CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

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The title of the project: Hunan Zhugaotan Hydropower Project
Document version: 05
Date: 01/04/2011

A.2. Description of the project activity:

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Description of the projects activity:

Zhugaotan Hydropower Project (hereinafter referred to as "the project") is located on the downstream of Youshui River in Huayuan County, Hunan Province, P. R. China. Before the implementation of the project activity, Central China Power Grid (CCPG) which is dominated by fossil fuel-fired power plants supplied equivalent electricity. The project is a new hydropower plant with the installed capacity of 33 MW (3×11MW) and the electricity generation of 103,590 MWh/yr, the annual operation hours are 3139h[1], the net electricity supply is 98,410 MWh/yr, the surface area at the full reservoir level is 3km^2 [2], and thus the power density of the project is 11 W/m^2. The power generated will be transferred to Huayuan County Power Grid by Huayuan substation, then to Central China Power Grid (CCPG) after the project operation. The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity.

The project activity utilizes hydropower to generate electric energy which would not produce any greenhouse gas (GHG) during the operation. The electricity generated by the project can displace part of the electricity generated by the fossil fuel fired power plants of CCPG, thus the project activity could reduce GHG emissions and the expected annual emission reductions are 95,802 tCO_2e.

In addition, the project will be beneficial in the following aspects:

- Sustainable development: By utilization of renewable hydro resources available in the project region, the project decreases environmental pollution caused by fossil-fuel fired plants. In addition to CO_2 emissions reductions, the project would mitigate other pollutants, such as SO_2, NO_x and particulates associated with power generation from fossil fuels.
- Stimulating economy development: the project located in a rural area, thus, the income from the electricity sales and CERs will contribute not only to the development of this area but also the alleviation of poverty condition.
- Improving the local infrastructure: The project developer would build the electric transmission facilities, which will be helpful to improve the living condition of local residents.

A.3. Project participants:

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[1] The annual average electricity generation of the proposed project is 103,590 MWh/yr, and the installed capacity is 33MW, thus the operation hour is: 103,590 /33= 3139.09, and the value is rounded to 3139h. The plant load factor is 0.36 (3,139h/8760h). The annual average electricity generation is approved by local government (The Approval of Preliminary Design Report, 19 Mar. 2007).

[2] Western Hunan Autonomous Prefecture Hydro & Power Design Institute, Preliminary Design Report of Zhugaotan Project, March 2007.

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
P.R. China (host)	Huayuan ChunJiang Power Generation Co., Ltd.	No
The United Kingdom of Great Britain and Northern Ireland	Camco International Limited	No
The United Kingdom of Great Britain and Northern Ireland	Camco Carbon Limited	No

Please refer to Annex 1 for more detailed information.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party (ies):

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People's Republic of China

A.4.1.2. Region/State/Province etc.:

>>
Hunan Province

A.4.1.3. City/Town/Community etc:

>>
Huayuan Town, Huayuan County, Western Hunan Autonomous Prefecture

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The project is located on the downstream of Youshui River within Huayuan County, Hunan Province, which is 1.5 km away from the Huayuan County, and its geographical coordinates are east longitude of 109.4644°and north latitude of 28.5944°. Fig. 1 shows the location of the project.

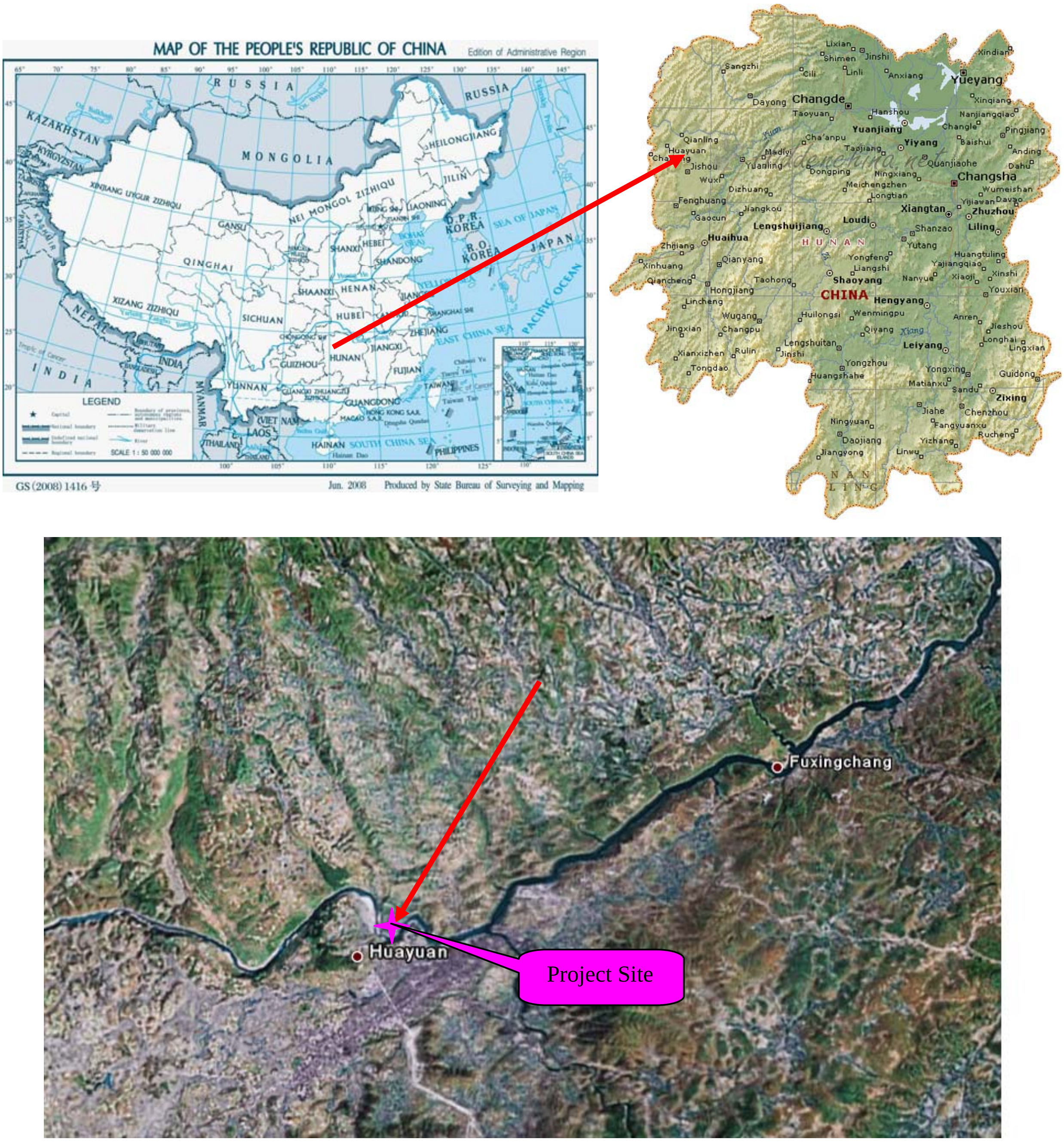

Fig. 1 Project activity location

A.4.2. Category (ies) of project activity:

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The project falls into:
Sectoral Scope 1: Energy industries(renewable sources)

A.4.3. Technology to be employed by the project activity:

(1) CCPG supplied equivalent electricity before the implementation of the project activity.
(2) The project is a hydropower plant located on the downstream of Youshui River, the total installed capacity is 33 MW and consists of three (3×11MW) turbines. The main construction works consist of

gravity dam, main and auxiliary powerhouse, booster station, stilling pool, etc. The water pressure drive the turbines to rotate through diverting water from the intake of the penstocks to the powerhouses, the turbines drive the generators to rotate, thus the water energy is changed into electric energy, the electricity will be transmitted to the CCPG. The project activity utilizes hydropower to generate electric power, thus no emission source or greenhouse gas is involved.
Major technical parameters of the project are as follows:

Table 1 Technical parameters of main buildings and facilities of the project [3]

Parameters		**unit**	**value**
Reservoir	Normal Water Level	m	259
	Area	km^2	3
Hydraulic Turbine	Model	—	ZZ550-LH-265
	Quantity	unit	3
	Rated output	MW	12.95
	Rated rotation	r/min	333.33
	Rated water head	m	26.8
	Rated flow	m^3/s	45
	Efficiency	—	94.0%
Generator	Model	—	SF11-24/4250
	Quantity	unit	3
	Rated Capacity	MW	11
	Rated Voltage	kV	10.5
	Load Factor	—	0.85
	Efficiency	—	98.0%

(3) The equivalent annual electricity generation is supplied by CCPG which is also the baseline scenario to the project activity.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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The project chooses the fixed crediting period, and the crediting period is from 01/06/2011-31/05/2021. The estimated amounts of annual and total emission reductions in the chosen crediting period are shown in Table 2.

Table 2 Estimated amount of emission reductions of the Zhugaotan Power Project

Year	**Annual estimation of emission reductions in tonnes of CO_2e**

[3] Technical Part of Water-turbine Generator Units Contract, Mar. 3, 2010

01/06/2011-31/05/2012	95,802
01/06/2012-31/05/2013	95,802
01/06/2013-31/05/2014	95,802
01/06/2014-31/05/2015	95,802
01/06/2015-31/05/2016	95,802
01/06/2016-31/05/2017	95,802
01/06/2017-31/05/2018	95,802
01/06/2018-31/05/2019	95,802
01/06/2019-31/05/2020	95,802
01/06/2020-31/05/2021	95,802
Total estimated reductions (tonnes of CO_2e)	958,020
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	95,802

A.4.5. Public funding of the project activity:

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No public funding from parties included in Annex I is available to the project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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1. **Baseline and Monitoring methodology**

   Approved consolidated baseline and monitoring methodology ACM0002 (Version 11): “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”

2. **Reference:**

   Tool for the demonstration and assessment of additionality (Version 05.2);
   Tool to calculate the emission factor for an electricity system (Version 02).

More information on the methodology and methodological tools listed above is available at the following website: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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The project is a grid-connected renewable power generation project activity which meets all the applicable criteria stated in the methodology ACM0002 (Version 11):

1. The project is a newly built 33 MW hydropower plant with a reservoir, and the electricity generated will be delivered to CCPG.
2. The project is a new hydropower power plant, its power density is 11W/m^2 which is greater than 4W/m^2.
3. The project activity doesn't involve switching from fossil fuels to renewable energy at the site of the project activity.
4. The geographic and system boundaries for CCPG which the project is connected to can be clearly identified and information on the characteristics of the grid is available.

Therefore, the methodology ACM0002 (Version 11) is applicable to the project activity.

B.3. Description of the sources and gases included in the project boundary:

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According to ACM0002 (Version 11), the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the power plant of the project activity is connected to. The project boundary is schematically illustrated in Figure 2.

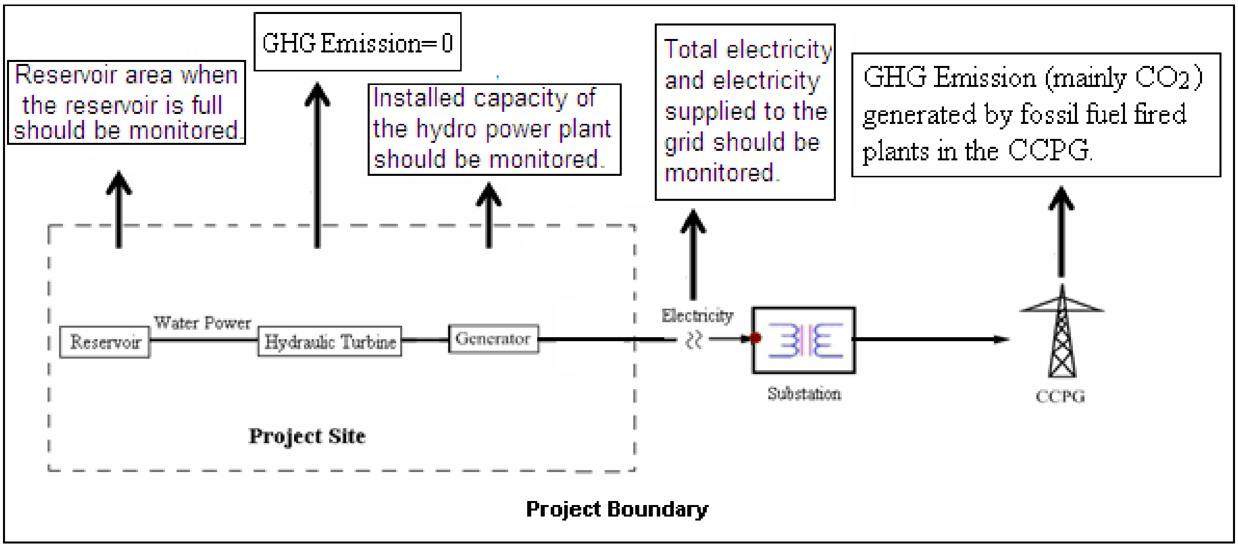

Fig. 2 Project boundary

The project is connected to CCPG; the geographic extent of the CCPG boundary includes Jiangxi Province, Henan Province, Hubei Province, Hunan Province, Sichuan Province and Chongqing City[4]. The GHG emissions sources in the project boundary are listed as Table 3 below:

Table 3 Sources and gases included in the project boundary

	Source	Gas	Included?	Justification/Explanation
Baseline	Electricity	CO_2	Yes	Main emission source

[4] National Development and Reform Commission, China's Regional Grid Baseline Emission Factors 2009, 2 July 2009.

	supplied by CCPG	CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	Emissions from the reservoir of the project	CO_2	No	Minor emission source
		CH_4	No	The project power density is greater more than 10MW/m^2, CH_4 emissions don’t have to be considered.
		N_2O	No	Minor emission source

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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According to ACM0002 (Version 11), if the project activity is the installation of a new grid-connected renewable power plant, the baseline scenario is the following:

“Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

The electricity generated by the project will be delivered to the CCPG. Therefore, the project’s baseline scenario is that equivalent amount of electricity is generated by CCPG-connected power plants and the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system” (Version 02).

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

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According to the “Tool for the demonstration and assessment of additionality” (Version 05.2) approved by EB, the additionality of the project is demonstrated and assessed through the following steps:

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

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

The alternatives available to the project activity are as follows:

Alternative 1 — The project activity undertaken without being registered as CDM project activity;

This scenario complies with national laws and regulations, and doesn’t face technology barrier, it is feasible.

Alternative 2 — Construct a fossil fuel-fired power plant with equivalent annual net electricity generation supplied to the grid;

This scenario doesn’t face technology barrier, it is feasible.

Alternative 3—Construct another renewable sources power plant with equivalent annual net electricity generation supplied to the grid;

This scenario is to construct renewable power plants, which can supply equivalent electricity annually as the project. Other renewable sources energy includes solar, wind, water, biomass, geothermal and ocean energy[5]. However, those kinds of energy are strongly depended on climate and natural resources, and are still in the investigation phase and can bring only poor economic benefits[6], which can not be operated without support from the national policies[7]. Moreover, the utilization of geothermal and ocean energy are just in the very beginning in China[8], therefore it's not feasible for the project owner to invest another renewable sources power plant with equivalent annual net electricity generation supplied to the grid.
Thus Scenario 3 is not feasible.

Alternative 4—Equivalent annual electricity supplied by CCPG.
This Scenario complies with national laws and regulations, and doesn't face any barrier, it is feasible.

Sub-step 1b. Consistency with mandatory laws and regulations:
As for alternative 2, the average annual utilization time of fossil fuel-fired power plants in China is 4,911h[9] which is larger than that of hydropower plants, so the installed capacity of the fossil fuel-fired plants with equivalent annual electricity supplied to the grid to this project will be smaller than 33MW. However, according to the current laws and regulations in China, the thermal power plant with an installed capacity equal to or less than 135MW is strictly forbidden[10]. Therefore, the Scenario 2 doesn't comply with current mandatory applicable legislation and regulations in China, and is not feasible.

The alternatives 1, alternatives 3 and alternatives 4 are in compliance with all current applicable law and regulations in China.

Thus, the plausible alterlative are alternatives 1 and alternatives 4.

Step 2. Investment analysis
Sub-step 2a. Determine appropriate analysis method
According to "Tool for the demonstration and assessment of additionality", there are three analysis methods for investment analysis, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

Because the project activity will generate economic benefits from the sale of electricity generation other than CDM related income, simple cost analysis method is not applicable; the electricity supply by CCPG isn't a concrete investment project, so investment comparison analysis method isn't applicable, too. Therefore, benchmark analysis method is chosen for the investment analysis.

Sub-step 2b. Option III. Apply benchmark analysis
The benchmark Internal Rate of Return (IRR) for total investment for a hydropower project with the installed capacity of over 25MW is 8%[11] (not including tax) which is quoted from the statement of Interim Rules on Economic Assessment of Electrical Engineering Retrofit Project. This benchmark IRR

[5] http://www.china5e.net/renewable_energy/

[6] http://www.in-en.com/power/html/power-1145114599271031.html

[7] http://www.sei.gov.cn/ShowArticle.asp?ArticleID=105482&ArticlePage=3

[8] http://env.people.com.cn/GB/6285168.html

[9] China Electricity Council, National Statistics Bulletin of Power Industry in 2009

[10] General Office of the State Council of China, Notice on Strictly Prohibiting the Construction of Fuel-fired power plants with installed Capacity of 135 MW or below, 15 April 2002

[11] State Electrical Power Corp., Interim Rules on Economic Assessment of Electrical Engineering Retrofit Project (China Electrical Power Press, 2003)

is used extensively in China for investment analysis of hydropower projects.

Sub-step 2c. Calculation and comparison of financial indicators
Based on Preliminary Design Report, the main assumptions for the investment analysis are shown in Table 4.

Table 4 Main assumptions for investment analysis and calculation

No.	Main Parameter	Unit	Value	Data source
1	Installed capacity	MW	33.0	PDR
2	Total investment	Million RMB yuan	241.89	PDR
3	Net electricity generation	MWh	98,410	PDR
4	Residual rate of fixed assets value	%	4%	PDR
5	Electricity tariff (with VAT)	RMB yuan/kWh	0.342	PDR
6	Value-added Tax	%	6	PDR
7	Sale surtax	%	8	PDR
8	Income tax	%	33	PDR
9	Project lifetime (including 3.5 years construction period)	Year	25	PDR
10	Annual O & M costs	Million RMB yuan	3.763	Calculated based on the data of PDR

The IRR of the project without CERs sale revenue is shown in Table 5.

Table 5 The project financial indicator without CERs revenue

Item	unit	Without CERs revenue	Benchmark
IRR	%	6.35	8

According to the benchmark analysis, IRR without CERs of the projects were obviously below the benchmark of 8%. Therefore the project was not financially attractive.

Sub-step 2d. Sensitivity analysis
Four parameters including electricity tariff, electricity generation, total investment and annual O&M costs are selected as sensitive factors to check the financial attractiveness, the result of the sensitivity analysis is shown as follows:

Table 6 Sensitivity Analysis

Variation rate / FIRR (%) / Factor	-10%	0	+10%
Electricity Tariff	5.39%	6.35%	7.26%
Electricity Generation	5.39%	6.35%	7.26%
Total Investment	7.32%	6.35%	5.51%
O&M Costs	6.51%	6.35%	6.18%

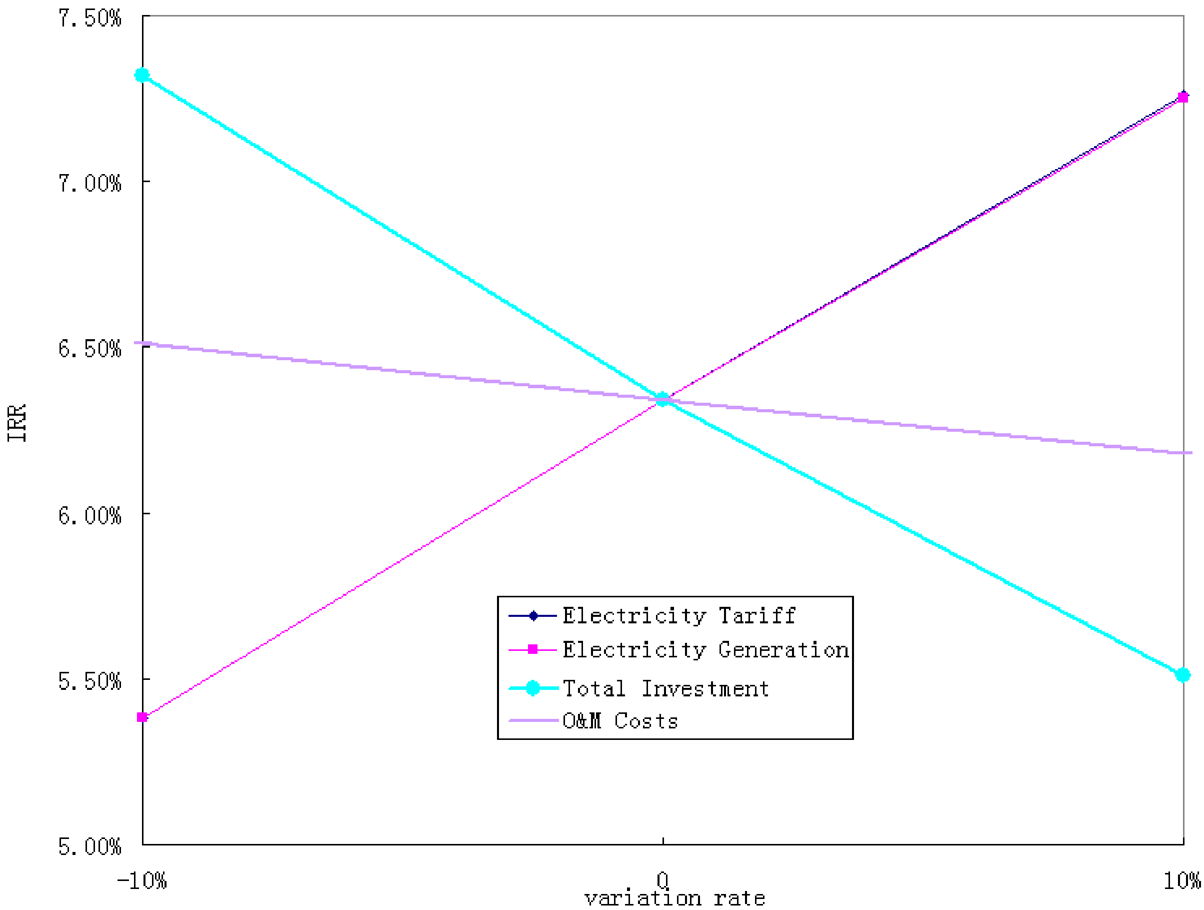

Fig. 3 Sensitivity Analysis

Table 7 Sensitivity Analysis

variation range & assessment / Factor	variation range to reach benchmark	Practical assessment of the critical factors
Electricity Tariff	18.5%	Only when the grid-in tariff is increased by 18.5% the IRR would reach the benchmark of 8%.

		In China, the policy of electricity tariff was strictly controlled by the government [12]. According to the document from the governmental price administration department, the electricity tariff of Hunan Province was 0.315 RMB yuan/kWh in 2004[13] and 0.316 RMB yuan/kWh in 2005[14] for the hydropower stations with the same scale as the project, and the tariff turns to 0.321RMB yuan/kWh in 2008[15], there is no adjustment for tariff in Hunan Province in 2009[16], and also no adjustment in 2010 for no new policy was issued, thus the tariff increase rate from 2004 to 2010 in Hunan Province is 1.87%, the electricity tariff in Hunan Province is unlikely for the electricity tariff to increase 18.5%. Thus, the increase of 18.5% of the electricity tariff shall not occur.
Electricity generation	18.6%	When the annual operation hour increase, the IRR of project moves up. Besides the determined design proposal of the project, the variation of electricity generation is mainly subject to the water resources of project site, and also be the outcome of the year's rainfall. It is impossible for the electricity generation of project to increase more than 18.6%, because the electricity generation was speculated according to the hydrology documents for 49 years (1957-2005)[17] and it would not change much. And thus, the 18.6% increase of project's electricity generation is unlikely to occur.
Total investment	-16.2%	When total investment of project decrease, the IRR of project moves up. The total investment of project is mainly subject to the industrial products' price indices, and according to the chart of "Ex-factory Price Indices of Industrial Products in 2007", which is published by the National Bureau of Statistics of China in 2007[18], the

[12] Notice of the State Council General Office on Print and Distribute Tariff Reform Programme, Guobanfa[2003]No.62

[13] Hunan Price Bureau, Notification on the Administration of Tariff Policy in Hunan Province (Xiangjiazhong [2004]114), Aug. 4 2004
http://www.xxpi.com/Article/ShowArticle.asp?ArticleID=2714

[14] Hunan Price Bureau, Notification on the administration of Coal Price and Tariff (Xiangjiazhong [2005]57), April 25, 2005

[15]Hunan Price Bureau, Notification on tariff administration (Xiangjiadian [2008]158), Oct. 22, 2008
http://www.priceonline.gov.cn/priceGOV/jgzc/content_119175.html

[16] Chinese NDRC, Notification on Adjustment of Tariff of CCPG (Fagaijiage [2009]2925), Nov. 18, 2009

http://www.sdpc.gov.cn/zcfb/zcfbtz/2009tz/t20091120_314530.htm

[17] Western Hunan Autonomous Prefecture Hydro & Power Design Institute, Prelimilary Designation Report of Zhugaotan Hydropower Project, Mar. 2007

[18] http://www.stats.gov.cn/tjsj/ndsj/2008/indexce.htm

		products price increased 19.98% from 1999 to 2007. Thus the price of raw materials is apt to an increasing trend and will not decrease. Moreover, according to the Statistical Bulletin of National Economy and Social Development in 2009, the price of industrial products increased 6.9% in 2008[19]. And thus, based on the recent published statistics, it is unlikely for the total investment of project to decrease more than 16.2%.
O&M cost	/	When the O&M cost of project decrease, the IRR of project moves up. Even the O&M cost turns to 0 the IRR of the project is still below the benchmark of 8%.

The analysis below shows that the project activity is not a financial acceptable project without CERs revenue.

Therefore the project isn't financially attractive without CDM support, alternatives 1 faces financial difficulty, isn't feasible. The most plausible scenario is alternatives 4: Equivalent annual electricity supplied by CCPG.

Step 4. Common practice analysis

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

According to the "Tool for the demonstration and assessment of additionality" (Version 05.2), the word similar means that projects with similar features in the aspects of location, type, scale, and investment climate, etc. Therefore, projects similar to the proposed project activity are hydropower projects in the same region, with similar technology, of similar scale, and are built in comparable investment climate.

Projects of other types are with different technology, return rate of investment, construction period, etc., Hydropower projects located in different provinces of CCPG are of different location, which means different hydraulic condition and investment climate (e.g. with regards to tax, loan policy, electricity tariff, the commodity price[20] and labor wage[21]). Therefore projects located in other provinces of CCPG or of other type needn't to be considered.

According to Classification & Design Safety Standard of Hydropower Project (DL5158-2003), hydropower plants with capacity below 50 MW are classified as small size projects, and common analysis is not applicable to projects below 15MW. Thus in the common practice anlysis in the PDD, the similar scale for other similar activities is defined between 15 ~ 50 MW of the installed capacity of the project.

Reform of the power sector in China took place since 2002. As a result, the investment environment of hydropower plants in China before and after 2002 is very different. Before 2002, according to "Note on Implement methods of Various Electricity Tariff (Document No. 101SDCZ[1987])", "the electricity tariff of each power plant should be determined according to the principle of full-cost recovery and reasonable benefit"[22]. With such favorable policies provided by the government, the developer of hydropower plants

[19] http://www.gov.cn/test/2009-02/26/content_1249960.htm

[20] http://www.askci.com/data/ShowData.asp?ID=81878

[21] http://www.stats.gov.cn/tjsj/ndsj/laodong/2006/html/06-03.htm

[22] Ministry of Water Resources and Electric Power, State Economic Commission and State Price Bureau, Note on Implement methods of Various Electricity Tariff (Document No.101SDCZ[1987]).

didn't face any investment risk. In Feb. 2002, the favorable policies for electricity tariff were cancelled due to "Notice on Issuing Electric Power Sector Reform Program" issued by State Council[23], the main aim is to break the monopolization and optimize resource collocation, which means an open and competitive regional electricity market, however, without governmental funds, project of high investment cost and bad financial index are of low financial attractive. Since the starting date of the project is later than 2002, project activities similar to the project should be those which are constructed later than 2002. Therefore hydropower projects constructed after 2002 are analized in this step.

The hydropower plants in Table 7 of PDD are all developed in areas with better hydrological conditions than the proposed project. Therefore their unit investments are much lower than that of the proposed project. The following table lists the parameters of those projects for comparison with our proposed project. And their individual cases are analyzed below.

Table 8 Hydropower projects completed after 2002 in Hunan (15-50MW) [24]

No.	The project name	Installed capacity (MW)	Project owner	Operation time (year)	Investment of per kWh (RMB yuan/kWh)	IRR
1	Mulongtan	15	State owned enterprise	2003	1.75	11.1%
2	Ruoshui	15	Private company	2006	1.85	10.35%
3	Yongxing II	20	State owned enterprise	2005	1.85	10.8%
4	Chengjiangkou	25	Private company	2006	1.96	10.2%
5	Leizhong	40.5	State owned enterprise	2004	1.8	10.9%
6	Ouyanghai Expanded Project	30	State owned enterprise	2006	1.62	10.8%
7	Yangmingshan II	25	State owned enterprise	2004	1.21	12.9%
Proposed project Zhugaotan		33	Private company	2011	2.34	6.35%

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

According to *The Investigation Report on Hydropower Plants with Installed Capacity of over 15MW Completed after 2002 in Hunan Province* from Hunan Hydro Power Design Institute, the IRRs of 7

http://www.cqpn.gov.cn/gb/laws/xxfg/wj20011.htm

[23] http://www.cogenchina.com/laws/index2.htm?id=200608080001

[24] Hunan Hydro Power Design Institute, Investigation Report on Hydropower Plants with Installed Capacity of over 15MW Completed after 2002 in Hunan Province

projects are higher than the benchmark of 8%. The IRR of the proposed project is only 6.35%, which is obviously lower than the benchmark of 8%, it is the essential distinction between the proposed project and the similar projects above.

Furthermore, in general, investors will give priority to the development of the hydropower plants with good technical and economic indicators, the hydropower plants in Table 8 are developed due to the excellent natural conditions or circumstances described as follow:

#1 Mulongtan Project has obtained the financial funds from Zhangjiajie City Government because it is also a flood prevention project of the city. And the annual operation hour is higher than the project. Therefore the investment per electricity generation is lower than the proposed project.

#2 Ruoshui Project is located in the downstream of Baiyun reservoir which has a year-regulating ability and thus can regulate the flow rate of the river water. So it can have more electricity generation on average, and the annual operation hour is much higher than the project. However, there was no reservoir in the upstream of Zhugaotan Project, and the reservior of Zhugaotan Project is of day-regulating ability which means weak regulate ability and less electricity generation. Therefore the unit investment is lower than the proposed project.

#3 Yongxing II Project and #5 Leizhong Project are both developed by state-owned enterprises. They're located in the downstream of Dongjiang reservoir which has a year-regulating ability and thus can regulate the flow rate of the river water. So both projects have high operation hours and more electricity generation compared to all other projects. So their unit investments are lower than the proposed project.

Similar to #3 and #5, #4 Chengjiangkou Project is also located in the downstream of Dongjiang reservoir but developed by a private company. Though its advantages are not as prominent as the above two state-owned projects, it still benefits from the upstream regulating facilities and has relatively low investment compared to the proposed project due to very small submergence. Therefore its unit investment is lower than the proposed project.

#6 Ouyanghai Expanded Project is an expansion project based on an existing reservoir, and some old facilities such as the dam can be utilized and didn't need rebuilt. So its total investment is much lower than that for a new project with the same scale. So its unit investment is among the lowest of the projects and is much lower than the proposed project.

#7 Yangmingshan II project was developed by a state-owned enterprise with even better natural conditions. It is a diversion type hydropower station with high water head (398m) and small submergence. Moreover, the construction cost on dam is small which leads to evident low total investment. So the investment per electricity generation of Yangmingshan II Project is among the lowest of all the projects, and are much lower than that of the proposed project.

Due to the better hydrological conditions of the similar projects above, those projects are more economically feasible than the proposed project. The IRRs of those projects are above benchmark of 8%, while the project IRR is below the benchmark. Therefore the projects in Table 8 didn't have any investment risk. It was easy for the project owners of these projects to obtain government funding or loans from banks. There weren't any financing difficulty for those projects. But the proposed project has poorer financial indicators and isn't financially attractive, it would be very difficult for the project owner of the proposed project to obtain bank loan without CDM support. Therefore, the proposed project activity faces severe financing difficulty and is not a common practice in Hunan Province.

The implementation timeline of the proposed CDM project activity is shown as follow:

Item	Date
Environmental Impact Assessment Report (EIA) was finished. [25]	Oct. 2006
Approval of EIA Report was received.[26]	Dec. 8, 2006
Feasibility Study Report (FSR) was finished.[27]	Sep. 2006
Approval of FSR was received.[28]	Dec. 27, 2006
Prelimilary Designation Report (PDR) was finished.[29]	Mar. 2007
Approval of PDR was received.[30]	Mar. 19, 2007
Decision to consider CDM Support in Board Meeting was made.[31]	July 6, 2007
Service Agreement of CDM Project Development was signed.[32]	Aug. 21, 2007
Procurement Contract of Water-turbine Generator Units was signed.[33]	Sep. 8, 2007
Construction Contract of Dam, Power House and Stilling Pool 34	Sep. 30, 2007
Date of Construction Starting[35]	Oct. 9, 2007
Term Sheet of CERs Purchase was signed.[36]	May 6, 2008
Submitted the application documents to Chinese NDRC[37]	May 2008
Received the approval of Chinese NDRC[38]	Aug. 22, 2008

[25] Hunan Hydro & Power Design Institute, Environmental Impact Assessment, Oct. 2006

[26] Hunan Environmental Protection Bureau, Approval of EIA, 8 Dec. 2006

[27] Western Hunan Autonomous Prefecture Hydro & Power Design Institute, Feasibility Study Report of Zhugaotan Hydropower Project, Sep. 2006.

[28] NDRC of Hunan Province, Approval of FSR, 27 Dec. 2006

[29] Western Hunan Autonomous Prefecture Hydro & Power Design Institute, Prelimilary Designation Report of Zhugaotan Hydropower Project, Mar. 2007

[30] Water Conservancy Bureau of Hunan Province, Approval of PDR, 19 Mar. 2007.

[31] Meeting Minutes of the Board of Directors of Huayuan ChunJiang Power Generation Co., Ltd., July 6, 2007

[32] CDM Project Development Service Agreement between Hunan CDM Project Service Center and Huayuan ChunJiang Power Generation Co., Ltd., 21 Aug. 2007

[33] Procurement Contract of Water-turbine Generator Units between Hangzhou Chunjiang Power Generation Equipment Co., Ltd. and Huayuan ChunJiang Power Generation Co., Ltd., Sep. 8, 2007

[34] Construction Contract of Dam, Power House and Stilling Pool between Huayuan ChunJiang Power Generation Co., Ltd. and China Hydropower 8th Project Burea, Sep. 30, 2007

[35] Western Hunan Autonomous Prefecture Hydropower Project Supervisor Co., Ltd., The Construction Licence of Zhugaotan Hydropowr Plant, 9 Oct. 2007

[36] Term sheet of CERs Purchase between Huayuan ChunJiang Power Generation Co., Ltd. and Camco International Limited, 12 April 2008

[37] Huayuan ChunJiang Power Generation Co., Ltd., The CDM application document, May 2008

[38] Chinese NDRC, The CDM Approval of Hunan Zhugaotan Hydropower Project, 22 Aug. 2008

GSP[39]	Oct. 2008
DOE validated the project[40]	April 2009
Transformer Purchase Contract[41]	Jul. 2, 2010
Purchase Contract of Speed Governor, Oil Pressure Installation and Accessory[42]	Sep. 28, 2010
Installation Contract of Metal Structure and Hoisting Equipment[43]	Oct. 28, 2010
Construction Contract of Grid Connection[44]	Nov. 22, 2010

Considering that the IRR of the project is less than the benchmark, and it is higher than the benchmark with CERs sale revenue, the project owner held a board meeting on 6 July 2007, the meeting decided to apply for the CDM support. The project owner signed the Service Agreement of CDM Project Development with Hunan CDM Project Service Center on 21 Aug. 2007. The Procurement Contract of Water-turbine Generator Units was signed on 08 Sep. 2007, and the project started construction on Oct. 9, 2007 due to the CDM incentives. So the incentives from the CDM have been seriously considered in the decision to proceed with the project activity.

The project owner signed the Term Sheet of CERs Purchase with the CERs Buyer on 12 April 2008, and the application documents was submitted to Chinese NDRC on May 2008, the approval of Chinese NDRC was received on 22 Aug. 2008. Then the GSP was implemented in Oct. 2008, and the DOE validated the project in April 2009.

From the timeline and corresponding description above, it can be concluded that the continuing and real actions have been taken to secure CDM status for the project in parallel with its implementation.

In conclusion, the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Project Emissions

According to the baseline methodology ACM 0002 (Version 11), if the power density of the project activity (PD) is greater than 4 W/m and less than or equal to 10W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000} \quad (1)$$

[39] http://cdm.unfccc.int/Projects/Validation/DB/BWEZ5WQA0DPYAPSXY1BK2RPSXXRVNW/view.html ,22 Oct. 2008

[40] The e-mail between DOE and CDM agent, April 2009

[41] Transformer Purchase Contract signed between Shandong Taikai Transformer Co., Ltd. and the project owner on 2 July 2010

[42] Purchase Contract of Speed Governor, Oil Pressure Installation and Accessory signed between Changsha Center Automatic Control Equipment Co., Ltd. and the project owner on 28 September 2010

[43] Installation Contract of Metal Structure and Hoisting Equipment signed between Hunan Taojiang Hydraulic Machinery Co., Ltd. and the project owner on 28 October 2010

[44] Construction Contract of Grid Connection signed between Sinohydro No.8 Bureau and the project owner on 22 November 2010.

Where:
$PE_{HP,y}$ is emission from reservoir expressed as tCO_2e/year
EF_{Res} is the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO_2e /MWh
TEG_y is total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh)

If the power density of the project activity (PD) is greater than $10W/m^2$, $PE_y = PE_{HP,y} = 0$

The power density of the project activity (PD) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \qquad (2)$$

Where:
PD is power density of the project activity (W/m^2).
Cap_{PJ} is the installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL} is the installed capacity of the hydropower plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.
A_{PJ} is the area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
A_{BL} is the area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

According to the PDR,, the installed capacity of the hydro power plant is 33MW, the installed capacity before the implementation of the project activity is 0, the area of the reservoir measured in the surface of the water after the implementation of the project activity when the reservoir is full is $3km^2$, the area of the reservoir measured in the surface of the water before the implementation of the project activity when the reservoir is full is 0:

$$PD=(33{,}000{,}000-0)/(3{,}000{,}000-0)=11\ W/m^2$$

Therefore the power density of the project is more than $10W/m^2$, PE_y =0.

Baseline Emissions
According to baseline methodology ACM0002 (Version 11), the baseline emissions are the CO_2 emissions from the equivalent electricity supply by CCPG that is displaced by the project activity. So the baseline emissions by the project activity during a given year *y* is obtained as follow:

$$BE_y=EG_{PJ,y}\cdot EF_{grid,CM,y} \qquad (3)$$

Where:
BE_y is baseline emissions in year y (tCO_2/yr).
EG_y is electricity supplied by the project activity to the grid in year *y* (MWh).
$EF_{grid,CM,y,}$ is combined margin CO_2 emission factor for grid connected power generation in year y calculated using “Tool to calculate the emission factor for an electricity system (version 02)”.

According to baseline methodology ACM0002, for greenfield renewable energy power plants:

$$EG_{PJ,y} = EG_{facility,y} \qquad (4)$$

Where:

$EG_{PJ,y}$ is quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).
$EG_{facility,y}$ is quantity of net electricity generation supplied by the project plant to ghe grid in year y (MWh/yr).

The emission coefficient (measured in kg CO_2e/kWh) should be calculated in a transparent and conservative manner as: a combined margin (CM), consisting of the combination of operating margin(OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system (Version 02)".
The data used for calculation are from an official source (where available) and publicly available. The calculation processes are as follows:

STEP 1: Identify the relevant electricity system.
STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3: Select a method to determine the operating margin (OM).
STEP 4: Calculate the operating margin emission factor according to the selected method.
STEP 5: Identify the group of power units to be included in the build margin (BM).
STEP 6: Calculate the build margin emission factor.
STEP 7: Calculate the combined margin (CM) emissions factor.

STEP 1: Identify the relevant electricity system

According to 'Tool to calculate the emission factor for an electricity system' (Version 02), as the generated electricity of the proposed project will be delivered to CCPG, relevant electricity system is defined as all power plants connected to CCPG[45], which includes Jiangxi Province, Henan Province, Hubei Province, Hunan Province, Sichuan Province and Chongqing City.

STEP 2: Choose whether to include off-grid power plants in the project electricity system (optional)

According to 'Tool to calculate the emission factor for an electricity system' (Version 02), there are two options to calculate the operationg margin and build margin emission factor:
Option I : Only grid power plants are included in the calculation.
Option II : Both grid power plants and off-grid power plants are included in the calculation.
For the proposed project, Option I is chosen.

STEP 3: Select a method to determine the operating margin (OM)

According to "Tool to calculate the emission factor for an electricity system (Version 02)", there are four methods for calculating the $EF_{grid,OM,y}$:

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

Method (a) can be used if 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 averages data for hydroelectricity production. It can be found from Table 9 that the low-cost/must run resources including hydro,

[45] Department of Climate Change of National Department and Reform Commission, China's Regional Grid Baseline Emission Factor 2008, 30 December 2008

geothermal, wind, low-cost biomass constitute less than 50% of CCPG during year 2003 to 2007. Thus, method (a) is applicable to calculate $EF_{grid,OM,y}$.

Table 9 Percentage of low-cost/must run resources in CCPG during year 2002～2006[46]

	2002	2003	2004	2005	2006
%Low cost/must run	35.95%	34.43%	37.89%	38.60%	35.12%

For the project, $EF_{grid,OMsimple,y}$ is calculated using ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

STEP 4: Calculate the operating margin emission factor according to the selected method

According to "Tool to calculate the emission factor for an electricity system (Version 02)", there are two options based on different data for calculating $EF_{grid,OMsimple,y}$:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.
For the project, the necessary data for Option A is not available, so Option A can't be used, Option B can be used if only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known and off-grid power plants are not included in the calculation. There isn't any nuclear power in CCPG at present and renewable power generation are considered as low-cost / must-run power sources in CCPG, and the quantity of electricity supplied to CCPG by these sources is known and off-grid power plants are not included in the calculation, so Option B is used for calculating $EF_{grid,OMsimple,y}$, the formula is as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO_{2,i,y}})}{EG_y} \qquad (2)$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$ = Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year y (MWh)
i = All fossil fuel types combusted in power plant/unit m in year *y*
y = The relevant year as per the data vintage chosen in step 3.

The calculation method of $EF_{grid,OMsimple,y}$ issued by National Development and Reform Commission is referred to for the project[47], to see A1～A7 in Annex 3 for details.

[46] China Electric Power Yearbook 2003～2007

STEP 5: Identify the group of power units to be included in the build margin (BM)

According to 'Tool to calculate the emission factor for an electricity system' (Version 02), the sample group of power units m used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently, or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The set of power units that comprises the larger annual generation should be used.

According to "China's Regional Grid Baseline Emission Factor 2009" issued by National Development and Reform Commission on 2 July 2009, because of the unavailability of the data at the power plant level in China, a deviation method is used to calculate the build margin emission factor, to see Step 5 for details.

STEP 6: Calculate the build margin emission factor

Build Margin emission factor ($EF_{grid, BM, y}$) is calculated by utilizing an *ex-ante* 3 years data vintage for CCPG, the formulae as follow:

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (3)$$

Where：

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available

'Tool to calculate the emission factor for an electricity system' (Version 02) provides two options (Option 1 and Option 2) to calculate the build margin emission factor in terms of vintage of data.

Option 1 is chosen to calculate the build margin emission factor. For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

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[47]National Development and Reform Commission, China's Regional Grid Baseline Emission Factors 2009, 2 July 2009.

Because of the data unavailability at the power plant level in China, the 22nd CDM EB meeting agreed the following deviation[48] approaches for $EF_{grid,BM,y}$ calculation:

1) Use the efficiency level of the most advanced commercialized technologies of provincial/regional or national grid of China, as a conservative proxy, for fuel *i* consumption estimation to estimate the $EF_{grid,BM,y}$;

2) Use of capacity additions during last several years for estimating the $EF_{grid,BM,y}$ i.e. the capacity addition over last several years, whichever results in a capacity addition that is closest to 20% of total installed capacity;

3) Use of installed capacity to replace annual power generation to estimate weights.

Due to the difficulty of separating the coal-fired, gas-fired or oil-fired installed capacity from the total thermal installed capacity, the $EF_{grid,BM,y}$ will be calculated as:

1) Based on the most recent years energy balance of the CCPG, calculating the proportions of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total CO_2 emissions of thermal power plants and taking them as weights of each type of plants in the following calculations;

2) Based on the most advanced commercialized technologies which applied by the coal-fired, oil-fired and gas-fired power plants, calculating the emission factor of thermal power plants in CCPG. This approach is more conservative as it assumes all recently built plants have the fuel efficiency as that of the most advanced commercialized technologies;

3) Calculating the $EF_{grid,BM,y}$ through multiplying the emission factor of thermal power plants by the percentage share of thermal power plants installed capacity addition within all recently built installed capacity. The proper year is selected so that it is the closest time when the last 20% of installed capacity was built.

The BM in this PDD is calculated as the following sub-steps.

SUB-STEP 6a: Calculating the percentages of CO_2 emissions from the coal-fired, gas-fired and oil-fired power plants in CO_2 emissions from total thermal power plants

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

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

[48] http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ

$$\lambda_{Gas,y} = \frac{\sum_{i \in Gas, j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (6)$$

Where:

$\lambda_{Gas,y}$	=	Percentage of CO_2 emissions from the gas-fired power plants in CO_2 emissions from total thermal power plants in year *y*;
$\lambda_{Oil,y}$	=	Percentage of CO_2 emissions from the oil-fired power plants in CO_2 emissions from total thermal power plants in year *y*;
$\lambda_{Coal,y}$	=	Percentage of CO_2 emissions from the coal-fired power plants in CO_2 emissions from total thermal power plants in year *y*;
$F_{i,j,y}$	=	Amount of fuel i (mass or volume unit, t for solid and liquid fuel, m^3 for gas fuel) consumed by the power sources of province j in year y;
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type i in year y (GJ/t for solid and liquid fuel, GJ/ m^3 for gas fuel);
$EF_{CO_2,i,j,y}$	=	CO_2 emission factor of fossil fuel type i in year *y* (tCO_2/MWh).

SUB-STEP 6b: Calculating the fuel-fired emission factor ($EF_{Thermal}$)

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (7)$$

Where:

$EF_{Thermal,y}$	=	Emission factor of thermal power plants;
$EF_{Coal,Adv,y}$	=	Emission factor of coal-fired power plants applying the most advanced commercialized technologies;
$EF_{Oil,Adv,y}$	=	Emission factor of oil-fired power plants applying the most advanced commercialized technologies;
$EF_{Gas,Adv,y}$	=	Emission factor of gas-fired power plants applying the most advanced commercialized technologies.

SUB-STEP 6c: Calculating the Build Margin (BM) emission factor ($EF_{grid,BM,y}$)

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (8)$$

Where:

$EF_{grid,BM,y}$	=	Build Margin (BM) emission factor with advanced commercialized technologies for year y of CCPG;
$CAP_{Total,y}$	=	Incremental installed capacity of recently built power plants, which constitutes near and greater than 20% of the total installed capacity;
$CAP_{Thermal,y}$	=	Newly installed capacity of recently built thermal power plants;
$EF_{Thermal,y}$	=	Emission factor of thermal power plants.

$EF_{grid,BM,y}$ is calculated according to the latest available data at the submission time of this PDD, the detailed data for the calculations is shown in Table A8-Table A10 of Annex 3.

STEP 7: Calculate the combined margin (CM) emissions factor

According to 'Tool to calculate the emission factor for an electricity system' (Version 02), baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$):

$$EF_{grid,CM,y} = w_{OM} \times EF_{grid,OM,y} + w_{BM} \times EF_{grid,BM,y} \quad (9)$$

Where:
w_{OM} = Weighting of operating margin emission factor (%);
w_{BM} = Weighting of build margin emission factor (%).

The weighs w_{OM} and w_{BM}, by default, are 50% (i.e., w_{OM}= w_{BM}= 0.5) in the crediting period.

Leakage

According to baseline methodology ACM0002 (Version 11), no leakage emissions are considered.

Emission Reductions

The annual emission reduction (ER_y) of the project is the difference between baseline emission and project emissions:

$$ER_y \text{ (tCO}_2\text{e/yr)} = BE_y - PE_y \quad (11)$$

B.6.2. Data and parameters that are available at validation:

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Data / Parameter:	*$NCV_{i,y}$*
Data unit:	kJ/kg or kJ/m^3
Description:	The net calorific value (energy content) per mass or volume unit of fuel i in year y.
Source of data used:	*China Energy Statistical Yearbook 2007*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	*Electricity generation*
Data unit:	MWh
Description:	The electricity generated by fuel-fired power plants in CCPG
Source of data used:	*China Electric Power Yearbook 2005-2007*

Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	*Internal power consumption rate of power plants*
Data unit:	%
Description:	The internal power consumption rate of power plants in province *j* in CCPG in year *y*.
Source of data used:	*China Electric Power Yearbook 2005-2007*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/TJ
Description:	The CO_2 emission factor per unit of fuel i in year y.
Source of data used:	*Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	No specific Chinese value available, to adopt the IPCC default value.
Any comment:	

Data / Parameter:	$FC_{i,y}$
Data unit:	10^4 t, 10^8 m^3
Description:	The quantity of fuel *i* (in a mass or volume unit) consumed by CCPG in year *y*.
Source of data used:	*China Energy Statistical Yearbook 2005-2007*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$CAP_{j,y}$

Data unit:	MW
Description:	Installed capacities of province *j* in CCPG in years *y*.
Source of data used:	*China Electric Power Yearbook 2002-2007*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$GENE_{Coal,Adv}$
Data unit:	/
Description:	The power supply efficiency of coal-fired power plants with best technology commercially available.
Source of data used:	China's Regional Grid Baseline Emission Factors 2008
Value applied:	38.10%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$GENE_{Oil,Adv,y}$
Data unit:	/
Description:	The power supply efficiency of oil/gas-fired power plants with best technologies commercially available.
Source of data used:	China's Regional Grid Baseline Emission Factors 2009
Value applied:	49.99%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. The proposed project is a new hydropower plant, this value is zero.
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or description of measurement methods	Determine the installed capacity based on recognized standards.

and procedures actually applied :	
Any comment:	

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For the project, the reservoir is new, this value is zero.
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Measured from topographical surveys and maps.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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Project emission (*PE_y*)

According to section B6.1, the calculation of PD is as follows:

$$PD=33MW/3km^3=11W/m^2$$

As the PD is over 10 W/m^2, the project emission in year y is:

$$PE_y = 0$$

Baseline emission

According to the formula (5)-(10) in section B.6.1, the results of $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ and $EF_{grid,CM,y}$ are listed in following Table 10 , the detailed calculation processes are shown in Annex 3.

Table 10 Calculating result of baseline emission factor of CCPG

$EF_{grid,OM,y}$ (tCO_2e/MWh)	$EF_{grid,BM,y}$ (tCO_2e/MWh)	$EF_{grid,CM,y}$ (tCO_2e/MWh)
1.2783	0.6687	0.9735

The project baseline emmision is:

$$BE_y = 98,410 \text{ MWh} \times 0.9735 \text{ } tCO_2e \text{ /MWh} = 95,802 \text{ } tCO_2e \text{ / yr}$$

Emission Reductions

According to the formula (5)-(10) in section B.6.1, the final GHG emission reduction for the Project is obtained as follows:

$$ER_y = BE_y - PE_y = 95,802 \text{ } tCO_2e \text{ / yr}$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

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The summary of the ex-ante estimation of emission reductions are listed in Table 11 below:

Table 11 The ex-ante estimation of the emission reductions

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
01/06/2011-31/05/2012	0	95,802	0	95,802
01/06/2012-31/05/2013	0	95,802	0	95,802
01/06/2013-31/05/2014	0	95,802	0	95,802
01/06/2014-31/05/2015	0	95,802	0	95,802
01/06/2015-31/05/2016	0	95,802	0	95,802
01/06/2016-31/05/2017	0	95,802	0	95,802
01/06/2017-31/05/2018	0	95,802	0	95,802
01/06/2018-31/05/2019	0	95,802	0	95,802
01/06/2019-31/05/2020	0	95,802	0	95,802
01/06/2020-31/05/2021	0	95,802	0	95,802
Total (tonnes of CO_2 e)	0	958,020	0	958,020

B.7 Application of a monitoring methodology and description of the monitoring plan:

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B.7.1 Data and parameters monitored:

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Data Parameter:	TEG_y
Data unit:	MWh
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*
Source of data to be used:	Project activity site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	103,590
Description of measurement methods and procedures to be applied:	Continuous measurement and at least monthly recording.
QA/QC procedures to be applied:	The meter will be calibrated once a year.
Any comment:	

Data Parameter:	$EG_{facility,y}$
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant to CCPG in year y.

Source of data to be used:	Project activity site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	98,410
Description of measurement methods and procedures to be applied:	Continuous measurement and monthly recording.
QA/QC procedures to be applied:	The main meter will be calibrated once a year and net electricity supplied by the project activity to CCPG would be double checked by receipt of sales.
Any comment:	

Data / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	33,000,000
Description of measurement methods and procedures to be applied:	Yearly monitored based on recognized standards.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	A_{PJ}
Data unit:	m^2
Description:	According to the PDR of the project, area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,000,000
Description of measurement methods and procedures to be applied:	Yearly measured from topographical surveys, maps, satellite pictures, etc.
QA/QC procedures to	

be applied:	
Any comment:	

B.7.2 Description of the monitoring plan:

>>

1. Monitoring subject

The main data monitored are the total electricity produced by the project activity, the net electricity generation delivered to the grid by the project, the installed capacity of the hydro power plant and the reservoir measured in the surface of the water.

2. Monitoring management structure

In order to obtain reliable monitoring data, the project developer will establish a monitoring management structure prior to the starting of the crediting period. Clear responsibilities will be assigned to all staffs involved in the CDM project. A monitoring director will be appointed who has the overall responsibilities for the monitoring of the project, other staffs will be responsible for the data recording, data collecting, data archiving and emission reductions calculation. The detailed structure is as follows:

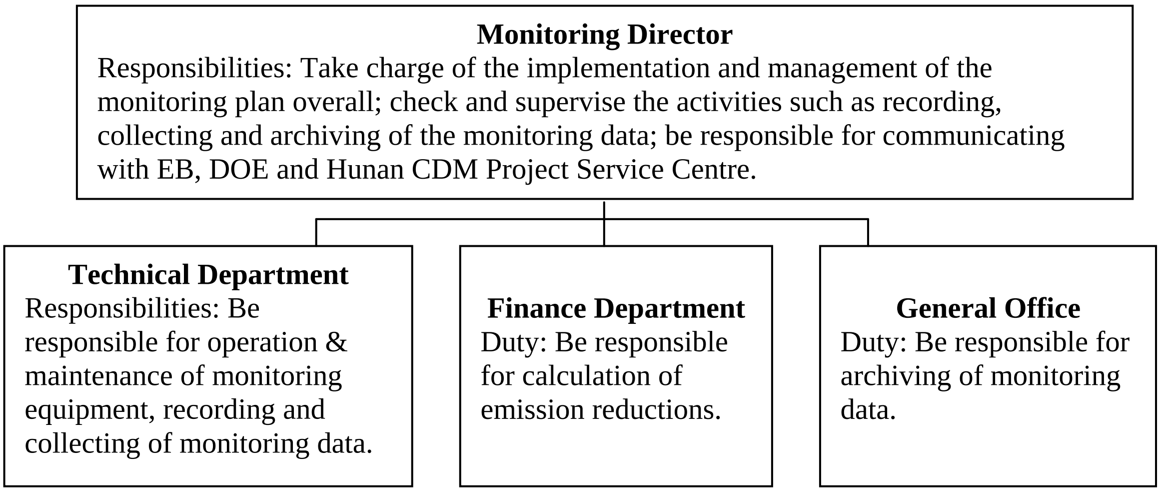

Fig.4 Operational and management structure

3. Monitoring apparatus and installment:

A main meter and a back-up meter monitoring the electricity delivered to the grid and electricity imported from the grid with bidirectional function for reading data will be installed at the connection point to the grid. A meter monitoring the total generation will be installed at the exit of the generator. The meters will be installed in accordance with “Technology & Management Regulations for Power Metering Devices” (DL/T448-2000), the accuracy of the meters will be 0.5S or higher than 0.5S meeting the national standard.

The detailed structure is as follow:

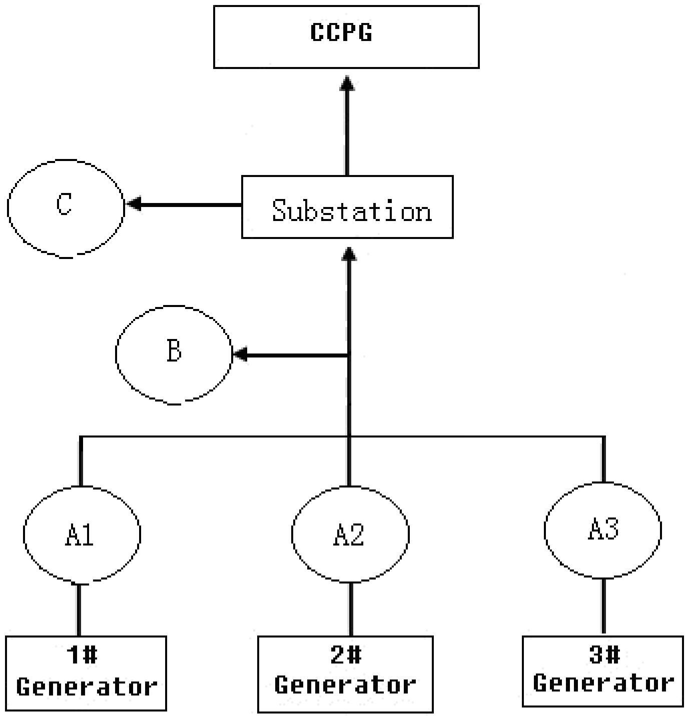

Fig. 5 Meter position of the project

A: monitor meters of generated electricity by generators
B: main monitor meter of net electricity generation delivered to the grid by the project
C: back up monitor meter of net electricity generation delivered to the grid by the project

4. Data monitoring

The readings of the main meter are used for calculating the emission reductions when the main meter is in normal operation state. The monitoring processes are as follows:
(1) The designated persons from the grid company and the project company record the readings of the meter for the electricity delivered to CCPG and consumed by the project activity from CCPG;
(2) The project owner provides the power grid company with a settling accounts sheet about the net electricity supplied to CCPG monthly;
(3) The project owner provides the power grid company with a sale receipt after the power grid company has confirmed the settling accounts sheet, and preserves the copy of the sale receipt.

5. Quality control

1) Calibration of meters

The calibration of meters conducted by a qualified organization must comply with national standard and sectional regulations to ensure the accuracy. The main meter and back-up meter at the connection point to the grid will be calibrated once per year.

When the main meter or back-up meter have a breakdown, the party finding the breakdown should tell another party and inform the qualified calibration organization to check, calibrate, test and treat the meter so as to recover the normal monitoring state.

2) Emergency treatment

For the the total electricity produced by the project activity and net electricity generation delivered to the grid by the project:

When the main meter or back-up meter have a breakdown, the electricity generation difference will be treated as follows:

(1) When one of the two meters has a breakdown, the readings of another meter will be adopted;
(2) If both of the main meter and back-up meter have breakdowns, the net electricity supplied to the grid will be calculated with the readings of other meters such as the meter installed at the exit of the generator deducting the loss after the discussion between the owner and the grid company.

6. Data management
All monitoring data and records will be archived electronically and be kept at least for 2 years after the end of the crediting period.

7. Training program
The proposed project developer and Hunan CDM Project Service Center will train all the related staffs before on duty and during project operation. The training contains CDM knowledge, operational regulations, quality control (QC), data monitoring requirements and data management regulations, etc.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

>>
Final Date of completion of the application of the baseline and monitoring methodology
10/03/2011
Name of the responsible person/entity:

Ying Ma
Unit: Hunan CDM Project Service Center
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Above individuals / entities are not as project participants.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
08/09/2007 (The date of the Procurement Contract of Water-turbine Generator Units, which is the earliest starting date of the activity.)

C.1.2. Expected operational lifetime of the project activity:

>>
25 years (including 3.5 years of construction period)

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

>>

C.2.1.1. Starting date of the first crediting period:

>>
Not applicable

C.2.1.2. Length of the first crediting period:

>>
Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/06/2011

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

"Outline Report of Land Expropriation and Immigration Resettlement" was carried out by Hunan Hydro & Power Design Institute in July 2007, and the approval was received on 31 Aug. 2007[49]. According to the report, there were 378.98 plantation to be expropriated and 117 immigrations.

The compensation of plantation will be implemented in line with government documents "Notification on the Standard of Annual Production Value for Land Expropriation, Xiangzhengbanfa [2005]47", the compensation of other land will be implemented in line with government documents "The Measurements on Implication of Land Administration in Hunan Province". The immigration will be resettled near the former living site.

The Environmental Impact Assessment was carried out by Hunan Hydro & Power Design Institute in Oct. 2006 and approved by the Hunan Environmental Protection Bureau on 8th December 2006 (Xiang Huan Ping [2006] 133). The conclusions of the reports are as follow: on one hand the project will provide considerable energy and improve the condition of local economic development; on the other hand the environmental impacts of the project are marginal and the project has been approved for development according to all national and local regulations, more details as follows:

Table 12 Assessment and views of impacts on environment and measures for environmental protection

Impact items	Assessment and Views on environmental impacts	Measures for environmental Protection
Water Quality	Waste water from sand process system.	Disposed by flocculent precipitation process.
	Oil wastewater from construction machinery.	Treated by high efficiency oil-water separator.
	Waste water from foundation pit.	Adding flocculating agent into foundation pit.
	Domestic sewage.	Adopt special sewage treatment equipment.
Air Quality	Cement dust.	Keep good airtightness of bulk cement storage tank.
	Dust from transportation.	Sprinkling for dust suppression.
	Waste gas from vehicles.	Install exhaust purifying device.
Noise	Noise from transportation.	Limit the speed of vehicles.

[49] The Reservoir Immigration Administration Bureau of Hunan Province, The approval on the Outline Report of Resettlement Arrangement (Xiang Yi Han [2007] 186), 31 Aug. 2007

	Noise from construction.	Adopt low noise construction machinery which meets the environmental requirement.
Solid waste	Earth and stone from construction.	Collect and transport the solid garbage to the fixed deposit place, take related soil & water conservation measures..
	Domestic waste.	Transport waste to refuse dump.
Ecological environment	No rare animals or plants in the neighboring area of the project, the impacts on ecological environment are very small.	To make green by planting trees in the construction area; the administering laws and propaganda for the wild animals' protection will be strengthened to improve the consciousness of the local people and workers to protect the wild animals.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

Both of the Host Party and the project owner regard that the proposed project would not bring significant impacts on the environment. After the completion of the project construction, the project will be put into operation only after the inspection and acceptance of local environmental protection department.

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

In order to survey the local resident's opinions about the construction, the bulletins were put up all around the project site, the main contents are as follows: "Zhugaotan Hydropower Station is located on the downstream of Youshui River in Huayuan County, the proposed installed capacity is 33MW, and the project will start construction around Oct. 2007".

Then they carried out questionnaire in September 2007. 150 survey papers have been distributed to local people and 145 valid papers received. Of the 145 respondents, 64 persons are over senior middle school, 70 persons are of junior middle school, 11 persons are of elementary school; 35 aged people, 79 middle age, 31 youth; 19 officials, 122 farmers and 4 other occupation. In addition, an internet survey was taken in the "Western Hunan Synthetic Community" (http://bbs.xxz.gov.cn/viewthread.php?tid=10724&fpage=1） at the same time, the public express their opinions actively.

The main content of questionnaire is shown in E.2.

E.2. Summary of the comments received:

>>

The questions mainly discussed are as follows:

Qustion	Choice	Rate
Do you think Zhugaotan hydropower project is good for local economic development?	Yes	100%
	No	0
	No comments	0
Do you support the construction of the project activity?	Yes	100%
	No	0
	No comments	0
How do you think the noise and dust from the project activity will have on local region?	No impact	99.3%
	Little	0.7%
	Impact much	0
How do you think the impact of the project activity would have on the animal?	No impact	98.6%
	Little	1.4%
	Impact much	0
How do you think the impact of the project activity would have on the water?	No impact	100%
	Little	0
	Impact much	0
What kind of impact would have on natural sight?	Positive	99.3%
	Negative	0.7%
	No comments	0
How do you think the impact of the project activity would have on residents health?	No impact	100%
	Little	0
	Impact much	0
How do you think the difficulty of	No difficulty	99.3%

immigrant relocation?	Little	0.7%
	Great difficulty	0
How do you think the life quality of immigrant after the resettlement?	Higher	91%
	Unchanged	9%
	Lower	0

According to the questionnaire, most residents support the project activity, they believe the project would relieve the power shortage situation of local region and promote the development of local economy, and they are willing to cooperate with the land expropriation, house removal and resettlement.
The main opinions are as follows:

1. The project will generate electricity with the water resources, it will mitigate the power lack of the area.
2. The project activity can provide some job opportunities for the local residents during the construction and after the project is put into operation, and promote the local development, thus the living standard of the local people will be improved.
3. They all support the project powerfully because it is helpful to the country and the masses. They hope that the project can be put into operation as soon as possible so as to produce benefits.

The people also presented the following issues and suggestions:

1. The local residents should have a priority to get job opportunities during the construction and operation.
2. The owner should take the measures of the environmental protection seriously to ensure that the production and living of the local people isn't affected obviously.
3. The water and soil conservation should be conducted well, especially the vegetation should be recovered after the completion of the construction.

E.3. Report on how due account was taken of any comments received:

>>

The developer has taken the stakeholders' comments into full account and will implement the following measures:

1. The project owner promises that the local residents have a priority to get job opportunities during the construction and operation.
2. The environmental protection measures presented in the EIA report will be taken strictly to minimize the adverse impacts from the project and bring the positive impacts on the environment into full play;
3. TThe vegetation will be recovered at once in the construction area after the completion of the construction of the project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from parties included in Annex I is available to the project activity.

Annex 3

BASELINE INFORMATION[50]

The installed capacity, fuel consumption data used for OM and BM calculation are derived from <China Energy Statistical Yearbook>, <China Electric Power Yearbook>.

The low calorific value, CO_2 emission factor and oxidation factor of fuels are listed in Table A1 below.

Table A1 Low calorific values, CO_2 emission factors and oxidation factors of fuels

Fuel	Low Calorific Value	Emission Factor (tC/TJ)	Oxidation Factor
Raw Coal	20908 kJ/kg	25.80	100%
Cleaned Coal	26344 kJ/kg	25.80	100%
Other Washed Coal	8363 kJ/kg	25.80	100%
Coal briquette	20908 kJ/kg	26.60	100%
Coke	28435 kJ/kg	29.20	100%
Crude Oil	41816 kJ/kg	20.00	100%
Gasoline	43070 kJ/kg	18.90	100%
Diesel Oil	42652 kJ/kg	20.20	100%
Fuel Oil	41816 kJ/kg	21.10	100%
Other Oil products	38369 kJ/kg	20.00	100%
Other Coke products	28435 kJ/kg	25.80	100%
Natural Gas	38931 kJ/m^3	15.30	100%
Coke Oven Gas	16726 kJ/m^3	12.10	100%
Other Gas	5227 kJ/m^3	12.10	100%
LPG	50179 kJ/kg	17.20	100%
Refinery Gas	46055 kJ/kg	15.70	100%

Data Source:

The net calorific values are quoted from <China Energy Statistical Yearbook 2007>, Page 287.

The emission factors and oxidation factors are quoted from <Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories >, Table 1.4, Page 1.24, Chapter 1, Volume 2.

[50] Office of National Coordination Committee on Climate Change, Bulletin of Baseline Emission Factor of China Grid, 18 July 2008.

Step 1: Calculating the Operating Margin emission factor ($EF_{grid,OM,y}$)

Table A2 Simple OM Emission Factors Calculation of CCPG for Year 2004

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	EF	Oxidation	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J * 44/12/10000 (for mass unit)
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	K=G*H*I*J *44/12 /1000 (for volume unit)
Raw Coal	10^4 t	1863.8	6948.5	2510.5	2197.9	875.5	2747.9	17144.1	25.8	100	20908	339,092,605
Cleaned Coal	10^4 t		2.34					2.34	25.8	100	26344	58,316
Other Washed Coal	10^4 t	48.93	104.22			89.72		242.87	25.8	100	8363	1,921,441
Coke	10^4 t		109.61					109.61	29.2	100	28435	3,337,011
Coke Oven Gas	10^8 m^3			1.68		0.34		2.02	12.1	100	16726	149,900
Other Gas	10^8 m^3					2.61		2.61	12.1	100	5227	60,527
Crude Oil	10^4 t		0.86	0.22				1.08	20	100	41816	33,118
Gasoline	10^4 t		0.06			0.01		0.07	18.9	100	43070	2,089
Diesel Oil	10^4 t	0.02	3.86	1.7	1.72	1.14		8.44	20.2	100	42652	266,627
Fuel Oil	10^4 t	1.09	0.19	9.55	1.38	0.48	1.68	14.37	21.1	100	41816	464,893
LPG	10^4 t							0	17.2	100	50179	0
Refinery Gas	10^4 t	3.52	2.27					5.79	15.7	100	46055	153,506
Natural Gas	10^8 m^3						2.27	2.27	15.3	100	38931	495,775

Other enery	10^4 t Stand Coal		16.92		15.2	20.95		53.07	20	100	38369	0
											Total	**346035810**

Data Source: <China Energy Statistical Yearbook 2005>

Table A5 Fuel-fired Electricity Generation of CCPG for Year 2004

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	**(MWh)**	**(%)**	**(MWh)**
Jiangxi	301.27	30127000	7.04	28006059
Henan	1093.52	109352000	8.19	100396071
Hubei	430.34	43034000	6.58	40202363
Hunan	371.86	37186000	7.47	34408206
Chongqing	165.2	16520000	11.06	14692888
Sichuan	346.27	34627000	9.41	31368599
Total				249074186

Data Source: <China Electric Power Yearbook 2005>

According to Table A2, the total CO_2 emissions of CCPG is 346,035,810 tCO_2e in year 2004. According to Table A3, the total supplied electricity of CCPG is 249,074,186 MWh. According to formula (2) in section B.6.1, the $EF_{OM, Simple, 2004}$ is 1.38929 tCO_2e/MWh.

Table A4 Simple OM Emission Factors Calculation of CCPG for Year 2005

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	EF	Oxidation	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J *44/12/10000 (for mass unit)
		A	B	C	D	E	F	G=A+B + C+D+E +F	H	I	J	K=G*H*I*J *44/12/1000 (for volume unit)
Raw Coal	10^4 t	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	17827.75	25.8	100	20908	352614497
Cleaned Coal	10^4 t	0.02						0.02	25.8	100	26344	498
Other Washed Coal	10^4 t		138.12			89.99		228.11	25.8	100	8363	1804669
Coke	10^4 t		25.95		105			130.95	29.2	100	28435	3986695
Coke Oven Gas	10^8 m^3			1.15		0.36		1.51	12.1	100	16726	112054
Other Gas	10^8 m^3		10.2			3.12		13.32	12.1	100	5227	308897
Crude Oil	10^4 t		0.82	0.36				1.18	20	100	41816	36185
Gasoline	10^4 t		0.02			0.02		0.04	18.9	100	43070	1194
Diesel Oil	10^4 t	1.3	3.03	2.39	1.39	1.38		9.49	20.2	100	42652	299798
Fuel Oil	10^4 t	0.64	0.29	3.15	1.68	0.89	2.22	8.87	21.1	100	41816	286959
LPG	10^4 t							0	17.2	100	50179	0
Refinery Gas	10^4 t	0.71	3.41	1.76	0.78			6.66	15.7	100	46055	176572
Natural Gas	10^8 m^3						3	3	15.3	100	38931	655209
Other coke products	10^4 t				1.5			1.5	25.8	100	28435	40349

Other energy	10^4 t Stand Coal		2.88		1.74	32.8		37.42	0	100	0	0
											Total	**360323575**

Data Source: <China Energy Statistical Yearbook 2006>

Table A5 Fuel-fired Electricity Generation of CCPG for Year 2005

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	**(MWh)**	**(%)**	**(MWh)**
Jiangxi	300	30000000	6.48	28056000
Henan	1315.9	131590000	7.32	121957612
Hubei	477	47700000	2.51	46502730
Hunan	399	39900000	5.00	37905000
Chongqing	175.84	17584000	8.05	16168488
Sichuan	372.02	37202000	4.27	35613474.6
Total				286203304.6

Data Source: <China Electric Power Yearbook 2006>

According to Table A4, the total CO_2 emissions of CCPG is 360,323,575tCO_2e in year 2005. According to Table A5, the total supplied electricity of CCPG is 286,203,305 MWh. According to formula (2) in section B.6.1, the $EF_{OM, Simple, 2005}$ is 1.25898 tCO_2e/MWh.

Table A6 Simple OM Emission Factors Calculation of CCPG for Year 2006

Fuel	**Unit**	**Jiangxi**	**Henan**	**Hubei**	**Hunan**	**Chongqing**	**Sichuan**	**Total**	**EF**	**Oxidation**	**Average Low Calorific Value**	**CO_2 Emission (tCO_2e)**
									(tC/TJ)	**(%)**	**(MJ/t,k**	**K=G*H*I*J**

											m^3)	***44/12/10000 (for mass unit)**
		A	**B**	**C**	**D**	**E**	**F**	**G=A+B+C+D+E+F**	**H**	**I**	**J**	**K=G*H*I*J *44/12 /1000 (for volume unit)**
Raw Coal	10^4 t	1926.02	8098.01	3179.79	2454.48	1184.3	3285.22	20127.82	25.8	100	20908	398107508
Cleaned Coal	10^4 t					5.79		5.79	25.8	100	26344	144295
Other Washed Coal	10^4 t	4.51	104.12		8.59	79.21		196.43	25.8	100	8363	1554036
Coal briquette							0.01	0.01	26.6	100	20908	204
Coke	10^4 t		17.23		0.32			17.55	29.2	100	28435	534299
Coke Oven Gas	10^8 m^3		0.52	1.07	4.24	0.38	0.01	6.22	12.1	100	16726	461572
Other Gas	10^8 m^3	12.69	3.95		1.7	4.36	0.01	22.71	12.1	100	5227	526655
Crude Oil	10^4 t		0.49					0.49	20	100	41816	15026
Gasoline	10^4 t		0.01					0.01	18.9	100	43070	298
Diesel Oil	10^4 t	0.91	2.23	1.41	1.78	0.96		7.29	20.2	100	42652	230298
Fuel Oil	10^4 t	0.51	1.26	1.31	0.8	0.57	3.49	7.94	21.1	100	41816	256872
LPG	10^4 t							0	17.2	100	50179	0
Refinery Gas	10^4 t	0.86	8.1	1	0.97			10.93	15.7	100	46055	289780
Natural Gas	10^8 m^3			0.28		0.16	18.63	19.07	15.3	100	38931	4164943
Other coke product	10^4 t						0.01	0.01	25.8	100	28435	269
Other energy	10^4 t Stand Coal	17.45	37.36	31.55	18.29	29.35		134	0	100	**0**	**0**
											Total	**406286055**

Data Source: <China Energy Statistical Yearbook 2007>

Table A7 Fuel-fired Electricity Generation of CCPG for Year 2006

Province	Electricity Generation (10^8 kWh)	Electricity Generation (MWh)	Auxiliary Power Ratio (%)	Supplied Electricity (MWh)
Jiangxi	344.49	34449000	6.17	32,323,497
Henan	1512.35	151235000	7.06	140,557,809
Hubei	548.41	54841000	2.75	53,332,873
Hunan	464.08	46408000	4.95	44,110,804
Chongqing	234.87	23487000	8.45	21,502,349
Sichuan	441.93	44193000	4.51	42,199,896
Total				334,027,226

Data Source: <China Electric Power Yearbook 2007>

According to Table A6, the total CO_2 emissions of CCPG is 408,776,270 tCO_2e in year 2006. According to Table A7, the total supplied electricity of CCPG is 337,056,176 MWh. According to formula (2) in section B.6.1, the $EF_{OM, Simple, 2006}$ is 1.212784 tCO_2e/MWh.

The Operating Margin (OM) emission factor is the weighted average emission factors of year 2004-2006, as follow:

$$EF_{grid,OM,y} = 1.2783\ tCO_2e/MWh$$

Step 2: Calculating the Build Margin emission factor ($EF_{grid,BM,y}$)

Sub-Step 2a: Calculating of percentages of CO_2 emissions from the coal-fired, gas-fired and oil-fired power plants in total fuel-fired CO_2 emissions

Table A8 Percentages of CO_2 emissions from the coal-fired, gas-fired and oil-fired power plants in total fuel-fired CO_2 emissions

		Jiangxi	**Henan**	**Hubei**	**Hunan**	**Chongqing**	**Sichuan**	**Total**	**Average Low Calorific Value**	**Emission Factor (tC/TJ)**	**Oxidation**	**CO_2 Emission (tCO_2e)**
Fuel	Unit	A	B	C	D	E	F	G=A+…+F	H	I	J	K=G*H*I*J*44/12/100
Raw Coal	10^4 t	1926.02	8098.01	3179.79	2454.48	1184.3	3285.22	20127.82	20908 kJ/kg	25.8	100%	398107507.69
Cleaned Coal	10^4 t					5.79		5.79	26344 kJ/kg	25.8	100%	144295.04
Other Washed Coal	10^4 t	4.51	104.12		8.59	79.21		196.43	8363 kJ/kg	25.8	100%	1554035.91
Coal briquette	10^4 t						0.01	0.01	20908kJ/kg	26.6	100%	203.92
Coke	10^4 t		17.23		0.32			17.55	28435 kJ/kg	29.2	100%	534299.34
Subtotal												**400340341.90**
Crude Oil	10^4 t		0.49					0.49	41816 kJ/kg	20	100%	15025.88
Gasoline	10^4 t		0.01					0.01	43070 kJ/kg	18.9	100%	298.48
Diesel Oil	10^4 t	0.91	2.23	1.41	1.78	0.96		7.29	42652 kJ/kg	20.2	100%	230297.77
Fuel Oil	10^4 t	0.51	1.26	1.31	0.8	0.57	3.49	7.94	41816 kJ/kg	21.1	100%	256872.06
Other coke products							0.01	0.01	28435 kJ/kg	25.8	100%	269.00

Subtotal												**502763.18**
Natural Gas	10^7 m^3			2.8		1.6	186.3	190.7	38931 kJ/m^3	15.3	100%	4164943.49
Coke Oven Gas	10^7 m^3		5.2	10.7	42.4	3.8	0.1	62.2	16726 kJ/m^3	12.1	100%	461571.81
Other Gas	10^7 m^3	126.9	39.5		17	43.6	0.1	227.1	5227 kJ/m^3	12.1	100%	526655.27
LPG	10^4 t							0	50179 kJ/kg	17.2	100%	0.00
Refinery Gas	10^4 t	0.86	8.1	1	0.97			10.93	46055 kJ/kg	15.7	100%	289779.75
Subtotal												**5442950.32**
Total												**406286055.41**

Data Source: <China Energy Statistical Yearbook 2007>

According to Table A8 and formula (4) in section B.6.1, the percentages of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total fuel-fired CO_2 emissions are calculated as:

$$\lambda_{Coal} = 98.54\%,\quad \lambda_{Oil} = 0.12\%,\quad \lambda_{Gas} = 1.34\%$$

Sub-Step 2b: Calculating the fuel-fired emission factor ($EF_{Thermal}$)

The most advanced commercialized technologies for coal-fired power plants in China are domestic 600 MW sub-critical generators, with the standard coal consumption of power supply of 329.94 gce/kWh. For gas-fired and oil-fired power plants in China, the most advanced commercialized technologies are 200 MW combined cycle generators. The standard coal consumption (equivalent) for power supply of oil-fired and gas-fired power plants are 252 gce/kWh.

Parameters used for calculating fuel-fired emission factor are shown in Table A9 below:

Table A9 Parameters used for calculating fuel-fired emission factor

	Parameter	Efficiency of Power Suppy	Emission Factor of Fuel (tc/TJ)	Oxidation Factor	Emission Factor (tCO2/MWh)
		A	B	C	D=3.6/A/1000*B*C*44/12
Coar-fired Power Plant	$EF_{Coal,Adv}$	37.28%	25.8	100%	0.9135
Gas-fired Power Plant	$EF_{Gas,Adv}$	48.81%	15.3	100%	0.4138
Oil-fired Power Plant	$EF_{Oil,Adv}$	48.81%	21.1	100%	0.5706

According to Table A9 and formula (5) in section B.6.1, the $EF_{Thermal}$ is 0.9064 tCO_2e/MWh

Sub-Step 2c: Calculating the Build Margin (BM) emission factor ($EF_{grid,BM,y}$)

Table A10 Installed Capacities of CCPG

Installed Capacity	**Unit**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Fuel-fired	MW	42569.2	43303.2	46893.5	53825.7	60167.3	76658
Hydro	MW	30397	31034.7	36557	34642	38405.1	42719
Nuclear	MW	0	0	0	0	0	0
Wind & Others	MW	0	0	0	0	24	41
Total	MW	72966.2	74337.9	83450.5	88386.7	98596.4	119418

Data Source: <China Electric Power Yearbook 2001-2007>

Table A11 Newly Added Installed Capacity

	2004	**2005**	**2006**	**F-D**	**Percentage**
	D	**E**	**F**		**Additions**
Fuel-fired (MW)	53825.7	60167.2	76658	22832.3	73.77%
Hydro (MW)	34642	38405.2	42719	8077	26.10%

Nuclear(MW)	0	0	0	0	0.00%
Wind & Others(MW)	0	24	41	41	0.13%
Total（MW）	88467.7	98596.4	119418	30950.3	100.00%
Percentage of year 2006	74.04%	82.52%	100%		

According to Table A11 and formula (6) in section B.6.1, the $EF_{grid,BM,y}$ is calculated as:

$$EF_{grid,BM,y} = 0.9064 \times 73.77\% = 0.6687 \text{ tCO}_2\text{e/MWh}$$

Step 3: Calculating the baseline emission factor ($EF_{grid,CM,y}$**)**

According to formula (7) in section B.6.1, the baseline emission factor of CCPG is calculated as:

$$EF_{grid,CM,y} = 0.9735 \text{ tCO}_2\text{e/MWh}$$

The EF_y applied in this PDD is fixed during the whole crediting period.

Annex 4

Monitoring Plan

Please refer to the part B.7 of the Project Design Document for more detailed information. There is no additional information could be provided in this part.
