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: China Xinhuang Xincun Small Hydropower Project
Version: 01
Date: 20/05/2007

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

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1. Description of the project activity:

China Xinhuang Xincun small hydropower project (hereafter referred to as "the project"), is located in Xinglong town, Xinhuang Dong Minority Autonomous County, Hunan province, People's Republic of China. The project is a low-head & run-of-river project, of which the total installed capacity is 7.4 MW, the annual utilization is 3118h and the annual output to grid is 20663MWh[1]. The project activity can reduce greenhouse gas (GHG) emissions by substituting part of fossil fuel generation of regional electric grid(Central China Power Grid ,for short CCPG) for clean hydroelectricity generation and the estimated annual emission reductions is 19,560tCO_2e/yr in the first crediting period.

2. Purpose of the project activity:

The project activity will contribute to local sustainable development in following aspects:

1. Reduce the GHG emission reduction to mitigate the trend of global warming by providing clean electric power.

2. The project will provide clean electricity to local areas through the development of the Wushui water resource, release the pressure of electric grid generation deficiency, improve investment atmosphere, and promote regional economic development in many industries.

3. The project located in Minority area, and it can enhance nation solidarity, promote harmonious society by promoting regional economic development.

4. The new reservoir of the project will be good for local farmland irrigation.

5. The finished project will make higher level of the up-river water, improve 10Km watercourse, provide more appropriate climate, and the project site will be a recreational and interested place.

A.3. Project participants:

[1] The Preliminary Project Design Report on the Xinhuang Xincun small hydropower project

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Table 1 Name of Parties involved

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)	Xinhuang Xincun hydropower Co., Ltd.	No
SWEDEN	Carbon Asset Management Sweden AB	No

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

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

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A.4.1.1. Host Party(ies):

People's Republic of China

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

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Hunan Province

A.4.1.3. City/Town/Community etc:

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Huaihua City/Xinhuang Dong Minority Autonomous County/ Xinglong Town

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 the Xincun Village, Xinlong Town, Xinhuang County, Huaihua City, Hunan Province, P.R.China, 9 km away from Xinhuang County which is in the middle of the Wushui River, one branch of Yuanshui River. The geographical coordinates of project are east longitude 108°′43~110°10′, north latitude 27°3′~27°41′. Chart 1 shows the location of the project.

Chart 1 the geographical position of the 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

The capacity of the proposed project is 7.4 MW, under the threshold qualifying capacity of 15 MW; the project activity can be regarded as a small scale CDM project activity and fit the simplified model and programmers of UNFCCC. The project activity utilizes the hydro potential for power generation. Thus the project type is renewable energy. According to the small-scale CDM modalities, the project type and category are defined as follows:

Project Type: I. Renewable energy project ;

Project Category: I D Grid-connected renewable electricity generation.

2. Technologies applied on the small-scale project activity

The project is a run-of-the-river hydropower project with low water head, the main buildings consist of diversion tunnel, pressure tube, strobe and factory. The designed installed capacity is 7.4MW, and the designed hydraulic head of power station is 3.5m, the annual output to grid is 20663MWh. The electricity will be transmitted to city center substation by 35kV×13km lines, access to the CCPG.
Major technological parameters of the project are as follows:

Table 2 The key technical data[2]

Installed capacity	7.4 MW
Hydraulic turbine	
Type	GD4028-WP-450 GD803-WP-315
Quantity	3
Rated capability	5236（1277）kW
Rated rotation speed	90.9(115.4) r/min
Exsuction height	－4.2m
Rated water head	3.5 m
Rated flow	180（40）m^3/s
Hydraulic generator	
Type	SFWG5000-66/4250, SFWG1200-52/3150
Quantity	3
Rated capability	5000（1200）kW
Rated voltage	6.3kV
Rated rotation speed	90.9(115.4)r/min
Power factor	0.9(0.85)

3. Environmental safe technology:
The technologies applied in the proposed project are environmental friendly, and shall not be harmful to the ecosystem, which has been applied world widely.
4. Technology transfer:
The main equipments, such as the turbines and electricity generators, are made in the host country. No technology is transferred from other countries to this project activity.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:
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The project chooses the renewable crediting period. The first crediting period is from 2007 to 2014. The amount of annual and total emission reductions are explained in the following table 3

[2] The Feasibility report on the Xinxun small hydropower project

Table 3 the estimation of greenhouse gas emission reductions

Years	Annual estimation of emission reductions in (tCO_2e)
2007/07～2007/12	9,780
2008	19,560
2009	19,560
2010	19,560
2011	19,560
2012	19,560
2013	19,515
2014/01～2014/06	9,780
Total estimated reductions (tonnes of CO_2e)	136,920
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	19,560

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

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

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 paragraph 2 of Appendix C to the Simplified Modalities and Procedures for Small-Scale CDM project activities, a small-scale project is considered a debundled component of a large project activity if there is a registered small-scale activity or an application to register another small-scale activity:

1. With the same project participants;
2. In the same project category and technology;
3. Registered within the previous two years; and
4. Whose project boundary is within 1 km of the project boundary of the proposed small scale activity.

The small-scale project is not a debundled component of a large scale project activity.The project proponents further confirm that they have not registered any small scale CDM project activity or applied to register another small scale CDM project activity within the same project boundary, in the same project category and technology/measure.

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 reference:
http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

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

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The applicable criteria stated in the methodology ACM0002 for new-planed project are:

1. The installed capacity is below 15MW;
2. The project activity comprises renewable energy generation units, and supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.

The total installed capacity of Xinhuang Xincun Hydropower Station is 7.4MW which is less than 15 MW. Therefore it is appropriate to adopt the methodology AMS-I.D. Version 10. This methodology applies renewable electricity generation for a grid. Thus this methodology can be applied to the project.

B.3. Description of the project boundary:

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According to methodology AMS I.D, the project boundaries contain the physical and geographical places that the renewable energy project is related to. 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 types of GHG in the project boundaries are listed in table 4 below:

Table 4 GHG emissions in project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Power generation of CCPG	CO_2	Yes	Included by the methodology.
		CH_4	No	Excluded by the methodology
		N_2O	No	Excluded by the methodology
Project Activity	The project	CO_2	No	Excluded by the methodology
		CH_4	No	The project emission need not be considered because it is a run-of river hydropower station
		N_2O	No	Excluded by the methodology

B.4. Description of baseline and its development:

[3] Chinese DNA's Guideline of emission factors of Chinese grids, published in Dec. 15th, 2006 http://cdm.ccchina.gov.cn/web/index.asp

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In this part, the project developer identified all the potential substituted scenarios as follows:

Alternative 1: Project activity not undertaken as CDM project activity.

This option is one of feasible alternatives. However, the IRR of the power station is 6.37% without CERs, less than benchmark IRR 10%, thus the project can not be implemented due to various barriers like investment barrier etc. (see B.5 for details).
Thus, the alternative1 is unfeasible and is excluded.

Alternative 2: Construction of fossil fuel based power plant with equivalent annual electricity generation, supplying power to the present grid mix.

The average annual operating time of thermal power plants of China is 5,633 h[4]in the year of 2006. Consequently, fossil fuel-based power plant with equivalent annual electricity generation has less installed capacity than the Project (7MW). However, building such small capacity (less than 135MW) coal-based power plants in the areas covered by large grids is forbidden by Chinese government[5]. And fossil fuel-fired power plants with the capacity lower than 100 MW are strictly limited for installation[6]. Thus, it is not available to construct a fossil fuel-fired power plant as alternative.

In summary, the alternative 2 is not available with the Project and is excluded.

Alternative 3: Construction of other renewable energy based power plant with equivalent annual electricity generation, supplying power to the present grid.

The alternative is to construct a renewable power plant in the project location, which can generate the equivalent electricity annually as the project. However, there are not enough renewable energy resources, such as wind, bio-energy, solar, tide or terrestrial heat etc., to support the operation of power plants. Therefore, the alternative 3 is unavailable and unrealistic to the possible baseline scenario.

Alternative 4: Equivalent electricity service provided by the CCPG.

This option is one of feasible alternatives and consistent with all the mandatory laws and regulations. So the Project Option 4 is considered as one of baseline scenarios.

From the above assessment it is concluded that the Project has the only alternative available and hence the baseline scenario is: **Alternative 4–Equivalent electricity service provided by the 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:

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Assessment and demonstration of additionality

[4] Association of Chinese Power Industry, Statistics for Electricity Generation of China in 2006.

[5] Notice on Strictly Prohibiting the Installation of Fuel-fired Generators with the Capacity of 135 MW or Below issued by the General Office of the State Council, decree no. 2002-6

[6] Interim Rules on the Installation and Management of Small-scale Fuel-fired Generators (issued in Aug., 1997).

According to Appendix B of the simplified modalities and procedures for small scale CDM project activities, the simplified model is given. The project must face at least one discriminating barrier that it self can't overcome.See it as follows.

- Investment barrier;
- Technical barrier;
- Practical barrier ;
- Other barrier.

1. Investment barrier

The Stations is a run-of river, which situated in Xinhuang Dong Minority Autonomous County, a national grade poverty County with no convenient traffic and poor economic conditions. Therefore, the obstacle to the implementation of project activities is the investment 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 expansion of existing power plants or construction of new fuel-fired power plants in CCPG, and investing in a new fuel-fired power plant is irrelevant for the project to make business decision of the project owner.

Option III: Benchmark analysis. According to *Economic Assessment Rules of Small Hydropower Project SL16-95*, the financial benchmark rate of return (after tax) for Chinese small hydropower projects is 10% of the total investment, therefore the benchmark analysis is applicable to the project.

According to the*Xinhuang Small Hydropower Project Preliminary Design Report*, the IRR was only 6.37% far lower than benchmark IRR 10%, but the IRR would increase by 4%-5% if the project took into account of the CERs income.

The key assumptions are summarized in the following Table 5.

Table 5 Basic parameters for calculation of financial indicators of the project

Project	Unite	Number	Data resources
Installed Capacity	MW	7.4	Feasibility report
Total investment cost	ten thousand RMB￥	4886.6	Feasibility report
Annual Output	MWh/yr	20662.8	Feasibility report
Electricity price (Incl. VAT)	元/kWh	0.3	Feasibility report
Annual peration investment	Million RMB￥	0.85① 0.54②	Feasibility report

Annual value added tax	%	17	Feasibility report
Construction surtax	%	5	Feasibility report (on basis of VAT)
Education surtax	%	3	Feasibility report (on basis of VAT)
Income tax rate	%	33	Feasibility report
Operation period	Year	25	Feasibility report

① the Annual Operation Investment take into consideration of Anaphase Support Fund of Reservoir in the first ten years of the project operation period;

② the Annual Operation Investment without Anaphase Support Fund of Reservoir since the beginning of eleventh year of the project operation period.

The IRR with and without CERs refer to as table 6:

Table 6 Comparative table of the financial indicators with or without CERs income

Project	Unite	without CERs income	Benchmark IRR	with CERs income
				$10
IRR	%	6.37	10	10.13

After < Kyoto Protocol> became effective, the project owner began to concern about the development of CDM project, and decided to develop the hydropower project as a CDM project after particular consultation. The project owner wants to do a feasibility study report on account of CDM income so as to enhance the confidence of the investors and reduce the risk of investment. Then considering the CDM incomes, Hunan Huaihua hydro electric design institute completed the Preliminary Project Design Report on Xinhuang Xincun hydropower project by commission of the project owner[8]. According to the report, considering CDM incomes, the IRR rise to 10.13% which is higher than Benchmark IRR. And then the project owner proposes a loan application to Agriculture Bank of China. Considering the promoting effect of CDM project, the bank provides a loan to Xinhuang Xincun Small Hydropower project[9].

So according to the benchmark analysis, IRR is only 6.39% without CERs income, which were obviously below the benchmark of 10%. The project is not financially attractive. It is found that the financial situation is obviously improved under the situations with CERs income. Thus there is sufficient additionally feature for this project.

2. Sensitivity analysis

The critical assumptions for investment analysis of the project are the total investment cost, electricity-sales price, and annual operation & management cost. A sensitivity analysis in the contexts of preliminary design phase was conducted to test whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions.

Table 7 Sensitivity Analysis of the first lever power station (IRR)

[8] Hunan Huaihua hydro electric design institute, the Preliminary Project Design Report on Xinhuang Xincun hydropower project

[9] The certification of Agriculture Bank of China, Hunan Province, Xinhuang branch.

Variation rate / IRR / factor	-10%	-5%	+5%	+10%
Total investment	7.34	6.84	5.95	5.55
Electricity-sales income	5.37	5.88	6.86	7.37
Management costs	6.56	6.47	6.28	6.18

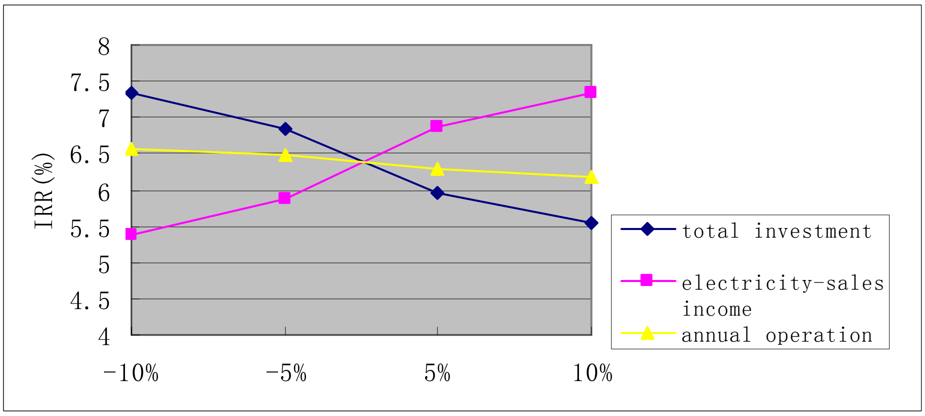

Chart 2. sensitivity analysis

Within the reasonable variation scope of the total investment, electric price and management costs, all IRRs are below the benchmark, so the project isn't financially attractive. But in the real situation, the management costs will not reduce, but increase on the opposite. During the construction of the project, the project was hardly destroyed by flood and collapse[10]. In the disaster, the water level rise to 305.5m form 299.5m, which resulted in a large collapse on the right bank of the project. The collapse was more than 80m width, 120m high and 10m depth and the volume was about 80,000m^3 which buried most part of the workshop. The disaster brought much loss to the project which aggravated finance burden. Therefore, the project hasn't enough ability against the risk, needs the CDM support to decrease the risk and improve the feasibility of the project implementation.

Conclusion:

In a summery, the project considered the financial stimulation factors under CDM mechanism before the date of starting the project. And the construction was started before improving the financial indicators of the project, thus there is sufficient additionality feature for this project.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Project Emissions

According to baseline methodology ACM0002, if the power density of project is greater than 4 W/m^2 and less than or equal to 10 W/m^2, the project emissions calculation formula is as follow:

[10] the certification of Xinhuang Dong Minority Autonomous County Bureau of Water

$$PE_y = \frac{EF_{Res} * EG_y}{1000} \qquad (1)$$

Where:

PE_y is emission from reservoir expressed as tCO_2e/yr;
ES_{Res} is the default emission factor for emissions from reservoirs, and the default value as per EB 23 is 90 kg CO_2e/MWh;
EG_y is electricity produced by the hydro electric power project in year *y*, in MWh

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:

$$BE_y=EG_y \cdot EF_y \qquad (2)$$

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 8 that installed capacity of hydropower plants constitute less than 50% of CCPG during year 2000 to 2004. 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 8 Electricity generation of hydropower plants in CCPG during year 2000～2004[11]

Year	2000	2001	2002	2003	2004
Electricity generation of hydros (%)	38.00	36.76	35.95	34.43	38.37

According to baseline methodology ACM0002, the method (a) Simple OM is chosen for calculating the $EF_{OM,y}$. The $EF_{OM,y}$ is calculated by utilizing an *ex-ante* 3 years data vintage for CCPG, the formula as follow:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad (3)$$

Where:

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *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 power sources *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 source *j*.
The CO_2 emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \qquad (4)$$

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*.

[11] China Electric Power Yearbook 2001～2005

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 2002 to 2004), the data are the newest and available at the time of this PDD submission, the detailed calculation is shown in Annex 3.

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:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \quad (5)$$

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[12] 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

$$\lambda_{Gas} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \lambda_{Oil} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad \lambda_{Gas} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad (6)$$

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 power grid in year *y*;

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

$COEF_{i,j}$ is the CO_2 emission coefficient (tCO_2/tce) of fuel *i*, taking into account the carbon content of the fuels used by the grid and the percent oxidation of the fuel in year *y*.

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

$$EF_{Thermal} = \lambda_{coal} \times EF_{coal,adv} + \lambda_{oil} \times EF_{oil,adv} + \lambda_{gasl} \times EF_{gas,adv} \qquad (7)$$

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.

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.

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:

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Data / Parameter:	NCV_i
Data unit:	GJ/t or GJ/m^3
Description:	The net calorific value (energy content) per mass or volume unit of fuel *i*
Source of data used:	*The China Energy Statistical Yearbook 2005*, Page 365, *General Code Comprehensive Energy Consumption Calculation* (GB2589-81)
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 rate 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, 10^7 m^3
Description:	The quantity of fuel *i* (in a mass or volume unit) consumed by the relevant power sources j in year(s) *y*
Source of data used:	*the China Energy Statistical Yearbook 2003-2005*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data are collected from the published official statistics.
Any comment:	

Data / Parameter:	$EGP_{j,y}$
Data unit:	MWh
Description:	The electricity quantity generated by the relevant power sources *j* in year(s) *y*
Source of data used:	*The China Electric Power Yearbook 2001-2005*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

	PR_y
Data unit:	%
Description:	The internal power consumption of power plants in year(s) *y*
Source of data used:	*The China Electric Power Yearbook 2001-2005*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	CC_{pq}
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:	Chinese DNA's Guideline of emission factors of Chinese grids
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:	tC/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:	$CAP_{j,y}$
Data unit:	MW
Description:	Installed capacities of hydropower and fuel-fired power of the CCPG during 2000-2004
Source of data used:	*the China Electric Power Yearbook 2001-2005*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data used are from Chinese authorities.
Any comment:	

Data / Parameter:	Installed Capacity
Data unit:	MW
Description:	Installed capacities of hydropower and fuel-fired power of the CCPG during 2000-2004
Source of data used:	*the China Electric Power Yearbook 2001-2005*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data are collected from the published official statistics.
Any comment:	

Data / Parameter:	CAPy,j
Data unit:	MW
Description:	the installed capacity of the y year of the fuel j in CCPG(2002~2004)

Source of data used:	*The China Electric Power Yearbook 2003-2005*
Value applied:	See Annex 3 for details.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data are collected from the published official statistics.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

>>

Project emission

According to ACM0002, the project is a run-of-river; therefore project emission is zero,

$$PE_y = 0$$

Baseline emission

As the discussion in Section B 6.1, the baseline emission factor i.e. the Combined Margin emission factor will be calculated as the average of EF_{OM} and EF_{BM} as Equation[13].

For CCPG, the Baseline Emission Factor is given as follows:

Table 9 CM calculation for CCPG (tCO_2e/MWh)

OM	BM	CM
1.2776	0.6156	0.9466

Since the annual power supply to the grid from the Project is 20,663MWh, the annual baseline emission (BE_y) of the Project is calculated as follow:

$$BE_y = 20{,}663\text{MWh} \times 0.9466\ tCO_2e\ /\text{MWh} = 19{,}560\ tCO_2\ e\ /\text{yr}$$

Leakage

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

Emission Reductions

Since both the project emission and leakage of the Project are zero, the estimated CER per year for the Project is obtained from the follows:

$$ER_y = BE_y - PE_y - L_y = 19{,}560\ tCO_2e\ /\text{yr}$$

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

>>

The estimated project emission reductions in the first crediting period are listed in Table 10:

Table 10 The ex-ante estimation of emission reductions

Year	Estimation of the	Estimation of	Estimation of	Estimation of

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

	project activity emission reductions (tonnes of CO_2e)	baseline emission reductions (tonnes of CO_2e)	leakage (tonnes of CO_2e)	emission reductions (tonnes of CO_2e)
2007/07～2007/12	0	9,780	0	9,780
2008	0	19,560	0	19,560
2009	0	19,560	0	19,560
2010	0	19,560	0	19,560
2011	0	19,560	0	19,560
2012	0	19,560	0	19,560
2013	0	19,560	0	19,560
2014/01～2014/06	0	9,780	0	9,780
Total(tones of CO_2e)	0	136,920	0	136,920

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

B.7.1 Data and parameters monitored:

Data / Parameter:	***EGy***
Data unit:	MWh
Description:	Electricity Quantity of the project to CCPG
Source of data to be used:	Measured by the ammeter
Value of data	Expected electricity quantity 20,663 MWh
Description of measurement methods and procedures to be applied:	1.Watt-hour meters are installed at the transformer substation exit, generator exits and within the powerhouse to monitor the power generated, power supplied to the grid and power consumed by itself, the data are measured continuously and are recorded automatically, the designated persons from the grid company and the project company record the power output supplied to the grid together according to the reading of the same meter at the Transformer substation exit at the end of per month. 2. the grid company and the project company together authorize a qualified unit to check the meter of measuring the power supplied to the grid quarterly at site according to "Technical Regulations for Electricity Measurement and Power Energy Metered Device Design (DL/T5137-2001) " and "Management Regulations for Power Energy Metered Device Technology (DL/T448-2000)", and the unit will take charge of the test at irregular intervals, fix breakdowns and decide whether the meters should be Exchanged to ensure the accuracy of the measurement. 3. The Operation Section of the plant will undertake the monitoring, and the Director of the operation section is the responsible person of the monitoring.
QA/QC procedures to be applied:	1. The power station's monitoring records should be identical to the selling receipts; 2. The percentage of monitoring data is 100%; 3. The written and electrical recorded data should be saved;

	4. The saving period is two years after the vintage; 5. The ammeter should be examined by a qualified institution once every year; 6. The data should be recorded by the main and auxiliary ammeters simultaneity. As if the main ammeter is failed, the auxiliary could in support.
Any comment:	With low uncertainty

B.7.2 Description of the monitoring plan:

>>

The aim of our monitoring plan is to make sure that the emission reduction quantity monitored and evaluated during the project activities' vintage is completed, consistent, clear and precise. In order to insure the project's operation, the project owner compiled "*the handbook of monitoring and management of Xinhuang Xincun Small Hyropower Project*". It has identified the duties of the related positions. 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 insure the monitor plan work effectively and efficiently, the project owner established the processing and managing structure as shown in figure 2, which identified the relative staffs and institution for data collection and preservation. In addition, the project owner will designate a monitoring commissioner to take charge of supervising and demonstrating all the measuring and recording tasks, such us collecting data (such as ammeter readings, selling receipts), calculating emissions reduction and preparing monitoring report etc..

The commissioner will receive technical supports from the Hunan CDM project service centre.

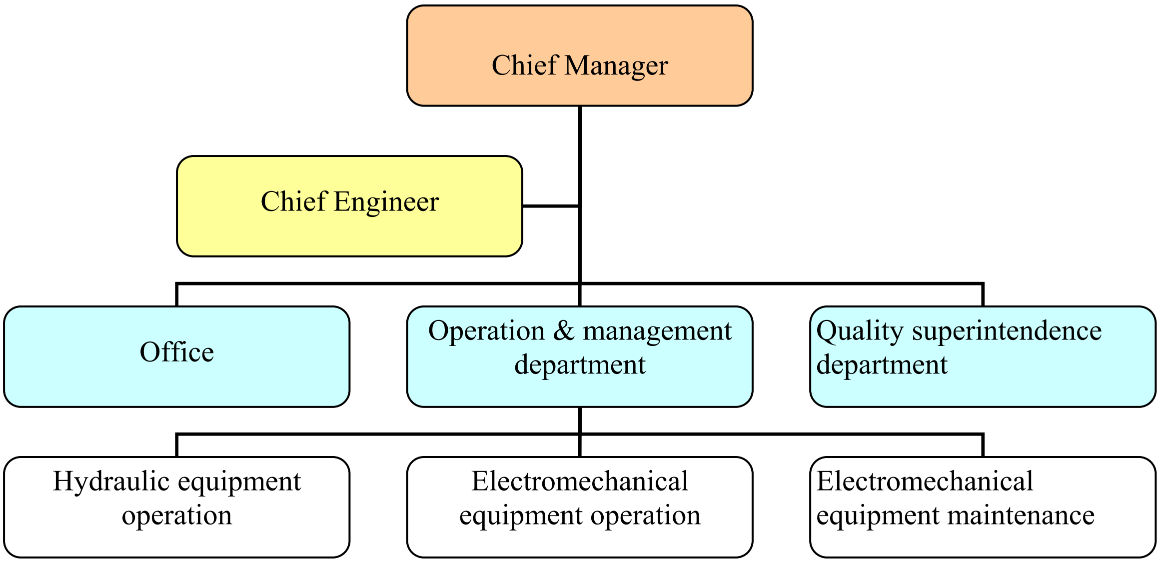

Chart 3. processing and management of project

3. Monitoring apparatus and instalment:

The electric ammeter will be configured as the technology requirements of "the handbook of electric ammeter" (DL/T448-2000). The electricity quantity apparatus should be examined and approved by the project owner and the quality control institution, which should be in accordance with the regulations on "the handbook of electric ammeter" (DL/T448-2000).

The project should simultaneity install main and auxiliary ammeters at two ends. One is installed at the output end of transfer substation(the output ammeter) of the power plants to measure the exports and imports of the electricity; and the other is installed at the input end of transfer substation of grids（the input ammeter）to measure the electricity up and down on grids. The net on-grid electricity quantity is the difference of the up and down electricity. The input ammeter readings shall be the benchmark.

In case of the main ammeter is failed, the auxiliary shall be in support. While the main and auxiliary input ammeters are both failed, the net on-grids electricity quantity offered shall be evaluated by the output ammeter readings and the selling and purchasing receipts.

4. Data monitoring

The project owner takes charge of the regular operation of output ammeter. The grids take charge of regular operation of input ammeter. All apparatus should be maintained in well states. If the error of the input ammeter is between the accepted ranges, the on-grids electricity quantity readings recorded by input ammeter can be used to afford the selling receipts and validate emission reduction. In this case, the detailed operational processes listed bellow:

i. The project owner and the power grid read and record the readings of output ammeter and input ammeter at the end of every month. Then they should verify the identity of two readings;
ii. The power grid provide the practical electricity quantity to the project owner;
iii. The project owner provide power grid with selling receipts and preserve the copies of selling receipts;
iv. The power grid provide the project owner with purchasing receipts and the project owner should preserve the copies of receipts;
v. The project owner saves records on the net on-grid electricity quantity of this project provided by the power grids, which is the difference between the up grid electricity quantity and the down grid electricity quantity;
vi. The project owner saves the reading records of the input ammeter and the copy of receipts provided by the power grids, which should be offered during the validation process conducted by the officers of DOE.

The principle of the processes is to guarantee the validation officers could obtain the actual ammeter readings and adjustment records.

5. Quality control

1) Ammeter adjustment

The ammeter periodic and on-spot periodic tests should follow the national electricity industry standards in order to insure the precision of ammeter. After the tests, the ammeter should be sealed. The project owner and the power grid should seal the ammeter collectively. Any party mustn't dismantle or change independently.

When the following circumstances occurred, all the ammeters should be tested by a qualified measurement institution in 10 days, which is commissioned collectively by the project owner and the power gird:

i. The error of output ammeter and input ammeter over the allowable ranges.

ii. The ammeter has been repaired or under repairing.

2) Data and information management

All monitoring data should be saved in electrical recording form and the electrical documents should be back in Compact Disc or Hard Disc, and printed on papers. The project owner should also keep the selling and purchasing receipts and prepare a monitoring report at the end of each year, which including the on-grid electricity quantity monitoring files, the verification files, the emission reduction evaluation files and the records on monitoring apparatus' repairs and tests.

The printed documents such as maps, forms, the environment evaluation reports shall be used in accompany with the monitoring plan to prove the authenticity of all the information. In order to make validation officers to obtain the information related to the certificated emission reduction, the project owner should provide the index of project materials and monitoring result reports.

All the monitored data should be distributed to the Hunan CDM project service centre. Moreover, the statistical works and processing works on the data collected, as well as distributing the results to the emission reduction purchaser, the DOE, and the executive board shall either be granted to the service centre.

All the data should be saved two years after the vintage.

6. Disposing process of urgency and abnormity

1) When the monitoring data is abnormal, the on-grid electricity quantity should be confirmed by the processes stated as below:

2) When the main ammeter is failed, the project owner should read and record the auxiliary ammeter data in stead and the main ammeter and auxiliary ammeter should have the same precision. The main ammeter should be repaired and replaced rapidly, and the main ammeter can't be used before it has been tested carefully.

When the main and auxiliary ammeter fails to work normally, the on-grid electricity quantity could be determined by the output ammeter readings' records and the electricity consumed by itself. The project owner should provide the method to evaluate the on-grid electricity quantity in clear and conservative ways and demonstrate the rationality to DOE.

7. Training program

Firstly, the project owner should train all the relative officers. The whole training program contains the CDM knowledge, the operational regulations, the quality control (QC) standard flows, the data recording requirements and the management rules.

If obtain further information on our monitoring plan, please refer to the *"he handbook of monitoring and management of Xinhuang Xincun Small Hyropower Project"*.

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

>>

Date of completion of the application of the baseline and monitoring methodology (*DD/MM/YYYY*)
10/04/2007
Name of the responsible person(s)/entity (ies)

Name: **Yu Cai,** expert
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Above mentioned individuals / entities who determined the baseline are not project participants.

SECTION C. Duration of the project activity / crediting period

C.1.1. Starting date of the project activity:

>>
01/12/2005(date of project start)

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

>>
25 years

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

C.2.1. Renewable crediting period

>>

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

>>
01/07/2007

C.2.1.2. Length of the first crediting period:

>>
7 years

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's Environmental Impact Assessment report (EIA) has been approved by the environmental protection research Agency of Huaihua City, China. The conclusion of the report is: the waste water, waste gas, noise and solid waste generated from the project could be eliminated or controlled by prevention and cure steps and environmental compensation system. So the negative impact to environment is small. Therefore, as the above conclusion, the project is feasible in environmental impact aspects.

And then the project obtained the Approval Letter (Huaihuanhan[2005]140) from Huaihua city, Hunan Provincial Environmental Protection Bureau.

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

Table 11 environmental impact of the project

	Impact factors		**Impact degree**	**Measures for environmental protection**
Construction period	**Waste water**	**Construction waste**	Main waste water is SS and oil mixed water, but the reservoir of Chunyantan hydropower station helps the sedimentation of SS.	(1) coagulase would be used for sedimentation of SS (2) sediment detention basin and oil detention basin would be used for oil mixed water
		Sanitary waste	Little	
	Waste gas	**Mill dust& flying dust**	Range of influence: mill dust, less than 200m;flying dust, less than 30m	(1) There would be a watering cart in construction area and watering 3 times a day during morning, noon and night (2) respirator would be prepaired for the works
		Tail gas （NO_2, CO）	lower concentration value than national standard, and distance between gas fall site and the border is less than 150m	
	Solid waste	**Waste dregs**	Waste dregs deposited at special field and would bring little impact	(1) Waste dreg field would be built on the right bank of the river , 60m down from project workshop (2) vegetation such as grass and fruit trees would be replanted at these area.
		Trash	Little	Transh producted in daily life would transport to Xinhuang garbage field.

	Noise	**Machine & vehicle noise**	mainly influence on builders	Reasonable arrangement on machine& vehicle work, and relevant measures on noise isolation& absorption
	Water lose and soil erosion		The project region will be some kind of impacted by project construction, so it will lead to water lose and soil erosion when flood happened	(1) cofferdam and soil countercheck wall would be constructed in the main construction project (2) vegetation would be planted in main project area, waste dregs field, and material exploitation area.
Operation period	**Waste water**	**Sanitary Waste& tail irrigation water**	A little adverse effects on water quality of the reservoir	Prohibition of untreated sewage discharge to reservoir
	ecosystem		Little impact(there are no migratory fish)	

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 owners regard that the proposed project will not bring significant impacts to the environment. After the completion of the project construction, the two projects will be put into operation respectively 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:

>>

Xinhuang Xincun Hydropower station Co. Ltd. made a public notice on this construction project to local residents and then held a symposium which refers to local stakeholders' comments on the project activity in the project office on Dec.20th, 2005[14]. The surveyed stakeholders include local residents as well as government officials, including different sex, different occupation, different ages and different level of education with extensive representativeness. The topics of meeting included evaluation and opinions of relevant stakeholders on social, economic and environmental impacts and benefits due to the project. Based on the records and statistics, the meeting summary was born which includes detailed time, address, participants' names, topics, etc.

E.2. Summary of the comments received:

>>

According to the symposium summary, all participants thought that the project activity would promote social and economic development in Xinhuang county, the foundation facilities can bring much convenience to residents. The project should be started, but required the project developer to do well in the following aspects.

1. Don't pour wastewater and solid waste into the river during the construction period.
2. Solve the flying dust pollution problem caused by vehicles.
3. Handle noise impacts.
4. Build water-shield slopes to keep banks from collapsing.
5. The power lines for construction power consumption should not overlap the lines for life power consumption of villagers, so as to avoid causing power shortage.
6. Do the project construction with water-and-soil conservation measures

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

>>

Considering the above-mentioned comments, the project developer promises to take the following resolutions.

1. Do the construction work in accordance with environmental protection request. Specifically, the waste water would be poured after treatment and the project will build an accident pool to reduce the risk.
2. The solid waste would be carried away to a putter field in about 60m down stream of the project for professional treatment, and will do the vegetation replanted project;
3. Pour water on dry and sandy road to prevent dust;
4. Set acoustic shield around the machines with high decibel such as mixer.
5. A special power line will be built for construction power consumption, in order to avoid conflicting of local daily life power consumption with construction power consumption.
6. Do the construction work with water-and-soil conservation measures; Build one water-shield slope with length beyond 300m at the downstream site[15].

---

[14] Stakeholders Meeting of Xinxun Small Hydropower Project, China

[15] Xinhuang Xincun hydropower water and soil preserve project

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Xinhuang Xincun Hydropower Co., Ltd.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

ANNEX 3
BASELINE INFORMATION[16]

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

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

Fuel	Low Calorific Value	Emission Factor (tCO_2/TJ)	Oxidation Factor
Raw Coal	20908 kJ/kg	94.6	100%
Cleaned Coal	26344 kJ/kg	94.6	100%
Other Washed Coal	8363 kJ/kg	94.6	100%
Coke	28435 kJ/kg	107	100%
Crude Oil	41816 kJ/kg	73.3	100%
Gasoline	43070 kJ/kg	69.3	100%
Diesel Oil	42652 kJ/kg	74.1	100%
Fuel Oil	41816 kJ/kg	77.4	100%
Natural Gas	38931 kJ/m^3	56.1	100%
Coke Oven Gas	16726 kJ/m^3	44.4	100%
Other Gas	5227 kJ/m^3	44.4	100%
LPG	50179 kJ/kg	63.1	100%
Refinery Dry Gas	46055 kJ/kg	57.6	100%

Data Source:

The net calorific values are quoted from *China Energy Statistical Yearbook 2005, Page 365.*

The emission factors are quoted from *Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories* , Table 2.2, Page 2.16, Chapter 2, Volume 2.

The default oxidation factor is assumed to be 1 on Page 2.6, Chapter 2, Volume 2 of *Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

[16] Chinese DNA's Guideline of emission factors of Chinese grids, 2006.12.05

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

Table A2 Simple OM Emission Factors Calculation of CCPG for Year 2002

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total	EF	Oxidation	Average Low Calorific Value	CO_2 Emission (tCO_2e)
									(tCO_2/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J /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 /1000 (for volume unit)
Raw Coal	10^4 t	1062.63	4679.02	1710	1113.78	398.57	1964.32	10928.32	94.6	100	20908	211827873.7
Cleaned Coal	10^4 t	2.72						2.72	94.6	100	26344	66430.54781
Other Washed Coal	10^4 t	3.66	26.49			249.99		280.14	94.6	100	8363	2171973.055
Coke	10^4 t		1.15					1.15	107	100	28435	34289.48215
Coke Oven Gas	10^8 m^3			1.11				1.11	44.4	100	16726	82432.4184
Other Gas	10^8 m^3		2.16					2.16	44.4	100	5227	50129.0208
Crude Oil	10^4 t		0.67	1.17			0.81	2.65	73.3	100	41816	81225.4892
Diesel Oil	10^4 t	1	1.34	1.08	2.19	0.51	0.51	6.63	74.1	100	42652	209542.0252
Fuel Oil	10^4 t	0.33	0.16	0.34	0.69		1.51	3.03	77.4	100	41816	98067.71952
LPG	10^4 t		0.02					0.02	63.1	100	50179	633.25898
Refinery Dry Gas	10^4 t	0.49			1.9			2.39	57.6	100	46055	64992.816
Natural Gas	10^8 m^3						1.75	1.75	56.1	100	38931	382205.0925
											Total	**215069794.7**

Data Source: *China Energy Statistical Yearbook 2000-2002*

Table A3 Fuel-fired Electricity Generation of CCPG for Year 2002

Province	Electricity Generation	Electricity Generation	Auxiliary Power Ratio	Supplied Electricity
	(10^8 kWh)	(MWh)	(%)	(MWh)
Jiangxi	186.48	18648000	7.67	17217698
Henan	847.34	84734000	8.03	77929860
Hubei	343.01	34301000	7.73	31649533
Hunan	200.58	20058000	7.73	18507517
Chongqing	147.27	14727000	10.21	13223373
Sichuan	278.79	27879000	9.59	25205404
Total				183733385

Data Source: *China Electric Power Yearbook 2003*

According to table A2, the total CO_2 emissions of CCPG is 219439194 tCO_2e in year 2002. According to table A3, the total supplied electricity of CCPG is 183733384.7 MWh. According to formula (3) in section B.6.1, the $EF_{OM, Simple, 2002}$ is 1.1943349 tCO_2e/MWh.

Table A4 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)
									(tCO_2/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J /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 /1000 (for volume unit)
Raw Coal	10^4 t	1427.41	5504.94	2072.44	1646.47	769.47	2430.93	13851.66	94.6	100	20908	273971539.9
Cleaned Coal	10^4 t							0	94.6	100	26344	0
Other Washed Coal	10^4 t	2.03	39.63			106.12		147.78	94.6	100	8363	1169146.396
Coke	10^4 t				1.22			1.22	107	100	28435	37119.049
Coke Oven Gas	10^8 m^3			0.93				0.93	44.4	100	16726	69064.9992
Other Gas	10^8 m^3							0	44.4	100	5227	0
Crude Oil	10^4 t		0.5	0.24			1.2	1.94	73.3	100	41816	59463.18832
Diesel Oil	10^4 t	0.52	2.54	0.69	1.21	0.77		5.73	74.1	100	42652	181097.4064
Fuel Oil	10^4 t	0.42	0.25	2.17	0.54	0.28	1.2	4.86	77.4	100	41816	157296.7382
LPG	10^4 t							0	63.1	100	50179	0
Refinery Dry Gas	10^4 t	1.76	6.53		0.66			8.95	18.2	100	46055	75018.9895
Natural Gas	10^8 m^3					0.04	2.2	2.24	56.1	100	38931	489222.5184
											Total	**276208969.2**

Data Source: *China Energy Statistical Yearbook 2004*

Table A5 Fuel-fired Electricity Generation of CCPG for Year 2003

Province	Electricity Generation (10^8 kWh)	Electricity Generation (MWh)	Auxiliary Power Ratio (%)	Supplied Electricity (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 A4, the total CO_2 emissions of CCPG is **276208969.2** tCO_2e in year 2003. According to table A5, the total supplied electricity of CCPG is 225987719.2 MWh. According to formula (3) in section B.6.1, the $EF_{OM, Simple, 2003}$ is 1.22223 tCO_2e/MWh.

Table A6 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)
									(tCO_2/TJ)	(%)	(MJ/t,km^3)	K=G*H*I*J /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 /1000 (for volume unit)
Raw Coal	10^4 t	1863.8	6948.5	2510.5	2197.9	875.5	2747.9	17144.1	94.6	100	20908	339092605.3
Cleaned Coal	10^4 t		2.34					2.34	94.6	100	26344	58316.13216
Other Washed Coal	10^4 t	48.93	104.22			89.72		242.87	94.6	100	8363	1921441.232
Coke	10^4 t		109.61					109.61	107	100	28435	3334933.575
Coke Oven Gas	10^8 m^3			1.68		0.34		2.02	44.4	100	16726	150012.1488
Other Gas	10^8 m^3					2.61		2.61	44.4	100	5227	60572.5668
Crude Oil	10^4 t		0.86	0.22				1.08	73.3	100	41816	33103.21824
Gasoline	10^4 t		0.06			0.01		0.07	69.3	100	43070	2089.3257
Diesel Oil	10^4 t	0.02	3.86	1.7	1.72	1.14		8.44	74.1	100	42652	266747.3141
Fuel Oil	10^4 t	1.09	0.19	9.55	1.38	0.48	1.68	14.37	77.4	100	41816	465093.4421
LPG	10^4 t							0	63.1	100	50179	0
Refinery Dry Gas	10^4 t	3.52	2.27					5.79	57.6	100	46055	153595.2672
Natural Gas	10^8 m^3						2.27	2.27	56.1	100	38931	495774.6057
											Total	**346034284.1**

Data Source: *China Energy Statistical Yearbook 2005*

Table A7 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 A6, the total CO_2 emissions of CCPG is 346034284.1 tCO_2e in year 2004. According to table A7, the total supplied electricity of CCPG is 249074186 MWh. According to formula (3) in section B.6.1, the $EF_{OM, Simple, 2004}$ is 1.389282 tCO_2e/MWh.

The Operating Margin (OM) emission factor is the weighted average emission factors of year 2002-2004, as follow:

$$EF_{OM} = 1.2776\ tCO_2e/MWh$$

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 (tCO_2/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/100
Raw Coal	10^4 t	1863.80	6948.50	2510.50	2197.9	875.50	2747.90	17144.1	20908 kJ/kg	94.6	100%	339092605.3
Cleaned Coal	10^4 t	0	2.34	0	0	0	0	2.34	26344 kJ/kg	94.6	100%	58316.13216
Other Washed Coal	10^4 t	48.93	104.22	0	0	89.72	0	242.87	8363 kJ/kg	94.6	100%	1921441.232
Coke	10^4 t	0	109.61	0	0	0	0	109.61	28435 kJ/kg	107	100%	3334933.575
Subtotal												**344407296.2**
Crude Oil	10^4 t	0	0.86	0.22	0	0	0	1.08	41816 kJ/kg	73.3	100%	33103.21824
Gasoline	10^4 t	0	0.06	0	0	0.01	0	0.07	43070 kJ/kg	69.3	100%	2089.3257
Diesel Oil	10^4 t	0.02	3.86	1.70	1.72	1.14	0	8.44	42652 kJ/kg	74.1	100%	266747.3141
Fuel Oil	10^4 t	1.09	0.19	9.55	1.38	0.48	1.68	14.37	41816 kJ/kg	77.4	100%	465093.4421
Subtotal												**767033.3001**
Natural Gas	10^7 m^3	0	0	0	0	0	22.7	22.7	38931 kJ/m^3	56.1	100%	495774.6057
Coke Oven Gas	10^7 m^3	0	0	16.8	0	3.4	0	20.2	16726 kJ/m^3	44.4	100%	150012.1488
Other Gas	10^7 m^3	0	0	0	0	26.1	0	26.1	5227 kJ/m^3	44.4	100%	60572.5668
LPG	10^4 t	0	0	0	0	0	0	0	50179 kJ/kg	17.2	100%	0
Refinery Dry Gas	10^4 t	3.52	2.27	0	0	0	0	5.79	46055 kJ/kg	57.6	100%	153595.2672
Subtotal												**859954.5885**
Total												**346034284.1**

Data Source: *China Energy Statistical Yearbook 2005*

According to table A8 and formula (6) 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:

$$\lambda_{Coal} = 99.53\%,\quad \lambda_{Oil} = 0.22\%,\quad \lambda_{Gas} = 0.25\%$$

Due to the sum of λ_{Oil} and λ_{Gas} account for only 0.47% 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	tCO_2/TJ	94.6	The data is derived from IPCC2006
Oxidation factor of coal	/	100%	The data is derived from IPCC2006

The $EF_{Thermal}$ is 0.8819 tCO_2e/MWh

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

Table A10 Installed Capacities of CCPG in Year 2004

Installed Capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Fuel-fired	MW	5496	21788.5	9509.3	6779.5	3271.1	6900.3	53744.7
Hydro	MW	2549.9	2438	7415.1	7448.2	1407.9	13382.9	34642
Nuclear	MW	0	0	0	0	0	0	0
Wind & Others	MW	0	0	0	0	0	0	0
Total	MW	8045.9	24226.5	16924.4	14227.8	4679	20283.2	88386.8

Data Source: *China Electric Power Yearbook 2005*

Table A11 Installed Capacities of CCPG in Year 2001

Installed Capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Fuel-fired	MW	4869.8	15349	8077.3	4997.8	2898.3	6377	42569.2
Hydro	MW	2067.8	2438	7125.6	5966.1	1268	11531.5	30397
Nuclear	MW	0	0	0	0	0	0	0
Wind & Others	MW	0	0	0	0	0	0	0
Total	MW	6937.6	17787	15202.9	10963.8	4166.3	17908.5	72966.1

Data Source: *China Electric Power Yearbook 2002*

Table A12 Installed Capacities of CCPG in Year 2000

Installed Capacity	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Total
Fuel-fired	MW	4474.3	13789	8038.8	4477.4	2995	6090.1	39864.6
Hydro	MW	1846	1528	7070.5	5858	1327	11008.3	28637.8
Nuclear	MW	0	0	0	0	0	0	0
Wind & Others	MW	0	0	0	0	0	0	0
Total	MW	6320.3	15317	15109.3	10335.4	4322	17098.4	68502.4

Data Source: *China Electric Power Yearbook 2001*

Table A13 Installed Capacity from Year 2000-2004

	Year 2000	Year 2001	Year 2004	New Capacity Additions from Year 2000-2004	Percentage of New Capacity Additions
	A	B	C	D=C-A	
Fuel-fired (MW)	39864.6	42569.2	53744.7	13880.1	69.80%
Hydro (MW)	28637.8	30397	34642	6004.2	30.20%
Nuclear (MW)	0	0	0	0	0.00%
Wind & Others (MW)	0	0	0	0	0.00%
Total （MW）	68502.4	72966.2	88386.7	19884.3	100.00%
Percentage of Year 2004	77.5%	82.55%	100%	22.50%	

It can be concluded from table A13 that capacity additions from year 2000 to 2004 is closer to 20% of the total additions and it is obvious the capacity additions during year 2000 to 2004 are larger than the capacity of five plants, so year 2000 and 2004 are chosen to calculate the BM emission factor of CCPG.

According to table A13 and formula (8) in section B.6.1, the EF_{BM} is calculated as:

$$EF_{BM} = 0.6156 \text{ tCO}_2\text{e/MWh}$$

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:

$$EF_y = 0.9466 \text{ tCO}_2\text{e/MWh}$$

Annex 4

MONITORING INFORMATION

The monitoring plan of the Project was described in Section B.7.2, and hence will not be repeated here. Please refer to section B.7.2 and *the handbook of monitoring and management of Xinhuang Xincun Small Hyropower Project* for more details.

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