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: 02
Date: 15/09/2008

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 net electricity supply is 98,410 MWh/yr, the surface area at the full reservoir level is 3km^2 [1], 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 98,110 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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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

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

England	Camco International 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):

>>
People's Republic of China

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

>>
Hunan Province

A.4.1.3. City/Town/Community etc:

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

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 1.5km away from the Huayuan County, and its geographical coordinates are east longitude of 109°27′52″ and north latitude of 28°35′40″. 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 [1]

Parameters		unit	value
Reservoir	Normal Water Level	m	259
	Area	km^2	3
Hydraulic Turbine	Model	—	ZZ920-LH-220
	Quantity	unit	3

	Rated output	MW	12.95
	Rated rotation	r/min	333.33
	Rated water head	m	27.5
	Rated flow	m^3/s	45
	Efficiency	—	93.0%
Generator	Model	—	SF11000-18/3250
	Quantity	unit	3
	Rated Capacity	MW	11
	Rated Voltage	kV	10.5
	Load Factor	—	0.8
	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 renewable crediting period, and the first crediting period is from 01/07/2009-30/06/2016. 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 (tCO_2e)**
01/07/2009 - 30/06/2010	98,110
01/07/2010 - 30/06/2011	98,110
01/07/2011 - 30/06/2012	98,110
01/07/2012 - 30/06/2013	98,110
01/07/2013 - 30/06/2014	98,110
01/07/2014 - 30/06/2015	98,110
01/07/2015 - 30/06/2016	98,110
Total estimated reductions (tons of CO_2e)	686,770
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tons of CO_2 e)	98,110

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 07): " Consolidated baseline methodology for grid-connected electricity generation from renewable sources "
2. **Reference:**
   Tool for the demonstration and assessment of additionality (Version 05);
   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 07):

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 07) 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 07), 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.

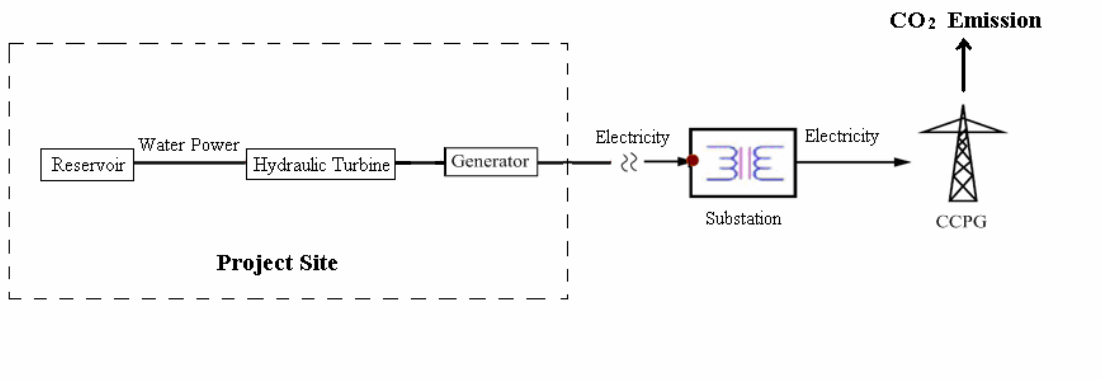

Fig. 2 Project boundary

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[2]. 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 supplied by CCPG	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	Electricity supplied by 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 (V7), the possible baseline scenarios of the project activity is the following: Electricity delivered to the grid by the project 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 in B.6.1.

According to the analysis above, two alternatives to the project scenario are identified and considered:
Scenario 1. Equivalent annual electricity supplied by grid-connected power plants, i.e. equivalent annual electricity supplied by CCPG;
Scenario 2. Addition of new generation sources, namely construct a fossil fuel-fired power plant with equivalent annual net electricity generation supplied to the grid.

The analysis on each scenario is as follows:

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

Scenario 1:
This Scenario complies with national laws and regulations, and doesn't face any barrier, it is feasible.
Scenario 2:
In China, the average annual utilization time of fossil fuel-fired power plants is 5,316h[3] 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[4]. Therefore, the Scenario 2 doesn't comply with current mandatory applicable legislation and regulations in China, and is not feasible.

According to the analysis above, the most plausible baseline scenario is Scenario 1: Equivalent annual electricity supplied by grid-connected power plants, i.e. equivalent annual electricity supplied by CCPG

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) 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;
Alternative 2 — Construct a fossil fuel-fired power plant with equivalent annual net electricity generation supplied to the grid;
Alternative 3 — Equivalent annual electricity supplied by CCPG.
Sub-step 1b. Consistency with mandatory laws and regulations:
As the description in Section B.4., 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. Therefore, the Alternative 2 doesn't comply with current mandatory applicable legislation and regulations in China, and is not feasible. The Alternative 1 and Alternative 3 are consistent with the current mandatory laws and regulations.
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.

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[3] China Electricity Council, National Statistics Bulletin of Power Industry in 2007

[4] 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

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%[5] (not including tax) which is quoted from the statement of Interim Rules on Economic Assessment of Electrical Engineering Retrofit Project. This benchmark IRR 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	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	%	7.01	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:

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

Table 6 Sensitivity Analysis

variation range & assessment / Factor	variation range to reach benchmark	Practical assessment of the critical factors
Electricity Tariff	+10.7%	When the tariff increase, the IRR of project moves up. That means only when the electricity tariff increases at least 10.7%, the IRR of the project would overtop the benchmark of 10%. But it is impossible. According to the document from Hunan Price Bureau, the electricity tariff of Hunan Province has decreased from 0.348 RMB yuan [6] in 2000 to 0.327 RMB yuan[7] in 2002 and then 0.30 RMB yuan [8] in 2004 which indicated a decreasing trend. In addition, the electricity tariff is fixed according to the signed PPA, and therefore will not increase. Thus, the 10.7% increase of electricity tariff is unlikely to occur.
Electricity generation	+10.8%	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 10.8%, because the electricity generation was speculated according to the hydrology documents for 49 years (1957-2005)[9] and it would not change much. And thus, the 10.8% increase of project's electricity generation is unlikely to occur.
Total investment	-10.1%	When total investment of project decrease, the IRR of project moves up. As there is no change for the composing of total investment, the total investment of project is mainly subject to the industrial products' price indices, and according to the chart of "Ex-factory

[6] Notice to adjust electricity tariff of Hunan Power Grid, Price Bureau of Hunan Province, [No. 49(2000)], March 6th of 2000,

http://www.xxpi.com/Article/ShowArticle.asp?ArticleID=952

[7] Notice to adjust and confirm the electricity tariff of Hunan Power Grid, Price Bureau of Hunan Province, [No.327 (2001)], December 31st of 2001,

http://www.xxpi.com/Article/pi22/pi221/pi22102/pi22102002/200504/940.asp

[8] Notice to adjust and confirm the electricity tariff of Hunan Power Grid, Price Bureau of Hunan Province, [xiangjiazhong (2004) No.114], August of 2004.
http://www.xxpi.com/Article/pi22/pi221/pi22102/pi22102002/200504/949.html

[9] Supplementary Feasibility Study Report of Tuojiang Hydropower Plant, Hunan Yongzhou Hydroelectric Investigation, Design and Research Institute, December of 2004

		Price Indices of Industrial Products", which is published by the National Bureau of Statistics of China in 2006[10], the price indices increased 9.38% from 1998 to 2005, which is equal to an 1.29% annual increase rate. And thus, based on the recent published statistics, it is unlikely for the total investment of project to decrease more than 10.1%.
O&M cost	- 60%	When the O&M cost of project decrease, the IRR of project moves up. In fact the price of construction materials and wage standard is rising in China[11], therefore the 60% decrease of O&M cost is impossible.

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

Step 4. Common practice analysis

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

The word *similar* means that the options have similar features in the aspects of type, scale, location, and construction time. According to *Investigation Report on Hydropower Plants with Installed Capacity above 15MW Operational since 2002 in Hunan Province*, compiled by the Hunan Hydropower Design Institute, the hydropower projects completed after 2002 with the installed capacity of 25MW to 25MW are listed in the Table 7 below:

Table 7 Hydropower projects completed after 2002 in Hunan (25-50MW) [12]

No.	The project name	Installed capacity (MW)	Project owner	Operation time (year)	Investment of per kWh (RMB yuan/kWh)	IRR
1	Chengjiangkou	25	Zixing Chengjiangkou Corp.	2006	1.96	10.2%
2	Leizhong	40.5	Shaoneng Group	2004	1.8	10.9%
3	Ouyanghai Expanded Project	30	Runhai Hydropower Exploitation Co., Ltd	2006	1.62	10.8%
4	Yangmingshan II	25	Hunan Xiangneng Group	2004	1.21	12.9%

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

There is an essential distinction between the proposed project and similar projects (listed in Table 7): In general, investors will give priority to the development of the hydropower plants with good technical and

[10] Ex-factory Price Indices of Industrial Products , National Bureau of Statistics of China, 2006 http://www.stats.gov.cn/tjsj/ndsj/2006/html/I0913C.HTM

[11] http://finance.sina.com.cn/g/20080124/10024447240.shtml

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

economic indicators, the hydropower plants in Table 7 are developed due to the excellent natural conditions or circumstances described as follow:

Due to the difference of the natural conditions or circumstances, the investment of unit power energy (per kWh) of the proposed project is high up to 2.34 RMB yuan/kWh which is much higher than that of the 4 projects (1.21～1.96 RMB yuan/kWh) in Table 7, so the 4 plants in Table 7 have excellent technical and economic indicators, the IRR of these plants is 10.2%～12.9% which is obviously much higher than that of the proposed project (7.01%). So these projects are financially attractive and haven't any investment risk. It was easy for the project owners of these projects to obtain loans from banks, there weren't any financing difficulty. 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 a bank's loan without CDM support. Therefore, there is a severe financing difficulty for the proposed project, moreover, the project owner of the proposed project doesn't have enough capital, therefore the 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 (EIA)	Oct. 2006
Approval of EIA	Dec. 8, 2006
Feasibility Study Report (FSR)	Aug. 2006
Approval of FSR	Dec. 27, 2006
Prelimilary Designation Report (PDR)	Mar. 2007
Approval of PDR	Mar. 19, 2007
Minute of Board Meeting	July 6, 2007
Service Agreement of CDM Project Development	Aug. 21, 2007
Procurement Contract of Water-turbine Generator Units	Sep. 8, 2007
Date of Construction Starting	Oct. 9, 2007
Emission Reductions Purchase Agreement	April 12, 2008

After "Procedures of CDM Projects Operation and Management" was issued by Chinese NDRC on Oct. 12 2005, the cases about CDM project development successfully in other hydropower projects in China encouraged the project owner. According to the PDR of the project, the IRR of the project is lower than the benchmark of 8% which is an important economic evaluation method in China. The PDR suggested that the project owner could apply for CDM support. Then the project owner made the decision to develop CDM project activity. Therefore the incentives from the CDM have been seriously considered in the decision to proceed with the project activity.

To sum up, the proposed project activity faces severe financial barrier and investment barrier and has strong additionally. The proposed project activity would not be implemented without the incentive provided by the CDM.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Project Emissions
The power density of the project is more than 10W/m^2, according to the baseline methodology ACM0002 (Version 07), PE_y =0.

Baseline Emissions
According to baseline methodology ACM0002 (Version 07), 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:

$$BE_y = EG_y \cdot EF_{grid,CM,y} \qquad (1)$$

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 01)" according to the following six steps:

STEP 1. Identify the relevant electric power system.
STEP 2. Select an operating margin (OM) method.
STEP 3. Calculate the operating margin emission factor according to the selected method.
STEP 4. Identify the cohort of power units to be included in the build margin (BM).
STEP 5. Calculate the build margin emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

Step 1. Identify the relevant electric power system
The project is connected to CCPG, according to "Bullet of Baseline Emission Factor of China Grid" issued by Office of National Coordination Committee on Climate Change on 9 August 2007, the geographic extent of the grid boundary includes Jiangxi Province, Henan Province, Hubei Province, Hunan Province, Sichuan Province and Chongqing City.

Step 2. Select an operating margin (OM) method
According to "Tool to calculate the emission factor for an electricity system (Version 01)", there are four methods for calculating the $EF_{grid,OMsimple,y}$:

(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 8 that the low-cost/must run resources constitute less than 50% of CCPG during year 2002 to 2006. Thus, method (a) is applicable to calculate $EF_{grid,OMsimple,y}$.

Table 8 Constitution of low-cost/must run resources in CCPG during year 2002～2006[13]

Year	2002	2003	2004	2005	2006
Percentage (%)	35.95	34.43	38.37	38.56	35.84

[13] *China Electric Power Yearbook 2003～2007*

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 3. Calculate the operating margin emission factor according to the selected method.
According to "Tool to calculate the emission factor for an electricity system (Version 01)", there are three options based on different data for calculating $EF_{grid,OMsimple,y}$, namely Option A, Option B and Option C. Due to the availability of the data, Option C 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 sources in the project electricity system in year y
y = Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

For the project, the result of $EF_{grid,OMsimple,y}$ issued by Chinese NDRC is used[14], to see A1～A7 in Annex 3 for details.

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

According to "Tool to calculate the emission factor for an electricity system (Version 01)", 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 "Bullet of Baseline Emission Factor of China Grid" issued by Office of National Coordination Committee on Climate Change on 17 July 2008, 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.

According to "Tool to calculate the emission factor for an electricity system (Version 01)", there are two options (Option 1 and Option 2) to calculate the build margin emission factor in terms of vintage of data.

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

For the proposed project, Option 1 is chosen to calculate the build margin emission factor, namely 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.

Step 5. Calculate the build margin emission factor.
The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (3)$$

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

Because of the unavailability of the data at the power plant level in China, the 22nd CDM EB meeting agreed the following deviation[15] approaches for $EF_{grid,BM,y}$ calculation:

1) Use the efficiency level of the best technologies commercially available in the 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 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 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;

2) Based on the best technologies commercially available 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;

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[15] http://cdm.unfccc.int/User/Management/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ

3) Calculating the $EF_{grid,BM,y}$ through emission factor of thermal power plants times 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 above calculation approach has been used by several recently registered China projects. The BM emission factor in this PDD is calculated as following sub-steps.

Sub-Step 5a: 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

$$\lambda_{coal} = \frac{\sum_{i\in COAL,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \lambda_{Oil} = \frac{\sum_{i\in OIL,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \lambda_{Gas} = \frac{\sum_{i\in GAS,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad (4)$$

Where:

λ_{Gas}, λ_{Oil} and λ_{Coal} are respectively the percentages of CO_2 emissions from the gas-fired, oil-fired, coal-fired power plants in CO_2 emissions from total thermal power plants;
$F_{i,j,y}$ is the amount of fuel *i* (tce) consumed by the power sources province *j* in year *y*;
$COEF_{i,j}$ is the CO_2 emission coefficient (tCO_2/tce) of fuel *i*, taking into account the carbon content of the fuels used by the grid and the percent oxidation of the fuel in year *y*.

Sub-Step 5b: Calculating the fuel-fired emission factor ($EF_{Thermal}$)

$$EF_{Thermal} = \lambda_{Coal} \times EF_{coal,adv} + \lambda_{Oil} \times EF_{oil,adv} + \lambda_{Gas} \times EF_{gas,adv} \quad (5)$$

Where:

$EF_{Thermal}$ is the emission factor of thermal power plants;
$EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ are corresponding to the emission factors of coal, oil and gas, which are applied by the most advanced commercialized technologies.

Sub-Step 5c: Calculating the Build Margin (BM) emission factor ($EF_{grid,BM,y}$)

$$EF_{grid,BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \quad (6)$$

Where:

$EF_{grid,BM,y}$ is the Build Margin (BM) emission factor with advanced commercialized technologies for year *y*;
CAP_{Total} is the installed capacity of all recently built power plants;
$CAP_{Thermal}$ is the newly installed capacity of recently built thermal power plants;
$EF_{Thermal}$ is the emission factor of thermal power plants.

The detailed calculations are shown in Table A8-Table A11 of Annex 3.

Step 6. Calculate the combined margin (CM) emissions factor.
The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (7)$$

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The following default values are used for W_{OM} and W_{BM}:
w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period , and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period.

Leakage

According to baseline methodology ACM0002 (Version 07), there is no need for the project to consider leakage (L_y).

Emission Reductions

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

$$ER_y\ (tCO_2e/yr) = BE_y - PE_y - L_y \quad (8)$$

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

>>

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	Data used are from Chinese authorities.

and procedures actually applied :	
Any comment:	

Data / Parameter:	$GENE_{best,coal,}$
Data unit:	/
Description:	The power supply efficiency of coal-fired power plants with best technology commercially available.
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids.
Value applied:	37.28%
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:	$GENE_{best,oil/gas}$
Data unit:	/
Description:	The power supply efficiency of oil/gas-fired power plants with best technologies commercially available.
Source of data used:	Chinese DNA's Guideline of emission factors of Chinese grids.
Value applied:	48.81%
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 and procedures actually applied :	Determine the installed capacity based on recognized standards.
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:

>>

Project emission(PE_y)

According to section B6.1, the project emission in year y is:

$$PE_y = 0$$

Baseline emission

According to the formula (2)-(7) 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 9 , the detailed calculation processes are shown in Annex 3.

Table 9 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	0.7156	0.99695

The project baseline emmision is:

$$BE_y = 98{,}410 \text{ MWh} \times 0.99695 \text{ tCO}_2\text{e /MWh} = 98{,}110 \text{ tCO}_2\text{e / yr}$$

Leakage

As mentioned in Section B.6.1, $L_y = 0$

Emission Reductions

Since both the project emission and leakage of the Project are zero, the final GHG emission reduction for the Project is obtained as follows:

$$ER_y = BE_y - PE_y - L_y = 98{,}110 \text{ tCO}_2\text{e / yr}$$

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

>>

The summary of the ex-ante estimation of emission reductions are listed in Table 10 below:

Table 10 The ex-ante estimation of the emission reductions

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tones of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
01/07/2009-31/07/2010/	0	98,110	0	98,110
01/01/2010-31/07/2011	0	98,110	0	98,110
01/01/2011-31/07/2012	0	98,110	0	98,110
01/01/2012-31/07/2013	0	98,110	0	98,110
01/01/2013-31/07/2014	0	98,110	0	98,110

01/01/2014-31/07/2015	0	98,110	0	98,110
01/01/2015-31/07/2016	0	98,110	0	98,110
Total (tons of CO_2 e)	0	686,770	0	686,770

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

>>

B.7.1 Data and parameters monitored:

>>

Data Parameter:	EGy
Data unit:	MWh
Description:	Net electricity supplied by the project activity to CCPG
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	98,410MWh
Description of measurement methods and procedures to be applied:	Hourly measurement and monthly recording.
QA/QC procedures to be applied:	The main meter will be calibrated once a year and tet 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:	Measured from topographical surveys and maps.
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 electricity delivered to CCPG by the project and electricity consumed by the project activity from the CCPG.

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:

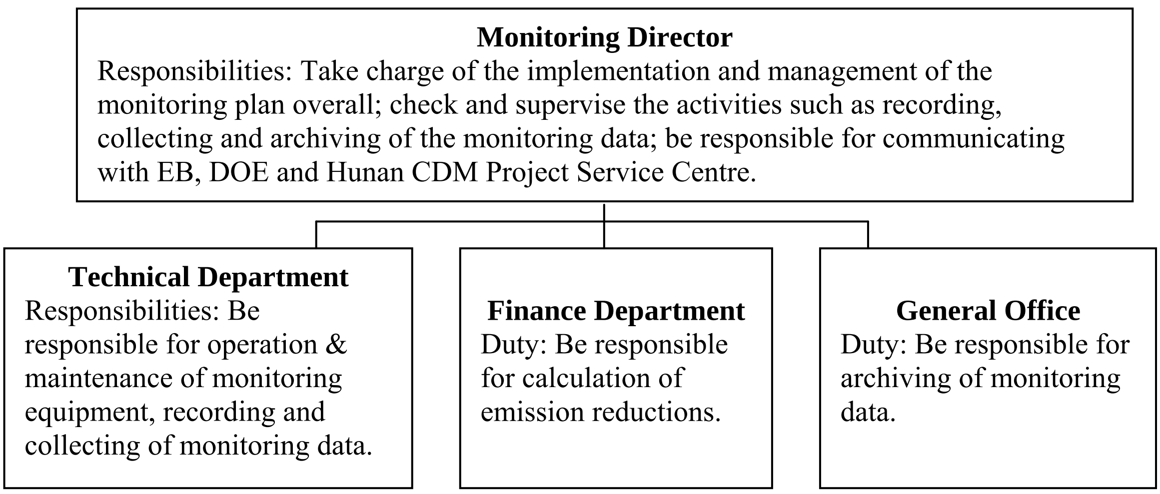

Fig. 3 Operational and management structure

3. Monitoring apparatus and installment:

The meters will be installed in accordance with "Technology & Management Regulations for Power Metering Devices" (DL/T448-2000), the accuracy of the meters meeting the national standard. The main meter and back-up meter will be installed at the connection point to the grid.

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

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

a. When Main Meter has a breakdown, the readings of Backup Meter will be adopted;

b. If both of the Main Meter and Backup Meter have breakdowns, the project owner should notice the power grid company immediately and solve the problem with a conservative calculation method.

After handling of the emergency, the project owner must prepare a report regarding the emergency to explain to DOE that the handling method is reasonable.

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 last crediting period.

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

15/09/2008

Name of the responsible person/entity:

Ying Ma
Unit: Hunan CDM Project Service Center
Address: No. 59 Bayi Road, Changsha, Hunan, 410001, China
Tel: +86-731-4586782-878
Email: cdmmy@yahoo.cn

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).

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

>>
25 years

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:

>>
01/07/2009 or the date of registration whichever is later.

C.2.1.2. Length of the first crediting period:

>>
7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Not applicable

C.2.2.2. Length:

>>
Not applicable

SECTION D. Environmental impacts

>>

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

>>

The Environmental Impact Assessment was carried out by Hunan Huaihua Hydro & Power Design Institute on Oct. 2006 and approved by the Hunan Environmental Protection Bureau on 8th December 2006 (XiangHuanPing [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 11 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.
	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 project owner put up bulletins all around the project site and carried out questionnaire in September 2006. 30 survey papers have been distributed to local people and all papers received. Of the 30 respondents, 3 persons are over senior middle school, 18 persons are of junior middle school, 9 persons are of elementary school; 18 aged people, 7 middle age, 5 youth; 3 officials, 26 farmers and 1 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 know the construction of Zhugaotan hydropower project?	Yes	100%
	No	0
	a little	0
How do you think the impact of the project activity will have on your family?	no impact	98.6%
	Little	1.4%
	impact much	0
What kind of environmental effect impact your life most?	noise pollution	100%
	water pollution	0
	air pollution	0
What kind of environmental impact do you think the project activity will bring?	noise pollution	100%
	water pollution	0
	air pollution	0
What kind of arrangement or compensation measurement can you accept?	back	98.1%
	move out	1.9%
	compensation	0
Do you support the construction of the project activity?	yes	100%
	no	0
	no comments	0
Other opinions and suggestions.		

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 local water resources will be developed fully through the project activity, a lot of clean energy will be generated to mitigate the power lack of the area; the local transportation condition will be

improved, this can solve the local people's difficulties of going out and transportation, and will be helpful to the local commodity circulation, specially to the local agricultural products circulation.
2. After the project is put into operation, the tax revenue will be improved for the local district, this will promote the local development in society and in economy powerfully.
3. The pubic expect the project could be accomplished on time and create benefit for local people.

The people also presented the following issues and suggestions:
1. The pubic hope the water, air, noise pollution and vegetation destruction would be alleviated, the abandon residues wouldn't be piled randomly for the sake of scenery protection, and the ecosystem problem should be taken into account during the operational period.
2. The local residents should have a priority to get job opportunities during the construction, and facilities like vehicles could be leased during the construction of project activity.

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 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.
2. The project activity will provide some job opportunities for the local residents, and idle vehicles will be leased during the construction period.

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[16]

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	25.8	100%
Cleaned Coal	26344 kJ/kg	25.8	100%
Other Washed Coal	8363 kJ/kg	25.8	100%
Coke	28435 kJ/kg	29.2	100%
Crude Oil	41816 kJ/kg	20.0	100%
Gasoline	43070 kJ/kg	18.9	100%
Diesel Oil	42652 kJ/kg	20.2	100%
Fuel Oil	41816 kJ/kg	21.1	100%
Natural Gas	38931 kJ/m^3	15.3	100%
Coke Oven Gas	16726 kJ/m^3	12.1	100%
Other Gas	5227 kJ/m^3	12.1	100%
LPG	50179 kJ/kg	17.2	100%
Refinery Dry Gas	46055 kJ/kg	15.7	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.

[16] 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*4 4/12 /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 Dry 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 Petroleum Products	10^4 t							0	20	100	38369	0
Other Coking Products	10^4 t							0	25.8	100	28433	0
Other Energy	10^4tce		16.92		15.2	20.95		53.7	0	100	0	0
											Total	**346035809.73**

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	352,614,497
Cleaned Coal	10^4 t	0.02	0					0.02	25.8	100	26344	498
Other Washed Coal	10^4 t		138.12			89.99		228.11	25.8	100	8363	1,804,669
Coke	10^4 t		25.95		105			130.95	29.2	100	28435	3,986,695
Coke Oven Gas	10^8 m^3			1.15		0.36		1.51	12.1	100	16726	112,054
Other Gas	10^8 m^3		10.2			3.12		13.32	12.1	100	5227	308,897
Crude Oil	10^4 t		0.82	0.36				1.18	20	100	41816	36184.78
Gasoline			0.02			0.02		0.04	18.9	100	43070	1193.90
Diesel Oil	10^4 t	1.3	3.03	2.39	1.39	1.38		9.49	20.2	100	42652	299,798
Fuel Oil	10^4 t	0.64	0.29	3.15	1.68	0.89	2.22	8.87	21.1	100	41816	286,959
LPG	10^4 t							0	17.2	100	50179	0
Refinery Dry Gas	10^4 t	0.71	3.41	1.76	0.78			6.66	15.7	100	46055	176,572
Natural Gas	10^8 m^3						3	3	15.3	100	38931	655,209
Other Petroleum Products	10^4 t							0	20	100	38369	0
Other Coking Products	10^4 t				1.5			1.5	25.8	100	28435	40,349
Other Energy	10^4tce		2.88		1.74	32.8		37.42	0	100	0	0
											Total	**360,323,575**

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,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	1926.02	8098.01	3179.79	2454.48	1184.3	3285.22	20127.82	25.8	100	20908	398,107,508
Cleaned Coal	10^4 t					5.79		5.79	25.8	100	26344	144,295
Other Washed Coal	10^4 t	4.51	104.12		8.59	79.21		196.43	25.8	100	8363	1,554,036

Briquette	10^4 t						0.01	0.01	26.6	100	20908	204
Coke	10^4 t		17.23		0.32			17.55	29.2	100	28435	534,299
Coke Oven Gas	10^8 m^3		0.52	1.07	4.24	0.38	0.01	6.22	12.1	100	16726	461,572
Other Gas	10^8 m^3	12.69	3.95		1.7	4.36	0.01	22.71	12.1	100	5227	526,655
Crude Oil	10^4 t		0.49					0.49	20	100	41816	15,026
Gasoline	10^4 t		0.01					0.01	18.9		43070	298
Diesel Oil	10^4 t	0.91	2.23	1.41	1.78	0.96		7.29	20.2	100	42652	230,298
Fuel Oil	10^4 t	0.51	1.26	1.31	0.8	0.57	3.49	7.94	21.1	100	41816	256,872
LPG	10^4 t							0	17.2	100	50179	0
Refinery Dry Gas	10^4 t	0.86	8.1	1	0.97			10.93	15.7	100	46055	289,780
Natural Gas	10^8 m^3			0.28		0.16	18.63	19.07	15.3	100	38931	4,164,943
Other Petroleum Products	10^4 t							0	20	100	38369	0
Other Coking Products	10^4 t						0.01	0.01	25.8	100	28435	269
Other Energy	10^4tce	17.45	37.36	31.55	18.29	29.35		134	0	100	0	0
											Total	**406,286,055**

Data Source: <China Energy Statistical Yearbook 2007>

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

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	(MWh)	(%)	(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	25.8	100%	398,107,508
Cleaned Coal	10^4 t	0	0	0	0	5.79	0	5.79	26344	25.8	100%	144,295
Other Washed Coal	10^4 t	4.51	104.12	0	8.59	79.21	0	196.43	8363	25.8	100%	1,554,036
Briquette	10^4 t	0	0	0	0	0	0.01	0.01	20908	26.6	100%	204
Coke	10^4 t	0	17.23	0	0.32	0	0	17.55	28435	29.2	100%	534,299
Subtotal												**400,340,342**
Crude Oil	10^4 t	0	0.49	0	0	0	0	0.49	41816	20	100%	15,026
Gasoline	10^4 t	0	0.01	0	0	0	0	0.01	43070	18.9	100%	298
Coal Oil	10^4 t	0	0	0	0	0	0	0	43070	19.6	100%	0
Diesel Oil	10^4 t	0.91	2.23	1.41	1.78	0.96	0	7.29	42652	20.2	100%	230,298
Fuel Oil	10^4 t	0.51	1.26	1.31	0.8	0.57	3.49	7.94	41816	21.1	100%	256,872
Other Petroleum Products	10^4 t	0	0	0	0	0	0	0	38369	20	100%	0
Other Coking Products	10^4 t	0	0	0	0	0	0.01	0.01	28435	25.8	100%	269
Subtotal												**502,763**
Natural Gas	$10^7 m^3$	0	0	2.8	0	1.6	186.3	190.7	38931	15.3	100%	4,164,943
Coke Oven Gas	$10^7 m^3$	0	5.2	10.7	42.4	3.8	0.1	62.2	16726	12.1	100%	461,572

Other Gas	10^7m^3	126.9	39.5	0	17	43.6	0.1	227.1	5227	12.1	100%	526,655
LPG	10^4 t	0	0	0	0	0	0	0	50179	17.2	100%	0.
Refinery Dry Gas	10^4 t	0.86	8.1	1	0.97	0	00	10.93	46055	15.7	100%	289,780
Subtotal												**5,442,950**
Total												**360283226.12**

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:

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

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	106
Total	MW	72966.2	74337.9	83450.5	88386.7	98596.4	119483

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

Table A11 Newly Added Installed Capacity

	2004	2005	2006	F-C	Percentage
	D	E	F		Additions
Fuel-fired (MW)	53825.7	60167.2	76658	16490.8	78.95%
Hydro (MW)	34642	38405.2	42719	4313.8	20.65%
Nuclear(MW)	0	0	0	0	0.00%
Wind & Others(MW)	0	24	106	82	0.39%
Total（MW）	88467.7	98596.4	119483	20886.6	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:

$$EF_{grid,BM,y} = 0.9064 \times 78.95\% = 0.7156\ tCO_2e/MWh$$

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:

$$EF_{grid,CM,y} = 0.99695\ tCO_2e/MWh$$

The EF_y applied in this PDD is fixed during the first crediting period and may be revised at the renewal of the 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.
