



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

Title: Yunnan Mangli Hydropower Project

Version: 02

Date: 28/12/2010

A.2. Description of the project activity:

The proposed Yunnan Mangli Hydropower Project (referred to the “proposed project” hereafter) is located on Mangshi River in Luxi City, Yunnan Province, P. R. China. The proposed project is developed and operated by Datang Mangli Hydropower Development Company Limited.

The implementation of the proposed project will achieve CO₂ emission reduction by replacing electricity generated by fossil fuel fired power plants. The purpose of the proposed project is to generate hydro power and deliver it to China Southern Power Grid (CSPG). For the proposed project, the scenario existing prior to the start of the implementation of the project activity is the CSPG providing the same electricity service as the proposed project. The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity.

The proposed project involves the installation of 2 turbines, each of which has a rated output of 18MW, providing a total capacity of 36MW. The annual grid-connected output of the proposed project is estimated to be 143,652¹MWh. The electricity to be generated will be sold to the CSPG. The project will help reduce GHG emissions generated from the high-growth, coal-dominated power generation. The estimated annual GHG emission reductions are 113,189tCO₂e.

The proposed project will contribute to the sustainable development of the host country through the following aspects:

- Reducing the emission of other pollutants resulting from local coal-based power plants compared to a business-as-usual scenario;
- Alleviating local supply shortfalls of electricity (the CSPG is a net importer of electricity);
- Creating approximately 10² employment opportunities during the project operation and construction.

A.3. Project participants:

Name of Party involved (*) (host indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered
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¹The electricity consumption for internal use and transmission loss is estimated to be 1.5% in *The Supplementary Feasible Report*

² *The Supplementary Feasible Report*



		as project participant (Yes/No)
People's Republic of China (host)	Datang Mangli Hydropower Development Company Limited (Project Owner)	No
Japan	Sumitomo Corporation	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.		

Please see Annex 1 for detailed contact information.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

People's Republic of China

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

Yunnan Province

A.4.1.3. City/Town/Community etc:

Zhefang Town, Luxi City, Dehong Prefecture

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

The centre of the project site is located on Mangshi River, in Luxi City of Yunnan Province. The exact geographical coordinates of the blocking dam are 98.3145° East longitude and 24.3083° North latitude. The proposed project is 38 km away from Mangshi City (capital of Dehong Prefecture) .

Figure A-1 shows the location of the proposed project.

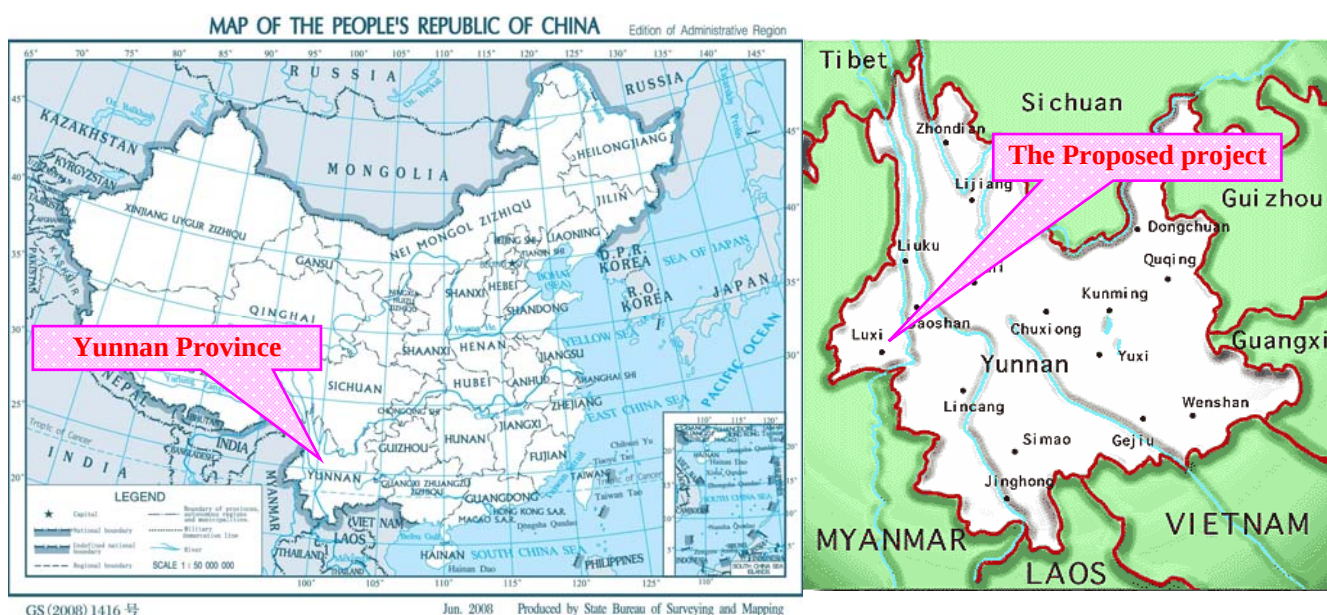


Figure A-1: Location of the proposed project

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

Category: Grid-connected electricity generation from renewable energy sources

Sectoral scope 1: energy industries

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

The purpose of the proposed project is to generate hydro power and deliver it to CSPG. For the proposed project:

- The scenario existing prior to the start of the implementation of the project activity is CSPG providing the same electricity service as the proposed project;
- The project scenario is the implementation of the proposed project which is a hydropower station with the total installed capacity of 36MW. The hydro-junction essentially consists of the water retaining structure (barrage), the sluice works, as well as the water intake and power generation system. The sluice works include free overflow spillway, flood discharging tunnel and desalting tunnel. Two turbines and two generators have been installed. It is expected that the annual electricity delivered to the grid is 143,652MWh to CSPG and replace the same amount of electricity generated by fossil fuel fired power plants connected to CSPG, the lifetime of the project is 28 years which include 3 years for construction and 25 years for operation.
- The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity.

The main parameters of the turbine and generator units are listed in the Table A-1.



Table A-1 Technical information of the turbine and generator units

Parameters		Value
Turbine	Amount	2
	Designation	HLA551c-LJ-262
	Rated Power	18.66 MW
	Rated Water Head	37 m
	Rated Flow Rate	55.42 m ³ /s
	Rated Rotational Speed	200 r/min
Generator	Amount	2
	Designation	SF18-30/5050
	Rated Capacity	18 MW
	Rated Voltage	10.5kV
	Rated Rotational Speed	200 r/min

*The model and the main parameters of the turbine and generator units have been updated to the actual ones based on the actual situation.

All the technology of project activity doesn't involve technology transfer.

The main equipments, such as the turbines and other equipments are made in China. The Chinese domestic manufacturers have the ability to produce the turbines and relevant facilities.

The annual electricity generation would be 145,840 MWh which made the annual operation hour of the project would be 4051 hours(145,840MWh/36MW), and the PLF is 0.462(4051/8760) determined by SFSR.

The project connected to the on-site 110kV step-up substation. The power in the 110kV step-up substation is transmitted to the Zhefang substation. Then the electricity generated is transmitted to the CSPG. Therefore the proposed project can replace electricity generated from fossil fuel fired power plant connected to the Grid and reduce GHG emissions. As a result, 113,189 tCO₂ emission reductions will be generated annually.

The project facility could be monitored and controlled by onsite central control room and the net electricity delivered to the grid is measured by electronic meters with accuracy of 0.5 or higher.

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

The estimated annual emission reduction of the project activity in the first crediting period is 113,189 tCO₂ and total estimated reductions are 792,323 tCO₂.

Year	Annual estimation of emission reductions(tCO ₂ e)
01/07/2011-31/12/2011	565,95
2012	113,189
2013	113,189



2014	113,189
2015	113,189
2016	113,189
2017	113,189
01/01/2018-30/06/2018	565,95
Total estimated reductions(tCO ₂ e) during the first crediting period	792,323
Total number of crediting years	7
Annual average of estimated reductions over the crediting period(tCO ₂ e)	113,189

A.4.5. Public funding of the project activity:

There is no public funding from Annex I Parties for this Project.

SECTION B. Application of a baseline and monitoring methodology**B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

Version 12.1.0 of ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 12.1.0, Sectoral Scope: 01, EB58)³

Version 02 of the tool to calculate the emission factor for an electricity system (Version 02.1/EB 50/Annex 14)²

Version 05.2 of the tool for demonstration and assessment of additionality (Version 05.2/EB 39/Annex10)²

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The approved methodology ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” is applicable to the proposed project activity, because:

- (1) The proposed project is a grid-connected renewable power generation that install a new hydro power plant at a site where no renewable power plant was operated prior to the implementation of the project activity
- (2) Based on the Feasibility Study Report, the proposed project results in the new reservoir. As mentioned before, its installed capacity is 36 MW and the surface area of full reservoir 2.975² million m². Thus the Power Density (PD) is equal to 12.1 W/m² greater than 4 W/m².
- (3) The proposed project does not involve switching from fossil fuels to renewable energy at the site of the project activity.
- (4) The monitoring methodology is used in conjunction with the approved baseline methodology ACM0002, and the proposed project has adopted the baseline methodology ACM0002.

Therefore, the approved consolidated baseline methodology, ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” is applicable to the proposed project.

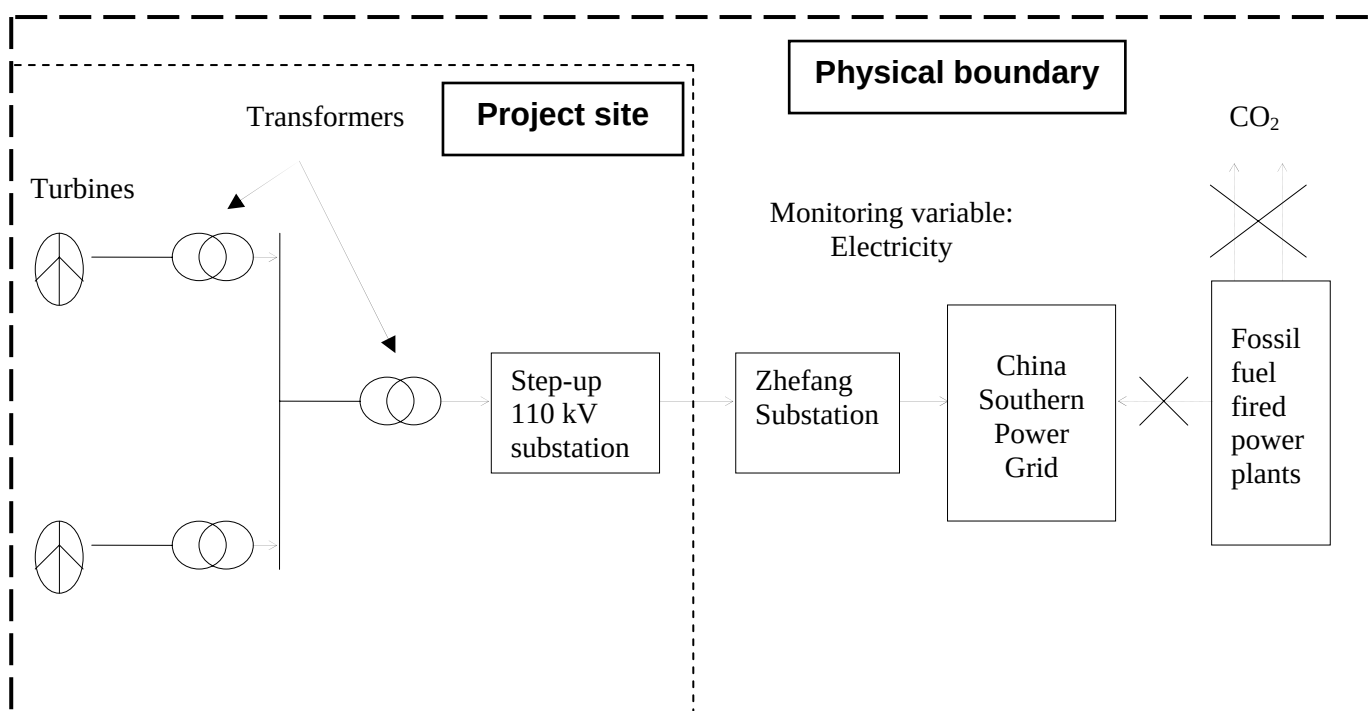
³ <http://cdm.unfccc.int/methodologies/approved>

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

The spatial extent of the project boundary includes the project power plant and all the power plants connected physically to the CSPG that the project is connected to. Electricity generated by the project will be delivered to the CSPG. According to the China Regional Grid Baseline Emission Factors issued by China's DNA which provides the delineation of grid boundaries, the CSPG is the grid boundary of the project.

	Source	Gas	Included?	Justification/Explanation
Baseline	Electricity generation in fossil fuel fired power that is dispatched due to the project activity	CO ₂	Yes	Main emission source and the only gas identified in the baseline methodology
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
Project Activity	Proposed project	CO ₂	No	Zero-emissions grid-connected electricity generation from renewable energy as per the Methodology
		CH ₄	No	Main emission source, however, as the project's power density is 12.1W/m ² , which is greater than 10 W/m ² , the project emissions are excluded.
		N ₂ O	No	Zero-emissions grid-connected electricity generation from renewable energy as per the Methodology

The flow diagram of the project boundary is delineated as FigureB-1:



FigureB-1 The flow diagram of the project

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

Referring to the provision in the approved baseline methodology ACM0002, since the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario can be identified as following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculated described in the “Tool to calculate the emission factor for an electricity system”.

According to “Tool to calculate the emission factor for an electricity system” (EB 50/Annex 14), since Chinese DNA has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. The electricity generated by the proposed project will be sold to the CSPG. Therefore, the CSPG will be considered as the “project electricity system”, while Central China Power Grid (CCPG) as the “connected electricity system”. Consequently, the baseline scenario of the proposed project can be described as following:

Electricity delivered to the grid by the proposed project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources within China Southern Power Grid, as reflected in the combined margin (CM) calculated described latter.

The above baseline scenario would be applied to calculate the GHGs emission reductions in Section B.6.

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):**

The incentive from the CDM was seriously considered in the decision to proceed with the project activity.

The proposed project was owned by Deyuan Electric Power Development Co., Ltd. (the former project owner) in 2006 and the construction began on 28//10/2006⁴, but due to the bad geological conditions⁵ and the increasing investment, the investment return was much lower than expected, the former project owner lost their confidence to continue investing and had no choice but to stop the construction on Jan, 2007⁴ due to fund shortage.

The project owner (Datang Mangli Hydropower Development Company Limited) had been aware of CDM from the first hydro CDM project in Yunnan province on Mar. 2007(Ref:0791), after careful consideration and the preliminary financial assessment, the project owner found that although the financial rate of return of the project would be very low and the project wouldn't be attractive without CDM revenue, but there were the possibility of obtaining the CDM revenue which would improve the financial situation of the project. In this case, the project owner signed the consulting contract with a consultant company on 25/06/2007, with the confidence of the increasing income from CDM revenue; the project owner signed the Assignment Agreements of 51% of the total shares with the former project owner on 07/08/2007.

The Supplementary Feasible Report of the project (SFSR) was completed on Apr, 2008 by the independent and certified “Kunming Survey and Design Institute of Water Resources and Hydropower” (It has obtained a “grade A” in electric power design industry issued by the Ministry of Construction of the People’s Republic of China), and was approved by Provincial Development & Reform Committee of Yunnan on 21/11/2008⁶.

Based on the financial analysis in SFSR, the project owner hold a board meeting to make the decision that the CDM revenue should be brought to improve the financial situation of the project on 21/06/2008. With confidence in the revenue from CDM, the project owner signed the contract of construction on 30/06/2008 and the equipment purchase contract (EPC) with the suppliers on 18/08/2008, and the construction restarted on 02/07/2008. The date at which the contract of construction was signed had been chosen to be the starting date as the earliest of the date at which the real action of the project activity begins.

Unfortunately, due to lack of the developing experience of the consultant company, the PDD was delayed again and again. The project owner lost their patient, stopped the contract with the former consultant and signed with CWEME (China National Water Resources & Electric Power Material & Equipment Co., Ltd) on 28/06/2008. In 2009, Sumitomo Corporation showed their interest in the proposed project and signed the Emission Reduction Purchase Agreement (ERPA) with the project owner on 26/02/2009, the LoA

⁴ Notification from Kunming Construction Consulting Supervision Company

⁵ www.bjefj.com.cn/Old/upfiles/200714154134157.doc

⁶ Yun Fagai Nengyuan [2008] No.1962



from China and Japan were got on 09/04/2009 and 06/07/2009. The PDD of the proposed project had been public for global stakeholder on August, 2010

The following is a combined timeline of implementation of the proposed project and events and actions taken to achieving CDM registration.

Date	Key Event
April, 2005	The Feasible Report of the project (FSR) was completed
27/06/2006	The FSR was approved by Provincial Development & Reform Committee of Yunnan
28/10/2006	The construction began.
29/01/2007	Deyuan Electric Power Development Co., Ltd. lost their confidence to continue investing and had no choice but to stop the construction due to fund shortage.
25/06/2007	The project owner signed the consulting contract with a consultant company.
07/08/2007	The project owner signed the Assignment Agreements of 51% of the total shares with Deyuan Electric Power Development Co., Ltd.
April, 2008	<i>The Supplementary Feasible Report</i> of the project (SFSR) was completed.
21/06/2008	The project owner held a board meeting to make the decision that the CDM revenue should be brought to improve the financial situation of the project.
28/06/2008	The project owner stopped the contract with the former consultant and signed with CWEME.
30/06/2008	The project owner signed the contract of construction
02/07/2008	The construction restarted
18/08/2008	The equipment purchase contract (EPC) with the suppliers
21/11/2008	The SFSR was approved by Provincial Development & Reform Committee of Yunnan
30/06/2008	The project owner signed the contract of construction
18/08/2008	The equipment purchase contract (EPC) with the suppliers
26/02/2009	The project owner signed Emission Reduction Purchase Agreement (ERPA) with Sumitomo Corporation.
09/04/2009	The LoA from China was got.
06/07/2009	The LoA from Japan was got.
Feb, 2010	The construction of the project finished.
August, 2010	The PDD of the proposed project had been public for global stakeholder

The project uses the *Tool for the Demonstration and Assessment of Additionality* (version 05.2), which was revised in the EB 39, to demonstrate its additionality. The tool includes the following steps:

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

Define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

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

Realistic and credible alternative(s) available to the proposed project that provides outputs or services comparable with the proposed CDM project activity include:

- a) The proposed project itself, but not undertaken as a CDM project activity



- b) Construction of a coal-fired power plant with equivalent installed capacity or annual electricity generation.
- c) Construction of a power plant using other renewable energy, such as wind and biomass power plant with equivalent installed capacity or annual electricity generation.
- d) Equivalent electricity service provided by the CSPG.

In China, biomass power generation technology is still in the demonstration phase and can bring only poor economic benefits, which is difficult to be operated without policies & financial support. Besides hydro energy, solar PV, geothermal, biomass and wind energy are the possible grid-connected renewable energy technologies that could be applied in China. Due to the technology development status and the high cost for power generation, solar PV, geothermal and biomass for the similar installed capacity as the proposed project are alternatives far from being attractive investment in the grid in China⁷. Additionally, there are no usable wind resources near the site of the Project Activity⁸. Therefore Alternative c) is not feasible.

Outcome of Step 1a: Identified realistic and credible alternative scenario(s) to the project activity

Four realistic and credible alternatives to the project activity are identified and one is excluded.

Sub-step 1b. Consistency with mandatory laws and regulation:

- a) The proposed project itself, but not undertaken as a CDM project activity

The Chinese Government encourages and promotes hydro power development through China Renewable Energy Law, regulations and preferential policies⁹. Alternative a) is in compliance with legal and regulatory requirements.

- b) Construction of a coal-fired power plant with equivalent installed capacity or annual electricity generation.

The capacity of the proposed project is 36MW, with annual estimated net generation of 143,652 MWh per year. If a fossil fuel power plant is built with the same annual electricity generation as the proposed project, considering the average operation hour (5360.75 hours) of fossil fuel power plants in Yunnan Grid¹⁰, the installed capacity of a fossil fuel power plant is built with the same annual electricity generation is calculated as 26.8 MW (143,652 MWh/5360.75h), far less than 135MW. Based on the

⁷ http://www.ce.cn/cysc/ny/dl/200706/28/t20070628_11978768.shtml

<http://finance.people.com.cn/GB/1038/59942/59949/6294546.html>

http://www.168report.cn/Product_Detail_P_ID_32040920.html

⁸ <http://baike.baidu.com/view/1197098.htm>

⁹ <http://www.chinapower.com.cn/article/1021/art1021546.asp>

¹⁰ China Electric Power Yearbook 2008 Page736~743



regulations¹¹ by Chinese government, it is prohibited to construct fossil fuel power plants with the installed capacity less than 135 MW.

According to Chinese power regulations, fossil fuel fired power plants of less than 135MW are prohibited for construction in the areas covered by large grids. Alternative b) is not in compliance with Chinese regulations. Therefore, b) is not a realistic and credible alternative.

c) Construction of a power plant using other renewable energy with equivalent installed capacity or annual electricity generation

Alternative c) is in compliance with legal and regulatory requirement; however, it is excluded from baseline scenario in sub-step 1a with reasonable explanation.

d) Equivalent electricity service provided by the CSPG.

Alternative d) is in compliance with legal and regulatory requirements.

Outcome of Step 1b:

Mandatory legislation and regulations to each alternative are taken into account in sub-step 1b. Based on the above analysis, the proposed project activity is not the only alternative amongst the project participants that is in compliance with mandatory regulations with which there is general compliance. Therefore, the proposed CDM project activity may be additional.

Step 2. Investment Analysis

Determine whether the proposed project activity is not:

The most economically or financially attractive; or

Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs)

To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

The Tool for the Demonstration and Assessment of Additionality recommends three analysis methods, including simple cost analysis (Option I), investment comparison analysis (Option II) and benchmark analysis (Option III).

The proposed Hydro Power Project generates financial and economic benefits through the sales of electricity other than CDM related income therefore the simple cost analysis (Option I) cannot be taken. And the investment comparison analysis (Option II) is only applicable to projects where alternatives should be similar investment projects. The alternative baseline scenario of the proposed project is the continuation of China Southern Power Grid, rather than a new investment project. Out of the investment comparison analysis (Option II) and the benchmark analysis (Option III), the benchmark analysis (Option III) shall be chosen.

¹¹ State Council Office, 2002-04-15. Notice on Strictly Prohibiting the Installation of Thermal Power Plant with the Capacity less than 135MW. GuoBanFaMingDian [2002]6.
<http://www.gov.cn/gongbao/content/2002/content_61480.htm>

**Sub-step 2b. Option III. Apply benchmark Analysis**

In accordance with *Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects* issued by former State Power Corporation of China in 2002, the financial benchmark IRR (Total investment Internal Rate of Return) is regulated as 8% (after income tax) for Chinese electricity industry, which has been used widely in feasibility studies of new power plants, including hydro power projects in China. When the total investment IRR of the project is above or equal to this benchmark IRR, the proposed project is considered to be financially feasible. The proposed project is a newly built hydropower project, so it also adopts 8% as the benchmark for total investment IRR.

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

1) Parameters needed for calculation of key financial indicators

According to approved *The Supplementary Feasible Report*, parameters needed for calculation of key financial indicators are as follows:

Table B-1 Basic Parameters for Financial Analysis

Items	Unit	Value	Data Source
Installed Capacity	MW	36	SFSR
Total investment	Million RMB	285.27	SFSR
Static investment	Million RMB	267.38	SFSR
The cost before the construction resume which considered as “sunk cost”	Million RMB	31.10	Assignment Agreements
Annual operation hour	Hour	4,051	SFSR
Annual electricity generation	MWh	145,840	SFSR
Annual electric output	MWh	143,652	SFSR
Annual electric output(wet period)	MWh	109,778	SFSR
Annual electric output(dry period)	MWh	33,874	SFSR
Tariff including VAT(RMB/MWh, wet period)	RMB/KWh	0.15	SFSR
Tariff including VAT(RMB/MWh, dry period)	RMB/KWh	0.20	SFSR
Operational lifetime	Year	25	SFSR
Income tax rate	%	25	SFSR
Value-add tax rate	%	6	SFSR
Residual value rate	%	5	SFSR
Surtax for education expenses	%	3	SFSR
city maintenance tax	%	1	SFSR



Depreciation rate	%	3.8	SFSR
Welfare rate	%	49.5	SFSR
Employee number		10	SFSR
Maintenance cost rate	%	1	SFSR
Insurance cost rate	%	0.25	SFSR
Material cost	RMB/kW	5	SFSR
Reservoir maintenance fund rate	RMB/kWh	0.006	SFSR
Other expenses rate	RMB/kW	12	SFSR
Water resources fee rate	RMB/kW	0.004	SFSR
Long term interest rate	%	6.12	SFSR
Selected crediting period		Renewable	SFSR
Expected CERs price	EUR/tCO ₂	10.5	Expected
Exchange rate		10.7:1	Expected

2) Comparison of IRR for the proposed project and the financial benchmark

In accordance with benchmark analysis (Option III), if the financial indicators of the proposed project, such as the project IRR, are lower than the benchmark, the proposed project is not considered to be financially attractive.

Table B-2 shows the project IRR of the proposed project with and without the sales of CERs. Without the sales of CERs the project IRR is 4.46% which is lower than the financial benchmark. Thus the proposed project is not considered to be financially attractive.

However, taking into account the CDM revenues, the project IRR is 10.56% which is higher than the financial benchmark. Therefore the CDM revenues enable the project to overcome the investment barrier and demonstrate the additionality of the proposed project.

Table B-2 Project IRR of the proposed project

IRR (without CERs revenue)	4.46%
IRR(with CERs revenue)	10.56%

Sub-step 2d. Sensitivity analysis

The sensitivity analysis shall show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. For the proposed project, four parameters were selected as sensitive factors to check out the financial attractiveness:

1) Total static investment

2) Annual O&M cost

3) Tariff (excl. VAT)

4) Annual electric output

The results of sensitive analysis are shown in Table B-3 and Figure B-2 below.

Table B-3 Sensitivity analysis of the proposed project

	-10.00%	-5.00%	0.00%	5.00%	10.00%
Total static investment	5.55%	5.01%	4.46%	3.94%	3.46%
Annual O&M cost	4.78%	4.62%	4.46%	4.29%	4.13%
Tariff(excl. VAT)	3.21%	3.84%	4.46%	5.02%	5.52%
Annual electric output	3.29%	3.88%	4.46%	4.98%	5.45%

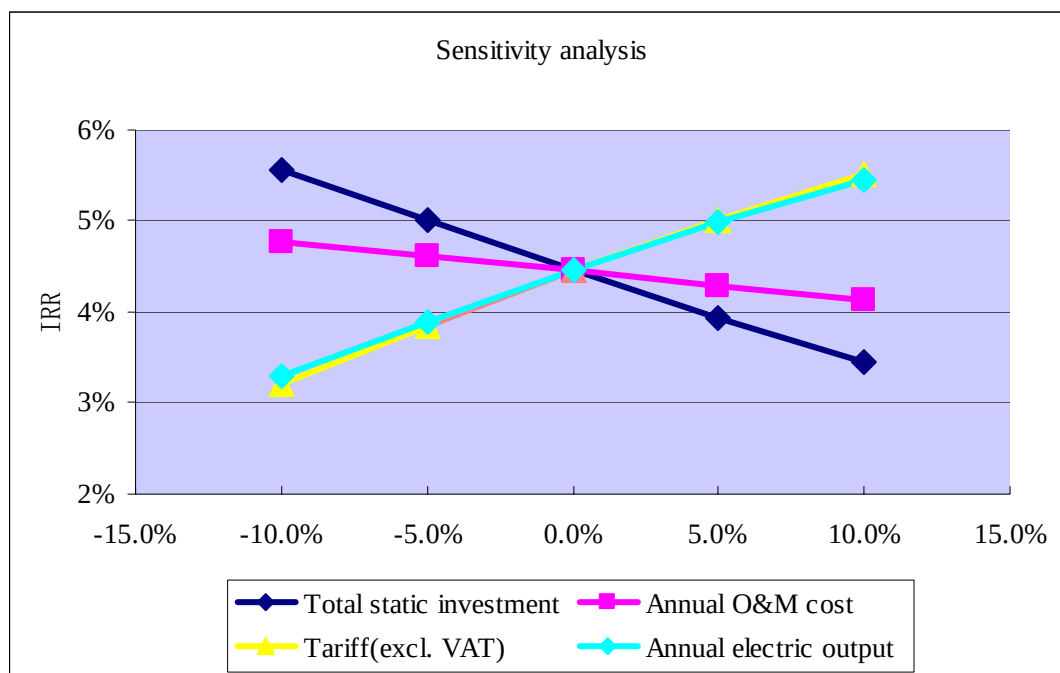


Figure B-2 Sensibility analysis of the proposed project

The sensitivity analysis examines the fluctuation of the other financial parameters when the project IRR reaches the benchmark, here is the result, see table B-4 given below,

Table B-4 Variation of financial parameters to make the project IRR reach 8%

Variation of the parameters to make IRR reach the benchmark 8%	Total static investment	Annual O&M Cost	Feed-in tariff (Excl.VAT)	Annual electric output
	-28%	-118.5%	37.3%	39.9%



From the above table, the change of static total investment is an important factor affecting the financial attractiveness of the proposed project. When the static total investment decreased by 28%, the IRR of the proposed project begins to exceed the benchmark. With the increase of cost, such as labour and equipments, it is unrealistic for total static investment to decrease by 28%. At present, the actual price of the main equipments had increased 1.5702 million RMB and the construction and installation costs had increased 10.687 million RMB compared to the expected price in SFSR, the relative evidence has been provided to DOE to confirm. According to the official statistic bulletins, the price of industrial products has increased by 5.8% from 2007 to 2008 in Yunnan Province¹² and the labour cost has increased by 15.5% from 2007 to 2008¹³. So the total investment is not likely to decrease by 28%.

Next, in the case that the expected power tariff increases by 37.3%, the IRR of proposed project begins to exceed the benchmark. The project is located in Dehong Prefecture which is a autonomous state with the policy of the minority nationality. According to “Notice on on-grid tariff of Dehong Prefecture by Dehong Prefecture govenment”¹⁴ (Dezhengfa[2003]No. 367), the on-grid tariff of power projects in Dehong Prefecture was regulated to be 0.20RMB/kWh for dry period(January-May), 0.15RMB/kWh for wet period(wet period). The government strictly control the tariff; the electricity tariff will not be significantly changed without permission by the government. In this case, the expected tariff wouldn't increase such huge rate. Furthermore, the highest tariff for the hydro power plant in Yunnan Province is 0.215RMB/kWh based on the published ‘INFORMATION NOTE ON THE HIGHEST TARIFFS APPLIED BY THE EXECUTIVE BOARD IN ITS DECISIONS ON REGISTRATION OF PROJECTS IN THE PEOPLE’S REPUBLIC OF CHINA’. Even the proposed project would get the historical highest tariff in Yunnan province, IRR would be 7.63%, still remains below benchmark.

When the annual electric output increases by 39.9%, the project IRR begins to exceed the benchmark. According to the approved SFSR, the annual output was calculated based on 47 years’ (1959-2005) historical data and the project is a newly built power plant with reservoir thus the power generation is stable. As a result, it is impossible to freely increase electricity output.

To be different, the annual O&M cost has the least affect on the project IRR. Thus it shall be regarded as a relatively insensitive factor.

According to SFSR, the construction period was 24 months including a preparing period of 4 months. As the a part of construction had been finished before the equity transfer, and with the construction resumed on 02/07/2008, it's reasonable the project owner could manage to make the construction of the project be finished on Feb, 2010.

Outcome of Step 2:

¹² Natioinal Economy and Social Development Statistic Bulletin for 2008 in Yunnan Province
<http://lc.xxgk.yn.gov.cn/tjxxgk_model/newsview.aspx?id=730276>

¹³ Natioinal Economy and Social Development Statistic Bulletin for 2008 in Yunnan Province
http://lc.xxgk.yn.gov.cn/tjxxgk_model/newsview.aspx?id=730273

¹⁴ Price document of Dehong Prefecture [2003] No.367
http://xxgk.yn.gov.cn/canton_model12/newsview.aspx?id=164269



The sensitivity analysis shows that without CER revenue, IRR of the project is difficult to reach the benchmark, which supports the conclusion, that the proposed project is unlikely to be financially attractive.

Step 4 Common practice analysis

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

Choose the similar scale

The activities similar to the Project should be with an installed capacity in the range of 18~54 MW which in according with $\pm 50\%$ of the installation capacity of the proposed project (36MW).

Choose the similar area

It is logically reasonable for each province to promulgate different measures that suit local circumstances, for example, the tariff could be distinctly different among provinces. That is to say, the common practice analysis should be limited within the province which the proposed project belongs to. Consequently, those selected power plants similar to the proposed project should be located within Yunnan Province.

Choose the similar construction year

In accordance with the *Notice on Issuing Electric Power Sector Reform Programme* by State Council on 10th February 2002¹⁵, a series of critical reform was conducted for the electric power sector. After that, the former national power company was divided into two separate sectors, i.e. the power grid sector and the power generation sector. Furthermore, the generation sector was split into five parallel power generation companies. Thus,

- The State Power Grid Corporation (including the corporations in five districts including North China, Northeast China, Northwest China, East China and Central China) and the South China Power Grid Corporation were established;
- Five power generation companies were set up, such as China Huaneng Corporation, China Datang Corporation, China Huadian Corporation, China Guodian Corporation, and China Electric Power Investment Corporation.
- State Electricity Regulatory Committee came into being.

All in all, the projects started before 10th February 2002 should be obviously differentiated from those afterwards and, accordingly, were excluded from the issues to be discussed.

Identify similar activities

From publicly available sources to China Hydro Resources Yearbook 2006, 2007 and 2008, there are totally 12 projects starting construction after 2002 and with installed capacity between 18MW~54MW in Yunnan province and need to be analyzed for common practice. Among these 12 projects, Mengahe

¹⁵ State Council. 2002-02-10. *Notice on Issuing Electric Power Sector Reform Programme*. GuoFa [2002]5.

< <http://www.competitionlaw.cn/show.aspx?id=3409&cid=32> >



hydro¹⁶ and Lamenga Hydro¹⁷ are in CDM application process and wouldn't be included. These projects are listed below:

Table B-5 Similar scale hydro power stations located in Yunnan province

No.	Project Name	Installed Capacity (MW)	Construction Starting year	Operation Starting year	Investment cost per kW (Yuan/kW)
1	Laodukou Hydro ¹⁸	36	2003	2007	5323
2	Xiashilong Hydro ¹⁹	25	2003	2005	4320
3	Yanziya Hydro ²⁰	25	2003	2005	4800
4	Wuni River Hydro ²¹	28	2003	2005	6071
5	Maomaotiao Hydro ¹⁹	40	2003	2005	3000
6	Houqiao Hydro ²²	48	2003	2005	6197
7	Nanting River Hydro ²³	34	2003	2004	4529
8	Mengdianhe 2 nd Hydro ²⁴	33	2003	2004	3818
9	Xima Xingyun Aluminium Factory Hydro ²⁵	26	2002	2004	N/A
10	Chongjianghe (Phase II) Expansion Hydro ²⁶	48	2003	2006	N/A

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

Xima Xingyun Aluminium Factory Hydropower Station is the captive station of Yunnan Yingjiang Xingyun Co., Ltd. and is not comparable to the proposed project because the electricity generated by the project are supplied for aluminium electrolysis production and not connected to the grid. Chongjianghe (Phase II) Expansion hydropower station is an expansion station in an existing power station and it is not a new project. Furthermore, Wunihe Hydropower Station Project is a VCS project²⁷, Mengdianhe 2nd

¹⁶ <http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File1386.pdf>

¹⁷ <http://cdm.ccchina.gov.cn/website/cdm/pdf/Item/Item293.pdf>

¹⁸ <http://km.xxgk.yn.gov.cn/newsview.aspx?id=35101>

¹⁹ <http://www.ynws.gov.cn/Detail.aspx?ID=9540>

²⁰ <http://www.cnaec.com.cn/Info/Show.asp?ID=78270&SortID>

²¹ <http://www.bsepb.gov.cn/cms/2006/9-7/101842.html>

²² http://www.7c.gov.cn/color/DisplayPages/ContentDisplay_455.aspx?contentid=9212

²³ <http://news.sina.com.cn/c/2004-12-30/09444669685s.shtml>

²⁴ <http://www.dhtjb.com/Html/20041230111017-1.html>

²⁵ <http://dehongzhou.mofcom.gov.cn/aarticle/jigou/200805/20080505566733.html>

http://xxgk.yn.gov.cn/canton_model2/newsview.aspx?id=182977

²⁶ <http://www.giwp.org.cn/index.do?act=mess&modu=123&mess=1>

²⁷ <http://www.ynsph.com.cn/information/1571.whhtml>



Hydropower Station Project has been approved by NCRC for CDM application²⁸, and Xiashilong Hydropower Station had applied as a VER project²⁹. Therefore these five projects are excluded.

Nanting River Hydropower Station and Maomaotiao Hydropower Station are benefited from The 10 Five-year development planning in Wenshan Zhuang-Miao Autonomous Prefecture Programme³⁰. These two projects developed under this Programme obtain national and local support by appropriate policy, funding, taxation, land acquisition and resettlement, etc. Furthermore, the annual operation hour of Nanting River Hydropower Station is 5726h³¹, which is higher than that of the proposed project (4051h); Maomaotiao project has favourable water resources as the Panlong River has a natural fall of around 40 meters³² at the site of Maomaotiao hydropower station with favourable water resources. Besides that, Maomaotiao hydropower station takes over the mission of the transferring power to Vietnam³³, and the bus-bar tariff of the power transferred is 0.28Yuan/kwh³⁴, which is much higher than the common bus-bar tariff of Yunnan province.

Houqiao Hydropower Station is connected to the West-East Electricity Transmission Projects and the China's Western Development Programmes³⁵. Under these two principals, the Houqiao project developed during 10th Five-year will obtain national and local support. Laodukou Hydropower Station developed under financial support by the local government³⁶, and the annual operation hour of Laodukou Hydropower Station is 5250 h¹⁸ which are higher than the proposed project of 4051h. Yanziya Hydropower Station project is invested by foreign-capital³⁷. Foreign investment in china enjoys many preferential policies³⁸, thus, this project have a different investment environment with the proposed project. Moreover, Yanziya Hydropower Station's rated water head available for power generation is 182 meters³⁹ which is higher than that of the proposed project (37m), and its annual operation hours is 5600h⁴⁰, which is higher than that of the proposed project (4051h). .

As shown in Table B-5, all the similar projects' construction starting year is before the year of 2008 as well the commissioning year. It can be found from above analysis that the similar project in Yunan

²⁸ <http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2612.doc>; No.750

²⁹

<http://cn.tqcdmchina.com/news/guanyuyunnanshengguangnanxianxiashilongshuidianzhangongchengshenqingxiangmuzhaokailiyixiangguanfangzixunhuiyidetongzhi.shtml>

³⁰ http://km.xxgk.yn.gov.cn/canton_model24/newsview.aspx?id=230735

³¹ <http://www.ydxw.cn/showinfo.asp?id=25717>

³² http://km.xxgk.yn.gov.cn/canton_model24/newsview.aspx?id=230735

³³ <http://news.sina.com.cn/c/2005-08-04/09276608613s.shtml>

³⁴ http://money.finance.sina.com.cn/corp/view/vCB_AllBulletinDetail.php?stockid=600995&id=399715

³⁵ <http://www.shp.com.cn/news/info/2002/7/19/17401655.html>

³⁶ http://www.yn.xinhuanet.com/newscenter/2003-07/29/content_757181.htm

³⁷ http://www.ynf.gov.cn/canton_model19/newsview.aspx?id=465092

³⁸ <http://www.chinaccm.com/40/4011/401104/news/20030618/161219.asp>

³⁹ <http://www.kem.com.cn/webpages/showprot.asp?id=17>

⁴⁰ Page 577, Yearbook of China Water Resources 2006



Province was developed earlier with better technical (annual operational hours) and/or financial indicators (investment per installed capacity) than the proposed project (7,924RMB/kW). Therefore, the proposed project have different investment environment with the above similar projects.

As stated above, it is concluded that the proposed project is not common practice in the region. The proposed project is not financially attractive and would therefore not have occurred without CDM revenue. In conclusion, the common practice analysis confirms that the project activity is in line with the additionality assessment criteria.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emission reductions from the proposed project can be calculated based on the ACM0002 consolidated methodology. According to the ACM0002, it is required to estimate the Operating Margin (OM) and Build Margin (BM) emission factor ex-ante, and through weighted average of OM and BM, the Combined Margin baseline emission factor of the CSPG can be obtained and then the emission reductions from CDM project activity can be estimated. The details are shown below:

1. Baseline emissions

1.1 To calculate the baseline emissions (BE_y)

According to the ACM0002 (Version 12.1.0/Section Scope: 01/EB 58), baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$$

Where:

BE_y = Baseline emissions in year y (tCO₂/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”.

As the proposed project activity is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y} = EG_{facility,y}$$

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)



$EG_{\text{facility},y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
(MWh/yr)

1.2 To calculate the emission factor for an electricity system

According to the *Tool to calculate the emission factor for an electricity system* (Version 02.1/EB 50/Annex 14), the baseline GHG emissions should be calculated by following six steps:

Step 1. Identify the relevant electric power system

According to the *Tool to calculate the emission factor for an electricity system* (Version 02.1/EB 50/Annex 14), if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. Since Chinese DNA has published a delineation of the project electricity system and connected electricity systems⁴¹, these delineations should be applied for the proposed project. China Southern Power Grid consists of Guangdong Grid, Guangxi Grid, Guizhou Grid, and Yunnan Grid. Hence, the project electricity system is China Southern Power Grid, while the connected electricity system is Central China Power Grid.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

Option I: Only grid power plants are included in the calculation.

Step 3. Select an operating margin (OM) method

The calculation of the operating margin emission factor ($EF_{\text{grid},OM,y}$) is based on one of the following methods:

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

The Simple OM method (a) can only be applied when low operating cost/must run resources⁴² constitute less than 50% of total grid generation in average of the five most recent years. According to the information from *China Electric Power Yearbook 2008*, the total electricity generation from China Southern Power Grid is 542.3 TWh⁴³ in 2007, while the generation from low cost/must run resources is 158.79 TWh with the fraction of only 29.28%, which is much less than 50%. The situation is basically

⁴¹ <http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/File2333.pdf>

⁴² Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

⁴³ China Electric Power Press. 2008. China Electric Power Yearbook 2008: P733.

similar for the other four years. The generation from low-cost/must run resources are all less than 33% of total generation from China Southern Power Grid from 2003 to 2007 and this percentage did not change significantly during that period (see Table B-5). Therefore, it is reasonable to select the method (a) to calculate the OM emission factor.

Table B-5 Low-cost/must-run generation in South China Grid⁴⁴

Year	Total generation (TWh)	Generation from low-cost/must run (TWh)	Share
2003	323.149	100.369	31.06%
2004	376.277	112.703	30.0%
2005	415.409	128.52	30.9%
2006	462.156	124.842	27.0%
2007	542.3	158.79	29.28%

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

- ◆ Ex ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emission factor during the crediting period, or
- ◆ Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

Here ex ante option is chosen, and $EF_{grid,OMsimple,y}$ is fixed during the crediting period.

Step 4. Calculate the operating margin emission factor according to the selected method

According to the *tool to calculate the emission factor for an electricity system* (Version 02.1/EB50/Annex14), there are three options to calculating the Simple OM emission factor ($EF_{grid,OMsimple,y}$):

- Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit;⁴⁵, or

⁴⁴ China Electric Power Press. 2004-2008. China Electric Power Yearbook (2004: P709; 2005: P474; 2006: P572; 2007: P638; 2008:P733).



- Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system

Option B can only be used if:

- (a) The necessary data for Option A is not available; and
- (b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
- (c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

Option A should be preferred and must be used if fuel consumption data or average efficiency and fuel type(s) used are available for each power plant / unit. However, the required data for each power plant / unit is unavailable in China. So option B is applied to calculate the operating margin emission factor.

Option B - Calculation based on total fuel consumption and electricity generation of the system

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

The formula of $EF_{grid,OMsimple,y}$ calculation is

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

Where:

- $EF_{grid,OMsimple,y}$ = Simple operating margin CO₂ emission factor in year y (tCO₂/MWh)
- $FC_{i,y}$ = Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
- $NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
- $EF_{CO2,i,y}$ = CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ)
- EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)⁴⁶
- i = All fossil fuel types combusted in power sources in the project electricity system in year y

⁴⁵ Power units should be considered if some of the power units at the site of the power plant are low-cost / must-run units and some are not. Power plants can be considered if all power units at the site of the power plant belong to the group of low-cost / must-run units or if all power units at the site of the power plant do not belong to the group of low-cost / must-run units.

⁴⁶ Electricity imports to the grid should be included, and an import from a connected electricity system should be considered as one power source.



y = The relevant year as per the data vintage chosen in Step 3

If available, $NCV_{i,y}$ and $EF_{CO2,i,y}$ from the fuel supplier of the power plants in invoices may be used; or, regional or national average default values may be used. In this PDD, $NCV_{i,y}$ of different fuels are obtained from *China Energy Statistical Yearbook 2008*. With regard to the fuel types where $NCV_{i,y}$ fluctuate in a certain range, the floor values of the fluctuation range are used for conservatism. $EF_{CO2,i,y}$ of fossil fuel comes from IPCC(2006) default values.

The Simple OM Emission Factor ($EF_{grid,OMsimple,y}$) of the proposed project is calculated on the basis of the fuel consumption data for electricity generation of China Southern Power Grid, not including those of low-operating cost and must-run power plants, such as wind power, hydropower and nuclear etc. These data are obtained from the *China Electric Power Yearbook* (2006~2008, published annually) and *China Energy Statistical Yearbook* (2006~2008). Based on these data, the Simple OM Emission Factor ($EF_{grid,OMsimple,y}$) of China Southern Power Grid is calculated as 0.9987 tCO₂e/MWh (see Annex 3 for details).

For the proposed project, the renewable crediting period, i.e. 7×3 years, is adopted.

Step 5. Identify the cohort of power units to be included in the build margin

The sample group of power units m used to calculate the build margin consists of either⁴⁷:

- (a) The set of five power units that have been built most recently, or
- (b) The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently⁴⁸.

In China Southern Power Grid, the information on the five power plants built most recently is not available. According to the EB's guidance on DNV deviation request, the EB accepted the following deviation⁴⁹:

- Use of capacity additions during last 1 - 3 years for estimating the build margin emission factor for grid electricity;
- Use the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy, for each fuel type in estimating the fuel consumption to estimate the build margin (BM).

Step 6. Calculate the build margin emission factor

⁴⁷ If this approach does not reasonably reflect the power plants that would likely be built in the absence of the project activity, project participants are encouraged to submit alternative proposals for consideration by the CDM Executive Board.

⁴⁸ If 20% falls on part capacity of a unit, that unit is fully included in the calculation.

⁴⁹ Please refer to <<http://cdm.unfccc.int/Projects/deviations>>. On 7 October 2005 DNV requested guidance for projects in China. The EB guidance was given in a response letter entitled "Several projects in China (application of approved methodology AM0005), see <http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_QEJWJEF3CFBP1OZAK6V5YXPQKK7WYJ>. While the request for deviation was submitted relating to AM0005, the guidance can also be used for ACM0002 as this directly replaces AM0005 and all OM and BM calculations in these two methodologies are the same.

According to ACM0002, $EF_{grid,BM,y}$ is determined by the formula as follow:

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

Where:

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)

m = Power units included in the build margin

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

As we stated in step 5, the information on the five power plants built most recently is not available. Therefore, this proposed project uses the alternative method to calculate $EF_{grid,BM,y}$.

ACM0002 allows project participants to choose between two given options for calculating the Build Margin for the project, one is ex-ante calculation, and the other is annual ex-post updating in the first crediting period. For this project the first option is chosen. The Build Margin Emission Factor therefore is based ex-ante on the most recent information available on plants already built at the time of PDD submission. The $EF_{grid, BM, y}$ therefore is fixed for the first crediting period.

Due to the unavailability of data, some changes have been made and approved by CDM EB. That is to calculate the incremental installed capacity and the mix of power generating techniques first, and then calculate the weight of the incremental installed capacity created by all kinds of power generating techniques and finally calculate emission factors by using the maximized efficiency figures of techniques.

Since the figures of the capacity of coal-fired, oil-fired and gas-fired power generation cannot be separated from the statistics of thermal power generation, the following measures will be taken in calculation: first, work out the proportion of CO₂ emission caused by solid, liquid or gas fuels to the total emission based on the available data of energy balance in the recent year; second, taking the proportion as the weight, calculate the emission factor of thermal power generation for each grid based on the emission factor at the maximized efficiency level of techniques; finally, BM of the grid equals to the emission factor of thermal power generation multiplied the weight of the thermal power installed capacity in the increase of total installed capacity which is close and exceeding 20% of existing installed capacity.

The calculation steps and formulas are as follows:

Sub-step6.1 Calculate the proportion of CO₂ emission caused by solid, liquid and gas fuels in the total emission respectively:

$$\lambda_{Coal,y} = \frac{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (3)$$

$$\lambda_{Oil,y} = \frac{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (4)$$

$$\lambda_{Gas,y} = \frac{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (5)$$

Where:

$F_{i,j,y}$ = the amount of fuel i (in a mass or volume unit) consumed by province j in year(s) y
 $NCV_{i,y}$ = the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
 $EF_{CO_2,i,j,y}$ = the weighted average CO₂ emission factor of fuel type i in year y (tCO₂/GJ)

Step6.2 Calculate the emission factor of thermal power generation

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

Where:

$EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$ are emission factor proxies of efficiency level of the best coal-fired, oil based and gas-based power generation technology commercially available in China.

Sub-step6.3 Calculate BM of the grid

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

Where:

$CAP_{Total,y}$ = the total amount of incremental installed capacity;

$CAP_{Thermal,y}$ = the increased installed capacity of thermal power generation.

The data on different fuel consumptions for power generation and the net caloric values of the fuels are obtained from the China Energy Statistical Yearbook 2008. The emission factors of the fuels adopted are obtained from Table 1.4 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook. With reference to the Notification on Determining Baseline Emission Factor of China's Grid, the weighted average fuel consumption for power generation of 30 sets of 600MW sub-critical coal-fired power generators built in 2007 (322.5 gce/kWh) and the 200 MW oil/gas based combined cycle power generators (246 gce/kWh) are taken as the efficiency level of the best technology commercially available in China.

Referring to the Notification on Determining Baseline Emission Factor of China's Grid, the build margin emission factor ($EF_{grid,BM,y}$) of China Southern Power Grid is calculated ex ante as 0.5772 tCO₂e/MWh (see Annex 3 for details).

Step7. Calculate the combined margin emission factor

Based on the *tool to calculate the emission factor for an electricity system* (Version 02.1/EB 50/Annex 14) the combined margin emissions factor $EF_{grid,CM,y}$ is calculated as follows:

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



Where:

$EF_{grid,CM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh)

$EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/MWh)

w_{OM} = Weighting of operating margin emissions factor (%)

w_{BM} = Weighting of build margin emissions factor (%)

The combined margin emissions factor $EF_{grid,CM,y}$ should be calculated as the weighted average of the Operating Margin emission factor ($EF_{grid,OM,y}$) and the Build Margin emission factor ($EF_{grid,BM,y}$). Regarding hydro power projects, $w_{OM} = 0.5$ and $w_{BM} = 0.5$ for the first crediting period. The ($EF_{grid,OM,y}$) and ($EF_{grid,BM,y}$) are calculated as described in Step 4 and 6. Consequently,

for the first crediting period:

$$EF_{grid,CM,y} = 0.9987*0.5 + 0.5772*0.5 = 0.7879 \text{ (tCO}_2\text{e/MWh)} \quad (9)$$

2 Project emissions (PE_y)

As per the methodology ACM0002 (Version 12.1.0/Section Scope: 01/EB58), the project emissions (PE_y) are equal to zero now that the power density of the proposed project is 12.1W/m² greater than 10 W/m².

3 Leakage

According to the ACM0002 (Version 12.1.0/Section Scope: 01/EB 58), no leakage emissions are considered.

4 Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (10)$$

Where:

ER_y = Emission reductions in year y (t CO₂e/yr).

BE_y = Baseline emissions in year y (t CO₂e/yr)

PE_y = Project emissions in year y (t CO₂/yr)

Since PE_y is zero as described before, ER_y can be calculated as follows:

$$ER_y = BE_y = EG_y * EF_{grid,CM,y} \quad (11)$$

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

Data / Parameter:	FC _{i,y}
Data unit:	10 ⁴ tons, 10 ⁸ m ³
Description:	Amount of fossil fuel type <i>i</i> consumed in the project electricity system in year <i>y</i>



Source of data used:	<i>China Energy Statistical Yearbook (2006~2008)</i>
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistical data
Any comment:	-

Data / Parameter:	$NCV_{i,y}$
Data unit:	MJ/ mass or volume unit of a fuel
Description:	Net calorific value (energy content) of fossil fuel type <i>i</i> in year <i>y</i>
Source of data used:	<i>China Energy Statistical Yearbook (2008)</i>
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Local values
Any comment:	-

Data / Parameter:	$EF_{c,i,y}$
Data unit:	tc/TJ
Description:	C Emission Factor of fossil fuel type <i>i</i> in year <i>y</i>
Source of data used:	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>
Value applied:	Details see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	-

Data / Parameter:	GEN_y
Data unit:	MWh
Description:	Electricity generation in CSPG in year <i>y</i>
Source of data used:	<i>China Electric Power Yearbook (2006-2008)</i>
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	National values



Any comment:	-
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Data / Parameter:	Electricity self-consumption ratio
Data unit:	%
Description:	The internal use rate of power source j in CSPG
Source of data used:	<i>China Electric Power Yearbook (2006-2008)</i>
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	National values
Any comment:	-

Data / Parameter:	Electricity imports to CSPG
Data unit:	MWh
Description:	Electricity imported from CCPG in year y
Source of data used:	<i>China Electric Power Yearbook (2006-2008)</i>
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	National values
Any comment:	-

Data / Parameter:	$CAP_{j,y}$
Data unit:	MW
Description:	Installed capacity of power source j of CSPG in year y
Source of data used:	<i>China Electric Power Yearbook (2006-2008)</i>
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	National values
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

According to the description in B.6.1 and B.6.2, the project emissions is zero, therefore $PE_y = 0$

As calculated before, the baseline emission factor of the first crediting period is 0.7879tCO₂e /MWh, i.e. $EF_{grid,CM,y} = 0.7879\text{tCO}_2\text{e /MWh}$ (more information are shown in Annex 3).



According to the feasibility study of the proposed project, the net electricity generated is approximately 143,652 MWh, i.e. $EG_y = 143,652 \text{ MWh}$

As per calculation formulae of baseline emission, the estimated anthropogenic emission of the first crediting period is as follows:

$$BE_y = EG_y * EF_{grid,CM,y} = 113,189 \text{ tCO}_2\text{e}$$

With the emissions from the proposed project being zero, the emission reductions of the project activity are equivalent to the emissions of the baseline. The annual emission reduction of the first crediting period is about 113,189 tCO₂e.

$$ER_y = BE_y = EG_y * EF_{grid,CM,y} = 113,189 \text{ tCO}_2\text{e}$$

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

Year	Estimation of project activity emissions (tonnes of CO ₂ e)	Estimation of baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of emission reductions (tonnes of CO ₂ e)
01/07/2011-31/12/2011	0	56,595	0	56,595
2012	0	113,189	0	113,189
2013	0	113,189	0	113,189
2014	0	113,189	0	113,189
2015	0	113,189	0	113,189
2016	0	113,189	0	113,189
2017	0	113,189	0	113,189
01/01/2018-30/06/2018	0	56,595	0	56,595
Total (tonnes of CO ₂ e)	0	792,323	0	792,323

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{export,y}$
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid in year y
Source of data to be used :	Measured by bidirectional meter with accuracy of 0.5% or higher
Value of data applied for the purpose of	143,652



calculating expected emission reductions in section B.5:	
Description of measurement methods and procedures to be applied:	Continuous measurement and at least monthly recording
QA/QC procedures to be applied:	Metering equipment will be calibrated annually according to the sectoral requirement. Data measured will be cross checked by ETNs. Other QA/QC procedures in section B.7.2
Any comment:	-

Data / Parameter:	$EG_{import,y}$
Data unit:	MWh
Description:	Electricity imported by the project activity from the grid in year y
Source of data to be used :	Measured by bidirectional meter with accuracy of 0.5% or higher
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	0
Description of measurement methods and procedures to be applied:	Continuous measurement and at least monthly recording
QA/QC procedures to be applied:	Metering equipment will be calibrated annually according to the sectoral requirement. Data measured will be cross checked by ETNs. Other QA/QC procedures in section B.7.2
Any comment:	-

Data / Parameter:	EG_{backup}
Data unit:	MWh
Description:	Electricity imported through backup line from the grid in year y
Source of data to be used :	Measured by the meter with accuracy of 2% or higher
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	0
Description of measurement methods and procedures to be applied:	Continuous measurement and at least monthly recording
QA/QC procedures to	Metering equipment will be calibrated annually according to the



be applied:	sectoral requirement. Data measured will be cross checked by ETNs. Other QA/QC procedures in section B.7.2
Any comment:	-

Data / Parameter:	CAP_{PJ}
Data unit:	MW
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data to be used :	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	36
Description of measurement methods and procedures to be applied:	Determine the installed capacity based on recognized standards yearly
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	A_{PJ}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data to be used :	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5:	357.4×10^4
Description of measurement methods and procedures to be applied:	The data will be measured by professional design institute after water storage annually
QA/QC procedures to be applied:	-
Any comment:	-

B.7.2 Description of the monitoring plan:

>>

The approved monitoring methodology ACM0002 is used for developing the monitoring plan. Monitoring tasks must be implemented according to the monitoring plan in order to ensure that the real, measurable and long-term greenhouse gas (GHG) emission reductions for the proposed project is monitored and reported.

1. Description of the monitoring system

Bidirectional metering equipment with the rated precision of 0.5% or higher has been installed at the substation of Grid Company and project site. The meter at the substation of Grid Company (M1) has been used to monitor the supplied and imported electricity. If the metering equipment of the Grid Company failed to monitor the electricity, the metering equipment at the project site (M2) has been used to report the data. The electricity imported through backup line from the grid could be measured by the meter with accuracy of 2% or higher. Figure B-3 illustrates the positioning of monitoring equipment. The above mentioned monitoring parameters $EG_{export,y}$ and $EG_{import,y}$ will be measured simultaneously. The implementation of the monitoring system has been strictly in line with the Power Purchase Agreement to be signed between the project company and the grid company.

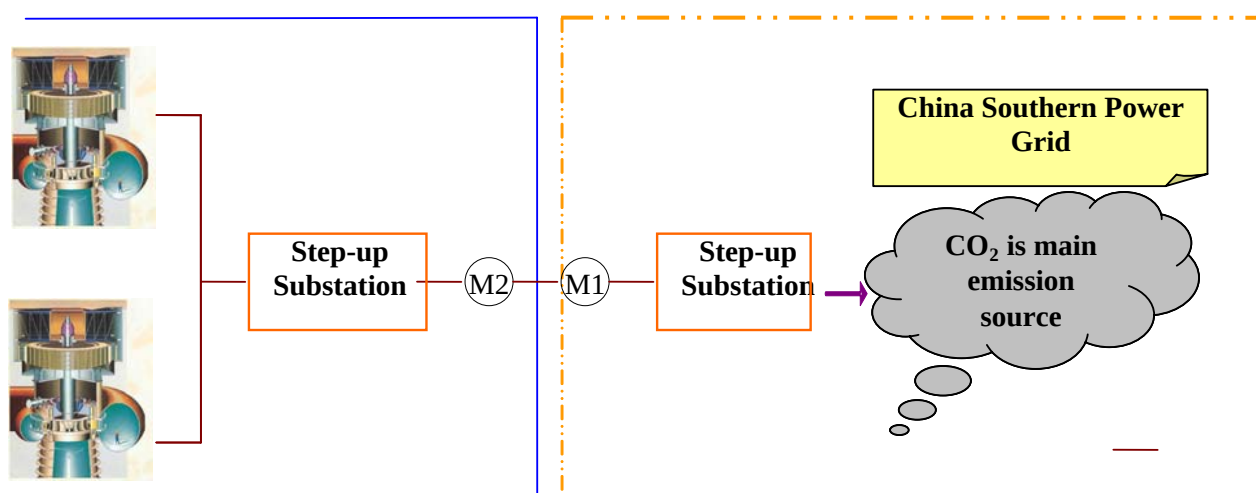


Figure B-3 Positioning of monitoring equipment

2. Management Structure

A CDM Monitoring Team has been established consisting of three units, which are data recording, data management and QA/QC. The staffs of the team have been selected from different departments of the project company. The Team Leader holds the overall responsibilities to the monitoring of the proposed project. His/her role is to ensure that the data monitored are accurately recorded, properly archived, QA/QC procedure is timely carried out and the entire monitoring process is strictly in line with the CDM requirements. He/she will also act as a liaison with the project manager of the consultancy company on a needy basis.

The organizational structure of the CDM Monitoring Team and work scope of each unit is illustrated in Figure B-4. The details about QA/QC unit are further elaborated in a separate section below.

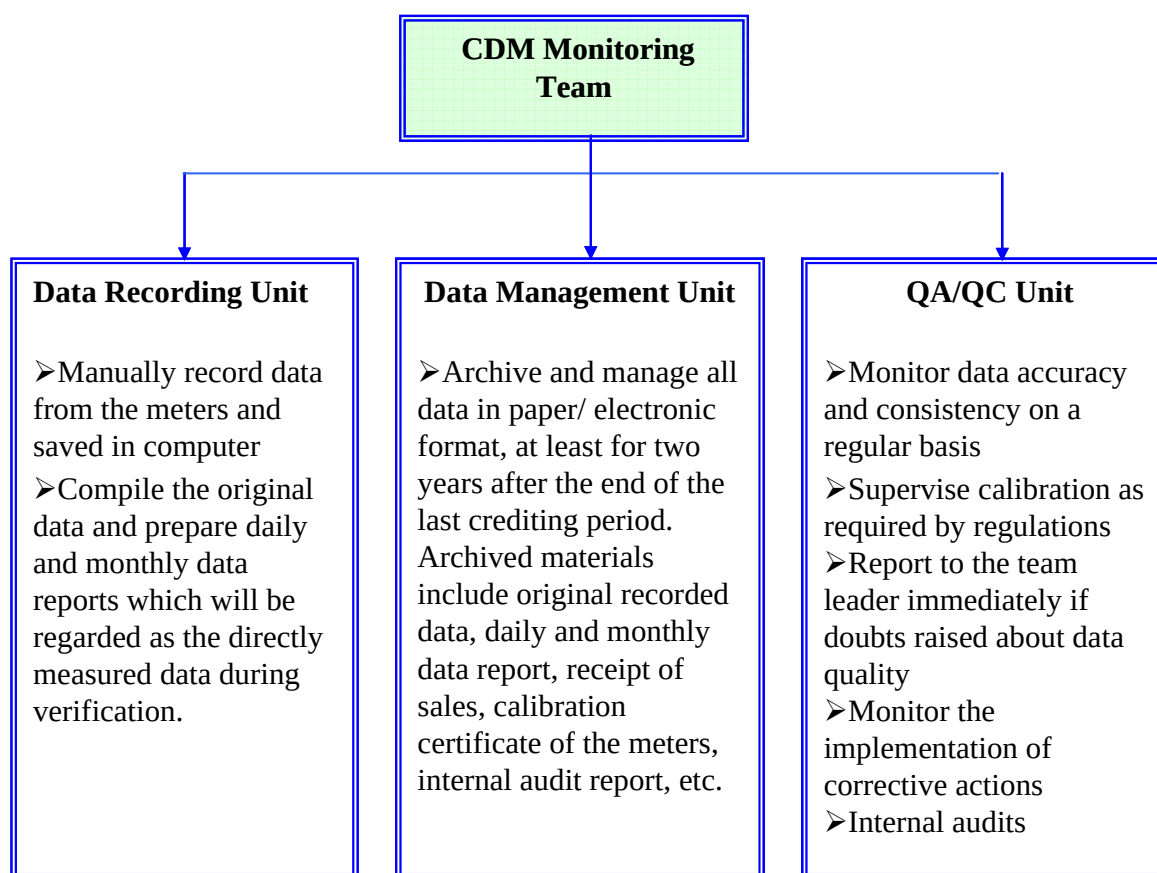


Figure B-4 Management Structure of the CDM Monitoring Team

3. Quality Assurance and Quality Control (QA/QC)

QA/QC is to ensure the accuracy of data collected through measures including periodic calibration of monitoring meters, corrective actions, and internal audits.

3.1 Data quality monitoring

QA/QC unit is responsible for comparing monthly data reports from Grid company with on-site original data, crosschecking ETNs with data reports to ensure data consistency and accuracy before transferring data to the data management unit. If problems occur, QA/QC unit manager will report to the team leader immediately.

3.2 Calibration

Procedure about calibration will be consistent with what is stipulated in the Power Purchase Agreement. The metering equipment will be calibrated by an accredited calibration agency according to the sectoral requirement. Calibration Certificates and relevant documents will be collected by the QA/QC unit and transferred to data management unit for archiving.

3.3 Corrective actions

If the metering equipment of the Grid Company (M1) failed to monitor the electricity, the metering equipment at the project site(M2) will be used to report the data and the QA/QC unit manager will initiate and supervise the implementation of corrective actions. For instance, metering equipment installed shall



be inspected by an accredited inspection agency after the repair of all or part of meter caused by the failure of one or more parts to operate in accordance with the specifications.

3.4 Internal audits

Internal audit procedure will be initiated under any of the below circumstances:

- modification of the monitoring system
- two months prior to verification

Firstly, the monitoring system will be checked on if the system functions properly and if the monitored results are correct. Secondly, spot check of daily/monthly data report will be undertaken. Internal audit report will be submitted upon completion of the procedure.

4. Monitoring Training

Monitoring training is critical to ensure that all members of the CDM Monitoring Team has a thorough understanding of the monitoring procedure and are able to carry out the monitoring tasks strictly in line with the CDM requirements. The team leader is responsible for evaluating training outcome. Only qualified staffs can work on duty. The training includes:

- Training on operation and monitoring system of the wind farm

This is the type of training which are routinely carried out by the wind farm itself for new staffs.

- Training on CDM basics with focus on monitoring

It will be carried out by the CDM consultancy company before the project is implemented. The CDM monitoring manual will be used as the primary training materials. The training includes the following contents:

- ✧ CDM project cycle and the significance of monitoring
- ✧ Management structure and work scope of each team member
- ✧ Components of the monitoring plan
- ✧ QA/QC procedure
- ✧ Monitoring report template
- ✧ Preparation for verification
- ✧ Questions and answers

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

The baseline study of the proposed project was completed on 28/12/2010 by CWEME (China National Water Resources & Electric Power Materials & Equipment Co., Ltd.)

The persons involved in baseline study are listed as follows:

- 1) Ms. Liying, CDM Office of CWEME, E-mail: liying@cweme.com, TEL: +86 10 51968593.
- 2) Ms. Zhengyue, CDM Office of CWEME, E-mail: zhengyue@cweme.com TEL: +86 10 51967993;
- 3) Mr. Lishangze, CDM Office of CWEME, E-mail: lishangze@cweme.com TEL: +86 10 51967749;

All above are not the project participants.

**SECTION C. Duration of the project activity / crediting period****C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

>>

30/06/2008 (The date of construction contract)

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:**

>>

01/07/2011 or the date of registration, whichever is later.

The crediting period of a project activity cannot commence prior to the date of registration. The date listed here is an indicative starting date and it will be updated by the secretariat as the date of registration, if the listed date is prior to the date of registration.

C.2.1.2. Length of the first crediting period:

>>

7 years

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

>>

Not applicable

C.2.2.2. Length:

>>

Not applicable

SECTION D. Environmental impacts

>>

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

>>

The project owner entrusted a third party, Yunnan University, to conduct the environmental impact assessment (EIA) on the proposed project, which was completed in July, 2005 and offered the approval



(Yunhuanxuzhun [2005] 182) from Yunnan Provincial Environmental Protection Bureau (YNEPB) on 27/10/2005.

The analysis and measures to be taken to mitigate the impacts during the constructing and operating stages are demonstrated in the following texts:

Waste water and sewage the sewage is mainly composed with the water produced by flushing and maintaining the construction machinery, and daily life waste generated by the operation staff. By collecting and processing through septic tank, the waste water and sewage could be processed for irrigating the farmland before discharging.

Dust and Air Quality The air impact during the construction period mainly comes from flying dust produced by excavating land and transportation vehicles, and some exhaust discharge from using and moving construction machinery. By using enclosed or semi-enclosed transportation vehicles with strictly managed schedule and route, strengthening the construction control, and regularly spraying the work area, the influences could be reduced under the construction standards set by governments and environmental protection departments.

Noise The noise pollution mainly comes from the instantaneous demolition noise, manual drills, cement mixers, and transportation vehicles during construction period. By choosing equipments with low noise, setting sound insulation workshop, and banning construction activity in the evenings, the noise could be controlled at a satisfactory level.

Soil Erosion Considering the soil erosion problem and disturbance of grassland, the waste soil will be used for backfilling, while solid wastes are collected regularly and transported into the designated dumping sites. After the project completion, the land in the project management site and temporary construction site will be restored and rehabilitated with trees and vegetation.

In conclusion, by all the measures taken by the project owner, the environmental impact of the proposed project was reduced to the minimum level.

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

>>

The project owner entrusted a third party, Yunnan University, to conduct the environmental impact assessment (EIA) on the proposed project, which was offered the approval (Yuanhuanxuzhun [2005] 182) from Yunnan Provincial Environmental Protection Bureau on October, 2005.

SECTION E. Stakeholders' comments

>>

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

>>

In order to get the comments and suggestions from local stakeholders, the project owner visited local residents and coherent organizations for stakeholder consultation in June, 2009.



100 questionnaires were sent to the stakeholders by the project developer. The questionnaire was designed to be easily filled in with the following sections:

- 1) Project introduction
- 2) Respondent's basic information and education level
- 3) Questions on:
 - Do they have any knowledge or understanding about the proposed project?
 - Do they support local hydropower projects?
 - Will the Project bring any positive impact to their livelihoods?
 - Will the Project have any negative impacts on their livelihoods?
 - Do they support the construction of the Project?
- 4) Space for the respondents' signature and date

E.2. Summary of the comments received:

>>

Table E-1 Information of the respondents

	Subject	Quantity	Proportion
Gender	Male	93	93%
	Female	7	7%
Age	17~25	16	16%
	26~45	60	60%
	>46	24	24%
Educational	Primary	82	82%
	Junior	17	17%
	Senior	1	1%

The investigation results are as the following:

- 1) 100% of the respondents had known the proposed Project in their hometown.
- 2) 100% of the respondents supports local hydropower projects.
- 3) 100% of the respondents think the hydropower station will bring benefits to their livelihoods.
- 4) 100% of the respondents think the hydropower station will not bring any negative influence to them.
- 5) 100% of the respondents support the construction of the project.

Conclusion

The survey shows that the proposed project receives strong support from local people, which is closely linked to the fact that the majority of local residents have some understandings with hydro power projects. All the respondents believe that the Project will have overall positive impacts on their livelihoods with increase of job opportunities, increase of income and others. The concern about the environmental impacts has been clarified in EIA. All the impacts will be reduced by mitigating measures. 100% of the investigated people are supportive to the project construction.

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

>>

No negative comments have been received on the project. Moreover, the local community possesses strong positive comments on the effects that the proposed project will make on the local economy and infrastructure. There has therefore been no need to modify the project due to comments received. And meanwhile, the project owner will concern much on the suggestions from stakeholders and put all of the



measures listed in the EIA into effect during construction and operation, so as to achieve environmental, social and economic benefits

**Annex 1****CONTACT INFORMATION ON PROJECT OWNER IN THE PROJECT ACTIVITY**

Organization:	Datang Mangli Hydropower Development Company Limited
Street/P.O.Box:	Guanglaliang Street
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FAX:	
E-Mail:	
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Represented by:	
Title:	
Salutation:	Mr.
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Middle Name:	
First Name:	Luo
Department:	
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Direct FAX:	86-0692-2977289
Direct tel:	
Personal E-Mail:	lxianjun@126.com

**CONTACT INFORMATION ON BUYER IN THE PROJECT ACTIVITY**

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URL:	
Represented by:	
Title:	
Salutation:	Mr.
Last Name:	Yamabe
Middle Name:	
First Name:	Naoshi
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for the proposed project.

**Annex 3****BASELINE INFORMATION**

The following tables summarise the numerical results from the equations listed in the *tool to calculate the emission factor for an electricity system* (Version 02.1/EB 50/Annex 14). The information listed in the tables includes data, data sources and the underlying computations.

Table 3-1 Thermal electric generation and OM of South China Grid in 2005

Province	Electricity generation	Electricity generation	Self service rate	Electricity Supplied to the grid
	10 ⁸ KWh	MWh	%	MWh
Guangdong	1764.53	176453000	5.58	166,606,923
Guangxi	250.23	25023000	7.95	23,033,672
Guizhou	584.3	58430000	6.94	54,141,238
Yunnan	272.81	27281000	7.34	25,387,699
Total				269,169,531

Data Source: China Electric Power Yearbook2006.

Table 3-2 Data Concerning Net Generation imported from Central to South China Grid in 2005

Net Generation imported from Central to South China Grid (MWh)	Average OM emission factors in Central China Grid (tCO ₂ e/MWh)	Total Power Supply of South China Grid in 2005(MWh)
20,264,000	1.16148	289,433,531

Data Source: China Electric Power Yearbook2006.

Table 3-3 Thermal electric generation and OM of South China Grid in 2006

Province	Electricity generation	Electricity generation	Self service rate	Electricity Supplied to the grid
	10 ⁸ KWh	MWh	%	MWh
Guangdong	1884.29	188429000	5.27	178,498,792
Guangxi	279.67	27967000	4.45	26,722,469
Guizhou	760.39	76039000	6.06	71,431,037
Yunnan	397.91	39791000	4.12	38,151,611
Total				314,803,908

Data Source: China Electric Power Yearbook2007.

**Table 3-4 Data Concerning Net Generation imported from Central to South China Grid in 2006**

Net Generation imported from Central to South China Grid (MWh)	Average OM emission factors in Central China Grid (tCO ₂ e/MWh)	Total Power Supply of South China Grid in 2006(MWh)
21,730,840	1.12157	336,534,748

Data Source: China Electric Power Yearbook2007.

Table 3-5 Thermal electric generation and OM of South China Grid in 2007

Province	Electricity generation	Electricity generation	Self service rate	Electricity Supplied to the grid
	10 ⁸ KWh	MWh	%	MWh
Guangdong	2157	215700000	6.01	202,736,430
Guangxi	361	36100000	7.42	33,421,380
Guizhou	843	84300000	6.62	78,719,340
Yunnan	474	47400000	7.23	43,972,980
Total				358,850,130

Data Source: China Electric Power Yearbook2008.

Table 3-6 Data Concerning Net Generation imported from Central to South China Grid in 2007

Net Generation imported from Central to South China Grid (MWh)	Average OM emission factors in Central China Grid (tCO ₂ e/MWh)	Total Power Supply of South China Grid in 2007(MWh)
24,237,240	1.10197	383,087,370

Data Source: China Electric Power Yearbook2008.



Table 3-7 Calculation of simple OM emission factor of the South China Grid (2005)

Fuel types	unit	Provinces in the Regional Grid				subtotal	default carbon content	CO2 Emission Factor	Average low Caloric value	CO2 Emission (tCO ₂ e)
		Guangdong	Guangxi	Guizhou	Yunnan		(tc/TJ)	(kgCO ₂ /TJ)	(MJ/t,km ³)	J=E×H×I/100000 (mass unit)
		A	B	C	D	E=A+B+C+D	F	H	I	J=E×H×I/10000 (volume unit)
Raw Coal	10 ⁴ t	6696.47	1435	3212.31	1975.55	13319.33	25.8	87,300	20,908	243,113,522
Cleaned Coal	10 ⁴ t				0.15	0.15	25.8	87,300	26,344	3,450
Other Washed Coal	10 ⁴ t			10.39	33.88	44.27	25.8	87,300	8,363	323,211
Coke	10 ⁴ t	4.79			8.05	12.84	29.2	95,700	28,435	349,406
Coke Oven Gas	10 ⁸ m ³				0.79	0.79	12.1	37,300	16,726	49,287
Other Gas	10 ⁸ m ³	1.87			15.96	17.83	12.1	37,300	5,227	347,626
Crude Oil	10 ⁴ t	10.91				10.91	20	71,100	41,816	324,367
Gasoline	10 ⁴ t	0.68				0.68	18.9	67,500	43,070	19,769
Diesel Oil	10 ⁴ t	31.96	2.02		1.81	35.79	20.2	72,600	42,652	1,108,250
Fuel Oil	10 ⁴ t	887.21				887.21	21.1	75,500	41,816	28,010,178
PLG	10 ⁴ t					0	17.2	61,600	50,179	0
Refinery Gas	10 ⁴ t	4.92				4.92	15.7	48,200	46,055	109,217
Natural Gas	10 ⁸ m ³	0.93				0.93	15.3	54,300	38,931	196,598
Other Petroleum Products	10 ⁴ t	1.7				1.7	20	75,500	41,816	53,671
Other Coking Products	10 ⁴ t					0	25.8	95,700	28,435	0
Other Energy	10 ⁴ tce	104.66	133.15		59.72	297.53	0	0	0	0
									subtotal	274,008,550

Data Source: China Energy Statistical Yearbook 2006;
2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook.



Table 3-8 Calculation of simple OM emission factor of the South China Grid (2006)

Fuel types	unit	Provinces in the Regional Grid				subtotal	default carbon content	CO2 Emission Factor	Average low Caloric value	CO2 Emission (tCO2e)
		Guangdong	Guangxi	Guizhou	Yunnan		(tc/TJ)	(kgCO2/TJ)	(MJ/t,km3)	J=E×H×I/100000 (mass unit)
		A	B	C	D	E=A+B+C+D	F	H	I	J=E×H×I/10000 (volume unit)
Raw Coal	104t	7303.19	1490.01	4001.54	2735.88	15530.62	25.8	87,300	20,908	283,475,499
Cleaned Coal	104t					0	25.8	87,300	26,344	0
Other Washed Coal	104t			19.53	45.8	65.33	25.8	87,300	8,363	476,968
Briquettes	104t	133.75				133.75	26.6	87,300	20,908	2,441,296
Coke	108m3				1.31	1.31	29.2	95,700	28,435	35,648
Coke Oven Gas	108m3		0.84		2.06	2.9	12.1	37,300	16,726	180,925
Other Gas	104t	0.89			19.15	20.04	12.1	37,300	5,227	390,714
Crude Oil	104t	0.87				0.87	20	71,100	41,816	25,866
Gasoline	104t					0	18.9	67,500	43,070	0
Diesel Oil	104t	29.92	1.26		3	34.18	20.2	72,600	42,652	1,058,396
Fuel Oil	104t	685.85	0.09			685.94	21.1	75,500	41,816	21,655,867
PLG	104t					0	17.2	61,600	50,179	0
Refinery Gas	108m3					0	15.7	48,200	46,055	0
Natural Gas	104t	7.92				7.92	15.3	54,300	38,931	1,674,251
Other Petroleum Products	104t	0.67				0.67	20	75,500	41,816	21,153
Other Coking Products	104tce					0	25.8	95,700	28,435	0
Other Energy		93.54	189.68		20.29	303.51	0	0	0	0
									subtotal	311,436,583

Data Source: China Energy Statistical Yearbook 2007;
2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook.



Table 3-9 Calculation of simple OM emission factor of the South China Grid (2007)

Fuel types	unit	Provinces in the Regional Grid				subtotal	default carbon content	CO2 Emission Factor	Average low Caloric value	CO2 Emission (tCO2e)
		Guangdong	Guangxi	Guizhou	Yunnan		(tc/TJ)	(kgCO2/TJ)	(MJ/t,km3)	J=E×H×I/100000 (mass unit)
		A	B	C	D	E=A+B+C+D	F	H	I	J=E×H×I/10000 (volume unit)
Raw Coal	104t	8214.78	1750.63	4298.8	3170.79	17435	25.8	87,300	20,908	318,235,546
Cleaned Coal	104t	3.46				3.46	25.8	87,300	26,344	79,574
Other Washed Coal	104t		0.65	21.58	14.64	36.87	25.8	87,300	8,363	269,184
Briquettes	104t	271.25				271.25	26.6	87,300	20,908	4,951,041
Coke	108m3	0.04	1.69		2.15	3.88	29.2	95,700	28,435	105,584
Coke Oven Gas	108m3		0.96	3.19	1.8	5.95	12.1	37,300	16,726	371,208
Other Gas	104t		30.77		21.63	52.4	12.1	37,300	5,227	1,021,628
Crude Oil	104t					0	20	71,100	41,816	0
Gasoline	104t					0	18.9	67,500	43,070	0
Diesel Oil	104t	21.37	2.13		2.29	25.79	20.2	72,600	42,652	798,596
Fuel Oil	104t	467.97	0.41			468.38	21.1	75,500	41,816	14,787,262
PLG	104t					0	17.2	61,600	50,179	0
Refinery Gas	108m3	0.37				0.37	15.7	48,200	46,055	8,213
Natural Gas	104t	32.17				32.17	15.3	54,300	38,931	6,800,588
Other Petroleum Products	104t	8.47				8.47	20	75,500	41,816	267,407
Other Coking Products	104tce					0	25.8	95,700	28,435	0
Other Energy		118.04	81.89	44.1	50.3	294.33	0	0	0	0
									subtotal	347,695,831

Data Source: China Energy Statistical Yearbook 2008;
2006 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook.



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Table 3-10 The list of three years OM emission factors in South China Grid

	CO ₂ Emission	Electricity supplied to the grid	OM
	tCO ₂ e	MWh	tCO ₂ e/MWh
Year 2005	289,433,531	297,544,857	1.02802
Year 2006	336,534,748	335,809,186	0.99784
Year 2007	383,087,370	374,404,628	0.97733

The three years weighed average OM ($EF_{grid,OMsimple,y}$) is: 0.9987tCO₂e / MWh

**Table 3-11 Calculation of the weight of CO₂ emissions from solid fuels, liquid fuels and gas fuels among total emissions in South China Power**

Fuel types	unit	Provinces in the Regional Grid				Subtotal	Effective Carbon Emission Factor	Carbon Oxidation Rate	Average Low Caloric Value	CO ₂ Emission (tCO ₂ e)
	U	Guangdong	Guangxi	Guizhou	Yunnan	FC _{i,y}	EF _{c,i,y} (tC/TJ)	%	NCV _{j,y} (MJ/t,m ³ ,tce)	H=D*E*F*G*44/12/ 10000(mass unit) H=D*E*F*G*44/12/ 1000 (volume unit)
	<i>U</i>	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E=A+B+C+D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>
Raw Coal	10 ⁴ t	8,214.78	1,750.63	4,298.8	3,170.79	17,435	20,908	87,300	1	318,235,546
Cleaned Coal	10 ⁴ t	3.46	0	0	0	3.46	26,344	87,300	1	79,574
Other Washed Coal	10 ⁴ t	0	0.65	21.58	14.64	36.87	8,363	87,300	1	269,184
Briquettes	10 ⁴ t	271.25	0	0	0	271.25	20,908	87,300	1	4,951,041
Coke	10 ⁴ t	0.04	1.69	0	2.15	3.88	28,435	95,700	1	105,584
Other Coking Products	10 ⁴ t	0	0	0	0	0	28,435	95,700	1	0
Total of solid fuels										323,640,928
Crude Oil	10 ⁴ t	0	0	0	0	0	41,816	71,100	1	0
Gasoline	10 ⁴ t	0	0	0	0	0	43,070	67,500	1	0
Diesel Oil	10 ⁴ t	21.37	2.13	0	2.29	25.79	42,652	72,600	1	798,596
Fuel Oil	10 ⁴ t	467.97	0.41	0	0	468.38	41,816	75,500	1	14,787,262
Other Petroleum Products	10 ⁴ t	8.47	0	0	0	8.47	41,816	75,500	1	267,407
Total of liquid fuels										15,853,266
Natural Gas	10 ⁸ m ³	321.7	0	0	0	321.7	38,931	54,300	1	6,800,588
Coke Oven Gas	10 ⁸ m ³	0	9.6	31.9	18	59.5	16,726	37,300	1	371,208
Other Coal Gas	10 ⁸ m ³	0	307.7	0	216.3	524	5,227	37,300	1	1,021,628
PLG	10 ⁴ t	0	0	0	0	0	50,179	61,600	1	0
Refinery Gas	10 ⁴ t	0.37	0	0	0	0.37	46,055	48200	1	8,213
Total of gas fuels										8,201,637
Total of solid, liquid and gas fuels										347,695,831

Data Source: China Energy Statistical Yearbook 2008



According to the table Table 3-11 and formula (3), (4) and (5) :

$$\lambda_{Coal,y}=93.08\%, \lambda_{Oil,y}=4.56\%, \lambda_{Gas,y}=2.36\%$$

Emission factor of best technology: $EF_{Coal,Adv,y}=0.8249$, $EF_{Oil,Adv,y}=0.5437$, $EF_{Gas,Adv,y}=0.3910$.

<http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2008/20081231101111351.pdf>

Calculation of

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y} = 0.8862 \text{ tCO}_2\text{e/MWh}$$

Table 3-12 Installed capacities of South China Grid in 2007

Isttalled capacities	Unit	Guangdong	Guangxi	Yunnan	Guizhou	Total
Thermal	MW	44,710	9,310	10,630	15,960	80,610
Hydro	MW	10,110	10,440	11,580	8,210	40,340
Nuclear	MW	3,780	0	0	0	3,780
Other	MW	250	0	0	0	250
Total	MW	58,850	19,750	22,210	24,170	124,980

Data Source: China Electric Power Yearbook2008

Table 3-13 Installed capacities of South China Grid in 2006

Isttalled capacities	Unit	Guangdong	Guangxi	Yunnan	Guizhou	Total
Thermal	MW	40615	5434	8564	14350	68963
Hydro	MW	9320	7624	9698	7534	34176
Nuclear	MW	3780	0	0	0	3780
Other (wind)	MW	183	0	0	0	183
Total	MW	53898	13058	18262	21884	107102

Data Source: China Electric Power Yearbook2007

Table 3-14 Installed capacities of South China Grid in 2005

Isttalled capacities	Unit	Guangdong	Guangxi	Yunnan	Guizhou	Total
Thermal	MW	35182.6	4931.2	4758.4	9634.8	54507
Hydro	MW	9035.7	6085.3	7993.1	7233	30347.1
Nuclear	MW	3780	0	0	0	3780
Other (wind)	MW	83.4	0	0	0	83.4
Total	MW	48081.7	11016.5	12751.5	16867.8	88717.5

Data Source: China Electric Power Yearbook2006

Table 3-15 Incremental installed capacity of South China Grid from 2005 to 2007

	Installed Capacity 2005	Installed Capacity 2006	Installed Capacity 2007	2005-2007 New Capacity Additions	Split of New Capacity
	A	B	C	D=C-A	



Coal	54,507	68,963	80,610	26,103	71.98%
Hydro	30,347.1	34,176	40,340	9,992.9	27.56%
Nuclear	3,780	3,780	3,780	0	0.00%
wind and Other	83.4	183	250	166.6	0.46%
Total	88,717.5	107,102	124,980	36,262.5	100.00%
percentage Of installed capacity in 2007	70.99%	85.70%	100.00%		

$$EF_{grid, BM, y} = 0.8018 \times 71.98\% = 0.5772 \text{ tCO}_2\text{e/MWh}$$

Table 3-16 Calculation of combined emission factor

A	B	C* = 0.5*A+0.5*B
OM Factor(tCO₂e/MWh)	BM Factor (tCO₂e/MWh)	Combined Emission Factor* (tCO₂e/MWh)
0.9987	0.5772	0.7879



Annex 4

MONITORING PLAN

No additional information.