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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The title of the project: Yuliangwan Small Hydroelectric Project (YSHP), Hunan Province, China
Version: 03
Date of Submission: 20/06/2007

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

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Yuliangwan Small Hydroelectric Project (hereinafter referred to as "the project') is a low head hydropower project, is located in Hongjiang District of Huaihua City, Hunan Province, P.R.China. The project construction commenced in December 2004. The total installed capacity of the project is 8 MW (4 MW×2) with annual net generated electricity of 32819.1 MWh. The surface area[1] at full reservoir level of the project is 697,000 m^2, thus the power density of the proposed project is 11.48 W/m^2. The generated electricity of the project will be delivered to the regional power grid, i.e. Central China Power Grid (CCPG).

The purpose of the project is to generate electricity by using Wushui River water resources to alleviate electricity shortage in Central China. The project will contribute to the reduction of GHG emission by displacing part of the electricity from the fossil fuel fired power plants of the CCPG, and the expected annual GHG emission reductions over the first crediting period is 31,216 tCO_2e/yr, which will contribute to alleviation of climate change. In addition, the project will be beneficial to:

(a) The project will provide clean electricity to CCPG. The project activity can increase temporary and permanent employment opportunities for local residents during construction and operation of the project, which will increase income of the local residents. It is helpful to local socio-economic development.

(b) The project developer will construct roads around the reservoir area and other traffic infrastructure, which will be greatly convenient for local residents and will ultimately promote the local transportation business development.

(c) During operation period of the project, it will pay lots of tax to local government, which will promote local economic development.

A.3. Project participants:

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[1] Proof document: Huaihua Institute of Hydraulic and Electric Engineering Reconnaissance Design & Research

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)	Yuliangwan Hydropower of Hongjiang District Co., Ltd.	No
Sweden	Carbon Asset Management Sweden AB	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Host country: People's Republic of China. P.R. China approved the Kyoto Protocol to the United Nations Framework Convention on Climate Change on 30 August 2002, and is a Party to the Kyoto Protocol. The Designated National Authority (DNA) of P. R. China is the National Development and Reform Commission (NDRC).

Project owner: Yuliangwan Hydropower of Hongjiang District Co., Ltd is a private joint-stock company, which business scope is mainly on hydropower station project.

Purchaser: Carbon Asset Management Sweden AB is a part of Tricorona AB which is a Swedish company listed on the Stockholm Stock Exchange since 1989. Sweden has ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change on May 31, 2002.

Please refer to Annex 1 for more detailed information.

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 (Host)

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

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Hunan Province

A.4.1.3. City/Town/Community etc:

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Hongjiang District, Huaihua City

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 located in Hongjiang District, Huaihua City, Hunan Province, P.R. China. The project site is 50 km away from Huaihua City, Hunan Province, People's Republic of China. The geographical coordinates of project are 109°09′30″ E and Latitude : 27°06′08″ N. Figure 1 below shows the location of the project.

Figure 1 Location of Yuliangwan Small Hydropower Project

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

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1. Type and category(ies) of the small-scale project activity

Type I: Renewable energy projects
Category I.D.: Renewable electricity generation for a grid

2. Technology of the small-scale project activity

The total installed capacity of the project is 8 MW with expected annual net generated electricity of 32819.1 MWh. The project was operational in May, 2007. The generated electricity will be delivered to Hongjiang Substation through 10.5 kV×0.6 km transmission line, and then delivered to CCPG. The main construction structures of the project consist of weir, power house and strobes etc. Table 1 below shows the design features and characteristics of the project.

Table 1 Design features and characteristics of the project[2]

Main construction	Main weir	24.1 m in height, 112 m in length	
	Damgate（m）	7 holes, 7.3×12 arc strobe	
	Power house size（m）	41.7×33.2×35.1	
Equipment	Turbine	Model	GZTFO8B-WP-350
		Quantity	2
		Rated water head	5.2 m
		Rated flow rate	89.4m^3/s
		Manufacturer	Tianjin Tianfa Hydroelectric Equipment Plant
	Generator	Model	SF4000-48/3970
		Quantity	2
		Capacity	4000 kW
		Rated voltage	10500 V
		Manufacturer	Tianjin Tianfa Hydroelectric Equipment Plant

The main equipments, such as the turbines and generators, are made in China. The manufacturers are well-known in Chinese hydropower equipment manufacture market. The power generation technology for the project is commonly used in China.

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

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The ex-ante estimated amount of emission reductions over the first crediting period of the project are listed in Table 2 below:

Table 2 Ex-ante estimation of emission reductions

Year	Annual estimation of emission reductions (tCO_2e)
01/09/2007-31/08/2008	31,216
01/09/2008-31/08/2009	31,216
01/09/2009-31/08/2010	31,216
01/09/2010-31/08/2011	31,216
01/09/2011-31/08/2012	31,216
01/09/2012-31/08/2013	31,216
01/09/2013-31/08/2014	31,216
Total estimated reductions (tones of CO_2e)	218,512
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tones of CO_2 e)	31,216

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

[2] *Yuliangwan Hydropower Plant Feasibility Study Report*

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There is no public funding for this project.

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

The project participants confirm that the project is not a debundled component of a larger project activity. There is no 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 1 km of the project boundary of the proposed small-scale activity at the closest point.

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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Title of the approved baseline and monitoring methodology: AMS-I.D.-Grid connected renewable electricity generation (Version 11, EB 31)

Reference: Appendix B of the simplified modalities and procedures for small scale CDM project activities

Please click following link for more information about the methodology and the reference:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

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

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The project is a grid-connected renewable power generation project activities which meet all the applicability criteria stated in methodology:

1. The project makes use of renewable water resources to supply electricity to regional power grid i.e. CCPG, which is dominant of fossil fuel fired power plants.

2. The total installed capacity of the project is 8 MW, which satisfies the requirement that the capacity of the project should be at most 15 MW for a small-scale CDM project.

3. The power density of the project is 11.48 W/m^2, which is greater than 4 W/m^2 regulated by EB rules.

Therefore, the methodology AMS.I.D is applicable to the project, and the emission from the project reservoir can be ignored.

B.3. Description of the project boundary:

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According to methodology AMS I.D, renewable energy and power generation activities of the project is the project boundary for physical and geographical places of the renewable energy projects. The generated electricity of the project will be delivered to CCPG, which includes Henan Province, Hubei Province, Hunan Province, Jiangxi Province, Sichuan Province and Chongqing Municipality Power Grid[3]. The main emission sources and type of GHGs in project boundary are listed in Table 3 below:

Table 3 GHG emissions in project boundary

[3] Chinese DNA's Guideline of emission factors of Chinese grids

	Source	Gas	Included?	Justification/Explanation
Baseline	Fuel-fired Power Plants in CCPG	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
Project Activity	Yuliangwan Hydropower Plant	CO_2	No	Excluded for simplification.
		CH_4	No	As two projects' power density will be greater than 10 W/m^2 respectively, the project emission is not needed to be calculated.
		N_2O	No	Excluded for simplification.

B.4. Description of baseline and its development:

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There are 4 realistic and credible baseline scenario alternatives identified for the project:

Alternative 1—The project activity not undertaken as CDM project activity

In this scenario the project will generate zero-emission power with renewable hydraulic energy source and cause the emission reduction by displacing equivalent power generation from CCPG. However, the project can not be implemented due to the investment barrier, which will be analyzed in detail in the section of B.5.

Therefore, the alternative 1 is not a possible baseline scenario.

Alternative 2 — Construct a fossil fuel-fired power plant with equivalent annual electricity generation

This alternative is to construct a fossil fuel-fired power plant with equivalent annual electricity generation to the project. The average annual utilization hours of the fossil fuel plants are 5,633[4] in China, which are larger than the average annual utilization of hydropower plants. Thus, the installed capacity of the fossil fuel-fired plants with equivalent annual electricity generation to the project will be smaller than 8 MW. However, according to the current laws and regulations in China, the coal-fired power plants with installed capacity of 135 MW or below are prohibited for construction in the areas covered by large power grids[5] and fuel-fired power plants with installed capacity less than 100 MW is strictly restricted for construction[6].

Therefore, the alternative 2 is not a possible baseline scenario.

Alternative 3 – Construct an alternative renewable power plant with equivalent annual electricity

4 <National Statistics Express of Power Industry in 2006>, China Electricity Council

5 General Office of the State Council [Decree No. 2002-6]: <Notice on Strictly Prohibiting the Construction of Coal-fired Power Plants with Installed Capacity of 135 MW or Below>

6 <Temporary Stipulation of Construction & Management of Small Scale Fuel-fired Generators>, August, 1997

generation

The alternative is to construct power plants using other renewable energy resources, which can generate equivalent electricity annually to the project. However, there are not enough renewable energy resources, such as photovoltaics, tidal/wave, wind, geothermal and renewable biomass etc., to support the construction of power plants. It can be seen from Table A10 that there are only fuel-fired power plants and hydropower plants in CCPG. Furthermore, due to the limitation of technology development and high costs, constructing an alternative renewable power plant is not financially attractive.

Therefore, the alternative 3 is not a possible baseline scenario.

Alternative 4 –Equivalent annual generated electricity supplied by CCPG (continuation of current practice)

Under this alternative, the increasing demand of electricity would be met from CCPG by increasing its installed capacity through the possible expansion of existing power plants as well as construction of new power plants according to the current policies and regulations in China. The installed capacity of the CCPG has been increased for many years, and CCPG is a fuel-fired dominant power grid. So the alternative 4 is the only realistic and credible choice.

From the analysis above, the only realistic and credible alternative for the project is:

Alternative 4 – Equivalent annual electricity supplied by CCPG

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The approved methodology AMS-I.D prescribes the use of Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities for determining whether the project is additional. The Attachment A asks the project owners to justify the additionality by showing that the project activity (and so the GHG emission reduction) faced prohibitive barriers such as:

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

The insurmountable barrier for the implementation of the project is investment barrier. There are three analysis methods recommended to conduct investment analysis, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

Option I: Simple cost analysis. This analysis method can be used if the project activity produces no economic benefits other than CDM related income. However, this option is not applicable to the project because the project activity generates the revenue from the sale of generated electricity.

Option II: Investment comparison analysis. This analysis method can be only used if the alternatives to the project are similar investment projects. However, this option is not applicable to the project because the alternative to the proposed project is equivalent annual electricity supplied by CCPG, which is irrelevant for the project owners to make business decision.

Option III: Benchmark analysis. According to *Economic Evaluation Code for Small Hydropower Projects*[7] (SL16-95) approved by Ministry of Water Resources of P. R. China, and is the most important reference for small-scale hydropower projects (SHP) assessment in China, the financial benchmark rate of return (after tax) for Chinese small hydropower projects (with installed capacity below 25 MW) is 10%. The benchmark analysis is applicable to the project.

According to the *Economic Evaluation Code for Small Hydropower Projects*, a project will be financially acceptable when its IRR of the total investment is better than the sectoral benchmark IRR of 10%.

Table 4 below are basic parameters for financial analysis.

Table 4 Basic parameters for financial evaluation

Parameter	Unit	Value	Data source
Installed capacity	MW	8	Feasibility Study Report
Fixed assets investment	Million RMB ¥	62.61	Feasibility Study Report
Equity	Million RMB ¥	21.56	Feasibility Study Report
Bank loan	Million RMB ¥	41.15	Feasibility Study Report
Current funds	Million RMB ¥	0.1	Feasibility Study Report
Investment horizon	Year	20	SL16-95
Net electricity generation	MWh	32819.1	Feasibility Study Report
Electricity tariff (VAT Incl.)	RMB ¥ /kWh	0.28	Feasibility Study Report
VAT	/	6%	Feasibility Study Report
City maintenance & construction tax and surtax for education expenses	/	4%	Feasibility Study Report
Income tax	%	33	Feasibility Study Report
Project lifetime	Year	30	Feasibility Study Report
O&M cost	10,000 RMB ¥	135.75	Calculated, from the first year to the tenth year of operational period
		86.52	Calculated, from the eleventh year to the twentieth year of operational period

Without CERs revenue, the NPV of the project is RMB ¥ -9.40 million and the project IRR is only 7.55%, which is lower than benchmark IRR. The project is not financially attractive.

Sensitivity Analysis

7 http://apps.lib.whu.edu.cn/12/test/gfbz/2/j/xsdpj.html

The sensitivity analysis is conducted to check whether, under reasonable variations in the critical assumptions, the project IRR remain below the benchmark IRR. The main factors affecting the financial indicators are total investment, electricity tariff and annual O&M cost, thus these three critical assumptions are used to conduct sensitivity analysis.

Table 5 Sensitivity Analysis (IRR)

Percentage variation / **Critical assumption**	**+10%**	**-10%**
Total investment	6.65%	8.61%
Electricity tariff (VAT Incl.)	8.59%	6.47%
Annual O&M cost	7.41%	7.70%

Sensitivity analysis of the project shows: without CERs revenue, the project IRR is lower than the benchmark IRR even under the most advantageous circumstances, such as electricity tariff increases by 10% or total investment declines by 10%. So, the project is not financially attractive to investors. However, with CERs revenue, the project IRR is 11.96%, which is above the benchmark IRR.

Financing barrier

The project is located in Hongjiang District, one of the poorest area in Hunan Province. Hunan is abundant with water resources, however, the most technically and commercially attractive water resources have already been developed in last century. The remaining are those with remote location and weak water resources. The project is a small scale hydropower plant without regulation and reserve function of water resources, so the power generation of the project is depended on unstable water resources which will increase the power generation risks.

It can be found from the *Yuliangwan Hydropower Plant Feasibility Study Report* that the project IRR is below the benchmark IRR. The project faced severe financing barriers. The project owner decided to suspend the project development until solving the financing problems.

The CDM experts of Hunan Provincial Sciences Information Institute visited the project site in August 2004. The experts realized the financing barriers of the project and introduced the CDM incentive to the project owner[8]. The project owner was encouraged by the news and decided to develop the project as a CDM project. The project owner entrusted the Fangxing Accountant Office of Huaihua City to analyze the financial indicator of the project, the results of the financial indicator shows that the project IRR is 11.98% with CERs revenue. The potential CERs revenue enhanced the shareholders' confidence. The project owner presented the CDM development application letter to local DRC. The Hongjiang District Development and Reform Commission approved the CDM application letter from the project owner in October 2004. Due to the CDM incentives, the project construction was commenced in December 2004 due to the CDM incentives.

The project owner still faced many unexpected problems during the construction period:

[8] Hongjiang District Development and Reform Commission: Inspection report of CDM experts from Hunan Provincial Sciences Information Institute, August, 2004.

1. The main financial revenue for Hongjiang District is the tourism industry. In order to be compatible with the development of tourism of Hongjiang District, the project owner had to abandon the weir site with good economic efficiency and geological conditions. As a result, the change of weir site caused additional investment by RMB￥ 6.96 million[9].

2. As national policy is adjusted, the increased land compensation standard caused additional investment by RMB￥ 1.5 million[10].

3. In order to improve the traffic infrastructure of the project site, the project owner constructed a highway bridge over the weir and strengthened the roads beside the river banks. It caused additional investment of RMB￥ 1.8 million[11].

4. The increasing prices of raw materials, labour force, installation of electric machinery equipments caused additional investment by RMB￥ 9.17 million[12].

The sum of above-mentioned additional investment accounted for 31% of planned fixed assets investment. The additional investment will lead to a much lower IRR when does not take into account of CERs revenue. The project owner sought support from Local DRC and Hunan CDM Project Service Centre in 2006. With their assistances, the project owner signed the Emission Reductions Purchase Agreement (ERPA) with foreign CERs purchaser. The CDM development got sustantial progress. The project owner applied for bank loan from local Construction Bank after subscription of ERPA, the bank approved the bank loan since they considered the CERs revenue could enhance the bank loan repayment ability from project owners.

Conclusion

Without CERs revenue, the project owner would not be able to develop the project. Therefore, the project is additional and it does not belong to conventional practice.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Project Emissions

The proposed project is a new small scale hydropower station, the power density is 11.48 W/m^2, greater than 10 W/m^2, thus PE_y=0

[9] Proof document: Institute of Hydraulic and Electric Engineering Reconnaissance Design＆Research

[10] Proof document: Resettlement Office of Hongjiang District, Huaihua City

[11] The Agreement of Yuliangwan Hydropower Station Bridge Construction

[12] Engineering Supervision Department: Summary of Yuliangwan Hydropower Station Engineering Cost Budget & Over Budget

Baseline Emissions

According to baseline methodology ACM0002, the baseline emissions are the CO_2 emissions from the equivalent electricity generation in CCPG that are displaced by the project activity. So the baseline emissions by the project activity during a given year *y* is obtained as follow:

According to ACM0002, the project emission should be calculated as:

$$BE_y=EG_y \cdot EF_y \quad (1)$$

Where:

EG_y is electricity supplied by the project activity to the grid in year *y*, in MWh;
EF_y is baseline emission factor in year y, in tCO_2e/MWh.

According to baseline methodology ACM0002, the baseline emission factor (EF_y) is calculated as a Combined Margin (CM), which is consisting of the weighted average of Operating Margin (OM) emission factor and Build Margin (BM) factor by utilizing an ex-ante 3 years data vintage for the CCPG.

the baseline emission factor (EF_y) is calculated as a Combined Margin (CM), which is consisting of the weighted average of Operating Margin (OM) emission factor and Build Margin (BM) factor by utilizing an ex-ante 3 years data vintage for the CCPG. The data used for calculation are from an official source (where available) and publicly available. The calculation processes are as follows:

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

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

Step 3. Calculating the baseline emission factor （EF_y）.

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

According to baseline methodology ACM0002, there are four methods for calculating the $EF_{OM,y}$:

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

Method (c) should be the first methodological choice. However, this method requires the detailed dispatch data of the CCPG, which is confidential information and is not available to be obtained by public. Thus, method (c) is not applicable. Due to the same reasons, the method (b) is not applicable.

Method (a) can be used where low-cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production. The only low-cost/must run resource in CCPG is hydropower plants. It can be found from Table 6 that installed capacity of hydropower plants constitute less than 50% of CCPG during year 2001 to 2005. Thus, method (a) is applicable to calculate $EF_{OM,y}$. And method (d) can only be used where low-cost/must run resources constitute more than 50% of total grid generation, therefore, method (d) is not applicable to calculate $EF_{OM,y}$.

Table 6 Electricity generation of hydropower plants in CCPG during year 2001 ~ 2005[13]

Year	2001	2002	2003	2004	2005
Electricity generation of hydros (%)	36.76	35.95	34.43	38.37	38.56

Due to the detailed data on the individual power plants connected to the power grid is not available, therefore information by type of generating source are used for OM calculation. According to baseline methodology ACM0002, tthe $EF_{OM,y}$ is calculated by utilizing an *ex-ante* 3 years data vintage for CCPG, the formula as follow:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (2)$$

Where:

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant provinces *j* in year (s) *y*; *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid;
$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant provinces *j* and the percent oxidation of the fuel in year (s) *y*; and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by province *j*.

The CO_2 emission coefficient $COEF_i$ is obtained as:

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

Where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*;
$OXID_i$ is the the oxidation factor of the fuel;
$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i*.

There are net exports from the CCPG to other power grids, thus the imports are not taken into account.

$EF_{OM,y}$ is calculated according to the statistics information of recent 3 years (from 2003 to 2005), the data are the latest and available at the time of this PDD submission, the detailed calculations are shown in Table A2-Table A7 of Annex 3.

[13] *China Electric Power Yearbook 2002 ~2006*

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

According to baseline methodology ACM0002, the Build Margin emission factor ($EF_{BM,y}$) is calculated by utilizing an *ex-ante* 3 years data vintage for CCPG, the formulae as follow:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \qquad (4)$$

Where ：

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method above for plants *m*.

Due to the difficulty of separating the coal-fired, gas-fired or oil-fired installed capacity from the total fuel-fired installed capacity, according to the approved deviation[14] by CDM EB, the $EF_{BM,y}$ will be calculated as:

1) Based on the most recent years energy balance of the CCPG, calculating the proportions of CO_2 emissions from the coal-fired, oil-fired and gas-fired power plants in total fuel-fired CO_2 emissions;

2) Based on the most advanced commercialized technologies which applied by the coal-fired, oil-fired and gas-fired power plants, calculating the fuel-fired emission factor of the CCPG;

3) Calculating the $EF_{BM,y}$ through fuel-fired emission factor times the weighted-average of fuel-fired installed capacity which is more close to 20% in the new capacity additions.

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

$$\lambda_{Gas} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \lambda_{Oil} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \lambda_{Gas} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \qquad (5)$$

Where:

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

[14] EB approved deviation for Methodologies AM0005 and AMS-I.D on 7 October 2005.

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

Error! Objects cannot be created from editing field codes. (6)

Where:

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

It can be found from Table A8 of Annex 3 that the sum of λ_{Oil} and λ_{Gas} account for only 0.52% of total fuel-fired CO_2 emissions, it is reasonable to replace $EF_{Thermal}$ with $EF_{Coal,\ Adv}$. As a conservative approach, the final $EF_{Thermal}$ is calculated as follow:

$$EF_{Thermal} = EF_{Coal,\ Adv} \cdot (1 - \lambda_{Oil} - \lambda_{Gas}) \qquad (7)$$

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

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

Where:

$EF_{BM,y}$ is the Build Margin (BM) emission factor with advanced commercialized technologies for year y;
CAP_{Total} is the new capacity additions;
$CAP_{Thermal}$ is the new fuel-fired capacity additions;
$EF_{Thermal}$ is fuel-fired emission factor.

$EF_{BM,y}$ is calculated according to the latest and available data at the time of this PDD submission, the detailed calculations are shown in Table A8-Table A11 of Annex 3.

Step 3: Calculating the baseline emission factor (EF_y)

According to baseline methodology ACM0002, baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,\ y}$) and the Build Margin emission factor ($EF_{BM,\ y}$):

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y} \qquad (9)$$

Where:

The weighs w_{OM} and w_{BM}, by default, are 50% (i.e., w_{OM}= w_{BM}= 0.5), and $EF_{OM,\ y}$ and $EF_{BM,\ y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2e/MWh.

Leakage

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

Emission Reductions

The annual emission reduction (ER_y) of the project is the difference between baseline emission and project activity emission. The final GHG emission reduction is calculated as follows:

$$ER_y \ (tCO_2e/yr) = BE_y - PE_y - L_y \qquad (10)$$

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

Data / Parameter:	NCV_i
Data unit:	kJ/kg or kJ/m^3
Description:	The net calorific value (energy content) per mass or volume unit of fuel *i*
Source of data used:	*China Energy Statistical Yearbook 2006*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	$OXID_i$
Data unit:	%
Description:	Oxidation factor of the fuel *i*
Source of data used:	*Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	No specific local value available, adopt the IPCC default value.
Any comment:	

Data / Parameter:	$F_{i,j,y}$
Data unit:	10^4 t, 10^8 m^3
Description:	The quantity of fuel *i* (in a mass or volume unit) consumed by the relevant provinces *j* in year(s) *y*
Source of data used:	*China Energy Statistical Yearbook 2004-2006*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods	Data used are from Chinese authorities.

and procedures actually applied :	
Any comment:	

Data / Parameter:	*Electricity generation in CCPG*
Data unit:	MWh
Description:	The electricity generated by source *j* in year *y* of each province connected to CCPG.
Source of data used:	*China Electric Power Yearbook 2004-2006*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	*Internal use rate of power plant*
Data unit:	%
Description:	The internal power consumption of power plants in year(s) *y*
Source of data used:	*China Electric Power Yearbook 2004-2006*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	*Standard coal consumption of power generation*
Data unit:	t/MWh
Description:	The standard coal consumption of power generation of Chinese mainly sub-critical and super critical power plants.
Source of data used:	Conservative value
Value applied:	0.32
Justification of the choice of data or description of measurement methods and procedures actually applied :	The best available technologies in China are mainly sub-critical and super critical power plants, with the standard coal consumption of power generation of 0.327t/MWh and 0.323t/MWh respectively. It is conservative for standard coal to adopt the value 0.32t/MWh. It can be found from *China Electric Power Yearbook 2005* that the standard coal consumption of power generation is 0.371t/MWh in Central China Power Grid. Thus, the value 0.32t/MWh is very conservative to calculation BM.
Any comment:	

Data / Parameter:	$EF_{CO2,i}$

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

Data / Parameter:	$CAP_{i,j,y}$
Data unit:	MW
Description:	Installed capacities of power plant category *i* of province *j* in years *y*.
Source of data used:	*China Electric Power Yearbook 2001-2006*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.

Data / Parameter:	Surface Area
Data unit:	m^2
Description:	Surface area at the full reservoir level
Source of data used:	Institute of Hydraulic and Electric Engineering Reconnaissance Design & Research
Value applied:	812,000
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data provided by Huaihua Institute of Hydraulic and Electric Engineering Reconnaissance Design & Research is reliable and creditable.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

>>

Project Emissions

The proposed project is a new small scale hydropower station, the power density is 11.48 W/m^2, greater than 10 W/m^2, thus PE_y=0

Baseline Emissions

According to formulae (3)-(9) in section B.6.1, the calculation results of EF_{OM}, EF_{BM} and EF_y are listed in table 7, the detailed calculation processes are shown in Annex 3.

Table 7 EF_{OM}, EF_{BM} and EF_y of CCPG (tCO_2e/MWh)

EF_{OM}	EF_{BM}	EF_y
1.28956	0.61277	0.95116

According to formula (2) in section B.6.1, the annual baseline emissions (BE_y) is calculated as follow:

$$BE_y = 32819.1 \times 0.95116 = 31{,}216\ tCO_2e/yr$$

Leakage

According to baseline methodology ACM0002, $L_y = 0$

Emission Reductions

According to formula (10) in section B.6.1, the annual emission reductions (ER_y) is calculated as follow:

$$ER_y\ (tCO_2e/yr) = 31216 - 0 - 0 = 31{,}216\ tCO_2e/yr$$

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

>>

The summary of the ex-ante estimation of emission reductions are listed in Table 8 below:

Table 8 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)
01/09/2007-31/08/2008	0	31,216	0	31,216
01/09/2008-31/08/2009	0	31,216	0	31,216
01/09/2009-31/08/2010	0	31,216	0	31,216
01/09/2010-31/08/2011	0	31,216	0	31,216
01/09/2011-31/08/2012	0	31,216	0	31,216
01/09/2012-31/08/2013	0	31,216	0	31,216
01/09/2013-31/08/2014	0	31,216	0	31,216
Total	0	218,512	0	218,512

(tonnes of CO_2e)				

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

B.7.1 Data and parameters monitored:

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity delivered to CCPG
Source of data to be used:	Measured onsite and checked with Electricity sales receipts provided by Hunan Power Grid Company.
Value of data	32819.1
Description of measurement methods and procedures to be applied:	The net generated electricity by the project is measured continuously through national standard electricity metering instruments and will be recorded manually by respective designated staff of daily.
QA/QC procedures to be applied:	The monitoring data will be directly used for emission reductions calculation. Sales receipts and other records will be used for double checking to ensure the consistency. The meters will be calibrated at a regular interval by qualified organization to ensure the normal operation.
Any comment:	The uncertainty of data is very low.

B.7.2 Description of the monitoring plan:

>>

An overall monitoring plan will be applied to the project. The project owner compiled a monitoring and management manual i.e. *The Monitoring and Management Manual of Yuliangwan Hydropower Plant*. The aim of monitoring plan is to make sure that the net generated electricity monitored and evaluated during the project activity operation period is completed, consistent, and precise. It has identified the duties of the related responsibilities. The details are summarized as follows:

1. Monitoring subject

The primary data monitored is the electricity quantity upon grids by the project activity.

2. Processing and managing structure

In order to obtain effective monitored data, the project owner established a monitoring management structure which identified the relative staffs for data recording, collection and preservation. In addition, the project owner will designate a special monitoring director to take charge of supervising. The monitoring director is responsible for checking of monitoring and recording tasks (such as meter reading, sales receipts), emission reductions calculation and monitoring reports preparation etc.. The director will receive technical supports from the Hunan CDM Project Service Centre. The detailed structure is as follow:

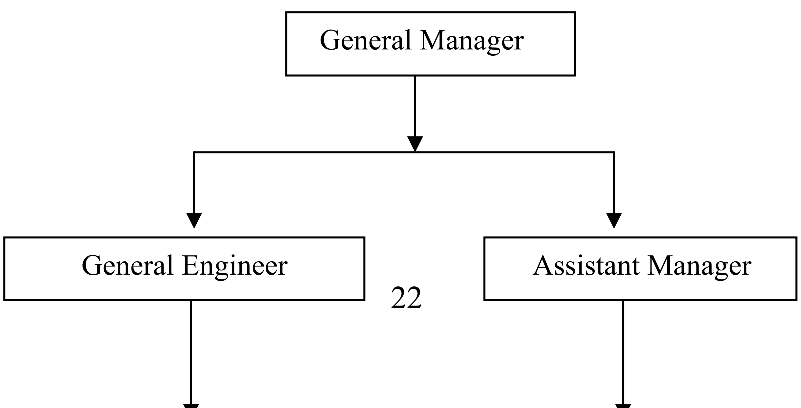

Figure 2 Operation and management structure of the project

3. Monitoring apparatus and instalment:

The meters will be installed in accordance with <Technology & Management Regulations for Power Metering Devices> (DL/T448-2000), the accuracy of the meters must meet the national standard. The meter (Master Meter) will be installed in power house and backup meter (Backup Meter) of Master Meter will be installed at Hongjiang Substation (high voltage side). The Master Meter and Backup Meter belong to the Power Grid Company. The project owner, Power Grid Company and quality supervision organization will check and accept the Master Meter and Backup Meter before the project operation. The meter (Meter$_1$) used for measuring captive electricity consumption will be installed in power house as well as owned by the project owner. There is an independent meter in power house (Meter$_2$ and Meter$_3$) for each generator to monitor the electricity generation. The Power Grid Company is responsible for maintenance and operation of Master Meter as well as Backup Meter and the project owner is responsible for meters inside the power house. All the installed meters must be pasted with seal after installation or calibration. The seal is forbidden to rip by either party independently. The principal diagram of the meter positions are as follows:

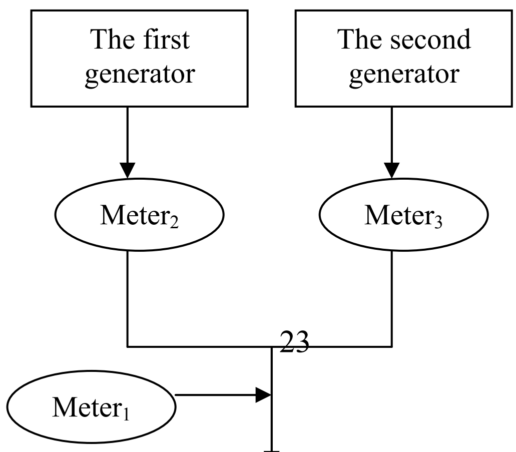

Figure 3 Meter positions of the project

4. Data monitoring

The readings of Master Meter are used for calculating the emission reductions when the Meter is in normal operation state. The monitoring steps are as follows:

(1) The duty staff record the readings of meters which are inside power house everyday;
(2) Project owner and Power Grid Company collect as well as record the Master Meter readings together monthly;
(3) The Power Grid Company provides the project owner with the net electricity generation data;
(4) The project owner provides the Power Grid Company with sales receipts and preserves the copies of the sales receipts.
(5) The project owner records the net electricity generation of the project.
(6) The project owner provides DOE with readings record of Master Meter and copies of sales receipts.

5. Quality control

1) Calibration of meters

The calibration of meters conducted by qualified organization must comply with national standards and sectoral regulations to ensure the accuracy. The meters must be pasted with seal after calibration. The calibration records must be archived together with other monitoring records.

When the following situations occurred, all the meters should be tested by a qualified organization in 3 days:

(1) The Master Meter reading is beyond the allowable error.
(2) The meters have any malfunction and are replaced.

2) Emergency treatment

The project owner should inform the Power Grid Company immediately if Master Meter occur malfunction situation. The net generated electricity during this period should be treated as follows:

(1) Using Backup Meter for net electricity generation monitoring.
(2) If the Backup Meter is also in malfunction, the net electricity generation should be calculated as follow:

net generated electricity = $(Meter_2 + Meter_3 - Meter_1) \times (1 -$ line lose ratio)

The line loss ratio is determined by historical data.
(3) After handling of the emergency, the project owner must prepare a report regarding the emergency to explain to DOE that the handling method is reasonable.

6. Data management

All monitoring data and records will be archived in electronic document as well as paper document. The electronic documents will be backed up in Compact Disc or Hard Disc form. The project owner will also keep the copies of sales receipts and prepare a monitoring report at the end of each year, which includes the net generated electricity, the monitoring data summary, the calibration records, the emission reductions calculation, meters' corrective action records and emergency report (if applicable). All the monitored data will be delivered to Hunan CDM Project Service Centre who is entrusted as monitoring consultant by the project owner.

All the electronic and paper documents will be archived during the crediting period and two years after.

7. Training program

The project owner and Hunan CDM Service Center together will train together all the relative staffs before operation of generators. The training contains CDM knowledge, operational regulations, quality control (QC) standard flow, data monitoring requirements and data management regulations etc..

More information can be obtained from *The Monitoring and Management Manual of Yuliangwan Hydropower Plant*.

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

>>

Final Date of completion of the baseline study and monitoring methodology (DD/MM/YYYY):

20/06/2007

The persons and entity completing the application of the baseline and monitoring methodology are:

Hengzhi Xu, Hunan CDM Project Service Center, E-mail: cdmxhz@163.com, Tel:+13911129715

Hanwen Zhang, Hunan CDM Project Service Center, E-mail: hncdmzhw@126.com, Tel:+86-731-4586782

The persons and entity mentioned above are not project participants.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
08/12/2007 (Starting date of construction)

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

>>
The project is expected to have a minimum operating life of 25 years and 0 month.

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:

>>
01/09/2007

C.2.1.2. Length of the first crediting period:

>>
7 years and 0 month

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. 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: Huaihua Environmental Protection Research Institute of Science & Technology to conduct the environmental impact assessment (EIA) on Yuliangwan Hydropower Project and obtained the approval from Environmental Protection Bureau of Huaihua City in October, 2005 (Huaihuanhan [2005] No.13).

The EIA report is prepared for future reference, and the main comments of the EIA are as follows:

1. The proposed project activity is mainly related to Changqing Village and Guihuayuan Village in Hongjiang District, Huaihua City and Huangmao Village in Huitong County, which does not involve in resettlement issues.

2. The proposed project is a hydropower project, which has no industrial pollutants drainage and has little pollution impact on surrounding environment. Environment influence occurs mainly in the period of the construction stage of the project.

3. Sewage generated during the construction period caused trifling contamination of the water downstream. There is no any rare aquatic animals in river. With the completion of the project, the water quality will recover in a short time. The project owner should construct sediment pool to treat wastewater.

4. The main impacts on the air quality will come from flying dust and emission caused by cement mixture process and transportation, the main pollutant is TSP. Another pollution source is the waste gas emission of machine fuel consumption, the main pollutant is NO_x. To avoid these impacts, the project owner should spray water regularly, and the workers should be protected by masks. The project owner should plant trees after construction completion. These measures would prevent air pollution effectively.

5. Solid waste generated during construction will caused temporary pollution. The project developer should specially build a garbage dump for the storage of life trash and solid waste produced during the construction process.

6. The construction of the project will have certain influence to the vegetation. There is no precious plants in project activity site. After the project completion, the project developer should carry on forestation to restore the vegetation of the construction site. The project has little effect on the biodiversity, but the construction of the weir will not lead to the eradication of species of terrestrial wildlife, so that it will not affect the biodiversity.

7. Completion of the project will have a series of benefits. It will greatly relieve the power shortage situation in Hongjiang District, improve the local investment environment and infrastructure construction, promote local industry development and agriculture production and enhance the life quality of the local residents persistently. After the construction completion of Yuliangwan project, it will also promote the development of the local tourism industry.

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

>>

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

SECTION E. Stakeholders' comments

>>

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

>>

The project developer held a stakeholders symposium in the office of Hongjiang District Government in March, 2006. Totally 30 representatives from government, school, mass organizations, Changqing Village, Guihuayuan Village and Huangmao Village attended the symposium. The developer introduces the basic situation of the project, and the representatives carried on a serious discussion on issues of the project construction and parties' interests.

E.2. Summary of the comments received:

>>

Summary of survey:

All of the participants of the stakeholders symposium made a statement of their position. They said that the project construction would relieve the power shortage situation of local region and promote the development of local economy. The combination of dam and bridge will bring great convenience to the local people's daily life. The participants of the stakeholders symposium agreed on that the proposed project will be beneficial to the environment. They expressed full support to the construction of the project and also raised some issues which need to be solved.

Issues presented in the stakeholders symposium were as follows:

1. In order to construct the project smoothly, the project owner was requested to coordinate relationships through the communication with local government and relevant departments, in particular the township government and Villages.

2. Some people worried about that the project will have negative impact to the local vegetation.

3. The local residents required the project owner to build life wharf and ferryboat wharf to facilitate their daily life.

4. Some residents required to solve the drinking water problem of Huangmaotuan Village although the problem was not derived from the project.

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

>>

After compiling the survey results, the project owner made a quick response in views of the questions reflected in the stakeholders symposium. The following are the corresponding replies towards the problems shown in the previous section:

1. The project owner promised to communicate frequently with local government officials, leaders of various departments, Village cadres and the related masses in the period of construction and

operation of the project so as to coordinate the relationship, and make a appropriate treatment when finding problems related to the project.

2．Vegetation around the project site will be restored immediately by the project owner after the completion of the project.

3．The project owner promised to construct wharf to facilitate the local residents' daily life.

4．The project owner promised to construct drinking water wells voluntarily for local villagers.

The above mentioned measures have been completed at the time of the PDD submission.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project owner

Organization:	Yuliangwan Hydropower of Hongjiang District Co., Ltd.
Street/P.O.Box:	
Building:	Office Buiding of Yuliangwan Hydropower of Hongjiang District Co., Ltd.
City:	Hongjiang District, Huaihua City
State/Region:	Hunan Province
Postfix/ZIP:	418200
Country:	People's Republic of China
Telephone:	+86-745-7634778
FAX:	+86-745-7634778
E-Mail:	zw0410@tom.com
URL:	None
Represented by:	Wenxiao Dong
Title:	Manager
Salutation:	Mr
Last Name:	Dong
Middle Name:	None
First Name:	Wenxiao
Department:	Yuliangwan Hydropower of Hongjiang District Co., Ltd.
Mobile:	+86-13707451961
Direct FAX:	+86-745-7634778
Direct tel:	+86-745-7634778
Personal E-Mail:	zw0410@tom.com

CERs Purchaser

Organization:	Carbon Asset Management Sweden AB
Street/P.O.Box:	Drottninggatan 92-94
Building:	/
City:	Stockholm
State/Region:	/
Postfix/ZIP:	111 36
Country:	Sweden
Telephone:	+46 8 506 885 00
FAX:	+46 8 34 60 80
E-Mail:	co2@tricorona.se
URL:	www.tricorona.se
Represented by:	Niels Von Zweigbergk
Title:	President & CEO
Salutation:	Mr.
Last Name:	Zweigbergk
Middle Name:	Von
First Name:	Niels
Department:	/
Mobile:	+46 708 59 35 00
Direct FAX:	+46 8 34 60 80
Direct tel:	+46 8 506 263 96
Personal E-Mail:	nvz@tricorona.semailto:nvz@tricorona.se

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for this project.

Annex 3

BASELINE INFORMATION

The installed capacity, fuel consumption data used for OM and BM calculation are derived from <China Energy Statistical Yearbook>, <China Electric Power Yearbook>. Furthermore, the data are compiled by Chinese DNA, for more information, please refer to following link: http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=1235

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

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

Fuel	Low Calorific Value	Emission Factor (tC/TJ)	Oxidation Factor
Raw Coal	20908 kJ/kg	25.8	100%
Cleaned Coal	26344 kJ/kg	25.8	100%
Other Washed Coal	8363 kJ/kg	25.8	100%
Coke	28435 kJ/kg	25.8	100%
Crude Oil	41816 kJ/kg	20.0	100%
Gasoline	43070 kJ/kg	18.9	100%
Diesel Oil	42652 kJ/kg	20.2	100%
Fuel Oil	41816 kJ/kg	21.1	100%
Natural Gas	38931 kJ/m^3	15.3	100%
Coke Oven Gas	16726 kJ/m^3	12.1	100%
Other Gas	5227 kJ/m^3	12.1	100%
LPG	50179 kJ/kg	17.2	100%
Refinery Dry Gas	46055 kJ/kg	15.7	100%

Data Source:

The net calorific values are quoted from <China Energy Statistical Yearbook 2006>, Page 287.

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

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

Table A2 Simple OM Emission Factors Calculation of CCPG for Year 2003

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	EF	Oxidation	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J*44 /12/10000 (for mass unit)
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	J	K=G*H*I*J*44 /12 /1000 (for volume unit)
Raw Coal	10^4 t	1427.41	5504.94	2072.44	1646.47	769.47	2430.93	13851.66	25.8	100	20908	273971539.89
Cleaned Coal	10^4 t							0	25.8	100	26344	0
Other Washed Coal	10^4 t	2.03	39.63			106.12		147.78	25.8	100	8363	1169146.40
Coke	10^4 t				1.22			1.22	29.2	100	28435	37142.18
Coke Oven Gas	10^8 m^3			0.93				0.93	12.1	100	16726	69013.15
Other Gas	10^8 m^3							0	12.1	100	5227	0
Crude Oil	10^4 t		0.5	0.24			1.2	1.94	20	100	41816	59490.23
Diesel Oil	10^4 t	0.52	2.54	0.69	1.21	0.77		5.73	20.2	100	42652	181015.94
Fuel Oil	10^4 t	0.42	0.25	2.17	0.54	0.28	1.2	4.86	21.1	100	41816	157229.00
LPG	10^4 t							0	17.2	100	50179	0
Refinery Dry Gas	10^4 t	1.76	6.53		0.66			8.95	15.7	100	46055	237285.34
Natural Gas	10^8 m^3					0.04	2.2	2.24	15.3	100	38931	489222.52
											Total	**276371084.63**

Data Source: <China Energy Statistical Yearbook 2004>

Table A3 Fuel-fired Electricity Generation of CCPG for Year 2003

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	(MWh)	(%)	(MWh)
Jiangxi	271.65	27165000	6.43	25418291
Henan	955.18	95518000	7.68	88182218
Hubei	395.32	39532000	3.81	38025831
Hunan	295.01	29501000	4.58	28149854
Chongqing	163.41	16341000	8.97	14875212
Sichuan	327.82	32782000	4.41	31336314
Total				225987719

Data Source: <China Electric Power Yearbook 2004>

According to Table A2, the total CO_2 emissions of CCPG is **276371084.63** tCO_2e in year 2003. According to Table A3, the total supplied electricity of CCPG is 225987719.2 MWh. According to formula (2) in section B.6.1, the $EF_{OM, Simple, 2003}$ is 1.2229 tCO_2e/MWh.

Table A4 Simple OM Emission Factors Calculation of CCPG for Year 2004

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	EF	Oxidation	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	($MJ/t,km^3$)	K=G*H*I*J* 44/12/10000 (for mass unit)
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	J	K=G*H*I*J*4 4/12 /1000 (for volume unit)
Raw Coal	10^4 t	1863.8	6948.5	2510.5	2197.9	875.5	2747.9	17144.1	25.8	100	20908	339092605.29
Cleaned Coal	10^4 t		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 t		109.61					109.61	29.2	100	28435	3337011.41
Coke Oven Gas	10^8 m^3			1.68		0.34		2.02	12.1	100	16726	149899.53
Other Gas	10^8 m^3					2.61		2.61	12.1	100	5227	60527.09
Crude Oil	10^4 t		0.86	0.22				1.08	20	100	41816	33118.27
Gasoline	10^4 t		0.06			0.01		0.07	20.2	100	43070	2089.33
Diesel Oil	10^4 t	0.02	3.86	1.7	1.72	1.14		8.44	21.1	100	42652	266627.32
Fuel Oil	10^4 t	1.09	0.19	9.55	1.38	0.48	1.68	14.37	17.2	100	41816	464893.14
LPG	10^4 t							0	15.7	100	50179	0
Refinery Dry Gas	10^4 t	3.52	2.27					5.79	15.3	100	46055	153506.38
Natural Gas	10^8 m^3						2.27	2.27	25.8	100	38931	495774.61
											Total	**346035809.73**

Data Source: <China Energy Statistical Yearbook 2005>

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

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

Data Source: <China Electric Power Yearbook 2005>

According to Table A4, the total CO_2 emissions of CCPG is 346035809.73 tCO_2e in year 2004. According to Table A5, the total supplied electricity of CCPG is 249074186 MWh. According to formula (2) in section B.6.1, the $EF_{OM,\ Simple,\ 2004}$ is 1.3893 tCO_2e/MWh.

Table A6 Simple OM Emission Factors Calculation of CCPG for Year 2005

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	EF	Oxidation	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tC/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J*44 /12/10000 (for mass unit)
		A	B	C	D	E	F	G=A+B+ C+D+E+F	H	I	J	K=G*H*I*J *44/12/1000 (for volume unit)
Raw Coal	10^4 t	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	17827.75	25.8	100	20908	352614496.76
Cleaned Coal	10^4 t	0.02	0					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 t		25.95		105			130.95	29.2	100	28435	3986695.05
Coke Oven Gas	10^8 m^3			1.15		0.36		1.51	12.1	100	16726	112053.61
Other Gas	10^8 m^3		10.2			3.12		13.32	12.1	100	5227	308896.88
Crude Oil	10^4 t		0.82	0.36				1.18	20	100	41816	36184.78
Gasoline			0.02			0.02		0.04	18.9	100	43070	1193.90
Diesel Oil	10^4 t	1.3	3.03	2.39	1.39	1.38		9.49	20.2	100	42652	299797.78
Fuel Oil	10^4 t	0.64	0.29	3.15	1.68	0.89	2.22	8.87	21.1	100	41816	286959.09
LPG	10^4 t							0	17.2	100	50179	0.00
Refinery Dry Gas	10^4 t	0.71	3.41	1.76	0.78			6.66	15.7	100	46055	176572.11
Natural Gas	10^8 m^3						3	3	15.3	100	38931	655208.73
											Total	**360283226.12**

Data Source: <China Energy Statistical Yearbook 2006>

Table A7 Fuel-fired Electricity Generation of CCPG for Year 2005

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	**(MWh)**	**(%)**	**(MWh)**
Jiangxi	305.61	30561000	6.48	28580647.2
Henan	1311.3	131130000	7.32	121531284
Hubei	476.15	47615000	2.51	46419863.5
Hunan	403.08	40308000	5	38292600
Chongqing	186.69	18669000	8.05	17166145.5
Sichuan	365.42	36542000	4.27	34981656.6
Total				286972196.8

Data Source: <China Electric Power Yearbook 2006>

According to Table A6, the total CO_2 emissions of CCPG is 360283226.12 tCO_2e in year 2005. According to Table A7, the total supplied electricity of CCPG is 286972196.8 MWh. According to formula (2) in section B.6.1, the $EF_{OM, Simple, 2005}$ is 1.2555 tCO_2e/MWh.

The Operating Margin (OM) emission factor is the weighted average emission factors of year 2003-2005, as follow:

$$EF_{OM} = 1.28956 \text{ tCO}_2\text{e/MWh}$$

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

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

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

		Jiangxi	**Henan**	**Hubei**	**Hunan**	**Chongqing**	**Sichuan**	**Total**	**Average Low Calorific Value**	**Emission Factor (tC/TJ)**	**Oxidation**	**CO_2 Emission (tCO_2e)**
Fuel	Unit	A	B	C	D	E	F	G=A+…+F	H	I	J	K=G*H*I*J*44 /12/100
Raw Coal	10^4 t	1869.29	7638.87	2732.15	1712.27	875.4	2999.77	17827.75	20908 kJ/kg	25.8	100%	352614496.76
Cleaned Coal	10^4 t	0.02	0					0.02	26344 kJ/kg	25.8	100%	498.43
Other Washed Coal	10^4 t		138.12			89.99		228.11	8363 kJ/kg	25.8	100%	1804669.00
Coke	10^4 t		25.95		105			130.95	28435 kJ/kg	29.2	100%	3986695.05
Subtotal												**358406359.24**
Crude Oil	10^4 t		0.82	0.36				1.18	41816 kJ/kg	20	100%	36184.78
Gasoline	10^4 t		0.02			0.02		0.04	43070 kJ/kg	18.9	100%	1193.90
Diesel Oil	10^4 t	1.3	3.03	2.39	1.39	1.38		9.49	42652 kJ/kg	20.2	100%	299797.78
Fuel Oil	10^4 t	0.64	0.29	3.15	1.68	0.89	2.22	8.87	41816 kJ/kg	21.1	100%	286959.09
Subtotal												**624135.55**
Natural Gas	10^7 m^3						30	30	38931 kJ/m^3	15.3	100%	655208.73
Coke Oven Gas	10^7 m^3			11.5		3.6		15.1	16726 kJ/m^3	12.1	100%	112053.61
Other Gas	10^7 m^3		102			31.2		133.2	5227 kJ/m^3	12.1	100%	308896.88
LPG	10^4 t							0	50179 kJ/kg	17.2	100%	0.00
Refinery Dry Gas	10^4 t	0.71	3.41	1.76	0.78			6.66	46055 kJ/kg	15.7	100%	176572.11
Subtotal												**1252731.33**
Total												**360283226.12**

Data Source: <China Energy Statistical Yearbook 2006>

According to Table A8 and formula (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:

$$\lambda_{Coal} = 99.48\% \ , \ \lambda_{Oil} = 0.17\% \ , \ \lambda_{Gas} = 0.35\%$$

Due to the sum of λ_{Oil} and λ_{Gas} account for only 0.52% of total fuel-fired CO_2 emissions, it is reasonable to replace $EF_{Thermal}$ with $EF_{Coal, Adv}$. As a conservative approach, the final $EF_{Thermal}$ is calculated as follow:

$$EF_{Thermal} = EF_{Coal, Adv} \cdot (1 - \lambda_{Oil} - \lambda_{Gas})$$

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

The best available technologies in China are mainly sub-critical and super critical power plants, with the standard coal consumption of power generation of 327g/kWh and 323g/kWh respectively. It is conservative for standard coal to adopt the value 320g/kWh. It can be found from <China Electric Power Yearbook 2005> that the standard coal consumption of power generation is 371kg/kWh in Central China Power Grid. Thus, the value 320g/kWh is very conservative to calculation BM.

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

Table A9 Parameters used for calculating coal-fired plant emission factor

Parameter	Unit	Value	Comment
NCV of standard coal	TJ/t coal	0.02927	The data is derived from General Code Comprehensive Energy Consumption Calculation (GB2589-81)
Coal consumption of power generation	t/MWh	0.32	Conservative value
Emission factor of coal	tC/TJ	25.8	The data is derived from IPCC2006
Oxidation factor of coal	/	100%	The data is derived from IPCC2006

The $EF_{Thermal}$ is 0.88145 tCO_2e/MWh

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

Table A10 Installed Capacities of CCPG

Installed Capacity	Unit	2000	2001	2002	2003	2004	2005
Fuel-fired	MW	39864.6	42569.2	43303.2	46893.5	53744.7	60167.3
Hydro	MW	28637.8	30397	31034.7	36557	34642	38405.1
Nuclear	MW	0	0	0	0	0	0
Wind & Others	MW	0	0	0	0	0	24
Total	MW	**68502.4**	**72966.2**	**74337.9**	**83450.5**	**88386.7**	**98596.4**

Data Source: <China Electric Power Yearbook 2001-2006>

Table A11 Newly Added Installed Capacity from Year 2000-2005

	2000	2001	2002	2003	2004	2005	F-C
	A	B	C	D	E	F	
Fuel-fired (MW)	39864.6	42569.2	43303.2	46893.5	53744.7	60167.3	16864.1
Hydro (MW)	28637.8	30397	31034.7	36557	34642	38405.1	7370.4
Nuclear	MW	0	0	0	0	0	0
Wind & Others	MW	0	0	0	0	0	24
Total (MW)	68502.4	72966.2	74337.9	83450.5	88386.7	98596.4	24258.5
Percentage of newly installed capacity to 2005	30.51%	25.98%	24.59%	15.34%	10.33%	0.00%	
Percentage of newly added fuel-fired plants			69.52%				

It can be concluded from Table A13 that capacity additions from year 2002 to 2005 is closer to 20% of the total additions and it is obvious the capacity additions during year 2002 to 2005 are larger than the capacity of five plants, so year 2002 and 2005 are chosen to calculate the BM emission factor of CCPG.

According to Table A11 and formula (8) in section B.6.1, the EF_{BM} is calculated as:

$$EF_{BM} = 0.61277 \text{ tCO}_2\text{e/MWh}$$

Step 3: Calculating the baseline emission factor (EF_y)

According to formula (9) in section B.6.1, the baseline emission factor of CCPG is calculated as:

$$EF_y = 0.95116 \text{ tCO}_2\text{e/MWh}$$

Annex 4

MONITORING INFORMATION

Please refer to the section B.7 of the PDD and *The Monitoring and Management Manual of Yuliangwan Hydropower Plant.*