponsor.

Public accumulation fund	10%		FSR
Public commonweal fund	5%		FSR
Operation period	20		FSR

All IRR calculations reported in this section are based on data in the Feasibility Study approved by National Development Reform Committee (NDRC) in July 2004 unless otherwise noted. All financial data used to calculate the Financial Internal Rate of Return (FIRR) of the project activity with and without VER revenues have been provided to the DOE together with the copy of the actual purchasing contracts and invoices.
The financial indicators (FIRR) with and without income from VCUs and CERs sales are summarized in Table 8. Without income from VCUs sales, the FIRR of the proposed project is 6.12 percent, which is much lower than the benchmark FIRR of 8 percent. As a result, the proposed project is financially unattractive because of its low profitability. With income from VCUs and CER sales, the FIRR of the proposed project is slightly higher than the 8 percent benchmark.

Table 6 Comparison of financial indicators with and without income from VCUs

	Without income fromVCUs	Benchmark	With income from VCUs
FIRR (%)	6.12	8	8.06

,
Sub-step 1c. Sensitivity analysis.
Five factors are considered in the following sensitivity analysis:
1) Total investment.
2) Gas price.
3) Annual electricity generation.
4) Electricity tariff
5) Annual O&M Costs
Assuming the above five factors vary in the range of -10% to +10%, the FIRR of the proposed project (without income from CERs sales) varies to different extent, as shown in Table 7 and Figure 4.

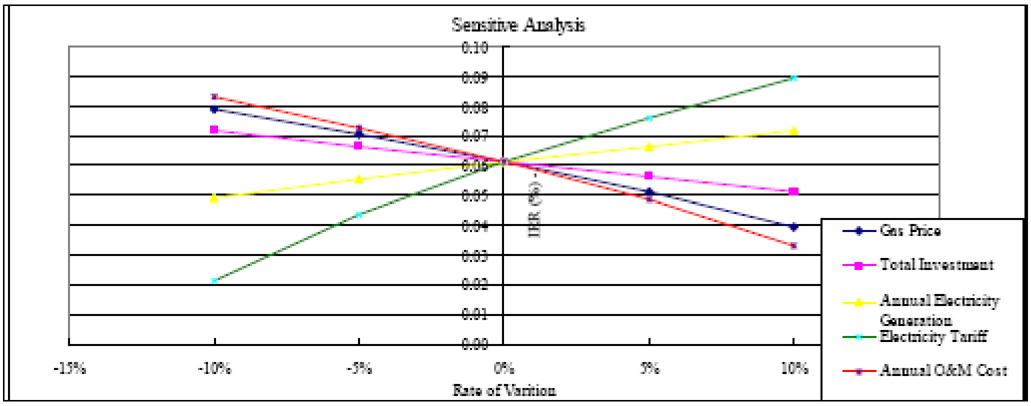

Figure 4 Sensitivity analysis of the Project

Table7 Sensitivity analysis

Change Factor	**-10%**	**-5%**	**0**	**5%**	**10%**
IRR with the change of gas price	**7.92**	**7.05**	**6.12**	**5.11**	**3.93**
IRR with the change of total investment	**7.19**	**6.64**	**6.12**	**5.61**	**5.12**

IRR with the change of annual electricity generation	**4.93**	**5.54**	**6.12**	**6.65**	**7.18**
IRR with the change of electricity tariff	**2.15**	**4.39**	**6.12**	**7.60**	**8.96**
IRR with the change of annual O&M Cost	**8.31**	**7.25**	**6.12**	**4.86**	**3.34**

As seen in Figure 4, with variation in each parameter between the range of -10% and +10%, the IRR of the proposed project without CER revenue varies to different extents. It is found that the IRR is most sensitive to the variation in electricity tariff. If the electricity tariff increases by 6.4%, the IRR will reach the benchmark of 8 percent. However, the electricity tariff is unlikely to increase by 6.4 percent considering that it is strictly regulated by the government[12]and decreasing electricity tariff stipulated by the regulations.[13] Annual O&M cost is the second most important factor affecting the fluctuation of the project IRR. IRR will reach the benchmark when annual O&M costs decreases by 9%. In the proposed project, main pieces of equipments in the project are imported and the maintenance service of CCGT units are provided by foreign manufacturers. It is shown that the price of raw material has been increasing[14] in recent years, therefore the O&M costs of the project are highly unlikely to decrease by 9 percent in the foreseeable future.
From Table 7, it is clear that the project IRR is also sensitive to variation of natural gas price. When the price decreases by more than 10%, the project IRR can achieve the benchmark. The gas price is subject to adjustment based on the pricing clause in the LNG sales and purchase contract, with a correlation to the price fluctuation of crude oil. The natural gas price is increasing these years[15] with current price rising to 1.5961 Yuan/m3[16], therefore it is highly unlikely that the natural gas price will decrease by 10%. The impacts of the annual electricity generation and total investment are less significant. If annual electricity generation increases by about 19%, the IRR begins to exceed the benchmark. Because the annual electricity generation depends on the gas supply contract, the IRR will not exceed the benchmark 8%. If the total investment decreases by about 17%, the IRR begins to exceed the benchmark. The raw material price is increasing these years[17], therefore the IRR will not exceed the benchmark 8%.

In sum, it is clear that with reasonable variations in the critical assumptions, annual electricity generation, total investment, gas price, electricity tariff and annual O&M costs, the FIRR of proposed project is always lower than the investment benchmark. Therefore, without revenues from the sale of CERs; the project lacks financial attractiveness.

Step 2: Common practice analysis.

Sub-step 2a. Analyze other activities similar to the proposed project activity.

Step 4 of the latest “Tool for the demonstration and assessment of additionality (Version 05)” prescribes that activities similar to the proposed project activity should be considered for the common practice analysis. Similar project activities include:

 Those activities that are implemented previously or currently underway

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[12] http://www.nnpn.gov.cn/zcfg/guojia/2001/2001g701.htm

[13] http://www.gzwjj.gov.cn/infomake2004/homepage/view/paper.asp?pap_no=PAP_040101_00365

[14] http://finance.jrj.com.cn/news/2008-04-14/000003523708.html

[15] http://okokok.com.cn/Htmls/GenCharts/080215/7037.html

[16] Refer to the Notice of the Price of Natural Gas from Guangdong Dapeng Company issued by Bureau of Commodity Price of Guangdong Province [Yuejia 2007 Doc No.190].

[17] http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20050228_402231854.htm

 Projects in the same region and/or rely on a broadly similar technology;
 Projects are of similar scale;
 Projects take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.

During 2002-present, there was no gas-fired electricity generating capacity in CSPG. It is clear that gasbased power plant is not a common practice within the project boundary. The HLPGP is one of the first LNG CCGT power plants in SCPG. Other three similar projects: Shenzhen Qianwan LNG power plant, Shenzhen Dongbu LNG power plant and Zhujiang LNG power plant are all in the process of applying as CDM projects.

Sub-step 2b. Discuss any similar options that accruing.

NG fired power stations are not widely available in CSPG, the grid boundary in the PD. The reasons for low penetration of similar activities are explained in the investment analysis section. Also, low penetration of LNG based power generation in the country is due to inadequate gas supply as well as pipeline infrastructure. Thus, the proposed project is additional.

Step 3: Impact of CDM registration.

According to the Additionality Step 3 of the latest AM0029, an analysis of impact of CDM registration is stated as follows:

Besides greenhouse gas emissions reduction, the following positive impacts of the approval and registration of the proposed project activity were anticipated at the beginning of the project activity:

 CDM revenue is important for the project's sustainability by greatly improving the financial performance of the proposed project and overcoming the investment benchmark. The project owner would be more confident in successful implementation of the proposed project.

 As China aims to diversify its energy sources away from carbon intensive sources such as coal and fuel oil to a cleaner fuel such as natural gas, the registration of the proposed project activity will be an important catalyst to encourage other prospective developers to invest in natural gas fired combined cycle power plants, which would lead to further reduction in GHG emissions.

The additionality analysis of the proposed project has clearly demonstrated that the proposed project is additional, according to the version 01.1 of AM0029 and Tool for the demonstration and assessment of additionality version 5.0

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

The project is LNG Power Generation Project, so it meets all the applicable criteria of following methodology:

Version 01 of AM0029: "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" (referred as The Methodology). More information about The Methodology can be found on the website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

The version 06 of ACM0002: "Consolidated Methodology for Grid-connected Electricity Generation from Renewable Sources"

Tool for the demonstration and assessment of additionality (Version 05).

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches:

Purpose of monitoring

Monitoring is a key procedure to verify the real and measurable emission reductions from the proposed project. To guarantee the proposed project's real, measurable and long-term GHG emission reductions, the monitoring plan is established.

Origin of the data

The electricity output by the Project will be continuously measured by the ammeters located in the project site. The project site will install three series of measurement and monitoring equipments, one as the main equipment and the other as standby. The LNG consumption will be continuously measured by the flow meters located in the project site.

Monitoring, including estimation, modelling, measurement or calculation approaches

Described in 4.3

Monitoring times and periods
The electricity output and LNG consumption by the Project will be continuously measured by the meters located in the project site.

Monitoring roles and responsibilities and Managing data quality

The monitoring plan will be executed and implemented by the monitoring principal who is appointed by the project developer. The local power grid company and Natural supplier should cooperate in the check of data.

3.3 Data and parameters monitored /Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

A:Monitoring parameters for the Baseline emission:

Data / Parameter:	Build Margin emission factor ($EF_{BL,CO2,y}$)
Data unit:	t CO_2/ MWh
Description:	E Build Margin emission factor of the grid in tonnes of CO_2 per MWh.
Source of data to be used:	NDRC of China will update the BM every year, which has been thoroughly checked and has been compiled in the best possible manner and therefore is considered to be a reliable data resource. Such data if available in a timely manner shall be used. Otherwise, this parameter shall be calculated based on the procedures described in section 4.2 and the relevant parameters should be monitored ex-post.
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	0.6748 t/MWh.
Description of measurement methods and procedures to be applied:	The real BM will be determined ex-post
QA/QC procedures to be	The uncertainty level of this data is low. This is calculated

applied:	based on data collected from official/ reliable data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as per Monitoring Plan. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

Data / Parameter:	$F_{i,j,y}$
Data unit:	Mt, Mm^3
Description:	the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources j in year(s) *y*
Source of data to be used:	China Energy Statistical Yearbook
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	Official statistical data
QA/QC procedures to be applied:	Official data, no QA/QC needed..
Any comment:	

Data / Parameter:	NCV_i
Data unit:	*TJ/ mass or volume unit of a fuel*
Description:	the net calorific value (energy content) per mass or volume unit of a fuel *i*
Source of data to be used:	China Energy Statistical Yearbook
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	National and official data
QA/QC procedures to be applied:	Official data, no QA/QC needed..
Any comment:	

Data / Parameter:	$OXID_i$
Data unit:	%
Description:	the oxidation factor of the fuel *i*
Source of data to be used:	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	National data not available, so IPCC default values are used.
QA/QC procedures to be applied:	IPCC data,, no QA/QC needed..

Any comment:	

Data / Parameter:	***$EF_{CO2,i}$***
Data unit:	tCO_2e/TJ
Description:	the CO_2 emission factor per unit of energy of the fuel *i*
Source of data to be used:	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	National data not available, so IPCC default values are used.
QA/QC procedures to be applied:	IPCC data,, no QA/QC needed..
Any comment:	

Data / Parameter:	$G_{j,\ y}$
Data unit:	MWh
Description:	the amount of electricity generation by source *j* in year *y*
Source of data to be used:	China Electric Power Yearbook
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	Official statistical data
QA/QC procedures to be applied:	Official data,, no QA/QC needed..
Any comment:	

Data / Parameter:	$e_{j,y}$
Data unit:	%
Description:	station service power consumption rate of source *j* in year *y*
Source of data to be used:	China Energy Statistical Yearbook
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	Official statistical data
QA/QC procedures to be applied:	Official data,, no QA/QC needed..
Any comment:	

Data / Parameter:	$EE_{coal,adv}$
Data unit:	%
Description:	Efficiency of most advanced coal-fired power technology that is

	commercially available
Source of data to be used:	Notice on the determination of emission factors of regional power grids by Chinese CDM DNA or other official statistics data.
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	36.53
Description of measurement methods and procedures to be applied:	Official statistics of state power authority
QA/QC procedures to be applied:	Official data,, no QA/QC needed..
Any comment:	

Data / Parameter:	$EE_{oil,adv}$
Data unit:	%
Description:	Efficiency of most advanced oil-fired power technology that is commercially available
Source of data to be used:	Notice on the determination of emission factors of regional power grids by Chinese CDM DNA or other official statistics data.
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	45.87
Description of measurement methods and procedures to be applied:	Official statistics of state power authority
QA/QC procedures to be applied:	Official data,, no QA/QC needed..
Any comment:	

Data / Parameter:	$EE_{gas,adv}$
Data unit:	%
Description:	Efficiency of most advanced gas-fired power technology that is commercially available
Source of data to be used:	Notice on the determination of emission factors of regional power grids by Chinese CDM DNA or other official statistics data.
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	45.87
Description of measurement methods and procedures to be applied:	Official statistics of state power authority
QA/QC procedures to be applied:	Official data,, no QA/QC needed..
Any comment:	

Data / Parameter:	$CAP_{j,y}$
Data unit:	MW
Description:	Installed capacity of source *j* in year *y* in SCPG

Source of data to be used:	China Energy Statistical Yearbook or other official statistical data.
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	See Annex 1 for details
Description of measurement methods and procedures to be applied:	Official statistical data
QA/QC procedures to be applied:	Official data,, no QA/QC needed..
Any comment:	

B Monitoring parameters for project activity and Leakages

Data / Parameter:	$FC_{LNG,y}$
Data unit:	t
Description:	Annual quantity of LNG consumed in project activity
Source of data to be used:	LNG flow meter reading at project boundary
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	506100
Description of measurement methods and procedures to be applied:	The LNG flow rate will be monitored through a ultrasonic flow meter continuously both by supplier and project owner. The LNG consumption will be aggregated automatically and recorded daily. These flow meters have an accuracy of 0.5% and will be calibrated in-site every month.
QA/QC procedures to be applied:	The total LNG consumption will be monitored both at supplier and project end for cross-verification. Natural gas supply metering to the project will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the gas supply company. The power plant will use the gas turbine generator control system to measure the gas fuel flow for cross-verification.
Any comment:	

Data / Parameter:	$NCV_{f,y}$
Data unit:	GJ/t
Description:	Net Calorific Value of LNG
Source of data to be used:	Supplier-provided data
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	49.39
Description of measurement methods and procedures to be applied:	The data used for ex-ante estimation is the country specific value from Chinese Energy Statistical Yearbook. The supplier-provided data will be used instead of country specific value once the project is put into operation. Data will be archived for 2 years following the end of the crediting period by means of electronic and paper backup.
QA/QC procedures to be applied:	No additional QA/QC procedures need to be planned

Any comment:	

Data / Parameter:	$EF_{CO2,LNG,y}$
Data unit:	tCO_2/GJ
Description:	Emission factor for LNG consumed in the project activity
Source of data to be used:	IPCC default value
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	0.0561
Description of measurement methods and procedures to be applied:	The IPCC default value
QA/QC procedures to be applied:	No additional QA/QC procedures need to be planned.
Any comment:	

Data / Parameter:	$FC_{Diesel,y}$
Data unit:	t
Description:	Annual quantity of Diesel as startup fuel consumed in project activity
Source of data to be used:	Diesel flow meter reading for startup usage
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	0
Description of measurement methods and procedures to be applied:	The diesel used for startup fuel will be recorded daily.
QA/QC procedures to be applied:	No additional QA/QC procedures need to be planned.
Any comment:	

Data / Parameter:	$NCV_{Diesel,y}$
Data unit:	GJ/t
Description:	Net Calorific Value of Diesel
Source of data to be used:	Country specific
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	42.65
Description of measurement methods and procedures to be applied:	The NCV of diesel available at Chinese Energy Statistical Yearbook (annually published) will be used country specific value
QA/QC procedures to be applied:	No additional QA/QC procedures need to be planned.
Any comment:	Supplier-provided data will be used if available.

Data / Parameter:	$EF_{CO2,Diesel,y}$
Data unit:	tCO_2/GJ

Description:	Emission factor for diesel consumed as startup fuel in the project activity
Source of data to be used:	IPCC default value
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	0.0741
Description of measurement methods and procedures to be applied:	The IPCC default value
QA/QC procedures to be applied:	No additional QA/QC procedures need to be planned.
Any comment:	

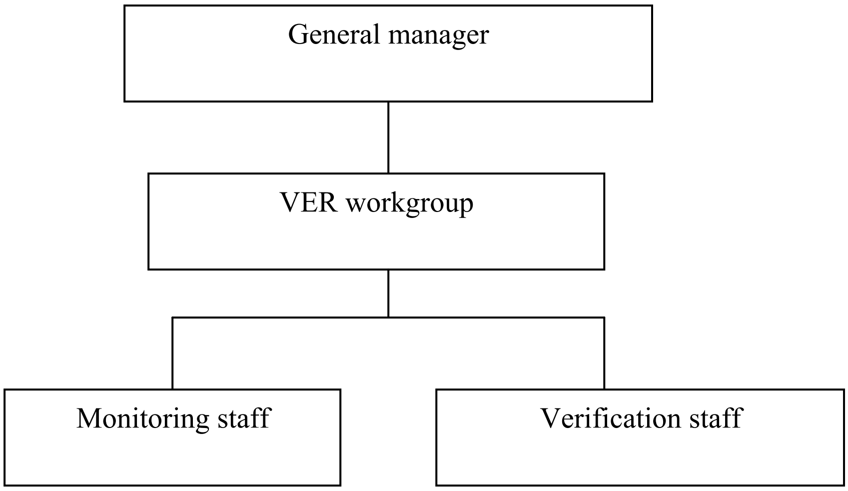
Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity supplied to the grid by the project
Source of data to be used:	Electricity meter reading at project boundary
Value of data applied for the purpose of calculating expected emission reductions in section 4.2	3703514
Description of measurement methods and procedures to be applied:	The readings of electricity meter will be hourly measured and monthly recorded. Data will be archived for 2 years following the end of the crediting period by means of electronic and paper backup. The metering equipments are ZMQ202C.6r4af6 with an accuracy of 0.2s.
QA/QC procedures to be applied:	The electricity output from each turbine will be monitored and recorded at the on-site control centre using a computer system. The project operator is responsible for recording this set of data. The electricity meters shall be calibrated once half a year by Guangdong Electric Power Science Institution according to the national calibration criterion 'JJG 596-1999' and 'JJG 307- 2006'. Electricity sales invoices will also be obtained for double check
Any comment:	Electricity supplied by the project activity to the grid. Double check by receipt of sales.

3.4 Description of the monitoring plan

The following steps will be taken to ensure accurate and consistent data is collected for monitoring and verification purposes:

Operational and Management Structure

A VER workgroup will be established to carry out the monitoring activity of the proposed project and other relevant tasks. The organization of the VER workgroup is shown in the following chart. The monitoring staff is responsible for recording and archiving the monitoring data in line with the monitoring manual. The verification staff is responsible for rechecking the data and completing verification report for DOE.



Formulate VER Monitoring Manual
A monitoring manual will be formulated as guidance for regular monitoring activity. The manual will cover the following contents:
1. Parameter to be monitored
2. Recording Frequency
3. Recording Format
4. Archive
5. Meter Calibration
Natural gas is supplied by Guangdong Dapeng Bay LNG through its pipeline from LNG terminal up to the power plant. Guangdong Dapeng Bay LNG has the necessary pressure regulation, conditioning and metering station at their gas supply terminal near power plant to ensure proper monitoring and quantification of gas intake in the power plant. LNG used in the gas turbine will be measured in the supplier’s terminal near power plant through a Daniel® Ultrasonic Flow Mete. Two ultrasonic flow meters will be installed in the supply terminal near power plant, one is master meter and another is for backup. These flow meters have an accuracy of 1.0% and have been calibrated in-site every year.
The power plant will use the gas turbine generator control system to monitor the accurate gas fuel flow and such data will be recorded daily for cross-verification with the data from gas supplier.
The gas supplier have prepared a daily report to the power plant which includes the daily gas used and it relevant NCV.
Training Procedure
Specific training sessions regarding the operation and maintenance of measurement equipments will be organized to strengthen capacity of monitoring staff by equipment suppliers and Dapeng Bay LNG terminal. All the staff mentioned above have also participate training session on general operation and management issues in the context of the proposed project.
Emergency Preparedness for Unintended Emissions
The emergency plan for LNG leakage and fire has been prepared in line with “*Safety Production Law of the People's Republic of China* ” and “*Fire Prevention and Control of the People's Republic of China*” to minimum damages as well as LNG emissions in the case of emergency. The plan has taken into effect since May 2006 and is available to be presented to DOE upon request.

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

The calculation of the GHG emission reductions by the proposed project is followed the baseline methodology AM0029 (Ver1.1) and ACM0002 (Ver06). The project electricity system of the proposed project is defined as the CSPG.

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

Calculate Baseline Emission Factor ($EF_{BL,CO2}$)

According to the version 01.1 of AM0029, the baseline emission factor $EF_{BL,CO2}$, is the lowest emission factor among the following three options:

Option 1. The build margin ($EF_{BL,BM}$), calculated according to ACM0002; and

Option 2. The combined margin ($EF_{BL,CM}$), calculated according to ACM0002, using a 50/50 OM/BM weight, then $EF_{BL,CM}$=0.5$EF_{BL,BM}$+0.5$EF_{BL,OM}$, where $EF_{BL,OM}$ is the operational margin calculated according to ACM0002.

Option 3. The emission factor of the technology (and fuel) identified as the most likely baseline scenario under Section 2.4, and calculated as follows:

$$EF_{BL,CO_2,Option3} = \frac{COEF_{BL}}{\eta_{BL}} \times 3.6GJ/MWh \quad (1)$$

Where,

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

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

As described in Section 2.4, the 600 MW subcritical coal-fired plant has been identified as the most likely baseline, then emission coefficients of coal can be calculated as follows:

$$COEF_{Coal} = NCV_{Coal} \times EF_{CO_2,Coal,y} \times OXID_{Coal} \quad (2)$$

Where:

$COEF_{Coal}$: is the emission coefficient of coal in tCO_2/tce.

NCV_{Coal}: is the net calorific value of coal (GJ/tce), value from China Energy Statistics Yearbook 2004 has been adopted.

$EF_{CO2,Gas,y}$: is the CO_2 emission factor per unit of energy of coal in year y (tCO_2/GJ), which is determined by IPCC default value.

$OXID_{Coal}$: is the oxidation factor of coal, the IPCC default value will be used.

Then the formula (1) can be translated into the following one:

$$EF_{BL,CO_2,Option3} = COEF_{Coal} \times PGCC_{BL} / (1 - \gamma_{selfuse}) \quad (3)$$

$COEF_{Coal}$: is the emission coefficient of coal in tCO_2/tce.

$PGCC_{BL}$: is the power generation coal consumption of the most likely baseline technology identified in previous step, 600 MW subcritical coal-fired plant in the PDD, in tce/MWh.

$r_{selfuse}$: is the rate of power generation self-consumed by the power plant.

Calculate the Operating Margin emission factor ($EF_{BL,OM}$)

According to ACM0002, version 06, four alternatives could be used to calculate the OM:

a) Simple OM

b) Simple adjusted OM, or

c) Dispatch Data Analysis OM, or

d) Average OM.

Dispatch data analysis should be the first methodological choice. Where this option is not selected project participants shall justify why and may use the simple OM, the simple adjusted OM or the average emission rate method taking into account the provisions outlined hereafter.

The Simple OM method (a) can only be used where low-cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normal for hydroelectricity production.
The average emission rate method (d) can only be used where low-cost/must run resources constitute more than 50% of total grid generation and detailed data to apply option (b) is not available, and where detailed data to apply option (c) above is unavailable.
The Simple OM, simple-adjusted OM, and average OM emission factors can be calculated using either of the two following data vintages for years(s) y:

- (ex-ante) the full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission, if or,
- the year in which project generation occurs, if $EF_{OM,y}$ is updated based on ex-post monitoring.

For The Project, the simple Operating Margin emission factor was chosen based on the following two reasons:
1. In China, the State Grid Corporation run the interregional dispatch system and each regional grid corporation run the intraregional dispatch system. The dispatch information is regarded as business secrets and not available to the public.
2. For the most recent 5 years (2001-2005), the low-cost/must run resources constitute less than 50% of total: 33.72%, 32.98%, 30.59%, 29.71% and 30.41% for 2001, 2002, 2003, 2004 and 2005[22].
As a result, the simple OM method can be used.
The OM in this PDD is calculated ex-ante based on the most recent 3 years data.
The Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{BL,OM} = \frac{\sum_{i,j} F_{i,j} \times COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (4)$$

Where,
$F_{i,j,y}$ is the amount of fuel i consumed (ton for solid and liquid fuel, m^3 for gas fuel) by relevant power sources j in years y,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and mustrun power plants, and including imports to the grid.
$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel i (tCO_2/t for solid and liquid fuel, tCO_2/m^3 for gas fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in years y, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.
The fuel consumption data for generation is extracted from energy balance table in China Energy Statistical Yearbook. The generation data is extracted from China Electric Power Yearbook. In the China Electric Power Year Book and other data resources, only generation data by fuel type is available. The generation from source j can be translated into electricity delivered to the grid by source j by excluding the plant self consumption part (please see B.6.2)

Calculate the Build Margin emission factor ($EF_{BL,BM}$)
According to ACM0002, the BM is calculated as the generation-weighted average emission factor of a sample of power plants m, as follows:

$$EF_{BL,BM} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m,y}}{\sum_{m} GEN_{m,y}} \quad (5)$$

Where
$F_{i,m,y}$ is the amount of fuel i (tce) consumed by plant m in year y.
$COEF_{i,m,y}$ is the CO_2 emission coefficient (tCO_2/tce) of fuel i, taking into account the carbon content of the fuels used by plant m and the percent oxidation of the fuel in year y.
$GEN_{m,y}$ is the electricity (MWh) delivered to the grid by plant m, equals to generation minus plant self consumption:
Project participants shall choose the sample of power plants m between one of the following two options.
The choice among the two options should be specified in the PDD, and cannot be changed during the crediting period.
Option 1. Calculate the Build Margin emission factor $EF_{BL,BM}$ *ex-post* based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m consists of either the five power plants that have been built most recently, or the power plant 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 from these two options that sample group that comprises the larger annual generation.
Option 2. For the first crediting period, the Build Margin emission factor $EF_{BL,BM}$ must be updated annually *ex-post* for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BL,BM}$ should be calculated *ex-ante*, as described in option 1 above. The sample group m consists of either the five power plants that have been built most recently, or the power plant 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 from these two options that sample group that comprises the larger annual generation.
In this PD, the BM is determined ex-post based on option 1.
A direct application of this approach is difficult in China. The Executive Board (EB) has provided guidance on this matter with respect to the application of the AMS-1.D and AM0005 methodologies for projects in China on 7 October 2005 in response to a request for clarification by DNV on this matter. The EB accepted the use of capacity additions to identify the share of thermal power plants in additions to the grid instead of using power generation.
The calculation of the published BM Emission Factor is based on this approach and is described below:
First，we calculate the share of the CO_2 emission factors of the solid fuel, liquid fuel and gas fuel in total emissions respectively by using the latest energy balance data available.
Second, the calculated shares are the weights. Using the emission factor for advanced efficient technology we calculate the BM emission factor for thermal power;
Third, use the BM emission factor to multiply the emission factor of the thermal power with the share of the thermal power in 20% of the newly-added capacity of the power grid.
Detailed steps and formulas are as below:
First, we calculate the share of CO_2 emissions of the solid, liquid and gas fuel in total emissions respectively

$$\lambda_{Coal} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j} \times COEF_{i,j}} \quad (6)$$

$$\lambda_{Oil} = \frac{\sum_{i \in Oil,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j} \times COEF_{i,j}} \quad (7)$$

$$\lambda_{Gas} = \frac{\sum_{i \in Gas, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j} \times COEF_{i,j}} \quad (8)$$

with:

$F_{i,j,y}$ *the amount of the fuel* i *consumed in y year of j province* (measured in tce

$COEF_{i,j,y}$ the emission afctor of fuel i (measured in tCO_2/tce) while taking into account the carbon content and oxidation rate of the fuel *i* consumed in *y* year;

COAL,OIL and *GAS subscripts standing for the solid fuel, liquid fuel and gas fuel*

Second, we calculate the emission factor of the thermal power

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \quad (9)$$

While $EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ represent the emission factors of advanced coal-fired , oil-fired and gas-fired power generation technology, see detailed parameter and calculation in Annex 2.

Third, we calculate BM of the power grid

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (10)$$

While CAPTotal represents the total newly-added capacity and CAPThermal represents newly-added thermal power capacity.

The detailed information of BM and OM calculation is listed in Annex 3 of this PDD.

Calculate the Combine Margin emission factor ($EF_{BL,CM}$)

The combined margin ($EF_{BL,CM}$) is calculated according to ACM0002, using a 50/50 OM/BM weight:

$$EF_{BL,CM} = 0.5 \times EF_{BL,BM} + 0.5 \times EF_{BL,CM} \quad (11)$$

Calculate the Baseline Emission Factor ($EF_{BL,CO2}$)

Then the baseline emission factor can be calculated as follows:

$$EF_{BL,CO_2} = \min(EF_{BL,BM} \cdot EF_{BL,CM}, \cdot EF_{BL,CO_2,Option3} \quad (12)$$

Calculate Baseline Emission (BE_y)

Once the baseline emission factor is determined, the baseline emissions can be calculated by multiplying the electricity generated in the project plant (EG_y) with the baseline emission factor $EF_{BL,CO2}$:

$$BE_y = EG_y \times EF_{BL,CO_2} \quad (13)$$

According to the Methodology and calculation steps described above, the baseline emission reductions can be ex-ante calculated as follows:

$EF_{BL,BM}$=0.6748 tCO_2/MWh, see also Annex2

$EF_{BL,OM}$=1.0119 tCO_2/MWh, see also Annex2

$EF_{BL,CM}$=0.5×$EF_{BL,BM}$+0.5×$EF_{BL,OM}$=0.843 tCO_2/MWh

$EF_{BL,CO_2,Option3}$ = $COEF_{Coal}$×$PGCC_{BL}$/(1 − $r_{selfuse}$) =2.769×0.312/(1-5.02%)=0.910 tCO_2/MWh.

Then EF_{BL,CO_2} = min($EF_{BL,BM}$, $EF_{BL,CM}$, $EF_{BL,CO_2,Option3}$) =0.6748 tCO_2/MWh. The build margin (Option 1) is selected as the baseline emission factor.

BE_y=EG_y×$EF_{BL,CO2}$=3703514×0.6748=2,499,131 tCO_2

4.3 Quantifying GHG emissions and/or removals for the project:

Calculate Project Emission (PE_y)

According to the Methodology, the project activity is on-site combustion of natural gas to generate electricity, then the CO_2 emissions from electricity generation are calculated as follows:

$$PE_y = FC_{LNG,y} \times COEF_{LNG,y} + FC_{Diesel} \times COEF_{Diesely} \quad (14)$$

Where

$FC_{LNG,y}$: is the total volume of LNG combusted in the project plant (tons) in year y.
$FC_{Diesel,y}$: is the total volume of diesel combusted in the project plant (tons) for start-up fuel in year y. In the proposed project activity, the diesel consumption for start up is zero.
$COEF_{LNG,y}$: is the CO_2 emission coefficient (tCO_2/tons) in year y for LNG.
$COEF_{Diesel,y}$: is the CO_2 emission coefficient (tCO_2/tons) in year y for diesel.

The emission coefficients of LNG and diesel are calculated as follows:

$$COEF_{LNG,y} = NCV_{LNG,y} \times EF_{CO_2,Gas,y} \times OXID_{Gas} \quad (15)$$

$$COEF_{Diesel,y} = NCV_{Diesl,y} \times EF_{CO_2,Diesel,y} \times OXID_{Diesel} \quad (16)$$

Where:

$NCV_{LNG,y}$: is the net calorific value of LNG (GJ/ton), which is determined from the fuel supplier.
$NCV_{Diesel,y}$: is the net calorific value of diesel (GJ/ton), which is determined from the most recent "Chinese Energy Statistics Yearbook" available when the verification begins.
$EF_{CO2,Gas,y}$: is the CO_2 emission factor per unit of energy of LNG in year y (tCO_2/GJ), which is determined from the fuel supplier.
$EF_{CO2,Diesel,y}$: is the CO_2 emission factor per unit of energy of diesel in year y (tCO_2/GJ), the IPCC default value will be used.
$OXID_{Gas}$: is the oxidation factor of LNG, the IPCC default value will be used.
$OXID_{Diesel}$: is the oxidation factor of diesel, the IPCC default value will be used.

Calculate Leakage (LE_y)

According to the Methodology, the following leakage emission sources are considered:

- Fugitive CH_4 emissions associated with fuel extraction, processing, liquefaction, transportation, regasification, and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity.
- In the case LNG is used in the project plant: CO_2 emission from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

Thus, the leakage can be calculated based on following steps:

Sub step 3a Calculate the Upstream fugitive CH_4 emission factor ($EF_{BL,upstream,CH4}$)

According to the Methodology, the emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity should be consistent with the baseline emission factor ($EF_{BL,CO2}$) in step 1 of this section. The BM will be selected as the baseline emission factor, then the corresponding upstream fugitive CH_4 emission factor can be calculated as follows:

$$EF_{BL,upsream,CH4} = \frac{FF_{Coal} \times EF_{Coal,upstream,y} + FF_{Gas} \times EF_{Gas,upstream,y} + FF_{Oil} \times EF_{Oil,upstream,y}}{GEN_y} \quad (17)$$

Where:

$EF_{BL,upstream,CH4}$: is the emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH_4/MWh
FF_{Coal}: Total quantity of coal type fuel combusted (tons raw coal) in power plants included in

the build margin.
FF_{Gas}: Total quantity of gas type fuel combusted (GJ) in power plants included in the build margin.
FF_{Diesel}: Total quantity of diesel type fuel combusted (GJ) in power plants included in the build margin.
$EF_{Coal,upstream,CH4}$: Emission factor for upstream fugitive methane emissions from production of coal in tCH_4/t coal. The Methodology suggested two default fugitive CH_4 associated with different source: underground mining and surface mining. Because 95% of the coal production in China are produced by underground mining, so the default value for underground mining 13.4 tCH_4/kt coal is used in this PD.
$EF_{Gas,upstream,CH4}$: Emission factor for upstream fugitive methane emissions from production of gas in tCH_4/GJ. The Methodology suggested several default fugitive CH_4 associated with different regions. In this PD, the default value for other oil exporting countries/rest of world is adopted, which is higher than the value for USA and Canada, resulting in an upward estimate of the leakage. Thus it is conservative.
The project might adopt the lower default value for USA and Canada because the new gas terminal and transmission and distribution network of this project is construed and operated by advance technology.
$EF_{Oil,upstream,CH4}$: Emission factor for upstream fugitive methane emissions from production of oil in tCH_4/GJ. The default value suggested in the Methodology is used in this PD.
GEN_y: Electricity generation in the plants included in the build margin in MWh/a.
For the BM is calculated based on a conservative way, we also use the following formula to estimate the upstream fugitive methane emissions as follows:

$$EF_{BL,upsream,CH4} = \lambda_{Coal,BM} \times PGCC_{Adv} \times EF_{Coal,upstream,CH4} \times \frac{NCV_{Coal}}{NCV_{Rawcoal}} \times \frac{FF_{Coal} \times EF_{Coal,upstream,y} + FF_{Gas} \times EF_{Gas,upstream,y} + FF_{Oil} \times EF_{Oil,upstream,y}}{GEN_y} \quad (18)$$

Where,
$\lambda_{Coa,BMI}$: is the share of coal-fired generation in BM generation.
$PGCC_{Adv}$: is the power supply coal consumption of the most advance coal-fired generation technology within the grid boundary, which is estimated as 343.33 gce/kWh in this PD.
NCV_{Coal}: is the net caloric value of standard coal equivalent in GJ/tce.
$NCV_{Rawcoal}$: is the net caloric value of raw coal which is used for power generation in GJ/tce.

Calculate Fugitive Methane Emissions ($LE_{CH4,y}$)

To estimated the fugitive methane emissions, one can multiply the quantity of LNG consumed by the project in year y with an emission factor for fugitive CH_4 emissions ($EF_{Gas,upstream,CH4}$) for LNG consumption and subtract the emissions occurring from fossil fuels used in the absence of the project activity, as follows:

$$LE_{CH4,y} = \left[FC_{LNG,y} \times NCV_{LNG,y} \times EF_{Gas,upstream,CH_4} - EG \times EF_{BL,upstream,CH_4}\right] \times GWP_{CH4} \quad (19)$$

Where:
$LE_{CH4,y}$: Leakage emissions due to fugitive upstream CH_4 emissions in the year y in tCO_2e.
$FC_{LNG,y}$: Total volume of LNG combusted in the project plant (tons) in year y.
$NCV_{LNG,y}$: Net calorific value of LNG (GJ/ton), which is determined from the fuel supplier.
$EF_{Gas,upstream,CH4}$: Emission factor for upstream fugitive methane emissions from production of gas in tCH_4/GJ. The Methodology suggested several default fugitive CH_4 associated with different regions. In this PD, the default value for other oil exporting countries/rest of world is adopted.
EG_y: Electricity generation in the project plant during year y in MWh.
$EF_{BL,upstream,CH4}$: is the emission factor determined in sub step 3a for upstream fugitive methane emissions occurring in the absence of the project activity in tCH_4/MWh.
GWP_{CH4}: Global warming potential of methane valid for the relevant commitment period.

Calculate CO_2 emissions from LNG ($LE_{LNG,CO2,y}$)

CO_2 emission from LNG combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is estimated by multiplying the quantity of natural gas combusted in the project with an appropriate emission factor, as follows:

$$LE_{LNG,CO_2,y} = FC_{LNG,y} \times NCV_{LNG,y} \times EF_{Gas,upstream,CH_4} \quad (20)$$

Where,

$LE_{LNG,CO2,y}$: Leakage emissions due to LNG combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system in tCO_2e.

$FC_{LNG,y}$: Total volume of LNG combusted in the project plant (tons) in year y.

$NCV_{LNG,y}$: Net calorific value of LNG (GJ/ton), which is determined from the fuel supplier.

$EF_{CO2,upstream,LNG}$: Emission factor for upstream CO_2 emission due to LNG combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system in tCO_2/GJ. Because such data is unavailable in this project, the default value of 6 tCO_2/TJ suggested in the Methodology is adopted as a rough approximation.

Calculate Leakage (LE_y)

Thus the leakage can be calculated as follows:

$$LE_y = LE_{CH4} + LE_{LNG,CO_2,y} \quad (21)$$

Where:

LE_y: leakage emission during the year y in tCO_2e.

$LE_{CH4,y}$: leakage emission due to fugitive upstream CH_4 emissions in year y in tCO_2e.

$LE_{LNG,CO2,y}$: leakage emission due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y in tCO_2e.

Calculate Project Emission (PE_y)

$COEF_{LNG\,y} = NCV_{LNG\,y} \times EF_{CO_2\ Gas\,y}$ =49.39×56100/1000=2.771 tCO_2/t

$PE_y = FC_{LNG\,y} \times COEF_{LNG\,y} + FC_{Diesel\,y} \times \cdot COEF_{Diesel\,y}$ =506100×2.771=1,402,403 tCO_2

Calculate Leakage (LE_y)

$EF_{BL,upstream,CH4} = \lfloor_{Coal} \times PGCC_{Adv} \cdot \times EF_{Coal,upstream,CH4}$

=0.6622×343.33×13.4×29.27/20.91/10^6=0.00426t CH_4/MWh

$LE_{CH_4\,y} = \left[FC_{LNG,y} \times NCV_{LNG\,y} \times EF_{Gas\ upstream\ CH_4} - EG_y \times EF_{BL\ upstream\ CH_4}\right] \times GWP_{CH_4}$

= [506100×49.39×296/10^6-3703514×0.00426] ×21= -175,939 tCO_2

$LE_{LNG\ CO_2\,y} = FC_{LNG\,y} \times NCV_{LNG\,y} \times EF_{CO_2\ upstream\ LNG}$ =506100×49.39×6/1000=149,978 tCO_2

$LE_y = LE_{CH_4\,y} + LE_{LNG\,CO_2\,y}$=149,978-175,939=-25,961 tCO_2, then $LE_y = 0$ tCO_2,

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

Calculate Emission Reduction (ER_y)

The emission reduction of the proposed project can be calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (22)$$

Where:

ER_y: emission reduction in year y in tCO_2e.

BE_y: emission in the baseline scenario in year y in tCO_2e.

PE_y: emission in the project scenario in year y in tCO_2e.

LE_y: emission in the year y in tCO_2e.

$ER_y = BE_y - PE_y - LE_y$ =2,499,131-1,402,403=1,096,728 tCO_2

5 Environmental Impact:

The Environmental Assessment Report of the proposed project has been approved by the State Environmental Protection Administration of China.
The main environmental protection objectives of the proposed project are: marine environment, air environment, sound environment, and terrestrial and marine environment.
The impacts on the marine environment: During the construction period, the use and release of water will have temporary impacts on the marine environment, which will disappear after the completion of the construction. During the operation period, the waste water will be treated and reused, and only small amount (about $43m^3/d$) will be released, which will not have large effect on the marine environment.
The impacts on the air environment: Since the proposed project is a NG power plant, there will be no SO_2 emissions. The NOx emissions of the proposed project will meet the requirement of China Air Environment Standard (GB3095-1996), which will not have large effect on the marine environment.
The impacts on the sound environment: The noise source during the construction and operation period of the proposed project will meet the requirement of Environmental Noise Standard (GB3096-93).
The impacts on the terrestrial and marine environment: The proposed project will not have large effect on the terrestrial environment. The water pump will lead to some amount of fish loss and the cooling water release will lead to slight temperature increase of the sea. If strict control measure was taken, the impacts on marine environment would be minimized.
In conclusion, the proposed project has no significant impacts on the environment

6 Stakeholders comments:

Brief description how comments by local stakeholders have been invited and compiled

The stakeholder comments were acquired through questionnaire investigation during the period of environment impact assessment for the proposed project. Totally 200 questionnaires were delivered, and 178 were received.

Summary of the comments received

No opposite comment was received. The summary of the comments is as follows:

>>
No opposite comment was received. The summary of the comments is as follows:
Most people know the proposed project, and more than 92% people agree with the proposed project, while the remaining people have no comments on construction of the proposed project. To conclude, the public think that the construction of the proposed project is in line with the sustainable development strategy of China, while reasonable measures should be taken to protect the local environment, and economic compensate and career opportunities should be provided to the local residents. The detailed information could be found on the EIA report of the proposed project[23]

Report on how due account was taken of any comments received

There is no negative comment on development of the proposed project, therefore no adjustment on design, construction and operation of the proposed project was needed.

7 Schedule:

Chronological plan for the date of the project can be find in the table below:

Date	milestone
October.2002	Feasibility Study Report(FSR)
July. 13 th 2004	Approval of FSR
September. 23th 2004	Date of construction
May. 17 th 2005	Date of financial closure completed
Sep 21th 2006	Operation date of the project
Sep. 21th 2006	Decision for VER development instead of CDM
April. 21th 2006	Starting date of the first crediting period
Sep. 1th 2008	Validation and verification of the Project by the DOE

8 Ownership:

8.1 Proof of Title:

The approval of EIA and FSR are evidences for legislative right. Besides, the purchasing contract for turbine generator set and ERPA for the project between project participates are to proof the ownership of the main equipment and process generating the reductions, respectively. The mentioned documents above will be provided to Registry Operator.

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

The project has request for CDM registration and will be registration on November 13st,2008. So the crediting period of CDM is from November 13st ,2008 to November 12st,2016 The crediting period of VER is from August 21st,2006 to September 31st,2008

ANNEX 1

BASELINE INFORMATION

Data recommended in the *Notification on Determining Baseline Emission Factors of China power Grid*（issued by Chinese DNA） for CCPG are adopted for the Project.
Table A1~A3 show the thermal power generation supplied to CCPG in 2003, 2004 and 2005.

Table A1. Thermal power generation data within CSPG in 2003

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Guangdong	143351000	5.5	135,466,695
Guangxi	17079000	8.43	15,639,240
Guizhou	43295000	7.4	40,091,170
Yunnan	19055000	8.01	17,528,695
Total			208,725,800

Data source: China Electric Power Yearbook 2004 Edition.

Table A2. Thermal power generation data within CSPG in 2004

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Guangdong	169389000	5.42	160,208,116
Guangxi	20143000	8.33	18,465,088
Guizhou	49720000	7.06	46,209,768
Yunnan	24322000	7.56	22,483,257
Total			247,366,229

Data source: China Electric Power Yearbook 2005 Edition.

Table A3. Thermal power generation data within CSPG in 2005

	Electricity generation (MWh)	Auxiliary electricity consumption (%)	Electricity delivered to the grid (MWh)
Guangdong	176453000	5.58	166606923
Guangxi	25023000	7.95	23033672
Guizhou	58430000	7.34	54141238
Yunnan	27281000	6.94	25387699
Total			269169531

Data source: China Electric Power Yearbook 2006 Edition.

With reference to the *on Determining Baseline Emission Factors of China Power Grid* published by Chinese DNA on Aug. 9th 2007, Table A4 shows the low calorific values, emission factors and oxidation rates of fuels consumed for electricity generation that are to be used in the following OM emission factor calculation and BM emission factor calculation.

Table A4. Data of fuels consumed for electricity generation

Fuel type	**Low calorific value**	**Emission factor (tC/TJ)**	**Oxidation rate**
Raw coal	20908 kJ/kg	25.80	1
Clean coal	26344 kJ/kg	25.80	1
Other washed coal	8363 kJ/kg	25.80	1
Coke	28435 kJ/kg	29.20	1
Crude oil	41816 kJ/kg	20.00	1
Gasoline	43070 kJ/kg	18.90	1
Kerosene	43070 kJ/kg	19.60	1
Diesel	42652 kJ/kg	20.20	1
Fuel oil	41816 kJ/kg	21.10	1
Other petroleum products	38369 kJ/kg	20.00	1
Natural gas	38931 kJ/m^3	15.30	1
Coke oven gas	16726 kJ/m^3	12.10	1
Other coal gas	5227 kJ/m^3	12.10	1
LPG	50179 kJ/m^3	17.20	1
Refinery gas	46055 kJ/m^3	15.7	1

Data sources: China Energy Statistical Yearbook 2006 edition, P287

Notification on Determining Baseline Emission Factors of China Power Grid issued by Chinese DNA published on Aug. 9th 2007

Table 1.3 and Table 1.4, Volume 2, "2006 IPCC Guidelines for National Greenhouse Gas Inventories"

Table A5. Emission and Power Supply Data of CSPG in 2003

Energy	Unit	Guangdong A	Guangxi B	Guizhou C	Yunnan D	Total Fuel E=A+B+C+D	Emission factor (tC/TJ) F	Oxidation rate (%) G	NCV (MJ/t or $1000m^3$) H	Emission[4] (tCO_2e) I
Coal	10^4t	4491.79	831.84	2169.11	1405.27	8898.01	25.8	100	20908	175993455.05
Cleaned coal	10^4t	0.05	0	0	0	0.05	25.8	100	26344	1246.07
Other washed coal	10^4t	0	0	36.38	20.37	56.75	25.8	100	8363	448971.84
Coke	10^4t	0	0	0	0.5	0.5	29.2	100	28435	15222.20
Coke oven gas	10^8m^3	0	0	0	0.04	0.04	12.1	100	16726	2968.31
Other coal gas	10^8m^3	3.21	0	0	11.27	14.48	12.1	100	5227	335797.81
Crude oil	10^4t	6.85	0	0	0	6.85	20	100	41816	210055.71
Gasoline	10^4t	0.02	0	0	0	0.02	18.9	100	43070	596.95
Diesel	10^4t	31.9	0	0	0.76	32.66	20.2	100	42652	1031759.27
Fuel oil	10^4t	627.22	0.3	0	0	627.52	21.1	100	41816	20301304.48
LPG	10^4t	0	0	0	0	0	17.2	100	50179	0.00
Refinery gas	10^4t	2.85	0	0	0	2.85	15.7	100	46055	75560.14
Natural gas	10^8m^3	0	0	0	0	0	15.3	100	38931	0.00
Other petroleum products	10^4t	11.35	0	0	0	11.35	20	100	38369	319357.98
Other energy	10^4tce	93.21			22.35	115.56	0	100	0	0.00
Net electricity import from the Central China Grid (MWh)						11100				
Average emission factor of the Central China Grid (tCO_2e/MWh)						0.797442				
Total emission of CSPG (tCO_2e)						198745147				
Fossil power supply of CSPG (MWh)						208736900				

Data sources: China Energy Statistical Yearbook 2004 Edition

[4] If the unit of the fuel is 10^4 t, then I=E×F×G×H×44/12/10^4; if the unit of the fuel is 10^8 m^3, then I=E×F×G×H×44/12/10^3. The same about the calculation of I in Table A6 and Table A7.

Table A6. Emission and Power Supply Data of CSPG in 2004

Energy	Unit	Guangdong A	Guangxi B	Guizhou C	Yunnan D	Total Fuel E=A+B+C+D	Emission factor (tC/TJ) F	Oxidation rate (%) G	NCV (MJ/t or $1000m^3$) H	Emission (tCO_2e) I
Coal	10^4t	6017.7	1305	2643.9	1751.28	11717.88	25.8	100	20908	231767573.55
Cleaned coal	10^4t	0.21	0	0	0	0.21	25.8	100	26344	5233.50
Other washed coal	10^4t	0	0	0	0	0	25.8	100	8363	0.00
Coke	10^4t	0	0	0	0	0	29.2	100	28435	0.00
Coke oven gas	10^8m^3	0	0	0	0	0	12.1	100	16726	0.00
Other coal gas	10^8m^3	2.58	0	0	0	2.58	12.1	100	5227	59831.38
Crude oil	10^4t	16.89	0	0	0	16.89	20	100	41816	517932.98
Gasoline	10^4t	0	0	0	0	0	18.9	100	43070	0.00
Diesel	10^4t	48.88	0	0	1.83	50.71	20.2	100	42652	1601975.28
Fuel oil	10^4t	957.71	0	0	0	957.71	21.1	100	41816	30983494.25
LPG	10^4t	0	0	0	0	0	17.2	100	50179	0.00
Refinery gas	10^4t	2.86	0	0	0	2.86	15.7	100	46055	75825.26
Natural gas	10^8m^3	0.48	0	0	0	0.48	15.3	100	38931	104833.40
Other petroleum products	10^4t	1.66	0	0	0	1.66	20	100	38369	46707.86
Other energy	10^4tce	79.42	0	0	0	79.42	0	100	0	0.00
Net electricity import from the Central China Grid (MWh)						10951240				
Average emission factor of the Central China Grid (tCO_2e/MWh)						0.826448				
Total emission of CSPG (tCO_2e)						274214038				
Fossil power supply of CSPG (MWh)						258317469				

Data sources: China Energy Statistical Yearbook 2005 Edition

Table A7. Emission and Power Supply Data of CSPG in 2005

Energy	Unit	Guangdong	Guangxi	Guizhou	Yunnan	Total Fuel	Emission factor (tC/TJ)	Oxidation rate (%)	NCV (MJ/t or 1000m^3)	Emission (tCO_2e)
		A	B	C	D	E=A+B+C+D	F	G	H	I
Raw Coal	10^4t	6696.47	1435	3212.31	1975.55	13319.33	25.8	100	20908	263442601.85
Clean Coal	10^4t				0.15	0.15	25.8	100	26344	3738.21
Other washed coal	10^4t			10.39	33.88	44.27	25.8	100	8363	350237.59
Coke	10^4t	4.79			8.05	12.84	29.2	100	28435	390906.18
Coke oven gas	10^8m^3				0.79	0.79	12.1	100	16726	58624.07
Other coal gas	10^8m^3	1.87			15.96	17.83	12.1	100	5227	413485.84
Crude oil	10^4t	10.91				10.91	20	100	41816	334555.88
Gasoline	10^4t	0.68				0.68	18.9	100	43070	20296.31
Diesel	10^4t	31.96	2.02		1.81	35.79	20.2	100	42652	1130638.84
Fuel oil	10^4t	887.21				887.21	21.1	100	41816	28702703.26
LPG	10^4t					0	17.2	100	50179	0.00
Refinery gas	10^4t	4.92				4.92	15.7	100	46055	130440.66
Natural gas	10^8m^3	0.93				0.93	15.3	100	38931	203114.71
Other petroleum products	10^4t	1.7				1.7	20	100	38369	47833.35
Other energy	10^4tce	104.66	133.15		59.72	297.53	0	100	0	0.00

Net electricity import from the Central China Grid (MWh)	96363000
Average emission factor of the Central China Grid (tCO_2e/MWh)	0.771225
Total emission of CSPG (tCO_2e)	369546731
Fossil power supply of CSPG (MWh)	365532531

Data sources: China Energy Statistical Yearbook 2006 Edition

The simple OM emission factor is weighted average value of simple OM emission factors of CSPG in 2003,2004,2005, as fellows:

$$EF_{OM,y} = (198745147 + 274214038 + 369546731) / (208736900 + 258317469 + 365532531)$$
$$= 1.0119 \ \ tCO_2e/MWh$$

Table A8. The data of efficiency level of the best electricity generation technologies commercially available in China and the corresponding emission factors

	Parameter	Best efficiency of supplying electricity tce/MWh	Fuel emission factor (tc/TJ)	Oxidation rate	Emission factor (tCO_2e/MWh)
		A	B	C	D=3.6/A/1000*B *C*44/12
Coal-fired power plant	$EF_{Coal,Adv}$	0.3582	25.8	1	0.9508
Gas-fired power plant	$EF_{Gas,Adv}$	0.4767	15.3	1	0.4237
Oil-fired power plant	$EF_{Oil,Adv}$	0.4767	21.1	1	0.5843

Data sources: Notification on Determining Baseline Emission Factors of China Power Grid issued by Chinese DNA
Table 1.3 and Table 1.4, Volume 2, "2006 IPCC Guidelines for National Greenhouse Gas Inventories"

Table A9. Data for calculating the thermal power emission factors

Energy	Unit	Guangdong A	Guangxi B	Guizhou C	Yunnan D	Total E=A+B+C+D	NCV (MJ/t or $1000m^3$) F	Emission factor (tC/TJ) G	Oxidation Rate H	Emission (tCO_2e) I =E*F*G*H *44/12/100
Raw coal	10^4t	6696.47	1435	3212.31	1975.55	13319.33	20908	25.80	1	263442602
Cleaned coal	10^4t	0	0	0	0.15	0.15	26344	25.80	1	3738
Other washed coal	10^4t	0	0	10.39	33.88	44.27	8363	25.8	1	350238
Coke	10^4t	4.79	0	0	8.05	12.84	28435	29.2	1	390906
Sub-total										264187484
Crude oil	10^4t	10.91	0	0	0	10.91	41816	20	1	334556
Gasoline	10^4t	0.68	0	0	0	0.68	43070	18.9	1	20296
Kerosene	10^4t	0	0	0	0	0	43070	19.6	1	0
Diesel	10^4t	31.96	2.02	0	1.81	35.79	42652	20.2	1	1130639
Fuel oil	10^4t	887.21	0	0	0	887.21	41816	21.1	1	28702703
Other oil products	10^4t	1.7	0	0	0	1.7	38369	20	1	47833
Sub-total										30236028
Natural gas	10^7m^3	9.3	0	0	0	9.3	38931	15.3	1	203115
Coke oven gas	10^7m^3	0	0	0	7.9	7.9	16726	12.1	1	58624
Other coal gas	10^7m3	18.7	0	0	159.6	178.3	5227	12.1	1	413486
LPG	10^4t	0	0	0	0	0	50179	17.2	1	0
Refinery gas	10^4t	4.92	0	0	0	4.92	46055	15.7	1	130441
Sub-total										805665
Total										**295229177**

Data sources: China Energy Statistical Yearbook 2006

Calculate with data provided in Table A8, A9 and formula (4)~(6), the value for

$$\lambda_{Coal} = 89.49\% ,$$

$$\lambda_{Oil} = 10.24\% ,$$

$$\lambda_{Gas} = 0.27\% ,$$

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

$$= 0.9118 \text{ tCO}_2\text{e/MWh}$$

Table A10. Installed capacity of the CSPG in 2003

	Guangdong	Guangxi	Yunnan	Guizhou	Tianshengqiao	Total
Thermal power (MW)	27231.4	3190.1	3556.8	6465.8	0	40444.1
Hydro power (MW)	8107.2	4525.2	6543.2	3713.7	2520	25409.3
Nuclear power (MW)	3780	0	0	0	0	3780
Wind power and Other (MW)	83.4	0	0	0	0	83.4
Total (MW)	39202	7715.3	10100	10179.5	2520	69716.8

Data source: China Electric Power Yearbook 2004.

Table A11. Installed capacity of the CSPG in 2004

	Guangdong	Guangxi	Yunnan	Guizhou	Total
Thermal power (MW)	30172.9	4378.1	4306.9	7801.8	46659.7
Hydro power (MW)	8584.6	5040.4	7058.6	6896.5	27580.1
Nuclear power (MW)	3780	0	0	0	3780
Wind power and Other (MW)	83.4	0	0	0	83.4
Total (MW)	42621	9418.5	11365.5	14698.3	78103.3

Data source: China Electric Power Yearbook 2005.

Table A12. Installed capacity of the CSPG in 2005

	Guangdong	Guangxi	Yunnan	Guizhou	Total
Thermal power (MW)	35182.6	4931.2	4758.4	9634.8	54507
Hydro power (MW)	9035.7	6085.3	7993.1	7233	30347.1
Nuclear power (MW)	3780	0	0	0	3780
Wind power and Other (MW)	83.4	0	0	0	83.4
Total (MW)	48081.7	11016.5	12751.5	16867.8	88717.5

Data source: China Electric Power Yearbook 2006.

Table A13. Capacity increase data of CSPG from 2003 to 2005

	Installed capacity in 2003 (MW) A	Installed capacity in 2004 (MW) B	Installed capacity in 2005 (MW) C	Capacity additions from 2003 to 2005 (MW) D=C-A	Share in total capacity additions
Thermal power	40444.1	46659.7	54507	14062.9	74.01%
Hydro power	25409.3	27580.1	30347.1	4937.8	25.99%
Nuclear power	3780	3780	3780	0	0.00%
Wind power and Other	83.4	83.4	83.4	0	0.00%
Total	69716.8	78103.3	88717.5	19000.7	100.00%
Share in total installed capacity of 2005	78.58%	88.04%	100%		

Data source: China Electric Power Yearbook 2004 ,2005, 2006 Edition.

$EF_{BM,y} = 0.7401 \times (0.8949 \times 0.9508 + 0.1024 \times 0.5843 + 0.0027 \times 0.4237) = 0.6748$ tCO2e/MW