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:

Yiyang Xiushan Hydropower Project, P.R. China

PDD Version: 03.2

Date of Completion: 08/04/2009

>>

A.2. Description of the project activity:

Yiyang Xiushan Hydropower Project activity (hereinafter known as "the Project") is located in the lower reaches of Zijiang River at Xiushan Town, Taojiang County, Yiyang City, Hunan Province, P.R. China. With a total installed capacity of 65MW (5*13MW), the proposed project activity is expected to supply electricity to Central China Power Grid (CCPG) via Hunan Provincial Power Grid. The annual electricity generation is expected to be 276,450 MWh and the electricity delivered to grid is expected to be 257,570MWh, with 4235 utilization hours. The surface area at full reservoir level is 6.3 km^2, with power density 10.3W/m^2.

The project activity is expected to replace part of the electric power in CCPG that is dominated by coal-fired power plants, so as to reduce the greenhouse gas (GHG) emission. The estimated annual GHG emission reductions will be 243,043 tCO_2e.

The main purpose of the Project activity is to generate electricity by using the renewable hydro sources to promote the sustainable development of the local region with environmental and economic benefits, as follows:

- to reduce pollution caused by fossil-fuel fired plants
- to increase job opportunities for the region during the project construction and operation
- to improve local traffic and transportation conditions as roads will be constructed for the project

A.3. Project participants:

>>

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)
People's Republic of China (Host)	Taohuajiang Energy Development Co., Ltd, Taojiang County	No
Germany	KfW Carbon Fund (KfW Bankengruppe)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

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:

>>
Xiushan Town/Taojiang County/Yiyang City

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

>>
The Project is located in the lower reaches of Zijiang River, Xiushan Town, Taojiang County, Yiyang City of Hunan Province, 16 kms from Taojiang County Seat and 100 kms from Changsha, the capital city of Hunan Province. See Chart 1 for details.

The exact geographic project site is:

Longitude: 112°11' E
Latitude: 28°51' N

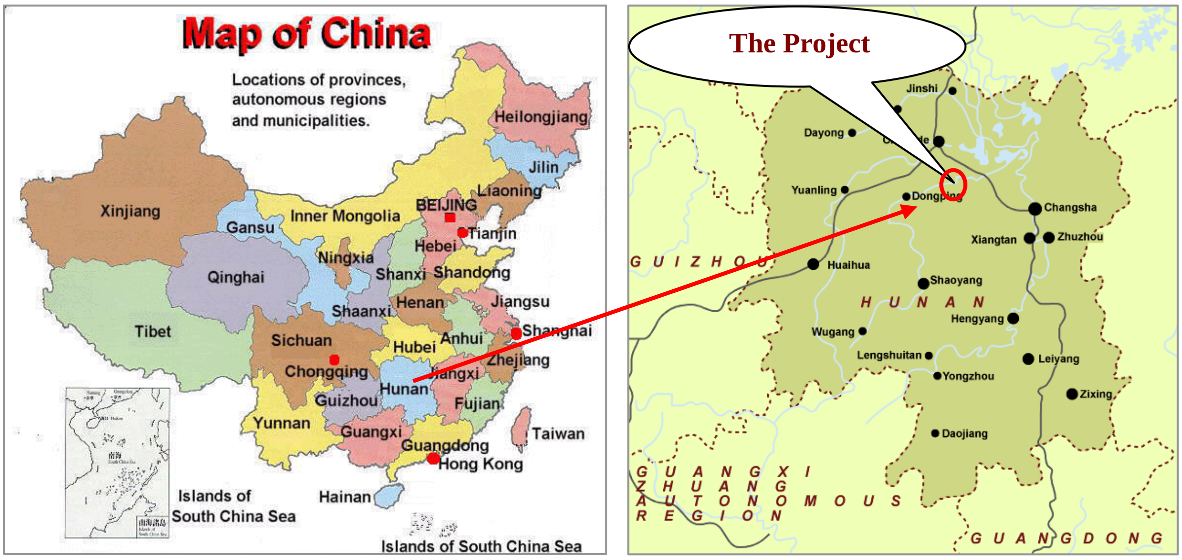

Chart 1 Location of the Project activity

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

>>

Sectoral scope 1: Energy industries (Renewable sources)

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

>>

Main buildings for the project activity include the dam, factory buildings, switch station and main transformer station. The technical parameters for Francis Turbine-Generator Units are as shown in table 1.

Table 1 Technical Parameters for Key Equipments

Quantity of turbines	Type	Rated water head	Rated flow	Rated output	Manufacturer
5	GZTF08-wp-625	5.1m	297.6m^3/s	13.4MW	Tianjin Tianfa Heavy Equipment Plant
Quantity of generators	Type	Rated voltage	Rated power	Power factor	Manufacturer
5	SFWG13-80/6630	10.5kv	14.9MW	0.9(hysteresis)	Tianjin Tianfa Heavy Equipment Plant

The generated power of the project activity will be connected to CCPG via Xiaojiashan Substation and Niutanhe Substation. The technology used in the project activity is domestically-developed. No technology transfer from other countries is involved in this project activity.

The PDD was made available on the DOE website on 19 September 2006. The changes between the PDD submitted for validation and the PDD submitted for registration is as below

a) capacity installed (from 64 to 65 MW)

All the data in the PDD published for the global stakeholder comments are from FSR. But all the data in the PDD submit for the registration are from PDR, which is also approved by local government. The PDR was conducted after FSR and the design is optimized as per the water source information base on the design in FSR so that PDR showed the project really active. So that the project owner has to make the final decision for the investment based on it. So the change of installed capacity from 64MW to 65MW is transparent and reasonable.

b) operating hours (from 4221 to 4235 hours),

All the data in the PDD published for the global stakeholder comments are from FSR. But all the data in the PDD submit for the registration are from PDR, which is also approved by local government. The PDR was conducted after FSR and the design is optimized as per the water source information base on the design in FSR so that PDR showed the project really active. So that the project owner has to make the final decision for the investment based on it. Furthermore, the increasing of operation hours will make the project IRR increased, which is conservative. So the increasing of operation hours from 4221 to 4235 hours is conservative, transparent and reasonable.

c) power density (from 14.2 to 10.3 W/m^2),
All the data in the PDD published for the global stakeholder comments are from FSR. But all the data in the PDD submit for the registration are from PDR, which is also approved by local government. The PDR was conducted after FSR and shown the project really active so that the project owner has to make the final decision for the investment based on it. So the change of power density from 14.2 to 10.3 W/m^2 (both of them are above $10W/m^2$) will not impact the additionality and is transparent and reasonable.

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

The Project activity chooses renewable crediting period. The first crediting period for emission reductions is expected to start on 2008 and end on 2014 (from 1th March to 28th February of next year).

Table 2 Estimated amounts of emission reductions

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
2008	243,043
2009	243, 043
2010	243, 043
2011	243, 043
2012	243, 043
2013	243, 043
2014	243, 043
Total estimated reductions (tonnes of CO_2e)	1,701,301
Total number of crediting years	21 (7 times 3)
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	243,043

>>

A.4.5. Public funding of the project activity:

>>

There is no public funding from Annex I Parties to be involved for this 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:

>>

The approved consolidated baseline and monitoring methodology ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable source" version 06, in effect as of 19 May 2006, is supposed to be applied to this project activity.

The *"Tool for the Demonstration and Assessment of Additionality"* (V3) approved by EB is supposed to be used to demonstrate the additionality of this Project activity.

For more information regarding the methodology, please refer to the link:

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:

>>

The Methodology ACM0002 is applicable to the proposed project activity for the following reasons:

1. The project activity is a grid-connected Hydropower project (connected to CCPG via Hunan Provincial Power Grid) and a grid-connected renewable energy project.
2. The power installation density of the Project activity is 10.3 W/m^2, greater than 10 W/m^2 as required by the methodology;
3. The proposed project activity does not involve switching from fossil fuels to renewable energy at the site of the project activity;
4. The geographic and system boundaries for the CCPG, which the proposed project activity is to be connected to, can be clearly identified and information on the characteristics of the grid is publicly available.

According to Methodology ACM0002 (Version 6), the most updated "*Tool for the Demonstration and Assessment of Additionality*" (V3) approved by EB will be used to assess the additionality of this project activity.

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

According to the relevant definition of project boundary in ACM0002 (version 06) for the proposed project activity, "The spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the CDM project activity power plant is connected to".

The spatial extent of the project boundary for the proposed project activity covers this project site and all other plants connected to the Central China Power Grid (CCPG), which includes Chongqing City, Sichuan Province, Henan Province, Jiangxi Province, Hubei Province and Hunan Province

Table 3 Greenhouse gas emissions included in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Central China Power Grid	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification, in compliance with conservative principles.
		N_2O	No	Ignored for simplification. This is conservative.
Project Activity	The Proposed Project activity	CO_2	No	Excluded for simplification, As per ACM0002
		CH_4	No	The power density of the project is 10.3 W/m^2, more than 10 W/m^2. No consideration is taken as per ACM 0002.
		N_2O	No	Excluded for simplification as per ACM 0002

>>

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

>>

In order to provide power service comparable to the proposed project activity, the realistic and credible alternatives to the project activity are as follows:

1. to undertake the project activity without registering it as a CDM project activity;
2. to build a grid-connected thermal power plant with comparable power generation;
3. to build other grid-connected power plant with comparable power generation by other renewable sources ;
4. to supply comparable electricity by CCPG.

Alternative 1 is in compliance with current laws and regulations in China. But without sales income of CERs, the total Internal Return Rate （IRR）for the Project activity investment is only 6.54% (see B5 for detailed analysis), which is by far lower than the 8% of the IRR benchmark for electric power industry. So the project activity is not economically attractive. Therefore, alternative 1 is not the realistic baseline scenario.

For alternative 2, because of the difference in generating hours between thermal power and hydropower, the thermal power plant that supplies equal power generation to the proposed project activity will be far less than 65 MW. According the laws and regulations in China, coal-fired thermal power plants with less than 135 MW are prohibited for construction in the areas covered by grids and construction of thermal power units under 100 MW is strictly controlled.[1] Therefore, alternative 2 is not in conformity with current laws and regulations in China and is not a plausible alternative.

For alternative 3, because there is not enough other renewable energy sources (such as wind energy and biomass energy) in the proposed project site, alternative 3 is not a realistic alternative and is to be excluded.

Alternative 4, to supply comparable electricity by CCPG without any insurmountable obstacles, complies with related laws and regulations. As a result, alternative 4 is the realistic baseline scenario for the proposed project activity.

[1] *Circular on Strictly Prohibiting the Installation of Fuel-fired Generators with the Capacity of 135MW or Below* issued by the General Office of the State Council, decree No. 2002-6; *Provisional Regulations on Management of Thermal Power Generators Construction* (August 1997).

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):

>>

The following steps are used to demonstrate the additionality of the project activity according to "*Tools for the Demonstration and Assessment of Additionality*" (V3) approved by Executive Board and requested by the baseline methodology ACM0002 (version 06).

Before the project was permitted to construction on 18 August 2005, the project owner commissioned the third party to carry out a preliminary design report and found that the project is not financial attractive without CDM revenue (see step2 below), which significantly decreased the confidence of the project owner and bank. So the project is pending until China Construction Bank decided to lend to the project in April 2005 and make the project proceed after seriously considering the CDM incentives.

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

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

In order to provide power service comparable to the proposed project activity, the realistic and credible alternatives to the project activity are as follows:

1. to undertake the project activity without registering it as a CDM project activity;
2. to build a grid-connected thermal power plant with comparable power generation;
3. to build other grid-connected power plant with comparable power generation by other renewable sources ;
4. to supply comparable electricity by CCPG.

Since there is not enough other renewable energy sources (such as wind energy and biomass energy) in the proposed project site, alternative 3 is not a realistic alternative, and therefore is excluded.

Sub-step 1b. Enforcement of applicable laws and regulations

Alternative 1 can conform to current laws and regulations in China, but there is no forced obligation for the project owner to develop Hydropower projects.

Alternative 2 does not conform to current laws and regulations in China, as discussed in details in section B4, and as a result it can not be the realistic alternative.

Alternative 4 conforms to current laws and regulations in China.

Therefore this project activity is not the only alternative that meets the current laws and regulations in China and possesses the prerequisite of additionality.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method.

"Tools for the Demonstration and Assessment of Additionality" (V3) provides three optional analyses: the simple cost analysis, the investment comparison analysis and the benchmark analysis.

The simple cost analysis is not applicable for this project activity because the project activity will produce economic benefit from electricity sale other than CERs revenues. Nor is the investment comparison analysis applicable because alternative 4 is not an investment activity. Then the benchmark analysis is chosen and the financial Internal Return Rate (IRR) is used to assess the financial viability of the project activity.

Sub-step 2b. Apply benchmark analysis.

According to the *"Procedures of Economic Evaluation for Electric Power Technological Reconstruction Items"* issued by the State Power Corporation, the benchmark IRR on total investment for Hydropower projects is 8%. And the proposed project activity adopts this benchmark economic indicator to analyse the economics of the project activity.

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

Table 4 Main parameters for calculation of financial indicators

No.	Key Parameter	Unit	Amount	Remarks
1	Installed capacity	MW	65	Preliminary Design Report
2	Total investment	Million Yuan	627.4113	Preliminary Design Report
3	Annual net electricity generation to Grid	MWh	257570	Preliminary Design Report
4	Electricity Tariff	Yuan/kWh	0.327	Preliminary Design Report
5	Value Added Tax	%	17	Preliminary Design Report
6	Income Tax	%	33	Preliminary Design Report
7	Project activity life time	Year	33	Preliminary Design Report
8	Annual operating cost	Thousand Yuan	9564	Preliminary Design Report
9	Expected CERs price	€/tCO_2	8.8	

The PDD was made available on the DOE website on 19 September 2006. The changes about the IRR data source (from FSR to PDR) between the PDD submitted for validation and the PDD submitted for registration is as below
IRR data source (from FSR to PDR),
All the data in the PDD published for the global stakeholder comments are from FSR. But all the data in the PDD submit for the registration are from PDR, which is also approved by local government. The PDR was conducted after FSR and the design is optimized as per the water

source information base on the design in FSR so that PDR showed the project really active. So that the project owner has to make the final decision for the investment based on it. So the change of IRR data source is transparent and reasonable.

The IRR with and without revenues from CERs sales are listed in Table 5. Without revenues from CERs sales, the IRR of the proposed project activity is 6.53%, which is lower than the benchmark IRR of 8%, and financially inviable.

The Preliminary Design Report (PDR - approved on September 2004) is the source of input values to the IRR calculation. It can be validated that the input values used in the IRR analysis by (a) confirming that values are consistent between the IRR calculation and PDR and (b) comparing with other similar projects validated by the DOE and confirming that they are appropriate.

According to the *Notification of Electric Power Tariff Reform by the Office of state council* issued on 09/07/2003, the actual project total investments are RMB 719, 435, 649 higher than RMB 627, 411, 300 estimated in the preliminary design report. So the calculation is conservative. The financial analysis assumes tariff and O&M cost fixed throughout the lifetime of the project activity. Since 2002, P. R. China has been applying a new electricity tariff control policy, known as the “Price Competition for Power Supply to the Grid” policy[2] , in the power industry. Free competition between power plants is encouraged in order to lower cost of power production and thereby electricity tariffs. Furthermore, the tariff is determined as per local price bureau relevant guidance documents[3]. The guidance price from local government i.e. local price bureau is fixed in the past 5 years[4], so it is unlikely that the tariff will increase very much to make the project IRR reach the benchmark. For the O&M cost, as per the Project Finance Audit Report[5] by Taojiang County Audit Bureau , it was able to verify that the actual project annual O&M cost is RMB 10,520,000 higher than RMB 9,564,000 estimated in the preliminary design report. So the calculation is conservative.

The sensitivity analysis below shows that the project IRR reaches the benchmark only if: a) the total investment decreases by 14.1%, b) the annual O&M cost decreases by 99.28% or c) the project revenue increases by 17.4%. However, the DOE validated that none of these scenarios are likely to happen because: a) the actual total investment of the project is RMB 719, 435, 649 higher than RMB 627, 411, 300 estimated in the PDR, b) the economical development in China shows that the price of material is rising in the recent years, and c) the *.local price bureau guidance.* shows that the price is fixed in the past five years, moreover, the power generation is based on decades of hydrological data.

With revenues from CERs sales, the financial acceptance will be dramatically improved and the IRR is 8.08%, surpassing the IRR of the industry and is therefore attractive to investment.

Table 5 Comparison of financial indicators with and without revenues from CERs

Items	Unit	Without revenues from CERs	Benchmark	With revenues from CERs
IRR	%	6.53	8	8.08

[2] the Notice of the State Council on Printing and Distributing the Plan Regarding the Restructuring of the Power Industry (No.5 [2002] of the State Council)

[3] Price guidance documents proof letter by local price bureau in 2007

[4] Price guidance documents proof letter by local price bureau in 2007

[5] Project Finance Audit Report by Taojiang County Audit Bureau in August 2008

Sub-step 2d. Sensitivity analysis

The purpose of the sensitivity analysis is to examine whether the conclusion regarding the financial viability of the proposed project is sound with those reasonable variations in the assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be financially attractive.

Four financial parameters including: total investment, project revenue and annual O&M cost were identified as the main variable factors for sensitive analysis of financial attractiveness. Their impacts on IRR of total investment were analyzed as follows.

(a) Total investment
When the total investment decreases by 14.1%, the IRR of total investment reaches the benchmark. Considering economical development in China and the price rising of materials during the recent years, the total investment increasing is reasonable and it couldn't be cut down so much.

(b) Annual O&M cost
When the annual O&M cost decreases by 99.28%, the IRR of total investment reaches the benchmark, and this will never happen for any project.

(c) project revenue
When the project revenue increases by 17.4%, the IRR of total investment reaches the benchmark. The project revenue is relevant the tariff and power generation. The tariff is determined as per local price bureau relevant guidance documents. The guidance price form local government i.e. local price bureau is fixed in the past 5 years, so the tariff can not increase so much to make the project IRR reach benchmark. The power generation is determined by third part design institute in the preliminary design report as per decades of local Hydrological data and the installed capacity is fixed, so the operation hours can not increase so much to make the project IRR reach the benchmark.

After above sensitive analysis, when financial indicators change within reasonable range, the proposed project is not financially feasible without CDM support.

Step 4. Common practice analysis

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

Table 7 shows the similar hydropower plants completed or under development in Hunan Province since 2001.

Table 7 50-100 MW hydropower plants in Hunan Province since 2001

Name of the Hydropower	Installed Capacity (MW)	Time of Commissioning (year)	Memo
Jinweizhou Hydropower Station	63.18	2003	Loan USD 30 million loans at preferential terms from the Austrian government
Baiyun Hydropower Station	54	2005	Main Shareholder: Shaoyang County Government. Provincial level
Sanjiangkou Hydropower	62.5	2004	Main Shareholder: Xiangtou Investment

Station			Group. State level
Gaotan Hydropower Station	57	2003	
Mangtangxi Hydropower Station	60	2001	
Changtanhe Hydropower Station, Zhangjiajie City	80	Under development	Applying for CDM
Dongping Hydropower Station, Anhua County	74	Under development	Applying for CDM
Zhuxikou Hydropower Station, Anhua County	74	Under development	Applying for CDM
Taoshui Hydropower Station, Chaling County, Zhuzhou City	69	Under development	Applying for CDM
Dayuan Hydropower Station, Yanling County, Zhuzhou City	51.6	Under development	Applying for CDM

Source: China Hydro Statistic Yearbook 2005 and relevant statistical report.

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

The existing hydro project in Hunan province do not call into question the claim that the proposed project is financially unattractive as discussed in Step 2 because there are essential distinctions between them. Firstly, 4 of the existing hydro projects listed in table 3 are developed by a state-level or provincial developer. As a county-level developer, the project developer, Taohuajiang Energy Development Co., Ltd lacks proven capacity to access financing, against the project risk and the ability to negotiate with the grid company.
Jinweizhou Hydropower Station has received USD 30 million loans at preferential terms from the Austrian government which is a long-term ODA loan with low interest.
The other 5 projects as listed in the table are also under development as CDM project activities.
To conclude, the existence of these projects in table 3 does not contradict the claim that the proposed project activity is financially unattractive.

B.6. Emission reductions:

>>

B.6.1. Explanation of methodological choices:

The Operating Margin (OM) emission factor ($EF_{OM,y}$) and the Build Margin (BM) emission factor ($EF_{BM,y}$) in CCPG are calculated using ACM0002. The baseline emission factor of the combined margin is calculated as the weighted average of the Operating Margin (OM) emission factor ($EF_{OM,y}$) and the Build Margin (BM) emission factor ($EF_{BM,y}$). Then the baseline emissions (BE_y) can be calculated according to the baseline emissions factor (EF_y) and the electricity supplied by the project activity to the grid.

Step 1. Calculate the Operating Margin emission factor (*EFOM, y*)

Under ACM0002, four methods are provided for calculating the Operating Margin Emission Factor, including:

(a) Simple OM, or

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

Option (c) is the optimal option. According to ACM0002, option (c) should be the first methodological choice, but in China, the dispatch information is not available to the public, therefore option (c) is not applicable to the proposed project activity. For the same reason, option (b) is also not applicable to this project activity. Option (d) is applicable to the project activity if the low-cost/must run resources constitute more than 50% and if the detailed information for option (b) is not publicly available or if the detailed information for option (c) is not publicly available. The option (a), Simple Operating Margin (OM) method, is applicable only when the low-cost/must run resources constitute less than 50%.

In the recent five years (2000-2004) , the electricity generation of CCPG from the low-cost/must run resources was less than 50% of total elctricity generation, i.e.: 38% in 2000, 36.8% in 2001, 36.0% in 2002, 34.2% in 2003, and 38% in 2004. This can not meet the condition for option (d) that the low-cost/must run resources constitute more than 50% grid generation. As a result, option (d) is not applicable to the proposed project activity, but conditions for option (a) can be met. Therefore, option (a) is the only one that can be used to calculate the Operating Margin emission factor ($EF_{OM,y}$) of this project activity. The ex-ante method is chosen because the data for calculation of Operating Margin emission factor ($EF_{OM,y}$) of the project activity will only be publicly available for one or two years late.

The Simple Operating Margin emission factor is defined as the generation-weighted average emissions per electricity unit (tCO2/MWh) of all generating sources serving the system.The calculating formula is as follows:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad (1)$$

where,

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

$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2/t mass or volume), taking into account the carbon content of the fuels used by relevant power plants *j* and percent oxidation in year(s) *y*, and

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

$$GEN_{j,y} = G_{j,y} \times (1 - e_{j,y}) \qquad （2）$$

Where:

$G_{j,y}$ is the amount of electricity generation (in MWh) by source *j* in year *y*;
$e_{j,y}$ is the rate of plant self consumption of source *j* in year *y*.

The CO2 emission coefficient *COEFi* is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad （3）$$

Where:

NCVi is the net calorific value (energy content) per mass or volume unit of a fuel *i*, which is a country-specific value;
$OXID_i$ is the oxidation factor of the fuel *i*, using IPCC default values;
EFCO2,i is the potential CO2 emission factor per unit of energy of the fuel *i*， using IPCC default values.

The Simple OM emission factor is calculated as a 3-year average (2002-2004), based on the most recent statistics (See Annex 3 for detail) available at the time of PDD submission. This project activity adopts CCPG Operating Margin emission factor ($EF_{OM,y}$) as published in the *Notification on Determining Baseline Emission Factor of China*, by Chinese DNA, whose value is 1.2526tCO_2e/MWh. （See Annex 3 for details）

The ex-ante method is selected to calculate OM, which will remain unchanged for the first crediting period.

Step 2. Calculate the Build Margin emission factor ($EF_{BM,y}$**)**

As per the Methodology, there are two options to be used to calculate Build Margin emission factor. The project activity adopts Option 1: Calculate the Build Margin emission factor $EF_{BM,y}$ ex-ante based on the most recent information available at the time of PDD submission, i.e.: calculate ex-ante without monitoring and updating ex-post.

Due to some data unavailability, a deviation approach to calculate build margin for the Chinese grids has been approved by CDM EB-22 in 2005, and such deviation approach is used to calculate BM for this project activity, i.e.: to calculate the new installed capacity and the components of the generating technologies of CCPG , and then to calculate the weights of the generating technologies of the new installed capacity of CCPG, and finally to calculate the emission factor, using the optimal efficiency of commercialized technologies.

The calculations are as follows:

$$EF_{BM,y} = \frac{CAP_{Thermal}}{CAP_{Total}} \times EF_{Thermal} \qquad (4)$$

$EF_{Thermal,adv}$ is the estimated emission factor of fuel-fired thermal plants using Best Practice Commercial Technology. Compared with the *BM* calculation specified in ACM0002, this method is more conservative as it assumes all recently built plants have the fuel efficiency as that of best practice commercial technology.
$CAP_{Thermal,new}$ is the newly installed generation capacity of recently built fuel-fired thermal plants, while CAP_{new} is the installed generation capacity of all recently built power plants. The proper year should be selected so that it is the closest time when the last 20% of generation capacity was installed.

Following table shows the installed power capacity in CCPG in year 2000, 2001 and 2004. It can be seen that the capacity additions during 2001-2004 represents a value that is closer to 20% of the total additions in 2004 than that during 2002-2004, and it is also obvious that the capacity additions during 2001-2004 are larger than the capacity of five plants, so data in years 2000 and 2004 can be used to calculate the BM emission coefficient of CCPG. Thermal power plants accounted for 69.8%of the total capacity additions in CCPG during 2001-2004.

	Installed capacity in 2000	Installed capacity in 2001	Installed capacity in 2004	New capacity addition from 2000 to 2004
	A	B	C	D=C-A
Thermal Plants (MW)	39864.6	42569.2	53744.7	13880.1
Hydro Plants (MW)	28637.8	30397.0	34642.1	6004.3
Wind farm(MW)	0	0	0	0
Total (MW)	68502.4	72966.2	88386.8	19884.4
Capacity as of installed capacity of 2004	77.5%	82.55%	100%	22.5%
The fraction of newly added coal fired capacity				69.8%
See Annex 3 for detail				

99.5% emissions(λ_{Coal}) in CCPG come from coal from 2002-2004 (see annex 3 for details), other emissions are mostly due to start up fuels, then it is safe to say that all the thermal power plant within CCPG are coal-fired power plants, i.e. using EF_{coal} to substitute $EF_{thermal}$ is reasonable. The most advanced and commercially available coal power technology in the CCPG is 600MW sub-critical unit with PSCC of 336.66 gce/kWh as published in the *Notification on Determining Baseline Emission Factor of China*, by Chinese DNA. According to above analysis, the conservatively estimated emission coefficient of new thermal power plants is $\lambda_{Coal} * EF_{coal}$=0.9091 kgCO2/kWh. According to formula (4), the build margin emission coefficient of CCPG $EF_{BM,y}$ is **0.6346** tCO_2/MWh (See Annex 3 for details).

Step 3 – Calculate the Baseline Emission Factor (EF_y)

The baseline emission factor **(**EF_y) will be calculated in the following formula:

$$EF_y = w_{OM} \times EF_{OM,y} + w_{BM} \times EF_{BM,y} \qquad (5)$$

Where
the weights w_{OM} and w_{BM}, are 50% by default (i.e., $w_{OM} = w_{BM} = 0.5$).

Therefore the baseline emission factor (EF_y) is calculated as:

$$EF_y = 0.5 \times 1.2526 + 0.5 \times 0.6346 = 0.9436 (tCO_2e/MWh).$$

The PDD was made available on the DOE website on 19 September 2006. The changes about the emission factor between the PDD submitted for validation and the PDD submitted for registration is as below

Emission factor
The PDD was made available on the DOE website on 19 September 2006, in which there is something wrong in emission factor calculation process and some data was incorrectly applied as below,

- the emission factor for refinery gas was incorrectly applied as 18.2 tCO_2/TJ. In fact it is 15.7tCO2/TJ in China Energy Year Book. So the emission factor of 15.7tCO_2/TJ for refinery gas is applied here in the PDD for registration.
- the emission factor for coke was incorrectly applied as 29.5 tCO_2/TJ. In fact it is 29.2tCO_2/TJ in China Energy Year Book. So the emission factor of 29.2tCO_2/TJ for coke is applied here.
- the emission factor for coke oven gas was incorrectly applied as 13 tCO_2/TJ. In fact it is 12.1tCO_2/TJ in China Energy Year Book. So the emission factor of 12.1tCO_2/TJ for coke over gas is applied here.
- the emission factor for coal gas was incorrectly applied as 13 tCO_2/TJ. In fact it is 12.1tCO_2/TJ in China Energy Year Book. So the emission factor of 12.1tCO_2/TJ for coal gas is applied here.

So the emission factor in PDD for the registration applied the same data source as that in PDD published on 19 September 2006, i.e. China Electric Power Yearbook 2002-2005, China Energy Statistic Yearbook 2000-2005, IPCC 1996.

Step 4 – Calculate the Baseline Emissions (*BEy*) **and emission Reduction***(ERy)*

The baseline emissions (*BEy*) are the product of the baseline emission factor (*EFy*) times the electricity supplied by the project activity to the grid(EG_y):

$$BE_y = EG_y \times EF_y \quad (6)$$

The emission reduction *ERy* by the project activity during a given year y is the difference between baseline emissions (*BEy*), project emissions (*PEy*) and emissions due to leakage (*Ly*), as follows:

$$ER_y = BE_y - PE_y - L_y \quad (7)$$

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

Data / Parameter:	$GEN_{j,y}$
Data unit:	MWh
Description:	Power generation of source *j* in year *y* (2002-2004, Chongqing City, Sichuan Province, Henan Province, Jiangxi Province, Hubei Province and Hunan Province)
Source of data used:	China Electric Power Yearbook （2003-2005）
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official Statistics

Any comment:	/

Data / Parameter:	$PR_{m,y}$
Data unit:	%
Description:	Utilization rate of thermal plant m in year *y*（2002-2004, Chongqing City, Sichuan Province, Henan Province, Jiangxi Province, Hubei Province and Hunan Province)
Source of data used:	China Electric Power Yearbook （2003-2005）
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official Statistics
Any comment:	/

Data / Parameter:	$F_{i,j,y}$
Data unit:	Mt /$10^{10}m^3$
Description:	Fuel *i* consumed in year *y* for electric power *j*（2002-2004, Chongqing City, Sichuan Province, Henan Province, Jiangxi Province, Hubei Province and Hunan Province)
Source of data used:	China Energy Statistical Yearbook （200-2005）
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official Statistics
Any comment:	/

Data / Parameter:	NCV_i
Data unit:	TJ/fuel mass or volume
Description:	Net calorific value per ton or m^3 of fuel i
Source of data used:	China Energy Statistical Yearbook 2005
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	country-specific values
Any comment:	/

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tC/TJ
Description:	Emission factor of fuel *i* per specific energy
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories (revised in 1996)
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values
Any comment:	/

Data / Parameter:	$OXID_i$
Data unit:	%
Description:	Oxidation factor of fuel i
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories (revised in1996)
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values
Any comment:	/

Data / Parameter:	$GENE_{best,coal}$
Data unit:	%
Description:	Power supply efficiency of commercially-optimized coal-fired thermal power plant
Source of data used:	*Notification on Determining Baseline Emission Factor of China-- Calculation of the Baseline BM of Electric Power Grid in China*, published at China CDM website, by Chinese DNA
Value applied:	36.53%
Justification of the choice	country-specific values

of data or description of measurement methods and procedures actually applied :	
Any comment:	/

Data / Parameter:	$GENE_{best, oil/gas}$
Data unit:	%
Description:	Power supply efficiency of commercially-optimized thermal power plant (including oil-firing and gas-firing)
Source of data used:	*Notification on Determining Baseline Emission Factor of China-- Calculation of the Baseline BM of Electric Power Grid in China*, published at China CDM website, by Chinese DNA
Value applied:	45.87%
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Values
Any comment:	/

Data / Parameter:	$CAP_{m, y, j}$
Data unit:	MW
Description:	Installed capacity of hydropower resources *i* in province(s) *m* in year *y* （2000-2004, Chongqing City, Sichuan Province, Henan Province, Jiangxi Province, Hubei Province and Hunan Province)
Source of data used:	China Electric Power Yearbook （2001-2005）
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official Statistics
Any comment:	/

B.6.3. Ex-ante calculation of emission reductions:

>>

The power density of the project activity is 10.3W/m^2 , higher than 10 W/m^2 and therefore the leakage emission of the project activity is 0. Therefore, the emission reduction (*ERy*) is equal to the baseline emission (BE_y), according to the methodology.

The $EF_{,y}$ in CCPG is 0.9436 tCO_2/MWh and the annual electricity supply of this proposed project activity to the grid is expected to be 257,570 MWh .
Then the emission reduction is estimated to be 243,043 tCO_2 e.

B.6.4. Summary of the ex-ante estimation of 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)
2007(Oct.-Dec.)	0	60,761	0	60,761
2008	0	243,043	0	243, 043
2009	0	243, 043	0	243, 043
2010	0	243, 043	0	243, 043
2011	0	243, 043	0	243, 043
2012	0	243, 043	0	243, 043
2013	0	243, 043	0	243, 043
2014(Jan. –Sept.)	0	182,282	0	182,282
Total (tonnes of CO_2e) of first crediting period	0	1,701,301	0	1,701,301

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

>>

B.7.1. Data and parameters monitored:

>>

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity supplied to CCPG
Source of data to be used:	Continuously monitoring the power of the Project activity supplied to CCPG via Xiajiashan and Niutanhe Substations
Value of data applied for the purpose of calculating expected emission reductions in section B.6	257,570
Description of measurement methods and procedures to be applied:	Monitor the data with ammeter installed jointly by project developer and grid company and make record jointly at regular time every month.
QA/QC procedures to be applied:	The sensitivity of the ammeter will meet the national standards, and will be checked by comparing with the electricity sales receipt.
Any comment:	

Data / Parameter:	EG_{aux}
Data unit:	MWh
Description:	Electricity supplied from CCPG
Source of data to be used:	Assumed to be 0 in PDD, and the actual data comes from ammeter.
Value of data applied for the	

purpose of calculating expected emission reductions in section B.6	0
Description of measurement methods and procedures to be applied:	Continuously monitor 10.5kV distribution cabinet at project site with ammeters, make record manually every month.
QA/QC procedures to be applied:	Cross check with main and auxiliary ammeters
Any comment:	-

Data / Parameter:	Area
Data unit:	m^2
Description:	Surface area at full reservoir level
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	6.3km^2
Description of measurement methods and procedures to be applied:	monitoring at start of the project
QA/QC procedures to be applied:	Archived data kept during the crediting period
Any comment:	

B.7.2. Description of the monitoring plan:

>>

The project developer will form a CDM team of operators to implement this monitoring plan and the team of operators will be in responsible for the data measurement, archiving, data collection (data analysis and database construction) and collection of electricity sales receipts and formulation of monitoring reports. The detailed monitoring plan is as follows:

1) Organization Structure

In order to monitor emission reductions and any other effects caused by the Project activity, the Project developer set up an operational and management structure to guide the operators for data collection and archiving. The operational and management structure is illustrated in Chart 2.

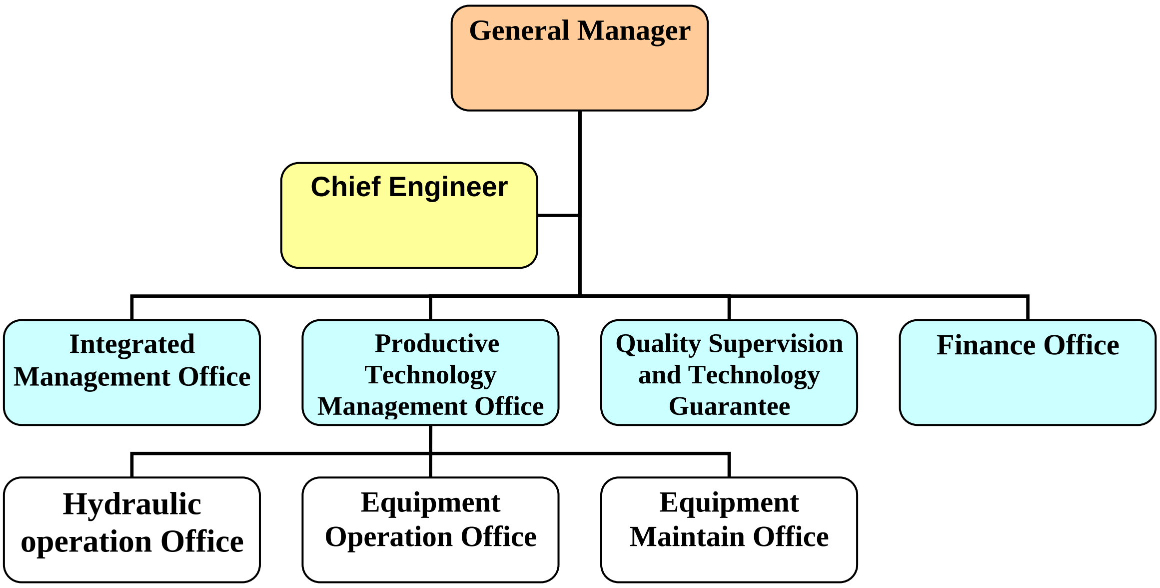

Chart 2 the operational and management structure

2) Training

The CDM team comprises relevant staff from technology, quality and finance offices. General Manager will commission CDM team manager to make sure of the implementation of the project monitoring plan.

The CDM team will be trained on CDM expertise, project implementation and management, and monitoring plan.

The Quality Assurance Department of the company of this project activity, which is responsible for running quality assurance systems during the operations of the project activity, will be trained as well on CDM knowledge.

3) Data Collecting and archiving

CDM team manager will introduce to the team members the Monitoring Plan, working flowchart and their responsibilities. The team members will be responsible for collecting the information as set out in the Monitoring Plan. The data will be collected monthly in a transparent manner. The team members will be responsible for data collecting and archiving, and responsible for checking the records with the sales receipts provided by Hunan Power Grid Company.

Electricity supplied to the Hunan power grid will be measured continuously and automatically by ammeter and the record of the ammeter will be taken down once every month in the Xiaojiashan and Niutanhe Substations by the team members. The ammeter will be recalibrated once every year in light with the *Technical Code of Electric Energy Metering and Metering Devices* （DL/T 5137-2001）. Further, the team members will also be in charge of recording and monitoring the electricity generated at the plant, and electricity consumed by plant self.

A three-party group with representatives from the Hunan Power Grid Company, Xiaojiashan and Niutanhe Substations and Xiushan Hydropower Station will record the electricity supply by reading the same ammeter. The team members will read the ammeter in its station for double-checking purpose. The team members responsible for recording electricity supply to grid will be trained in advance on the use of ammeters.

In addition, the operation and maintenance log for hydropower generator will be stipulated in detail and at the same time, hydrological data of the project activity will also be recorded.

All of the data and records will be kept for a period of 2 years following the end of the 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)

>>

Date of completing of this baseline study and monitoring methodology *(DD/MM/YYYY)*

06/03/2007

Name of the responsible persons/entity(ies):

HE Hongbo, Changsha University of Science & Technology; E-mail:hehongbo186@163.com

DENG Xuehua Changsha University of Science & Technology; E-mail:dengxuehua7102@126.com

TAO Rong, Changsha University of Science & Technology; E-mail:taorong252@126.com

SHI Jingyang, Hunan University,Phone: 13973688246; E-mail:shijingyang8246@163.com

XIA Shanquan, Hunan University ,Phone: 13511128688; E-mail:xsq0624@163.com

None of the above persons are 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:

>>
18/08/2005(permission of construction)
Starting date of project activity (from 31 October 2004 for the construction start date to 18 August 2005 for the construction approval)
It was misunderstood to defined the start date as October 31, 2004 in the PDD for global stakeholder comments. During the site visit, DOE interviewed local government and was able to verify that the real project starting date should be the project construction permit date of 18 August 2005 according to DNV's understanding on the start date at that time. So the choose of 18 August 2005 as the project starting date is conservative and reasonable. According to the new guidance by EB on start date that shall mean the actual cost would occur, then the start date should be further changed as 10th September 2005 (the earliest contract signed, i.e. turbines purchase agreement signed).
So on the conservative manner, the earlier date of 18th August 2005 was selected as project starting date. The change for the starting date has no impact for the additionality.

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

>>
33 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:

>>
01/06/2008, or on the date of registration of the CDM project activity, whichever is later

C.2.1.2. Length of the first crediting period:

>>
7 years and 0 months

C.2.2. Fixed crediting period:

>>
Not applicable

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Environmental impacts

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

>>

A complete *Environmental Impact Assessment (EIA)* for the Yiyang Xiushan Hydropower Project was done by Hunan Province Design & Research Institute of Water Resources and Hydropower as entrusted by the project owners. The *EIA* has been approved by Hunan Environmental Protection Bureau.

The EIA is available for reference, and the main conclusions of *the EIA* are as follows:

1. Ecological Impacts

No significant negative impacts are expected to take place on the terrestrial animals and plants because detailed analysis shows that there are no rare and endangered propagation species in the area of the project impact.

For the aquatic creatures, no rare and endangered aquatic species were found in reservoir inundation area and construction area. With the dam rising, the water surface will broaden and benefit the aquatic creatures' existence and fish culture.

2. Water Environment

During the construction period, it is anticipated that there will be four types of pollutants: suspended substances (SS), alkaline water, petroleum and COD. The wastewater containing SS are mainly coming from sand flushing and concrete curing wastewater, which will have slight impact on water quality. Wastewater discharge during construction period will have neglectably slight impact on water PH and petroleum concentration. The COD concentration in the wastewater discharged into the Zijiang River will have insignificant change.

During the project construction period, measures will be taken to reduce the impact of construction wastewater and domestic wastewater on the water quality of the lower reaches of the dam. The sedimentation treatment for construction wastewater will be applied. Oil separation treatment for equipment flushing wastewater will be used. These measures can reduce the impact of construction wastewater to be nearly neglectable.

When the project is put into operation, the main pollutions are the domestic pollution of the local residents and agriculture. The water in the reservoir will be qualified to the level of Type III standard of the *Environmental Quality Standard for Surface Water*（GB3838-2002）.

3. Atmospheric Environment

During construction, the main impacts on the atmospheric environment will come from flying dust from construction and transportation. The main pollutants are TSP and NO_x.

To control atmospheric pollution, intensified management will be adopted to ensure all of the equipment will comply with automobile emission standards.

4. Noise

The noise impact will mainly come from construction machines and transportation during construction period.

To minimize these impacts, the project developer will strengthen the construction management and limit the operation time of construction machines with high noise. In addition, the workers will be protected by noise protecting devices such as earplugs and helmets.

5. Solid Wastes

The solid wastes will mainly come from construction wastes and domestic wastes. The project developer will build a dumping site to store the solid wastes.

6. Water loss and soil erosion

On the basis of investigation, a *Report on Scheme of Water and Soil Conservation for Xiushan Hydropower Project,* with detailed protection measures of soil erosion, was formulated, and was approved by Hunan Province Water Conservancy Department.

It is concluded that with the implementation of the scheme the soil erosion will be under effective control

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:

>>

The environmental impacts of this project activity are considered insignificant by the project participants and the Chinese government, even though, the EIA of this project activity has been done, and has been approved by the local environmental protection authority.

SECTION E. Stakeholders' comments

>>

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

>>

At project proposal stage, the project developer invited comments by issuing questionnaires and holding consultation meeting of the potential stakeholders for this project activity. The comments were collected from the regions which are directly connected with the project activity, covering Santangjie Town, Xiushan Town, Zhanxi Township and Fuqiushan Township.

Total 140 questionnaires were distributed and 126 were collected. All of the opinions from the local stakeholders had been collected and considered.

E.2. Summary of the comments received:

>>

All of the comments received were summarized in Table 8. It is obvious that most of people uphold Yiyang Xiushan Hydropower Project; they think that the project will benefit the local traffic situation and flood control. In the meantime, the project will accelerate the local economic development, most of

the inhabitants will benefit from the project directly or indirectly. And most of the people consulted are care of the influence to the environment. More than 90% of the consulted people wish the project can start early;
The stakeholders at the meeting expressed their views on emigration, transportation and electricity supply, and fully supported the project activity. The stakeholders also raised three issues to the project developer, and hoped these three issues can be addressed, as follows:

1. It is their hope that the traffic infrastructure of reservoir area can be further improved.
2. The Project activity may lead to soil salinization for part of the land, the project developer was expected to take actions to address this issue.
3. To avoid the flood risk, the Project developer should take actions to reinforce the embankment.

Table 8 Summary of the comments received

Item		Number of people consulted	Percentage (%)
Which kind of influences will be brought to you from the project?	Preparing period	21	17.5
	Construction period	63	52.5
	Running period	36	30
The degree of influence on your life from the project?	Severely	27	22.5
	Lightly	66	55
	No	27	22.5
Which aspect do you pay attention to about the project?	Economic	63	52.5
	Environment	51	42.5
	Others	6	5
Is the project benefiting the local natural environment?	Advantage	102	85
	Disadvantage	9	7.5
	No influence	9	7.5
Would you like to move and resettle?	Yes	75	62.5
	No	9	7.5
	With some terms	36	30
Which kind of environmental pollution affects you most severely?	Noise	21	17.5
	Ecological destroy	42	35
	Water pollution	36	30
	Others	21	17.5
Do you uphold this project to be implemented?	Yes	108	90
	Unconcern	12	10
	No	0	0

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

>>

All in all, the local government and inhabitants are supportive of the Project activities. According to the comments received, further protective measurements will be taken for alleviating environmental impacts. Response measures to the issues raised at the meeting are as follows:

1. As to the local traffic infrastructure, the Project developer will increase investment to build road, bridge and ferry;
2. The Project developer will increase irrigation and drainage machines, and build drainage ditches to minimize soil salinization, the EIA and relevant environmental protection plan have been approved by local government.
3. The Project owner will increase the flood control standard of the embankments by strengthening the banks.
4. The resettlement plan report have been carried out by Hunan Province Design & Research Institute of Water Resources and Hydropower in May 2005, in which the compensation for resettlement is detailed as per state regulation and the plan has been approved by Hunan provincial Government in June 2005.

All the measures will be carried out under the supervision of construction supervisors and relevant departments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Taohuajiang Energy Development Co., Ltd. Taojiang County
Street/P.O.Box:	Taohuajiang Avenue
Building:	Room No. 5114, Administration Building
City:	Taojiang County, Yiyang City
State/Region:	Hunan Province
Postfix/ZIP:	413400
Country:	P.R.China
Telephone:	+86-737-8218050
FAX:	+86-737-8218025
E-Mail:	wenzhijun668@yahoo.com.cn
URL:	
Represented by:	GUO Lin
Title:	
Salutation:	Executive Director
Last Name:	GUO
Middle Name:	
First Name:	Lin
Department:	Taohuajiang Energy Development Company Ltd. Taojiang County
Mobile:	+86-13907378024
Direct FAX:	+86-737-8218025
Direct tel:	+86-737-8218050
Personal E-Mail:	wenzhijun668@yahoo.com.cn

Organization:	**KfW Bankengruppe**
Street/P.O.Box:	Palmengartenstrasse 5-9
Building:	KfW Bankengruppe, KfW Carbon Fund
City:	Frankfurt
State/Region:	
Postfix/ZIP:	60325
Country:	Germany
Telephone:	+49 69 7431-4218
FAX:	+49 69 7431-4775
E-Mail:	
URL:	www.kfw.de
Represented by:	Bernhard Zander
Title:	First vice-president
Salutation:	Mr
Last Name:	Zander
Middle Name:	
First Name:	Bernhard
Department:	KfW Bankengruppe
Mobile:	
Direct FAX:	+49 69 7431-4775
Direct tel:	+49 69 7431-4218
Personal E-Mail:	carbonfund@kfw.de

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

>>

There is no public funding from Annex I Parties to be involved for this Project activity.

Annex 3

BASELINE INFORMATION

Table A1. Calculation of thermal power in Central China Power Grid in 2002

Province	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Generation from thermal plants（MWh)	18,648,000	84,734,000	34,301,000	20,058,000	14,727,000	27,879,000	
plant consumption rate（%）	7.67	8.03	7.73	7.73	10.21	9.59	
Thermal power in CCPG（MWh)	17,217,698.4	77,929,859.8	31,649,532.7	18,507,516.6	13,223,373.3	25,205,403.9	183,733,384.7

Data Source：China Electric Power Yearbook 2003

Table A2. Calculation of thermal power in Central China Power Grid in 2003

Province	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Generation from thermal plants（MWh)	27,165,000	95,518,000	39,532,000	29,501,000	16,341,000	32,782,000	
plant consumption rate（%）	6.43	7.68	3.81	4.58	8.97	4.41	
Thermal power in CCPG（MWh)	25,418,290.5	88,182,217.6	38,025,830.8	28,149,854.2	14,875,212.3	31,336,313.8	225,987,719.2

Data Source：China Electric Power Yearbook 2004

Table A3. Calculation of thermal power in Central China Power Grid in 2004

Province	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal Power Generation（MWh)	30,127,000	109,352,000	43,034,000	37,186,000	16,520,000	34,627,000	
plant consumption rate（%）	7.04	8.19	6.58	7.47	11.06	9.41	
Thermal power in CCPG（MWh)	28,006,059.2	100,396,071.2	40,202,362.8	34,408,205.8	14,692,888.0	31,368,599.3	249,074,186.3

Data Source：China Electric Power Yearbook 2005

Table A4. Statistics of energy consumption for power generation in Central China Power Grid in 2002

Fuel Type	Unit	Jiangxi A	Henan B	Hubei C	Hunan D	Chongqing E	Sichuan F	Total G=A+B+C+D+E+F
Raw Coal	10^4 Tons	1,062.63	4,679.02	1,710.00	1,113.78	398.57	1,964.32	10,928.32
Clean Coal	10^4 Tons	2.72	0.00	0.00	0.00	0.00	0.00	2.72
Other washed	10^4 Tons	3.66	26.49	0.00	0.00	249.99	0.00	280.14
Coke	10^4 Tons	0.00	1.15	0.00	0.00	0.00	0.00	1.15
Coke Oven Gas	10^8 m^3	0.00	0.00	1.11	0.00	0.00	0.00	1.11
Other Coal Gas	10^8 m^3	0.00	2.16	0.00	0.00	0.00	0.00	2.16
Crude Oil	10^4 Tons	0.00	0.67	1.17	0.00	0.00	0.81	2.65
Diesel	10^4 Tons	1.00	1.34	1.08	2.19	0.51	0.51	6.63
Fuel Oil	10^4 Tons	0.33	0.16	0.34	0.69	0.00	1.51	3.03
LPG	10^4 Tons	0.00	0.02	0.00	0.00	0.00	0.00	0.02
Refinery Gas	10^4 Tons	0.49	0.00	0.00	1.90	0.00	0.00	2.39
Natural Gas	10^8 m^3	0.00	0.00	0.00	0.00	0.00	1.75	1.75
Other Petroleum Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Coking Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Energy Sources (standard coal)	10^4 Tce	0.00	3.38	0.00	0.00	0.00	0.00	3.38

Data Source: *China Energy Statistics Year Book2000-2002*

Table A5. Statistics of energy consumption for power generation in Central China Power Grid in 2003

Fuel Type	Unit	Jiangxi A	Henan B	Hubei C	Hunan D	Chongqing E	Sichuan F	Total G=A+B+C+D+E+F
Raw Coal	10^4 Tons	1,427.41	5,504.94	2,072.44	1,646.47	769.47	2,430.93	13,851.66
Clean Coal	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other washed	10^4 Tons	2.03	39.63	0.00	0.00	106.12	0.00	147.78
Coke	10^4 Tons	0.00	0.00	0.00	1.22	0.00	0.00	1.22
Coke Oven Gas	10^8 m^3	0.00	0.00	0.93	0.00	0.00	0.00	0.93
Other Coal Gas	10^8 m^3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crude Oil	10^4 Tons	0.00	0.50	0.24	0.00	0.00	1.20	1.94
Diesel	10^4 Tons	0.52	2.54	0.69	1.21	0.77	0.00	5.73
Fuel Oil	10^4 Tons	0.42	0.25	2.17	0.54	0.28	1.20	4.86
LPG	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Refinery Gas	10^4 Tons	1.76	6.53	0.00	0.66	0.00	0.00	8.95
Natural Gas	10^8 m^3	0.00	0.00	0.00	0.00	0.04	2.20	2.24
Other Petroleum Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Coking Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Energy Sources (standard coal)	10^4 Tce	0.00	11.04	0.00	0.00	16.20	0.00	27.24

Data Source: *China Energy Statistics Year Book2004*

Table A6. Statistics of energy consumption for power generation in Central China Power Grid 2004

Fuel Type	Unit	Jiangxi A	Henan B	Hubei C	Hunan D	Chongqing E	Sichuan F	Total G=A+B+C+D+E+F
Raw Coal	10^4 Tons	1,863.80	6,948.50	2,510.50	2,197.90	875.50	2,747.90	17,144.10
Clean Coal	10^4 Tons	0.00	2.34	0.00	0.00	0.00	0.00	2.34
Other washed	10^4 Tons	48.93	104.22	0.00	0.00	89.72	0.00	242.87
Coke	10^4 Tons	0.00	109.61	0.00	0.00	0.00	0.00	109.61
Coke Oven Gas	10^8 m^3	0.00	0.00	1.68	0.00	0.34	0.00	2.02
Other Coal Gas	10^8 m^3	0.00	0.00	0.00	0.00	2.61	0.00	2.61
Crude Oil	10^4 Tons	0.00	0.86	0.22	0.00	0.00	0.00	1.08
Gasoline	10^4 Tons	0.00	0.06	0.00	0.00	0.01	0.00	0.07
Diesel	10^4 Tons	0.02	3.86	1.70	1.72	1.14	0.00	8.44
Fuel Oil	10^4 Tons	1.09	0.19	9.55	1.38	0.48	1.68	14.37
LPG	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Refinery Gas	10^4 Tons	3.52	2.27	0.00	0.00	0.00	0.00	5.79
Natural Gas	10^8 m^3	0.00	0.00	0.00	0.00	0.00	2.27	2.27
Other Petroleum Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Coking Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Energy Sources (standard coal)	10^4 Tce	0.00	16.92	0.00	15.20	20.95	0.00	53.07

Data Source: *China Energy Statistics Year Book 2005*

Table A7. Calculation of the Simple OM of Central China Power Grid in 2002

Fuel Type	Unit	Total fuel in CCPG in 2002	EF （tc/TJ ）	OXID (%)	Mean low heat value （MJ/t,km^3）	CO_2 Emission（tCO_2e）
		G	H	I	J	K=G*H*I*J*44/12/10000 (Mass Unit) K=G*H*I*J*44/12/1000 (Cubage Unit)
Raw Coal	10^4 Tons	10,928.32	0.258	98.0	20,908	211,827,873.70
Clean Coal	10^4 Tons	2.72	0.258	98.0	26,344	66,430.55
Other washed	10^4 Tons	280.14	0.258	98.0	8,363	2,171,973.06
Coke	10^4 Tons	1.15	0.295	98.0	28,435	34,663.36
Coke Oven Gas	10^8 m^3	1.11	13.0	99.5	16,726	88,054.79
Other Coal Gas	10^8 m^3	2.16	13.0	99.5	5,227	53,548.11
Crude Oil	10^4 Tons	2.65	20.0	99.0	41,816	80,449.80
Diesel	10^4 Tons	6.63	20.2	99.0	42,652	207,353.29
Fuel Oil	10^4 Tons	3.03	21.1	99.0	41,816	97,045.23
LPG	10^4 Tons	0.02	17.2	99.5	50,179	629.76
Refinery Gas	10^4 Tons	2.39	18.2	99.5	46,055	73,087.08
Natural Gas	10^8 m^3	1.75	15.3	99.5	38,931	380,294.07
Other Petroleum Products	10^4 Tons	0.00	20.0	99.0	38,369	0.00
Other Coking Products	10^4 Tons	0.00	25.8	98.0	28,435	0.00
Other Energy Sources(standard coal)	10^4 Tce	3.38	0.0	0.0	0.00	0.00
Total Emission Q		215,081,402.80tCO_2e				
Total thermal power in CCPG (P)		183,733,384.70MWh				
OM emission factor in 2002 [＝Q/ P]		1.17062tCO_2e/MWh				

Data Source：the calorific values of the fuels are from China Energy Statistics Year Book 2005, p365. the potential emission factors are from" Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook", in chapter I ,pages 1. 6, Table 1-2.OXID Data are from" Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook", Chapter 1, page 1.8, Table1-4.

Table A8. Calculation of the Simple OM of Central China Power Grid in 2003

Fuel Type	Unit	Total fuel in CCPG in 2002	EF （tc/TJ）	OXID (%)	Mean low heat value （MJ/t,km^3）	CO_2 Emission（tCO_2e）
		G	H	I	J	K=G*H*I*J*44/12710000 (Mass Unit) K=G*H*I*J*44/12/1000 (Cubage Unit)
Raw Coal	10^4 Tons	13,851.66	25.8	98.0	20,908	268,492,109.10
Clean Coal	10^4 Tons	0.00	25.8	98.0	263,44	0.00
Other washed	10^4 Tons	147.78	25.8	98.0	8,363	1,145,763.47
Coke	10^4 Tons	1.22	29.5	98.0	28,435	36,773.30
Coke Oven Gas	10^8 m^3	0.93	13.0	99.5	16,726	73,775.63
Other Coal Gas	10^8 m^3	0.00	13.0	99.5	5,227	0.00
Crude Oil	10^4 Tons	1.94	20.0	99.0	41,816	58,895.33
Diesel	10^4 Tons	5.73	20.2	99.0	42,652	179,205.78
Fuel Oil	10^4 Tons	4.86	21.1	99.0	41,816	155,656.71
LPG	10^4 Tons	0.00	17.2	99.5	50,179	0.00
Refinery Gas	10^4 Tons	8.95	18.2	99.5	46,055	273,694.28
Natural Gas	10^8 m^3	2.24	15.3	99.5	38,931	486,776.41
Other Petroleum Products	10^4 Tons	0.00	20.0	99.0	38,369	0.00
Other Coking Products	10^4 Tons	0.00	25.8	98.0	28,435	0.00
Other Energy Sources(standard coal)	10^4 Tce	27.24	0.0	0.0	0	0.00
Total Emission Q		270,902,650.00tCO_2e				
Total thermal power in CCPG (P)		225,987,719.20MWh				
OM emission factor in 2003 [＝Q/ P]		1.19875tCO_2e/MWh				

Data Source：the calorific values of the fuels are from China Energy Statistics Year Book 2005, p365. the potential emission factors are from” Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook”, in chapter I ,pages 1. 6, Table 1-2. OXID Data are from” Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook”, Chapter 1, page 1.8, Table1-4.

Table A9. Calculation of the Simple OM of Central China Power Grid in 2004

Fuel Type	Unit	Total fuel in CCPG in 2002	EF（tc/TJ）	OXID (%)	Mean low heat value （MJ/t,km^3）	CO_2 Emission（tCO_2e）
		G	H	I	J	K=G*H*I*J*44/12 (Mass Unit) K=G*H*I*J*44/12/1000 (Cubage Unit)
Raw Coal	10^4 Tons	17,144.10	25.8	98.0	20,908	332,310,753.20
Clean Coal	10^4 Tons	2.34	25.8	98.0	26,344	57,149.81
Other washed	10^4 Tons	242.87	25.8	98.0	8,363	1,883,012.41
Coke	10^4 Tons	109.61	29.5	98.0	28,435	3,303,869.86
Coke Oven Gas	$10^8 m^3$	2.02	13.0	99.5	16,726	160,243.83
Other Coal Gas	$10^8 m^3$	2.61	13.0	99.5	5,227	64,703.96
Crude Oil	10^4 Tons	1.08	20.0	99.0	41,816	32,787.09
Gasoline	10^4 Tons	0.07	18.9	99.0	43,070	2,068.43
Diesel	10^4 Tons	8.44	20.2	99.0	42,652	263,961.05
Fuel Oil	10^4 Tons	14.37	21.1	99.0	41,816	460,244.21
LPG	10^4 Tons	0.00	17.2	99.5	50,179	0.00
Refinery Gas	10^4 Tons	5.79	18.2	99.5	46,055	177,060.32
Natural Gas	$10^8 m^3$	2.27	15.3	99.5	38,931	493,295.73
Other Petroleum Products	10^4 Tons	0.00	20.0	99.0	38,369	0.00
Other Coking Products	10^4 Tons	0.00	25.8	98.0	28,435	0.00
Other Energy Sources(standard coal)	10^4 Tce	53.07	0.0	0.0	0	0.00
Total Emission Q		339,209,149.90tCO_2e				
Total thermal power in CCPG (P)		249,074,186.30MWh				
OM emission factor in 2004 [＝Q/ P]		1.36188tCO_2e/MWh				

Data Source：the calorific values of the fuels are from China Energy Statistics Year Book 2005, p365. the potential emission factors are from" Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook", in chapter I ,pages 1. 6, Table 1-2. OXID Data are from" Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook", Chapter 1, page 1.8, Table1-4.

The weighted average for Simple Operating Margin (OM) in the three years 2002-2004 is:

$$EF_{OM,y} = \frac{(215{,}081{,}402.80 + 270{,}902{,}650.00 + 339{,}209{,}149.90)}{(183{,}733{,}384.70 + 225{,}987{,}719.20 + 249{,}074{,}186.30)} = 1.2526 tCO_2e / MWh$$

Table A10 Calculation of the CO_2 emissions corresponding to solid, liquid and gas fuels for power generation

Fuel Type	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	Calorific value (kJ/kg kJ/m^3)	Emission factor	OXID	CO_2 Emission（tCO_2e）
Raw Coal	10^4 Tons	1,863.80	6,948.50	2,510.50	2,197.9	875.50	2,747.90	1324,2650	20,908	25.80	0.980	332,310,753
Clean Coal	10^4 Tons	0.00	2.34	0.00	0.00	0.00	0.00	140	26,344	25.80	0.980	57,150
Other washed	10^4 Tons	48.93	104.22	0.00	0.00	89.72	0.00	532	8,363	25.80	0.980	1,883,012
Coke	10^4 Tons	0	109.61	0.00	0.00	0.00	0.00	170	28,435	29.50	0.980	3,303,870
Total coal												337,554,785
Crude Oil	10^4 Tons	0.00	0.86	0.22	0.00	0.00	0.00	212	41,816	20.00	0.990	32,787
Gasoline	10^4 Tons	0.00	0.06	0.00	0.00	0.01	0.00	111	43,070	18.90	0.990	2,068
Coal Oil	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43,070	19.60	0.990	0
Diesel	10^4 Tons	0.02	3.86	1.70	1.72	1.14	0.00	354	42,652	20.20	0.990	263,961
Fuel Oil	10^4 Tons	1.09	0.19	9.55	1.38	0.48	1.68	353	41,816	21.10	0.990	460,244
Other Oil Products	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38,369	20.00	0.990	0
Total Fuel												759,060
Natural Gas	$10^7 m^3$	0.00	0.00	0.00	0.00	0.00	22.7	1360	38,931	15.30	0.995	493,296
Coke Oven Gas	$10^7 m^3$	0.00	0.00	16.8	0.00	3.40	0.00	1740	16,726	13.00	0.995	160,244
Other Coal Gas	$10^7 m^3$	0.00	0.00	0.00	0.00	26.10	0.00	1430	5,227	13.00	0.995	64,704
LPG	10^4 Tons	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50,179	17.20	0.995	0
Refinery Gas	10^4 Tons	3.52	2.27	0.00	0.00	0.00	0.00	188	46,055	18.20	0.995	177,060
Total gas												895,304
Total												339,209,149

Calculate: λ_{Coal} =99.51%， λ_{Oil} =0.22%， λ_{Gas} =0.27%。

Table A11. Calculation of emission factor for different types of fuels

	Variable	Power supply efficiency	Fuel emission factor (tc/TJ)	OXID	Emission factor (tCO_2e /MWh)
		M	N	X	Y=3.6/M/1000*N*X*44/12
Coal-fired plant	$EF_{Coal,Adv}$	36.53%	25.8	0.980	0.9136
gas-fired plant	$EF_{Gas,Adv}$	45.87%	15.3	0.995	0.4381
oil-fired plant	$EF_{Oil,Adv}$	45.87%	21.1	0.990	0.6011

Calculate the emission factor for thermal power plant:

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} = 0.9091 tCO_2e/MWh$$。

Table A12. Installed Capacity of CCPG in 2004

Installed Capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal Capacity	MW	5,496.0	21,788.5	9,509.3	6,779.5	3,271.1	6,900.3	70,743
Hydro Capacity	MW	2,549.9	2,438.0	7,415.1	7,448.2	1,407.9	13,382.9	34,642.0
Nuclear Capacity	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind Capacity and Other	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	MW	8,045.9	24,226.5	16,924.4	14,227.8	4,679	20,283.2	88,386.8

Data Source：China Electric Power Yearbook 2001, among which the power generation of the Three Gorges is not included in Hubei Province

Table A13. Installed Capacity of CCPG in 2001

Installed Capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal Capacity	MW	4,869.8	15,349.0	8,077.3	4,997.8	2,898.3	6,377.0	64,567
Hydro Capacity	MW	2,067.8	2,438.0	7,125.6	5,966.1	1,268.0	11,531.5	50,395.0
Nuclear Capacity	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind Capacity and Other	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	MW	6,937.6	17,787.0	15,202.9	10,963.8	4,166.3	17,908.5	103,963

Data Source: China Electric Power Yearbook 2002

Table A14. Installed Capacity of CCPG in 2000

Installed Capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Thermal Capacity	MW	4,474.3	13,789.0	8,038.8	4,477.4	2,995.0	6,090.1	55,863
Hydro Capacity	MW	1,846.0	1,528.0	7,070.5	5,858.0	1,327.0	11,008.3	36,637
Nuclear Capacity	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind Capacity and Other	MW	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	MW	6,320.3	15,317.0	15,109.3	10,335.4	4,322	17,098.4	25,42

Data Source：China Electric Power Yearbook 2001

Table A15. Calculation of BM in Central China Power Grid

	Installation in 2000	Installatio n in 2001	Installation in 2004	Newly added installation in 2000-2004	Ratio in newly added installation
	A	B	C	D=C-A	
Thermal Capacity（MW）	39,864.6	42,569.2	53,744.7	13,880.1	69.80%
Hydro Capacity（MW）	28,637.8	30,397	34,642	6,004.2	30.20%
Nuclear Capacity（MW）	0.0	0.0	0.0	0.0	0.00%
Wind Capacity（MW）	0.0	0.0	0.0	0.0	0.00%
Total（MW）	2082,501	30,397	34,642	18,884	100.00%
Ratio in 2004 installation	77.50%	82.55%	100.00%		

Therefore it can be obtained that :

$$EF_{BM,y}=0.9091\times 69.80\%=0.6346\ tCO_2e/MWh$$

The operating marginal (OM) emission factor is 1.2526tCO_2e/MWh and the build marginal (BM) emission factor is 0.6346 tCO_2e/MWh.

For OM emission factor and BM emission factor, the default weights in ACM0002 (V6) is applicable.

$$w_{OM} = 0.5$$

$$w_{BM} = 0.5$$

By weighted average, the baseline emission factor is obtained as 0.9436tCO_2e/MWh.

<u>Annex 4</u>

MONITORING PLAN

No additional information.