CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1. Title of the small-scale project activity:

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Project: Hunan Tongdao Yaolaitan 5.55MW Hydro Power Project

Version: 03(revised as per the draft validation report)

Date of submission: 11/09/2009

A.2. Description of the small-scale project activity:

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Hunan Tongdao Yaolaitan 5.55MW Hydro Power Project (hereinafter referred to as **"the project"**) is a run-of-river hydro power plant located in Tongdao County, Hunan Province. The project is developed by Tongdao Yaolaitan Hydro Power Development Co., Ltd. The project construction commenced in August 2006, and the power generation started in November 2008. The total installed capacity of the project is 5.55MW (3×1.85MW). The annual electricity generation is 22,360MWh and the annual feed-in electricity is 21,136MWh. All electricity generated is finally transmitted to Central China Power Grid (the CCPG)[1].

Electricity generated by the proposed project will displace part of the electricity supplied by the CCPG which is dominated by fossil fuel-fired power plants, and thus greenhouse gas (GHG) emission reductions can be achieved. The estimated annual GHG emission reductions are 20,576tCO_2e.

As a renewable hydro power project, the proposed project will bring environmental and economic benefits and promote sustainable development, including:

- Alleviating power shortage in the local areas. The project activity will act as a direct supplement to the local electricity capacity, and thus would supply reliable power for the local community.
- Displacing part of the electricity generated from coal-fired power plants, and thus reducing greenhouse gas (GHG) emission and improving local environment.
- Creating new job opportunities for the local people in the project area during the construction and operation periods, and thus helping alleviating local poverty.

A.3. Project participants:

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Table A-1 The information of the 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)
P. R. China (host)	Tongdao Yaolaitan Hydro Power Development Co., Ltd. (the project owner)	No
UK	Climate Bridge Ltd.	No
UK	Noble Carbon Credits Limited	No

Detailed information on participants is included in Annex 1.

[1] Refer to *The Preliminary Design Report of Hunan Tongdao Yaolaitan Hydro Power Project* (Hunan Huaihua Survey & Design Institute of Hydro Power) [May 2005].

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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People's Republic of China

A.4.1.2. Region/State/Province etc:

Hunan Province

A.4.1.3. City/Town/Community etc:

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Tongdao Dong Autonomous County

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

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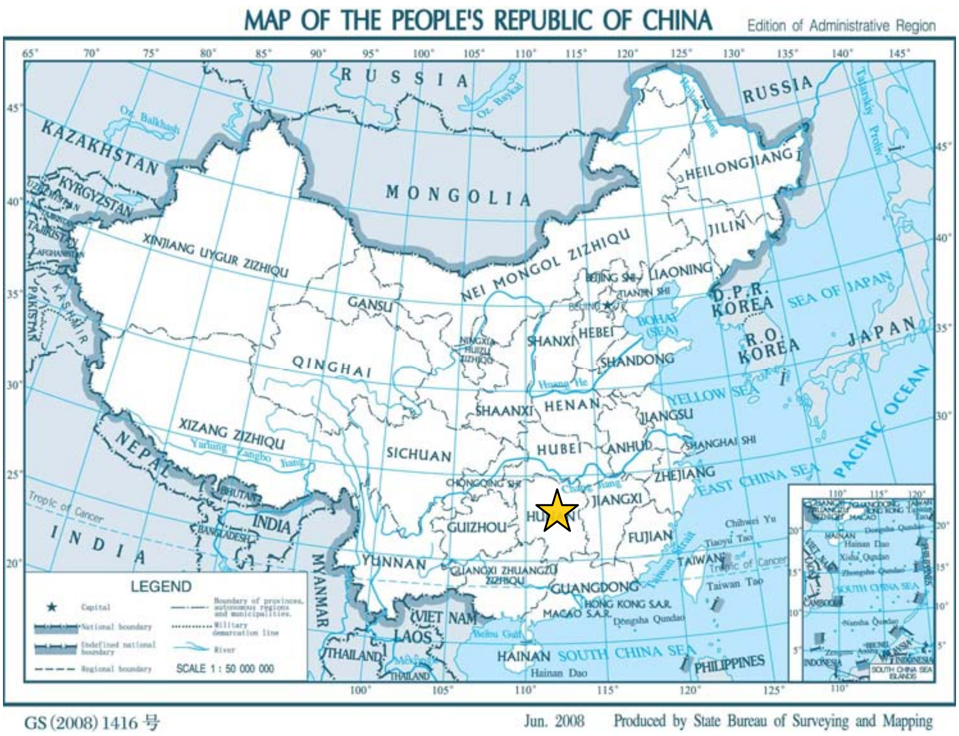
The project is sited at Yaolaitan, the upper range of Qushui River[2] between Jiangkou Village and Xianxi Township, Tongdao Dong Autonomous County in Huaihua city, Hunan Province. The geographical coordinates are east longitude 109°39′32″ and north latitude 26°21′15″. Map 1 shows the location of the proposed project.



[2] Qushui River is the tributary of Yuanshui River

Map 1 Geographical Location of the Proposed Project

A.4.2. Type and category (ies) and technology/measure of the small-scale project activity:

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According to Appendix B of the UNFCCC's simplified procedures for small-scale activities, the type and category of the proposed project is as follows:

Type I - *Renewable Energy Project*

Category I.D. – *Grid Connected Renewable Electricity Generation*

The project uses run-of river hydropower technology which converts the potential energy available in the water flow into mechanical energy using hydro turbines and then generates electricity with generators. This is a proven technology and widely used throughout China with years of experience in operation.

The major infrastructure for the project includes a non-overflow dam (6.5m in height), and a main powerhouse (41.72m×36.4×29.69m). The flux used for power generation is 44.06m^3/s, and the designed water head is 5.0m. With a total installed capacity of 5.55MW (3×1.85MW), the project includes three generators model SFW-1850-8/1430, and three turbines model GD008-WZ-275. The generated electricity will be delivered to Xianxi Transmission Sub-station by the 35KV×3.5km transmission lines, and finally be delivered to the CCPG[3]. Table A-2 below shows the technical parameters of the equipments.

Table A-2 Specifications of the equipments[4]

[3] Refer *to The Preliminary Design Report of Hunan Tongdao Yaolaitan Hydro Power Project* (Hunan Huaihua Survey & Design Institute of Hydro Power)[May 2005].
[4]Refer to *The Preliminary Design Report of Hunan Tongdao Yaolaitan Hydro Power Project* (Hunan Huaihua Survey & Design Institute of Hydro Power) [May 2005].

Turbine		Generator	
Model	GD008-WZ-275	Model	SFW-1850-8/1430
Quantity	3	Quantity	3
Rated Power	1.8996MW	Capacity	1.85MW
Rotated speed	154.96r/min	Rotated speed	750r/min
Water head	5.0m	Rated voltage	6.3KV
Flux	44.06m^3/s	Power Factor	0.8
Manufacturer	Gaoyou City Water Pump Plant	Manufacturer	Zhejiang Linhai Motor Plant

The technology adopted by the proposed project is domestic technology, so technology transfer was not leveraged in the proposed project.

A.4.3. Estimated amount of emission reductions over the chosen crediting period:

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The renewable crediting period of 7×3 is chosen for the proposed project. The ex-ante estimated amount of annual emission reductions over the first crediting period are 20,576tCO_2e. In the first crediting period from December 2009 to November 2016, the total emission reductions are estimated to be 144,032tCO_2e.

Table A-3 Ex-ante estimated amount of emission reductions over the first crediting period

Years	Annual emission reductions (tCO_2e)
01/12/ 2009-31/12/ 2009	1,715
2010	20,576
2011	20,576
2012	20,576
2013	20,576
2014	20,576
2015	20,576
01/01/2016-30/11/2016	18,861
Total emission reductions (tCO_2e)	144,032
The length of the crediting period	7
Annual average emission reductions in the crediting period (tCO_2e)	20,576

A.4.4. Public funding of the small-scale project activity:

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The Project activity obtains no public funding from Parties included in Annex I of the UNFCCC.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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According to Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities, a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1km of the project boundary of the proposed small scale activity at the closest point.

The project owner has not registered and is not applying for the registration for other small-scale CDM project activities; therefore the proposed project is not a debundled component of a large-scale project.

SECTION B. Application of a baseline and monitoring methodology

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

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The approved small-scale methodology "AMS-I.D. Grid Connected renewable electricity generation" (version 13) is used for proposed project. For more information regarding the methodology, please refer to http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

The 'Tool to calculate the emission factor for an electricity system' (version 01.1) is also adopted. For more information regarding the methodology, please refer to
http://cdm.unfccc.int/methodologies/Tools/EB35_repan12_Tool_grid_emission.pdf

B.2. Justification of the choice of the project category:

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According to 'Simplified modalities and procedures for small-scale clean development mechanism project activities', the project activity falls in the type of renewable energy with a maximum output capacity equivalent to up to 15 MW . The total installed capacity for the proposed project is 5.55 MW and is within the limit of 15 MW.

B.3. Description of the project boundary:

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According to methodology AMS-I.D. (version 13), the project boundary encompasses the physical, geographical site of the renewable generation source. For the proposed project, the boundary therefore is the project power plant including the dam, and the power house.

B.4. Description of baseline and its development:

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According to AMS-I.D. (version 13), the baseline emissions can be determined by the electricity produced by the proposed project multiplied by a combined margin *(CM)* which consists of the combination of operating margin *(OM)* and build margin *(BM)* of the CCPG.

The basic parameters used for calculating baseline emissions of the project are listed in Table B-1:

Table B-1 Key parameters for baseline determination

Parameter	Value	Data Source
The operating margin emission factor (EF_{OM}) of the CCPG	1.2783tCO_2e/MWh	*OM* is determined by the amount of fossil fuel consumed for power generation in the grid and net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units for the CCPG, in accordance with the 'Tool to calculate the emission factor for an electricity system' (ver01.1). The data is released by China NDRC on 18th July 2008 on its official website.

		Please refer to B6.1 for more details.
The build margin emission factor (EF_{BM}) of the CCPG	0.6687 tCO_2e/MWh	The data is released by China DNA on 18th July 2008
The emission factor (EF_y) of the CCPG	0.9735 tCO_2e/MWh	Calculated based on the value of EF_{OM} and EF_{BM}
Net electricity supplied to the grid (EG_y)	21,136MWh	Calculated according to the Preliminary Design Report

The detailed calculation for emission reductions are specified in Section B.6 and Annex 3.

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 small-scale CDM project activity:

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In accordance to the Appendix A to B of the UNFCCC's *Simplified Modalities and Procedures for Small-scale CDM Project Activities*, additionality can be demonstrated by showing that the project activity would have not occurred due to one or more of the prohibitive barriers listed below:

(a) Investment barrier;
(b) Technological barrier;
(c) Barrier due to prevailing practice; or
(d) Other barriers.

Investment Barrier

Benchmark analysis has been adopted to compare the IRR of project with and without CDM revenue. According to *Economic Evaluation Code for Small Hydropower Projects*[5] (SL 16-95), published by Ministry of Water Resource, the post-tax benchmark IRR on total investment for small hydropower projects (less than 50MW) should be higher than 10%, thus a benchmark of 10% is used by the project.

Table B-2 shows the main parameters for the financial analysis.

Table B-2 Main parameters for financial calculation[6]

Item	Unit	Value	Data Source
Installed capacity	MW	5.55	PDR
The total static investment	Million Yuan	34.8186	PDR
Annual grid-connected electricity generation	MWh/year	21,136	PDR
Electricity Tariff (including VAT)	Yuan/KWh	0.25	PDR
Annual O&M Cost	Million Yuan	0.4568	PDR
Value Added Tax	%	6	PDR
City Maintenance and Construction Tax	%	1	PDR
Education Supplementary Tax	%	3	PDR
Income tax	%	33	PDR

[5] The Ministry of Water Resources of P. R. China, *Hydropower [Decree 1995] No. 186*

[6] Refer to *The Preliminary Design Report of Hunan Tongdao Yaolaitan Hydro Power Project* (Hunan Huaihua Survey & Design Institute of Hydro Power) [May 2005].

Expected CERs Price	EUR/ tCO_2e	9	Assumption
Project Lifetime	Year	20	PDR

The results of IRR of the proposed project with and without CDM revenue are shown in the table B-3 as below.

Table B-3 Comparison of financial indicators with and without income from CERs

Item	Unit	Without the income from CERs	Benchmark rate	With the income from CERs
FIRR of total investment	%	7.74	10	11.70

Without considering the income from CERs, the IRR of the proposed project is 7.74%, lower than the benchmark IRR 10% set in the *Economic Evaluation Code for Small Hydropower Projects* (SL 16-95), so the proposed project is financially unattractive. With the income from CERs sale, the IRR is increased to 11.70%, which is higher than the benchmark 10%, and thus becomes financially attractive. It is extremely difficult for the project owner to make a decision to construct the project without the income from CERs sale.

The sensitive analysis is conducted to check whether, under reasonable variations in the critical assumptions, the project IRR remains below the benchmark IRR. The four main factors affecting the financial indicators of the project are:

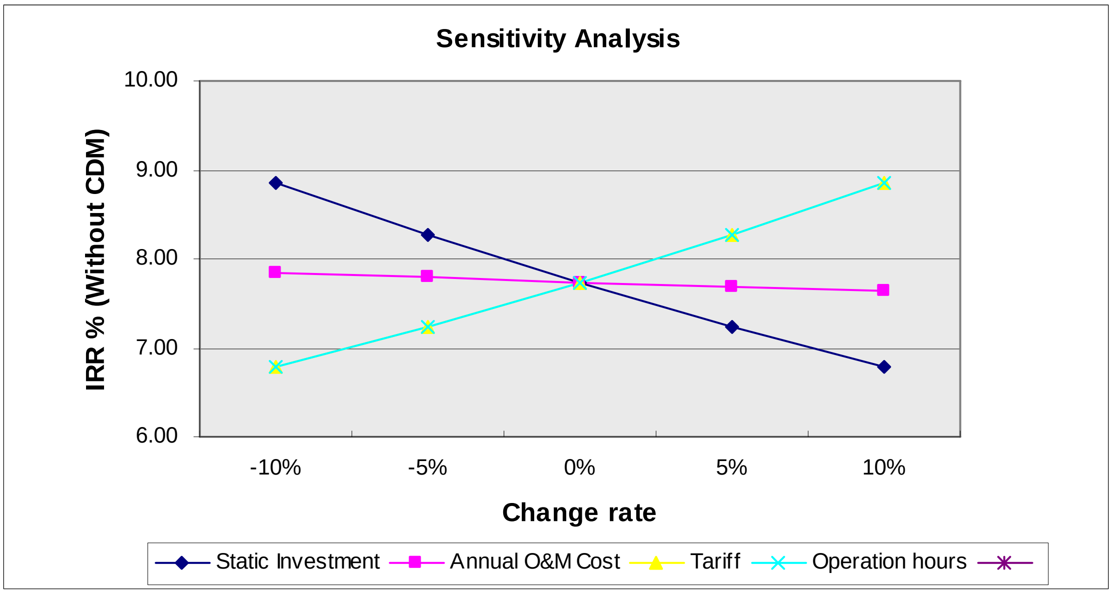
- Total Static Investment
- Annual O&M Cost
- Electricity tariff
- Operation Hours(at full capacity)

Table B-4 shows how the variation of the four main parameters in the range of -10% ~ +10% will affect the IRR of the project without the income from the CERs sale.

Table B-4 Sensitivity analysis

	-10%	-5%	0	5%	10%
Total Static Investment	8.86	8.28	7.74	7.24	6.78
Annual O&M Cost	7.84	7.79	7.74	7.69	7.63
Electricity tariff	6.78	7.24	7.74	8.28	8.86
Operation hours	6.78	7.24	7.74	8.28	8.86

Figure 1 Sensitivity analysis of the proposed project



As shown in the above Figure 1, IRR will not reach the benchmark of 10% while four key parameters vary from ±10%.

(1) For total static investment, with a decrease of 10% in the total static investment, the project IRR can only reach 8.86%.Given the real situation that the increase of prices of raw materials, labor, and equipments through the construction period, the actual investment has been raised and it is not likely for the project total cost to be cut by 10% by the time of project completion. The actual proven investment cost at the point of PDD submission is over 31 million, thus the project IRR is much below the benchmark.

(2) For electricity tariff, the price has to go up to 0.302 RMB/KWh to reach the 10% benchmark and make the project financially attractive, but the price is unlikely to be achieved given the current local policy on electricity tariff. The final electricity tariff is set to be 0.29 RMB/KWh, which is less than 0.302 RMB/KWh, thus the project IRR is below the benchmark.

(3) For operating hours, as it is estimated based on multiple-year data of water resources in the project basin, it is unlikely that the annual operation hours would vary about 30% in order to reach the benchmark of 10%.

(4) The change of annual O&M cost has little impact on IRR variation as can be seen from the above figure and therefore IRR is least sensitive to this parameter. The annul O& M cost are mainly composed of machine maintenance fee, staff salary, welfare fund, staff insurance, and other costs, and therefore will not change greatly as the time goes by.

Based on the above analysis, it can be concluded that the proposed project is not financially attractive in the absence of CDM revenue given the variation of four parameters in a -10%～+10% range. Thus the project is shown to be additional.

CDM Consideration

On 6th May, 2005, the project owner, Tongdao Yaolaitan Hydro Power Development Co., Ltd participated in a CDM training program hosted by Tongdao DRC where they got some knowledge of CDM. Meanwhile, the Preliminary Design Report was preparing and revealed low financial indicator. Thereafter, the Board decided to invest in the project and apply for CDM fund to overcome the low financial return of the project in a meeting held on 15th May, 2005 and CDM financial indicators were

included in the PDR and got its approval on 21st, June 2005.After that, the project owner contacted with several CDM consulting companies and on 31st August 2006, a CDM project consultation contract was signed between the project owner and Beijing Shihang Environment Investment Consulting Co., Ltd. Later on 20th, Nov. 2007, an Emission Reduction Purchase Agreement (ERPA) was signed between the project owner and Climate Bridge Ltd. The project PDD was completed later on and the project was approved by China NDRC (China DNA) in February 2009 and UK the Secretary of State for Energy and Climate Change (UK DNA) in June 2009 and September 2009.

The following table shows the key events of the proposed project:

Table B-5 Timeline of project implementation and CDM consideration

Time	***Project Implementation***
09/2004	Completion of Environment Impact Assessment (EIA) Report
25/10/2004	Approval of EIA
05/2005	Completion of the Preliminary Design (PDR) Report
21/06/2005	Approval of PDR
07/06/2005	The loan application was accepted by China Construction Bank, Tongdao County Branch.
14/07/ 2005	Equipment purchase agreement was signed between project owner and Jiangsu Gaoyou water pump Co.,Ltd.
05/12/2005	Bank loan contract was signed between project owner and China Construction Bank, Tongdao County Branch.
20/12/2005	Grid connection and power purchase agreement was signed between project owner and local grid owner.
08/08/2006	Project Construction started
11/2008	Expected operation date
Time	***CDM Consideration***
06/05/2005	CDM Training Program Participation
15/05/2005	Board resolution with decision on CDM activity implementation
31/08/2006	Agreement on CDM development cooperation was signed between the project owner and a CDM consulting company.
20/11/2007	The Emission Reduction Purchase Agreement (ERPA) was signed between the project owner and Climate Bridge Ltd.
18/02/2009	Issuance of LOA from China NDRC
09/06/2009	Issuance of LOA from UK DNA(Climate Bridge Ltd. as project participant)
09/09/2009	Issuance of LOA from UK DNA(Nobel Carbon Credits Limited as project participant)

B.6. Emission reductions

B.6.1. Explanation of methodological choices:

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According to methodology AMS-I.D. (version 13), the baseline emissions is calculated as the electricity delivered to the project multiplied by an emission coefficient that can be determined through two options: (a) a combined margin *(CM)*, consisting of the combination of operating margin *(OM)* and build margin *(BM)* according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system". Or (b) the weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used. Option (a) is used.

According to the "Tool to calculate the emission factor for an electricity system" (version 01.1), the following six steps are applied to determine the *OM*, *BM*, and *CM* used for calculating project baseline emissions:

Step 1: Identify the relevant electric power system

In accordance with delineations of connected electricity systems by China NRDC (China's DNA)[7], the Central China Power Grid (the CCPG) is the connected electricity system for the project as it is the spatial extent of the power plants that are physically connected through transmission and distribution lines to the proposed project and can be dispatched without significant transmission constraints. The CCPG includes Henan Province Power Grid, Hubei Province Power Grid, Hunan Province Power Grid, Jiangxi Power Grid, Sichuan Power Grid and Chongqing Power Grid.

Step 2: Select an operating margin (*OM*) method

Four alternative methods are available for the calculation of operating margin emission factor ($EF_{grid,\ OM,y}$) as follows:

a) Simple *OM,* or
b) Simple adjusted *OM*, or
c) Dispatch data analysis *OM*, or
d) Average *OM*.

For the proposed project, the method a) Simple *OM* was chosen because low-cost/must-run resources constitute less than 50% of total grid generation. According to *China Electric Power Yearbook* (2003-2007),in the most recent 5 years (2002-2006), the proportions of low-cost/must run resources in the total electricity output in the CCPG are 37.8%, 34.8%, 40.45%, 38.67%, and 36.4% respectively, which are much less than 50%.

The Simple *OM* emission factor can be calculated using either of the two following data vintages for years(s) *y*:

- Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of CDM-PDD to the DOE validation, without requirement to monitor and recalculate the emission factor during the crediting period, or
- Ex post option: The year in which the project activity displaces grid electricity, requiring the emission factor to be updated annually during monitoring.

This PDD uses the ex ante option for $EF_{grid,OM,\ y}$ calculation to be in accordance with the baseline emissions factor for regional power grids published by China DNA.

Step 3: Calculate the operating margin emission factor according to method (a) the Simple *OM*

The simple *OM* emission factor is calculated as the generation-weighted average CO_2 emission per unit

7 http://cdm.ccchina.gov.cn/web/main.asp?ColumnId=25

net electricity generation (tCO_2e/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. It may be calculated among the options:

(A) Based on data on fuel consumption and net electricity generation of each power plant

(B) Based on data on net electricity generation, the average efficiency of each power unit and the fuel types used in each power unit, or

(C) Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

In accordance with the guideline of China's DNA, option C is used for calculating project *OM* since the data for option A and B is not available as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \quad (1)$$

Where:

$EF_{grid,OMsimple,y}$	is simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,y}$	is amount of fossil fuel type *i* consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	is net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{co2,i,y}$	is CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
EG_y	is net electricity generated and delivered to the grid by all power sources serving the system, no including low-cost/must-run power plants/units, in year *y* (MWh)
i	is all fossil fuel types combusted in power sources in the project electricity system in year *y*
y	is the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

According to the above formula (1) and statistical information from the last 3 years (2004-2006) where the data are the latest and available at the time of this PDD submission, the $EF_{grid,OM,y}$ is calculated to be 1.2783 tCO_2e/MWh. Please refer to Annex 3 for detailed calculation.

Step 4: Identify the cohort of power units to be included in the build margin

According to the 'Tool to calculate the emission factor for an electricity system' (version 01.1), there are two options for calculation of $EF_{grid,BM,y}$:

Option 1 Calculate the Build Margin Emission Factor $EF_{grid\ BM\ y}$, ex-ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group *m* consists of either the set of five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. The sample group that comprises the larger annual generation should be adopted.

Option 2 The Build Margin Emission Factor $EF_{grid\ BM\ y}$, must be updated annually ex-post for the year in which actual project generation and associated emissions reductions occur.

The PDD choose **Option 1**, which requires the project participant to calculate the Build Margin Emission Factor $EF_{grid\ BM\ y}$, ex-ante based on the most recent information available already built for sample group *m* at the time of PDD submission.

Step 5: Calculate the build margin emission factor (*BM*)

The build margin emissions factor is the generation-weighted average emission factor (tCO_2e/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (2)$$

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_2e/MWh)

m = Power units included in the build margin

y = Most recent historical year for which power generation data is available.

However, in China it is very difficult to obtain the data of the five existing power plants built most recently or the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that were built most recently. Due to the fact that no plant specific generation and fuel consumption is currently available in China, *BM* calculation adopts the following deviation[7] in methodology application:

First, to calculate the newly added installed capacity and the contribution component of other various power generation technologies, then calculation of the weight of newly added installed capacity of each power generation technology. Finally the commercial and efficient level of each power generation technology is adopted to calculate *BM* emission factor.

Since the generating capacity of coal-fired, oil-fired and gas-fired technologies can not be separated from the existing statistical data, the BM calculation in this PDD adopts the following method:

Firstly, based on the available data of the latest year, determine the ratio of CO_2 emissions from coal, oil and gas fuels consumption for power generation to total CO_2 emissions;

Secondly, take the ratio as the weight, based on the emission factors in terms of optimal efficiency and commercial technologies; calculate the emission factor of the thermal power in each grid.

Thirdly, this thermal emission factor is multiplied by the portion of thermal power added capacity in the newly additional 20% capacity. The result is the *BM* emission factor of grid.

Concrete steps and the formula for *BM* are carried out below:

Sub-Step 1: Calculate the proportion of CO_2 emissions from solid, liquid and gaseous fuels corresponding to the total CO_2 emissions.

[7] http://cdm.unfccc.int/UserManagement/FileStorage/6POIAMGYOEDOTKW25TA20EHEKPR4DM

$$\lambda_{Coal} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}} \quad (3)$$

$$\lambda_{Oil} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}} \quad (4)$$

$$\lambda_{Gas} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{co_2,i,j,y}} \quad (5)$$

Where:

$F_{i,j,y}$	is the amount of fuel *i* (tce) consumed by plants in province *j* in year *y*
$NCV_{i,y}$	is the net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{co2,i,j,y}$	is the CO_2 emission factor of fossil fuel type i in province *j* in year *y*

Coal, Oil and Gas is the feet for solid fuels, liquid fuels and gas fuels.

Sub-Step 2: Calculate the emission factor of thermal power (*$EF_{Thermal}$*)

$$EF_{Thermal} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} \quad (6)$$

$EF_{Coal,\ Adv}$, $EF_{Oil,\ Adv}$, and $EF_{Gas,\ Adv}$ are the operating margin emission factors respectively consumed by coal-fired, oil-fired and gas-fired generation technology in the commercial optimization efficiency.

Sub-Step 3: Calculation of *BM* in the grid

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (7)$$

Where:

$CAP_{thermal,,\ y}$	is the added installed capacity of thermal power generation sources (MW) in year *y*
$CAP_{total,\ y}$	is the total added installed capacity of all kinds of power generation sources (MW) in year y which is close to but less than 20% of the existing installed capacity
$EF_{Thermal\ ,y}$	is the emission factor of thermal power plants in year *y*

The key parameters used to calculate *BM* emission factor include: the low calorific value of each fuel, the oxidation rate, the potential emission factors and the efficiency of various power generation technologies.

The data of low calorific value of each fuel and their oxidation rate comes from China Energy Statistical yearbook 2007 (p.287). The potential emission factors are sourced from '2006 IPCC Guidelines for National Greenhouse Gas Inventories', Table 1.3 and Table 1.4 of Page 1.21-1.24 in Chapter 1, Volume 2 Energy.

Please refer to the selection of these values in Annex 3 and China NDRC's report for the CCPG.

According to the latest and available data at the time of this PDD submission, $\boldsymbol{EF_{grid,BM,y}}$ is calculated to be 0.6687 tCO_2e/MWh. Please refer to Annex 3 for the details of calculation.

Step 6: Calculate the combined margin emission factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = \omega_{OM} \times EF_{OM,y} + \omega_{BM} \times EF_{BM,y} \qquad (8)$$

For the proposed project, the weight ω_{OM} and ω_{BM}, by default, are 50%.

$$EF_{grid,CM,y} = 1.2783 \times 50\% + 0.6687 \times 50\% = 0.9735 tCO_2e/MWh$$

Baseline Emission (BE_y)

The baseline emissions can be calculated as follows:

$$BE_y = EG_y \times EF_{grid,CM,y} \qquad (9)$$

Project Emission (PE_y)

According to AMS-I.D (version 13), PE_y=0tCO_2e.

Leakage (LE_y)

According to AMS-I.D (version 13), the project activity is a new construction project and thus the energy generating equipment is not transferred from another activity and the existing equipment is not transferred to another activity, so no leakage is to be considered (LE_y=0 tCO_2e).

Emission reductions (ER_y)

The emission reduction (ER_y) by the project activity during a given year y are the difference among baseline emissions (BE_y), project emissions (PE_y) and emissions due to leakage (LE_y). The final GHG emission reduction is calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad (10)$$

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

Data / Parameter:	$FC_{i,y}$, $F_{i,j,y}$
Data unit:	mass or volume unit
Description:	The amount of fuel i consumed in the project electricity system in year y or the amount of fuel i consumed in the project electricity system of province j 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 :	Official statistics data
Any comment:	

Data / Parameter:	NCV_i
Data unit:	TJ/t , or TJ/km^3
Description:	The net calorific value (energy content) per mass or volume unit of fuel *i*
Source of data used:	*China Energy Statistical Yearbook 2005-2007*.
Value applied:	Please refer to Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistical data
Any comment:	Used for the calculation of $EF_{OM,y}$ and $EF_{BM,y}$

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tC/TJ (which can be converted to tCO_2e/TJ)
Description:	The CO_2 emission factor per unit of the fuel *i*
Source of data used:	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied:	Please refer to Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values.
Any comment:	Used for the calculation of $EF_{OM,y}$ and $EF_{BM,y}$

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by all power sources in the project electricity system, not including low-cost/must-run power plants/units, in year *y* (MWh)
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 :	Official statistics data
Any comment:	Used for the calculation of $EF_{OM,y}$

Data / Parameter:	$EF_{coal,Adv,y}$
Data unit:	%
Description:	The optimum commercial, coal-fired power supply efficiency
Source of data used:	2008 Baseline Emission Factors for Regional Power Grids in China
Value applied:	37.28%
Justification of the choice of data or	National Fixed Value

description of measurement methods and procedures actually applied :	
Any comment:	Used for the calculation of $EF_{BM,y}$

Data / Parameter:	$EF_{Oil, Adv, y}$
Data unit:	%
Description:	The optimum commercial, oil power supply efficiency
Source of data used:	2008 Baseline Emission Factors for Regional Power Grids in China
Value applied:	48.81%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official released data
Any comment:	Used for the calculation of $EF_{BM,y}$

Data / Parameter:	$EF_{Gas, Adv, y}$
Data unit:	%
Description:	The optimum commercial gas power supply efficiency
Source of data used:	2008 Baseline Emission Factors for Regional Power Grids in China
Value applied:	48.81%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official released data
Any comment:	Used for the calculation of $EF_{BM,y}$

Data / Parameter:	$CAP_{i, j, y}$
Data unit:	MW
Description:	The installed capacity of power source i of province j of the CCPG in the 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 :	This kind of data accords with the latest version of '*Tool to calculate the emission factor for an electricity system*'
Any comment:	Used for the calculation of $EF_{BM,y}$

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

>>
The ex-ante emission reduction is calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	is the emission reductions (tCO_2e) in year *y*
BE_y	is the baseline emissions (tCO_2e) in year *y*
PE_y	is the project emissions (tCO_2e) in year *y*
LE_y	Is the leakage emissions (tCO_2e) in year *y*

The project emission is set as zero (PE_y=0tCO_2e), since no use of fossil fuel is related to the project activity.

According to AMS I.D (version 13), the leakage needs to be considered only if the energy generating equipment is transferred from another activity or the existing equipment is transferred to another activity. Therefore, the leakage emission of the project activity is zero (LE_y=0 tCO_2e).

As a result, $ER_y = BE_y$

According to section B.6.1, the baseline emission factor of the CCPG ($EF_{grid, CM, y}$) is calculated as 0.9735 tCO_2e/MWh. The annual electricity supplied to the grid is estimated to be 21,136 MWh. Therefore, the baseline emissions can be calculated as follows:

$\mathbf{BE}_y = EG_y \times EF_{grid, CM, y}$=21,136MWh×0.9735$tCO_2e$/MWh=20,576 tCO_2e

The emission reductions ER_y by the project activity during a given year is:
$\mathbf{ER}_y = BE_y$=20,576-0-0=20,576 tCO_2e.

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

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of total emission reductions (tCO_2e)
01/12/2009-31/12/2009	0	1,715	0	1,715
2010	0	20,576	0	20,576
2011	0	20,576	0	20,576
2012	0	20,576	0	20,576
2013	0	20,576	0	20,576

2014	0	20,576	0	20,576
2015	0	20,576	0	20,576
01/01/2016-30/11/ 2016	0	18,861	0	18,861
Total emission reductions (tCO_2e)	0	144,032	0	144,032

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

B.7.1. Data and parameters monitored:

Data / Parameter:	$EG_{export,y}$
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid in year *y*
Source of data to be used:	Measured by meter
Value of data	21,136 (for ex-ante calculation)
Description of measurement methods and procedures to be applied:	Hourly measured and monthly recorded.
QA/QC procedures to be applied:	The meter will be calibrated periodically based on the relevant national and industrial standards. Double check by receipt of electricity sales.
Any comment:	

Data / Parameter:	$EG_{import,y}$
Data unit:	MWh
Description:	Electricity imported from the grid by the proposed project in year y
Source of data to be used:	Measured by meter
Value of data	0 (for ex-ante calculation)
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	The meter will be calibrated periodically based on the relevant national and industrial standards. Double check by the receipt of electricity consumption.
Any comment:	

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Net Electricity delivered to the grid by the proposed project

Source of data to be used:	Calculated
Value of data	21,136 (for ex-ante calculation)
Description of measurement methods and procedures to be applied:	Calculated based on $EG_y = EG_{export,y} - EG_{import,y}$ every month
QA/QC procedures to be applied:	
Any comment:	

B.7.2. Description of the monitoring plan:

>>

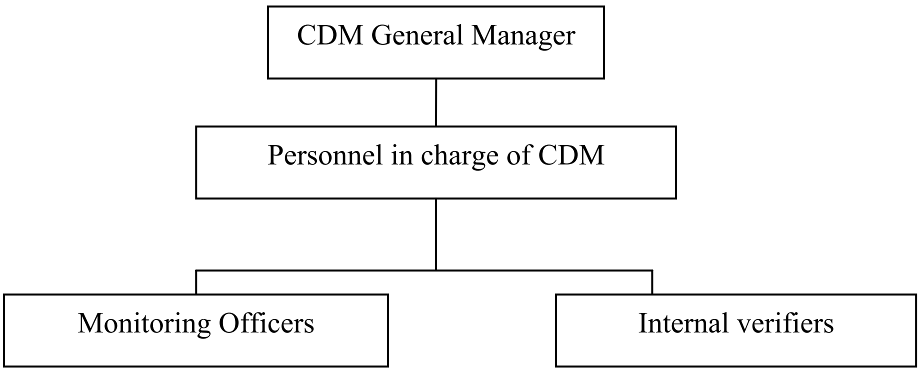
An overall monitoring plan will be applied to the project in order to guarantee the actual long-term measurement of GHG emission reductions of the proposed project and to have complete, consistent, and precise emission reduction calculation. The details of the monitoring plan are summarized as follows:

1. Operation and management structure of monitoring

An operation and management structure is established by the project owner to identify roles of data recording, collection and preservation for relevant staff as shown in Figure 2. The general manager will mange the process of training new staff, ensuring trained staff perform the monitoring duties and the integrity of the monitoring system is maintained by other trained staff when trained monitoring staff are absent.

In addition, the project owner will designate a few staff members as monitoring officers and internal verifiers who will be in charge of data collection and management, such as reading meters, keeping sales receipts, and guarantee the normal operation of QA/QC system during the project crediting period.

Figure 2 Operations and Management Structure of the Project



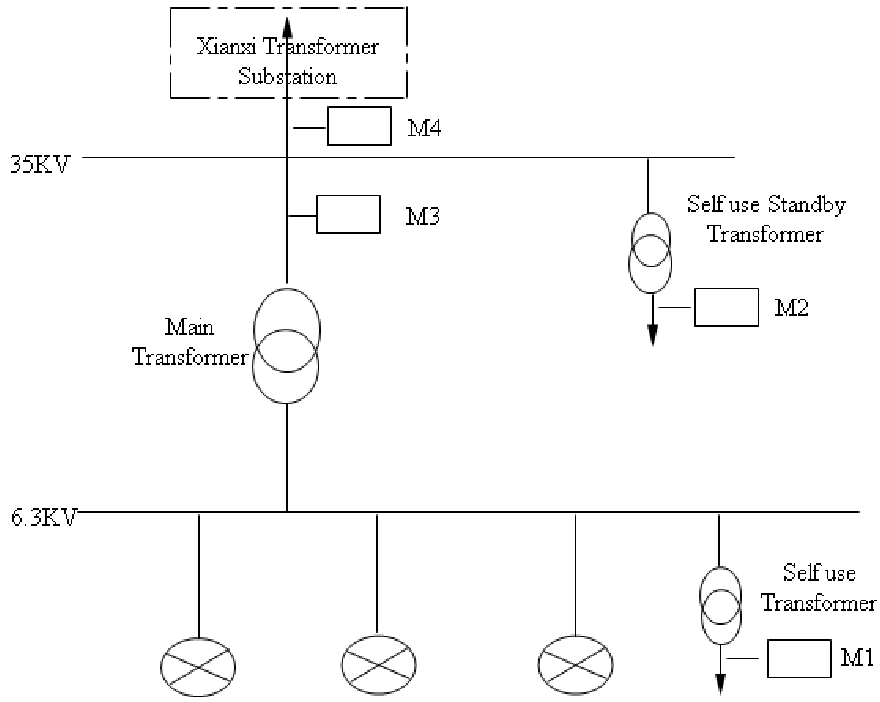
A monitoring and management manual of Yaolaitan hydropower plant identifying detailed duties and responsibilities of the relevant parties has been developed by Climate Bridge Ltd., and will be served as a basis of the project monitoring.

All the relevant staff of the Yaolaitan hydropower plant will receive the training on issues related with CDM monitoring, such as data monitoring procedures, quality control (QC) & quality assurance (QA), and emergencies from Climate Bridge Ltd., one of the project participants, before the operation starts.

2. Monitoring equipment and installation

The data requires monitoring for the project is the amount of electricity exported to the grid by the project and the amount of electricity imported from the grid by the project (refer to Section B.7.1). A connection diagram with installed meters is shown in Figure 3 as below:

Figure 3 Yaolaitan Power Connection Diagram



The electricity generated from three generators will be combined and connected to the Xianxi Transformer Substation. The meter M4 is the main meter. It is owned by the local grid company and is a bi-directional meter which can measure both the electricity exported to the grid and the electricity imported from the grid. Meter M3 is the backup meter of M4. It is owned by the project owner, which is also a bi-directional meter to measure both the electricity exported to the grid and the electricity imported from the grid. Calculation of net electricity supplied to the grid will be based on data recorded by the main meter, and the invoice accordingly.

The meter M1 is used to measure internal electricity usage of power plant. In case the main electricity line is not function, meter M1 will stop record. Only in this situation, meter M2 will measure the internal electricity usage.

In case of malfunction of the main meter, the readings from the backup meter M3 and the other meter M2 will be used for reference.

The readings of the meters will be recorded on a monthly basis by the monitoring staff. The accuracy of all meters will be no less than 0.5s. All the meters will be installed in accordance with the Chinese national standard *Electricity Meter Installation Technical Management Code* (DL/T448-2000) and calibrated periodically in accordance with *Verification Regulation of Electrical Energy Meters with Electronics* (JJG 596-1999) by an accredited third party.

3. Data collection and management

The project owner and the local grid company will read and check the meters and record the data on a monthly basis. All written documents such as maps, diagrams and reports would be stored and available to the verifier so that the reliability of the information may be checked. All data should be archived for 2 years after the end of the last crediting period.

The project owner also need to keep and back up the original and copies of electricity sales and purchase receipts for each month provided by the power grid company for cross check purposes .

4. Quality assurance and quality control

(1) The meters should be installed in accordance with the relevant national and industrial regulations. Prior to the project operation, the project owner and the grid company should check the meters according to relevant national and industrial regulations.

(2) The meters should be installed and calibrated in accordance with the relevant national and industrial standards and regulation.

(3) In case the meter operates abnormally, the proposed project owner and the grid company shall jointly prepare a new agreement of the correct readings.

(4) In case of emergencies, the project owner will not claim emission reductions due to the project activity for the duration of emergency.

(5) Data and records will be checked prior to being recorded and archived, and possible errors would be identified during this step.

5. Monitoring results and verification

The verification of the monitoring results of the project activity is required for each crediting period. The monitoring results will be combined in a monitoring report that will be served as a basis for project verification in each crediting year.

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):

>>

The baseline study and monitoring methodology of the proposed project was completed on 30/10/2008.

Name of person/entity determining baseline study and monitoring methodology:

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Climate Bridge Ltd. is one of the 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:

>>

14/07/2005[8]

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

>>

20 years

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

C.2.1. Renewable crediting period:

>>

7 years × 3

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

>>

01/12/2009 or the registration date 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.

[8] Refer to Table B-5 in Section B.5,

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

The project owner entrusted a third party, the Institute of Environment Protection Research, to conduct the *Environmental Impact Assessment* (EIA) on Yaolaitan Hydropower Project. The EIA report was completed in September 2004 and was approved by Huaihua Environmental Protection Bureau in October 2004 (refer to Huaihua Environment Document [2004] No.74). The impacts of the proposed project on the environment as summarized as follows in the period of construction and operation.

1. Construction Phase

1.1 Waste water

Waste water in construction period comes from both the production process and the living sector. The pollutants in wastewater during the construction period are mainly SS, suspending materials and oil. The production wastewater is allowed to be discharged only after processing. Latrines will be constructed in the living sector. The wastewater will be processed to reach the standard of irrigation or farmland use. It is forbidden to be discharged to rivers; therefore it will not have any impact on the river water quality.

1.2 Waste gas

The waste gas is from fuel, rock blasting, explosion, and transportation. The people affected are mainly the on-site workers. Sprinkling on the roads is adopted to reduce about 70% dust pollution. The impact on the air lasts for a relatively short period and will stop at the end of construction period. Its impact on the atmosphere is trivial.

1.3 Noise pollution

Noise mainly comes from the temporary sources including explosions, fixed source of excavation, drilling, and processing, and moving noise source of transportation vehicles. The noise is to be measured in accordance with "*the Standard of Noise Limitation on Construction Site*" (GB12523-90). The nearest residence place is 250m away from the construction site; therefore it has little impact on the local residents. People affected are mainly the onsite workers. The impact lasts for a relatively short period of time. The monitoring shows that the noise fulfils standard I of "*Standard for Environmental Noise of Urban area*" (GB3096-93).

1.4 Solid wastes

Solid waste includes excavation waste and rubbish. Excavated earth and stones should be transported to and processed in the dumping site. Rubbish produced during construction period should be collected regularly and processed in the landfill place.

2. Operation Phase

The proposed project is a run-of-river hydro power project. The operation of the proposed project won't have negative impacts on river ecosystem and hydrophilic biology community. No residents are displaced due to the construction of the project.

As mentioned above, the negative impact of the proposed project during the construction period lasts for a relatively short period, and appropriate measures are to be taken to minimize the adverse environmental impacts. The environmental impact during the operation period is negligible.

In conclusion, the proposed project as a clean renewable energy project can reduce greenhouse gas emissions and the environmental pollution caused by coal consumption. It has favourable influences on the local ecological environment; especially after the project is put into operation the ecological restoration measures can improve the local ecological environment.

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:

>>

No significant impacts on environment according to the approved EIA.

SECTION E. Stakeholders' comments

>>

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

>>

The project owner and the CDM buyer worked together to investigate the stakeholders' opinions and suggestions on the proposed project.

The project owner published a notice on "*Huaihua Daily*" on 26 March, 2008, informing residents of the time and location of the stakeholders' meeting, as well as the questionnaire distribution. At the same time a public notice was posted to inform the villagers and the affected people. Representatives from the local government, the Land Management Bureau, the Bureau of Water Resources were invited to the meeting by means of phone calls.

The Stakeholders' meeting was held 2nd, April 2008. Questionnaires were distributed at the meeting. The distribution took into consideration the opinions of people from different age groups, education backgrounds, and occupations as shown in Table E-1.

Table E-1 Stakeholders' Basic information

Item		Number	Percentage（%）
Total collected questionnaires		20	80
Nationality	Han	12	60
	Dong	6	30
	Miao	2	10
Educational background	Primary School	3	15
	Junior Middle School	6	30
	High School	6	30
	College and above	4	20
	Not Identified	1	5
Age	18~30	1	5
	30~50	8	40
	More than 50	11	55

E.2. Summary of the comments received:

>>

25 questionnaires were distributed to the local people, and 20 questionnaires had been returned. The response rate is 80%. Comments from these questionnaires for local people are summarized in table E-2 below. (The percentage of the result is open in some case because that question was not answered by the respondent):

Table E-2 Summary of stakeholders' comments

No.	Questions	Attitudes	Number	Percentage (%)
1	Do you know about the proposed project?	very much	9	45
		heard of it	11	55

			know nothing	0	0
2	What is your attitude towards the project construction?		support	19	95
			against	0	0
			don't care	1	5
3	What kind of impact do you think the project might have on the environment?		positive	3	15
			no impact	17	85
			negative	0	0
4	Whether the project promotes the local economic development?		Yes	18	90
			No	0	0
			know nothing	2	10
5	Do you think it is more beneficial and advantageous to have the project?		Yes	18	90
			No	1	5
			know nothing	1	5
6	Do you want to participate in its construction or operation		Yes	18	90
			No	0	0
			don't care	2	10
7	Respondents' expectations on how the project may affect them as individuals / families	Income	more	35	60
			less	15	0
			unchanged	50	36
		Living standard	better	65	60
			worse	0	0
			unchanged	35	36
		Working conditions	better	55	44
			worse	0	0
			unchanged	45	48
		Education	better	45	36
			worse	0	0
			unchanged	55	60
		Medical care	better	60	36
			worse	0	0
			unchanged	40	60
8	What do you think will be the major impact on the environment once the		air pollution	0	0
			water pollution	19	95

	project is complete? (multiple choices)	noise pollution	0	0
		on surrounding plants and animals	1	5
		other	2	10
9	What do you think will be the project's impact on the lower river?	negative	0	0
		positive	1	5
		no impact	19	95
10	What do you think will be the project's impact on the local community? (multiple choices)	increase employment	17	85
		promote economic development	18	90
		improve electricity supply condition	20	100
		no great impact	3	15

The result of this investigation shows that 95% of the respondents support the construction of the proposed project, 85% believe it can promote the local employment opportunities, and 90% believe it improves the local economic development. In general, local people are supportive of the construction. In their opinion, the proposed project will help improve the living standard of local people, promote the economic development of the area, and have little impact on natural environment.

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

>>

In the questionnaire investigation and the stakeholders' meeting, some expressed their worries: they worried that the project construction and operation may cause some environment pollution; animals in the lower river will be impacted due to the lack of water; they also concerned about the relocation problems raised by the proposed project.

After compiling the survey results, the project owner made a quick response in views of the questions reflected in the stakeholders' symposium as follows:

1. The air pollution, water pollution, and noise pollution are mainly caused during the construction period. According to the EIA report, the negative impact can be minimized by appropriate measures and strict management.
2. The project will have little impact on the multiplicity of species or integrity of the ecosystem. Moreover, there is no rare fish species in the river where the project is located, and the project will ensure that there will be enough water flux for the lining species.
3. The project owner had signed the compensation agreements with the affected people for the occupied and submerged land as well as immigrants' relocations due to the project activity. The compensation fee was decided by the area of the occupied land and the relevant compensation standard of the local government. These compensations will be allocated to relevant people soon.
4. The project helps with the local economic development and contributes to the employment and better living standards.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex I Parties is involved in this project activity.

Annex 3
BASELINE INFORMATION

The baseline information for calculation of *OM*, *BM* and *CM* emission factors of Central China Power Grid is shown in the Report on Determination of Baseline Grid Emission Factory by China DNA at http://cdm.ccchina.gov.cn released on July, 18th, 2008. The concrete processes are shown in the following tables.

Calculation of the Operating Margin emission factor ($EF_{OM,y}$)

The low calorific value, CO_2 emission factor and oxidation factor of fuels are listed in Table1 below.

Table 1 Low calorific values, CO_2 emission factor and oxidation factor of fuels

Fuel type	Low Calorific Value	EF (tC/TJ)	OXID
Raw coal	20908 kJ/kg	25.8	1
Cleaned coal	26344 kJ/kg	25.8	1
Other cleaned coal	8363 kJ/kg	25.8	1
Coke	28435 kJ/kg	29.2	1
Briquette	20908 kJ/kg	26.6	1
Crude oil	41816 kJ/kg	20.0	1
Petrol	43070 kJ/kg	18.9	1
Coal oil	43070 kJ/kg	19.6	1
Diesel	42652 kJ/kg	20.2	1
Fuel oil	41816 kJ/kg	21.1	1

Other petroleum products.	38369 kJ/kg	20.0	1
Other Coke Products	28435 kJ/kg	35.8	1
Natural gas	38931 kJ/m3	15.3	1
Coke oven gas	16726 kJ/m3	12.1	1
Other gas	5227 kJ/m3	12.1	1
LPG	50179 kJ/m3	17.2	1
Refinery Dry Gas	46055 kJ/m3	15.7	1

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 *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Table 1.3, 1.4, page 1.21-1.24, Chapter 1, Volume 2.

Table 2 Fuel-fired Electricity Generation of the CCPG for year 2004

Item	**Electricity Generation**	**Electricity Generation**	**Auxiliary Power Ratio**	**Supplied Electricity**
	(10^8 kWh)	**(MWh)**	**(%)**	**(MWh)**
Jiangxi	301.27	30127000	7.04	28,006,059
Henan	1093.52	109352000	8.19	100,396,071
Hubei	430.34	43034000	6.58	40,202,363
Hunan	371.86	37186000	7.47	34,408,206
Chongqing	165.2	16520000	11.06	14,692,888
Sichuan	346.27	34627000	9.41	31,368,599
Total				**249,074,186**

Data source: China Electric Power Yearbook 2005

Table 3 Fuel-fired Electricity Generation of the CCPG for year 2005

Item	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	(MWh)	(%)	(MWh)
Jiangxi	300	30000000	6.48	28,056,000
Henan	1315.9	131590000	7.32	121,957,612
Hubei	47	47700000	2.51	46,502,730
Hunan	399	39900000	5	37,905,000
Chongqing	175.84	17584000	8.05	16,168,488
Sichuan	372.02	37202000	4.27	35,613,475
Total				**286,203,305**

Data source: China Electric Power Yearbook 2006

Table 4 Fuel-fired Electricity Generation of the CCPG for year 2006

Item	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

Table 5 Calculation of Simple *OM* Emission Factors of the CCPG for Year 2004

Fuel	Un	Jiangxi	Henan	Hubei	Hunan	Chongqin	Sichua	Total	EF	Oxidati	Average Low	CO_2

		A	B	C	D	E	F	G=A+B +C+D+ E+F				
									H	I	J	
Raw Coal	10^4	1863.8	6948.5	2510.5	2197.9	875.5	2747.9	**17144.1**	25.8	100	20908	339092605.29
Cleaned Coal	10^4		2.34					**2.34**	25.8	100	26344	58316.13
Other Washed Coal	10^4 t	48.93	104.22			89.72		**242.87**	25.8	100	8363	1921441.23
Coke	10^4		109.61					**109.61**	29.2	100	28435	3337011
Coke Oven	10^8			1.68		0.34		**2.02**	12.1	100	16726	149899.53
Other Gas	10^8					2.61		**2.61**	12.1	100	5227	60527.09
Crude Oil	10^4		0.86	0.22				**1.08**	20	100	41816	33118.27
Gasoline	10^4		0.06			0.01		**0.07**	18.9	100	43070	2089.33
Diesel Oil	10^4	0.02	3.86	1.7	1.72	1.14		**8.44**	20.2	100	42652	26627.32
Fuel Oil	10^4	1.09	0.19	9.55	1.38	0.48	1.68	**14.37**	21.1	100	41816	464893.14
LPG	10^4							**0**	17.2	100	50179	0.00
Refinery Gas	10^4	3.52	2.27					**5.79**	15.7	100	46055	153506
Natural Gas	10^8						2.27	**2.27**	15.3	100	38931	495774.61
Other Petroleum	10^4 t							**0**	20	100	38369	0.00
Other Coke Oven Products	10^4 t							**0**	25.8	100	28435	0.00
Other Energies	10^4		16.92		15.2	20.95		**53.07**	0	100	0	0.00
											subtotal	**346035810**

Data source: China Energy Statistical Yearbook 2005

Table 6 Calculation of Simple *OM* Emission Factors of the CCPG for Year 2005

Fuel	Un	Jiangxi	Henan	Hubei	Hunan	Chongqin	Sichua	Total	EF (tC/TJ)	Oxidation (%)	Average Low Calorific Value (MJ/t, km3)	CO_2 emission (tCO_2e) K= G*H*I*J*44/12/10000
		A	B	C	D	E	F	G=A+B+C+D+E+F	H	I	J	
Raw Coal	10^4	1869.29	7638.8	2732.15	1712.27	875.4	2999.7	**17827.7**	25.8	100	20908	352614496.76
Cleaned Coal	10^4	0.02						**0.02**	25.8	100	26344	498.43
Other Washed Coal	10^4 t		138.12			89.99		**228.11**	25.8	100	8363	1804669.00
Coke	10^4		25.95		105			**130.95**	29.2	100	28435	3986695
Coke Oven	10^8			1.15		0.36		**1.51**	12.1	100	16726	112053.61
Other Gas	10^8		10.2			3.12		**13.32**	12.1	100	5227	308896.88
Crude Oil	10^4		0.82	0.36				**1.18**	20	100	41816	36184.78
Gasoline	10^4		0.02			0.02		**0.04**	18.9	100	43070	1193.90
Diesel Oil	10^4	1.3	3.03	2.39	1.39	1.38		**9.49**	20.2	100	42652	299797.78
Fuel Oil	10^4	0.64	0.29	3.15	1.68	0.89	2.22	**8.87**	21.1	100	41816	286959.09
LPG	10^4							**0**	17.2	100	50179	0.00
Refinery Gas	10^4							**6.66**	15.7	100	46055	176572
Natural Gas	10^8							**3**	15.3	100	38931	655208.73
Other Petroleum	10^4 t							**0**	20	100	38369	0.00
Other Coke Oven Products	10^4 t							**1.5**	25.8	100	28435	40349.27
Other Energies	10^4							**37.42**	0	100	0	0.00

											subtotal	**360323575**

Data source: China Energy Statistical Yearbook 2006

Table 7 Calculation of Simple *OM* Emission Factors of the CCPG for Year 2006

Fuel	**Un**	**Jiangxi**	**Henan**	**Hubei**	**Hunan**	**Chongqin**	**Sichua**	**Total**	**EF (tC/TJ)**	**Oxidation (%)**	**Average Low Calorific Value (MJ/t, km3)**	**CO_2 emission (tCO_2e) K= G*H*I*J*44/12/10000**
		A	**B**	**C**	**D**	**E**	**F**	**G=A+B+C+D+E+F**	**H**	**I**	**J**	
Raw Coal	10^4	1926.02	8098.0	3179.79	2454.48	1184.3	3285.2	**20127.8**	25.8	100	20908	398107508
Cleaned Coal	10^4					5.79		**5.79**	25.8	100	26344	144295
Other Washed Coal	10^4 t	4.51	104.12		8.59	79.21		**196.43**	25.8	100	8363	1554036
Briquette	10^4						0.01		26.6	100	20908	204
Coke	10^4		17.23		0.32			**17.55**	29.2	100	28435	534299
Coke Oven	10^8		0.52	1.07	4.24	0.38	0.01	**6.22**	12.1	100	16726	461572
Other Gas	10^8	12.69	3.95		1.7	4.36	0.01	**22.71**	12.1	100	5227	526655
Crude Oil	10^4		0.49					**0.49**	20	100	41816	15026
Gasoline	10^4		0.01					**0.01**	18.9	100	43070	298
Diesel Oil	10^4	0.91	2.23	1.41	1.78	0.96		**7.29**	20.2	100	42652	230298
Fuel Oil	10^4	0.51	1.26	1.31	0.8	0.57	3.49	**7.94**	21.1	100	41816	256872
LPG	10^4							**0**	17.2	100	50179	0
Refinery Gas	10^4	0.86	8.1	1	0.97			**10.93**	15.7	100	46055	289780
Natural Gas	10^8			0.28		0.16	18.63	**19.07**	15.3	100	38931	4164943

Other Petroleum	10^4 t							**0**	20	100	38369	0
Other Coke Oven Products	10^4 t						**0.01**	**0.01**	25.8	100	28435	269
Other Energies	10^4	17.45	37.36	31.55	18.29	29.35		**134**	0	100	0	0
											subtotal	**406286055**

Data source: China Energy Statistical Yearbook 2007

Power imorted from NWCPG (MWh)	**3,028,950**
Average emission factor in NWCPG in 2006	**0.82214**

Data source: China Energy Statistical Yearbook 2007

Table 8 Calculation of Simple *OM* Emission Factors of the CCPG

	Electricity Generation (MWh)	**CO_2 emission (tCO_2)**	***OM* Emission Factor (tCO_2/MWh)**
2004	249,074,186	346,035,810	1.38929
2005	286,203,305	360,323,575	1.25898
2006	337056176	408776270	1.212784
The weighted average *OM* Emission Factor (tCO_2/MWh)			1.27834

Data source: China Energy Statistical Yearbook 2005-2007; China Electric Power Yearbook 2005-2007

The Operating Margin (*OM*) emission factor is the weighted average emission factors of year 2004-2006, as follows: $\boldsymbol{EF_{OM}}$ **=** 1.27834 tCO_2/MWh

Calculation of the Build Margin emission factor ($EF_{BM,y}$)

1. Calculation 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 9 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	10^4t	1926.02	8098.01	3179.79	2454.48	1184.3	3285.22	20127.82	20908	25.80	1	398107508
Cleaned Coal	10^4t	0	0	0	0	5.79	0	5.79	26344	25.80	1	144295
Other Washed Coal	10^4t	4.51	104.12	0	8.59	79.21	0	196.43	8363	25.80	1	1554036
Briquette	10^4t	0	0	0	0	0	0.01	0.01	20908	26.6	1	204
Coke	10^4t	0	17.23	0	0.32	0	0	17.55	28435	29.2	1	534299
Subtotal												**400,340,342**
Crude Oil	10^4t	0	0.49	0	0	0	0	0.49	41816	20.00	1	15026
Gasoline	10^4t	0	0.01	0	0	0	0	0.01	43070	18.90	1	298
Coal Oil	10^4t	0	0	0	0	0	0	0	43070	19.60	1	0
Diesel Oil	10^4t	0.91	2.23	1.41	1.78	0.96	0	7.29	42652	20.20	1	230298
Fuel Oil	10^4t	0.51	1.26	1.31	0.8	0.57	3.49	7.94	41816	21.10	1	256872
Other	10^4t	0	0	0	0	0	0	0	38369	20.00	1	0

Petroleum Products												
Other Coke Oven Products	10^4t						**0.01**	**0.01**	28435	25.8	1	269
Subtotal												**502,763**
Natural Gas	10^7m^3	0	0	2.8	0	1.6	186.3	190.7	38931 kJ /m3	15.30	1	4164943
Coke Oven Gas	10^7m^3	0	5.2	10.7	42.2	3.8	0.1	62.2	16726 kJ /m3	12.10	1	461572
Other Gas	10^7m^3	126.9	39.5	0	17	43.6	0.1	227.1	5227 kJ/ m3	12.10	1	526655
LPG	10^4t	0	0	0	0	0	0	0	50179	17.20	1	0
Refinery Gas	10^4t	0.86	8.1	1	0.97	0	0	10.93	46055	15.7	1	289780
Subtotal								6.66				**5,442,950**
Total												**406,286,055**

Data Source: *China Energy Statistical Yearbook 2007*

According to Table 9 and formula (3), (4), (5) in section B.6.1, the percentages of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total fuel-fired CO_2 emissions are calculated as:

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

2. Calculating the fuel-fired emission factor ($EF_{Thermal}$)

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

Parameters used for calculating fuel-fired emission factor are shown in Table 10 below:

Table 10 Parameters used for calculating fuel-fired emission factor

	Parameter	Efficiency of Power Supply	Emission Factor of Fuel (tc/TJ)	Oxidation Factor	Emission Factor (tCO_2/MWh)
		A	B	C	D=3.6/A/1000*B*C*44/12
Coal-fired Power Plant	$EF_{Coal,Adv}$	37.28 %	25.8	1	0.9135
Gas-fired Power Plant	$EF_{Gas,Adv}$	48.81 %	15.3	1	0.4138
Oil-fired Power Plant	$EF_{Oil,Adv}$	48.81 %	21.1	1	0.5706

Data source: *China Energy Statistical Yearbook 2005-2007*

According to Table 10 and formula (7) in section B.6.1, the $\boldsymbol{EF_{Thermal}}$= 0.9064t$CO_2$/MWh.

3: Calculating the Build Margin (*BM*) emission factor ($\boldsymbol{EF_{BM,y}}$)

Table 11 Installed Capacities of the CCPG

Installed capacity	Unit	2004	2005	2006
Fuel-fired	MW	53825.7	60167.2	76658
Hydro	MW	34642	38405.2	42719
Nuclear	MW	0	0	0

Wind & Others	MW	0	24	106
Total	MW	88467.7	98596.4	119483

Data source: *China Electric Power Yearbook 2005-2007*

Table 12 Newly Added Installed Capacities from Year 2004-2006

Installed capacity	**2004**	**2005**	**2006**	**Newly capacity additions from 2004-2006**	**Percentage of newly added fuel-fired power plants**
	A	**B**	**C**	**D=C-A**	
Fuel-fired (MW)	53825.7	60167.2	76658	22832.3	73.77%
Hydro (MW)	34642	38405.2	42719	8077	26.10%
Nuclear (MW)	0	0	0	0	0.00%
Wind & Others (MW)	0	24	106	41	0.13%
Total (MW)	**88467.7**	**98596.4**	**119483**	**30950.3**	**100%**
Percentage of newly installed capacity to 2006	74.08%	82.56%	100%		

Data source: *China Electric Power Yearbook 2005-2007*

It can be concluded from Table 12 that capacity additions from year 2004 to 2006 is closer to 20% of the total additions and it is obvious that the capacity additions during year 2004 to 2006 are larger than the capacity of five plants, so year 2004 and 2006 are chosen to calculate the *BM* emission factor of the CCPG.

According to Table 12 and formula (7) in section B.6.1, the $EF_{BM,y}$ is calculated as:

$$EF_{BM,y} = 0.9064 \times 73.77\% = 0.6687\ tCO_2/MW$$

Calculating the baseline emission factor (EF_y)

According to formula (8) in section B.6.1, the baseline emission factor of the CCPG is calculated as:

$$EF_y = 1.2783 \times 0.5 + 0.6687 \times 0.5 = 0.9735 \text{ tCO}_2\text{/MWh}$$

The EF_y applied in this report is fixed for a crediting period and may be revised at the renewal of the crediting period.

Annex 4

MONITORING INFORMATION

Please refer to the Monitoring plan in Section B.7.