



CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03.1 - 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 of the project activity:** Yunnan Sinanjiang Hydropower Project**Version of the document:** 05**Date of the document completed:** 17/02/2010**Table 1. Revision History**

Version	Date	Description
00	04/2007	Draft PDD, submitted for LoA
01	03/2008	Revised according to ACM0002 version 7 and emission factor calculation tools, submitted for GSP
02	25/07/2008	Revised according to the DOE's resolution of Corrective Action and Clarification Requests from.
03	20/02/2009	Revised according to DOE's further Corrective Action and Clarification Requests.
04	25/07/2009	Revised according to DOE's further Corrective Action and Clarification Requests. Monitoring parameters
05	17/02/2010	PDD updated according to the Executive Board (EB) 52 nd Meeting in which the EB agreed to register the Project Activity with corrections: <i>"if the project participant and DOE (TÜV-SÜD) submit a revised PDD and the corresponding validation report which incorporate the information submitted in response to the review regarding the additionality of the project activity; in particular, the financial commitments, the input values to the IRR calculation, the investment and O&M costs, and the common practice analysis"</i>

A.2. Description of the project activity:

The Yunnan Sinanjiang Hydropower Project (hereafter referred as the "Project Activity") is located in the territory of Naha Town, Baliu Town and Sinanjiang Town, Mojiang Hanizu Autonomous County, Simao Region, Yunnan Province. The Project Activity is developed and operated by Yunnan Dianneng Sinanjiang Hydropower Development Co., Ltd (the "Project Entity"). The Project Activity is a low-head pondage hydropower station located in a river channel. The total installed capacity is 201 MW, annual gross electricity output is 919.6 GWh and annual electricity delivered to the grid is 825.6 GWh. The annual operation hour is 4575hrs. The surface area at full reservoir level is 8.168 km², and the power density is 24.61 W/m².

The electricity generated by the Project Activity will directly connect to the China Southern Power Grid (CSPG) via the Yunnan Power Grid. After the Project Activity is completed, electricity generated by the Project Activity will effectively displace an equal amount of electricity generated by the China CSPG which is dominated by fossil fuel power plants, and thus reduce greenhouse gas (GHG) emissions. The estimated annual GHG emission reductions will be 696,245 tCO₂e. As this is a new built project; there is no project scenario and related measures/activities existing before the implementation of the Project Activity. The baseline scenario is therefore the continued supply of electricity by the CSPG.

Construction of the Project Activity is consistent with China's energy industry priority areas, contributing to the sustainable development of the host party and the local area in the following ways:

- Reducing GHG emissions and other air-borne pollutants compared with the business-as-usual use of cheap fossil fuel-fired power;



- Alleviating local supply shortfalls of electricity (the CSPG is a net importer of electricity);
- 99.98% of the terrain of Mojiang County is classified as mountainous. This unfavourable terrain seriously constrains the development of the local economy. The standard of living in Mojiang is below the average level within Yunnan Province. The Project Activity creates employment opportunities with 146 local jobs offered.

A.3. Project participants:**Table 2. Participants of the Project Activity**

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
The People's Republic of China (host)	Yunnan Dianneng Sinanjiang Hydropower Development Co., Ltd.	No
The United Kingdom of Great Britain and Northern Ireland	Trading Emissions PLC (CER Buyer)	No

Detailed contact information of the project participants are provided in Annex 1.

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:****A.4.1.1. Host Party (ies):**

The People's Republic of China

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

Yunnan Province

A.4.1.3. City/Town/Community etc:

Mojiang Hanizu Autonomous County, Simao Region

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

The Project Activity is located in the territory of Naha Town, Baliu Town and Sinanjiang Town, located within the Mojiang Hanizu Autonomous County of Simao Region in Yunnan Province. The dam is located at the entry of the Tudui Gorge situated at the lower reaches of the Jiaolianzhu River which flows past Manniang Village, Baliu Town. The dam's geographical coordinates are 23°05'44"N and 101°52'41"E. The power plant is about 10 km west from the dam, 18 km away from Naha Town, 20 km from Sinanjiang Town and 376km from Kunming. The geographical coordinates of the power plant are 23°04'53"N and 101°46'30"E. The geographic location of the Project Activity is shown in Figure 1.



Figure 1. Location of the Project Activity

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

The Project Activity falls into the sector scope 1: Energy industries (renewable sources)-- Hydropower Project.

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

There is no project scenario and related measures/activities existing before the implementation of the Project Activity. Therefore no historical technology information is available to present. Consequently only technology employed in the proposed activity is described here.

The installed capacity of the Project Activity is 201MW (3×67MW). The main structures of the Project Activity include a stone-piled dam covered by concrete panels, water inlet and scour sluiceway for the power station, spillway tunnel, water tunnel, surge chamber, pressure conduit, main and auxiliary power plant buildings (including gas insulated switchgear and main transformer station). The water tunnel lies at the left bank of Sinanjiang with 10.3km in length, the main dam-structure is 20.1m in width, 70.6m in length and 49.47m in maximum height. Three water-turbine generators, each with a single unit capacity of 67MW will be installed. The power station will deliver electricity by one outlet with 220kV voltage to the Mojiang 500kV transformer substation and connect to the CSPG via the local Yunnan Power Grid.

Table 3. Technical specifications of the turbines and generators

Turbines	Generators
Quantity: 3	Quantity: 3
Model: HL97.1-LJ-225	Model: SF-J67-12/4420
Rated Output: 69.07MW	Rated Capacity: 67MW/78.82MVA
Rated Revolution: 500r/min	Rated Revolution: 500r/min
Rated Head: 320m	Rated Voltage: 10.5kV
Rated Flow: 23.61m ³ /s	Power Factor: 0.85

The Project Activity uses equipment produced by GE Hydro Asia Co. Ltd and involves international technology transfer. GE Hydro Asia Co. Ltd is a joint venture 90% owned by US-based GE Power Systems and the technology is based on Norwegian Kvaerner Energy.¹ No additional training for operation and maintenance for the Project Activity was required apart from that given by the equipment supplier.

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

The Project Activity will adopt a renewable crediting period (7 years ×3). The total greenhouse gas emission reductions will amount to 4,873,715 tCO₂e over the first crediting period.

Table 4. Estimation of emission reduction of the first crediting period

Years (dd/mm/yyyy)	Annual estimation of emission reductions in tonnes of CO₂e
01/11/ 2009 -31/10/ 2010	696,245
01/11/ 2010 -31/10/ 2011	696,245
01/11/ 2011 -31/10/ 2012	696,245
01/11/ 2012 -31/10/ 2013	696,245

¹ For a description kindly refer to: http://www.gepower.com/about/press/en/2003_press/020403b.htm



01/11/ 2013 -31/10/ 2014	696,245
01/11/ 2014 -31/10/ 2015	696,245
01/11/ 2015 -31/10/ 2016	696,245
Total estimated reductions (tonnes of CO ₂ e)	4,873,715
Number of years in the first crediting period	7
Annual average over the crediting period of estimated reductions (tonnes of CO ₂ e)	696,245

The starting day of the first credit period is expected to be 01/10/2008, or the registration date, whichever is later. The last day of the first credit period is postponed accordingly.

A.4.5. Public funding of the project activity:

No public funding from Annex I countries is provided for the Project Activity.

SECTION B. Application of a baseline and monitoring methodology

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

Baseline and monitoring methodology ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 07)

“Tool for the demonstration and assessment of additionality” (Version 05.2)

“Tool to calculate the emission factor for an electricity system” (Version 01.1)

“Guide on the assessment of investment analysis” (Version 02)

For detailed information please refer to:

<http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

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

The Project Activity fully meets all the applicability requirements of ACM0002, as shown below:

- The Project Activity is a new grid-connected generation project from renewable sources;
- The Project Activity is a hydropower plant with reservoir, which power density is greater than 4W/m²;
- The Project Activity does not involve switching from fossil fuels to renewable energy at the site of the project;
- The geographic and system boundary for the CSPG which the Project Activity is to be connected to can be clearly identified, and information on the characteristics of the grid is available².

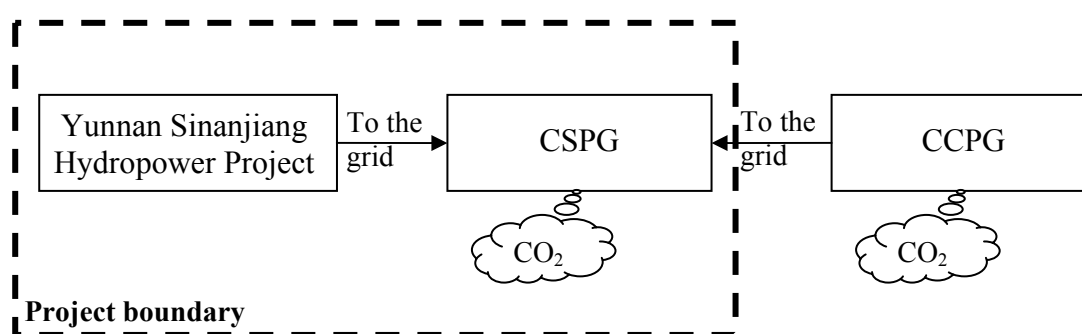
² Bulletin about confirming 2008 baseline emission factor of regional power grid in China announced by Office of National Coordination Committee on Climate Change, National Development and Reform Commission (NDRC) of China on Jul. 18th, 2008. <http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=2976>

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

The physical structures of the Project Activity including the reservoir, dam, water tunnel, power plant and supporting facilities. are included in the project boundary. The project electricity system is the CSPG. For this new hydropower project no electricity consumption from grid is needed during operation. However, should any electricity be purchased from the grid and used within the project boundary this will be monitored and deducted from the claimed CER amount. Methane emissions by inundation are excluded according to ACM0002 (see Table 5). The potential sources, GHG and inclusion in project boundary are listed below:

Table 5. Baseline and project activity emission

	Source	Gas	Included	Justification / Explanation
Baseline	CO ₂ emissions from electricity generation dominated by fossil fuel fired power plants that is displaced due to the project activity.	CO ₂	Yes	Main emission source.
		CH ₄	No	Minor emission source.
		N ₂ O	No	Minor emission source.
Project Activities	Emissions of CH ₄ from the reservoir.	CO ₂	No	Minor emission source.
		CH ₄	No	Main emission source. However according to ACM0002, power density of the Project Activity (24.61W/m ²) is greater than 10W/m ² . (see B.6.1) emission is excluded
		N ₂ O	No	Minor emission source

**Figure 2. Emissions sources included in the project boundary**

The CSPG is a net importer of electricity sourced from the Central China Power Grid³ (abbreviated to “CCPG”) (see Figure 2). The Project Activity does not provide electricity to the CCPG; however the amount of electricity imported must be taken into account when determining the baseline emissions factor of the CSPG (see Annex 3 for further details).

³ The CCPG is a regional power grid in China and includes the provincial grids of Henan, Hubei, Hunan, Jiangxi, Sichuan and Chongqing city

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

According to ACM0002 (version 7), the baseline scenario of grid connected electricity generation from renewable energy sources is that the project connected grid provides the same electricity generation which otherwise is provided by the Project Activity. Identification of the baseline scenario is further demonstrated with “Tool for the demonstration and assessment of additionality” in Section B.5.

Baseline emissions are the product of electricity generation by the Project Activity and the combined emission factor (CM) of the CSPG. Imported electricity from the CCPG is considered as well. The baseline for the first crediting period will employ the latest data at the time the PDD is submitted for validation. The baseline will be checked for validity and updated with the latest baseline data for the 2nd and 3rd crediting periods. Baseline data will be validated for each crediting period. For details, see 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):

Participation of the CDM played a key role in the implementation of the Project Activity. Table 6 below outlines the timeline of project development which have been supported by documentary evidence validated by the DOE.

The Feasibility Study Report (FSR) and Environmental Impact Assessment (EIA) of the Project Activity were completed in June 2003 and July 2004 by the Kunming Investigation and Design Research Institute. Approvals were issued on 27 September 2003 (FSR) and 9 October 2004 (EIA) respectively. Early preparations for construction of the dam and water tunnel started in April 2004. (Table 6, Items 1-6).

As implementation of the project progressed, the construction of the underground water tunnel⁴ was seriously hindered due to the surrounding weak rock structures which induced frequent collapse and severe underground water bursts. Frustrated by these setbacks, two of the three contractors for the water tunnel decided to withdraw their participation only six months into the construction of the project (Table 6, Items 7&8). The construction of the underground water tunnels was suspended since then. The same geological issue also forced the postponement of the river diversion plan in December 2004. This led to a delay in excavation activities and a redesign of the cofferdam which was better able to cope with flooding conditions rather than the dry conditions it was originally designed for (Table 6, Item 9). In March 2005 the Kunming Investigation and Design Research Institute re-evaluated the conditions of the project and suggested that the only solution would be to modify the tunnel route design which could alleviate the adverse geological conditions. It was recognised however that these modifications would involve significant incremental cost (Table 6, Item 10). In March 2005 the Board of directors decided to stop the project activity and re-assess the feasibility of Sinanjiang Hydropower project (Table 6, Item 11).

The Kunming Investigation and Design Research Institute was commissioned to provide a solution and in September 2005 it proposed an updated technical report focussing on optimising water tunnel construction which could potentially slightly decrease the cost required to implement the project (Table 6, Item 12). With this new information the Project Entity commissioned an internal Financial Capital Stock-taking Report to assess the financial condition of the project. This introduced the concept of the CDM to the Board of Directors as a possibility for the Project Activity to participate in

⁴ The underground water tunnel is one of the three key structures of the hydropower plant. The other two key structures are the dam and generator plant.



the CDM (Table 6, Items 13&14). With this knowledge the Board of Directors formally decided to apply for CDM revenue on 23 September 2005 (Table 6, Item 15). On 12 October 2005 the Project Entity entrusted Coway International Tech Transfer Ltd. to take responsibility for CDM development (Table 6, Items 16).

The possibility of obtaining additional revenue from the sale of CERs helped to obtain a bank loan where previously banks had refused to provide a loan for the Project Activity (Table 6, Items 17, 19&21). After the first loan for the Project Activity was approved, partial construction recommenced on 25 November 2005 (Table 6, Item 18, CDM project start-date). On 4 December 2005 new contractors for the underground water tunnel construction were assigned (Table 6, Item 20). Searching for a buyer of CERs commenced in early 2006 which led to a non-disclosure agreement (Table 6, Item 23), term-sheet (Table 7, Item 24) and primary CER purchase agreement (Table 6, Item 26) with Trading Emission Plc. Approval from the China DNA was obtained in January 2008. The revision history of the PDD can be found in Table 1.

Table 6. Timeline of project development

No.	Time	Key Event
1	6/2003	Completion of Feasibility Study Report (FSR) by the Kunming Investigation and Design Research Institute
2	27/9/2003	Administrative approval by the Yunnan Development and Reform Committee
3	6/11/2003	Approval on Outline and Scope of EIA by the Yunnan Environmental Protection Bureau
4	4/2004	Initial construction of dam and water tunnel starts
5	7/2004	Completion of EIA by the Kunming Investigation and Design Research Institute
6	9/10/2004	Approval of EIA by the Yunnan Environmental Protection Bureau
7	25/10/2004	Frustrated by the frequent accident involving tunnel-collapse and major underground water burst, the contractor of “section 3” of the underground water tunnel system (C3-3) ⁵ withdraws from project construction. Construction on C3-3’s section is ceased. The termination agreement details the cancellation of the construction contract with Sixth Engineering Company of Gezhouba Group for water tunnel Section 3
8	13/11/2004	For similar reasons to C3-3, the contractor for “section 2” of the water tunnel (C3-2) withdraws its involvement in the project. Construction on C3-2 part of underground water tunnel is ceased. The termination agreement details the cancellation of the construction contract with Eighth Engineering Company of Sino Hydro Corporation for water tunnel Section 2
9	1/2005	The river diversion plan is postponed due to delayed excavation activities and the cofferdam is redesigned to fit flooding river flow.
10	3/2005	To alleviate the adverse geological condition of the water tunnel, the Project Entity explores methods to modify the water tunnel and penstock joint. A preliminary modification design done by the Kunming Investigation and Design Research Institute suggests a 92 million RMB increment would be required for the modification.
11	26/03/2005	Boards of directors decide to cease all the project activities (i.e. discontinuation of dam construction and equipment purchases).
12	20/04/2005	Fourteenth Engineering Company of Sino Hydro Corporation cancelled the dam construction activities and propose the withdraw plan in the termination agreement of the dam construction contract.
13	9/2005	Design modification for underground water tunnel system done by the Kunming Investigation and Design Research Institute
14	13/9/2005	Financial Capital Stock-taking Report on financial situation of project by the Kunming Hydropower Investigation, Design and Research. The “Context Section” of this report states that “After considering the facts including practical construction difficulty,

⁵ One contractor was appointed for the dam (C1), one for the power plant (C2) and three contractors were appointed for the three sections of the water tunnel (C3-1, C3-2 and C3-3).



		budget and external financial environment, Sinanjiang Hydropower Development Company decided to stop all the construction activities and related supporting activities on 20 March 2005 [sic].”
15	15/9/2005	Financial Capital Stock-taking Report summary to the Board of Directors proposing participation in the CDM
16	23/09/2005	Board of Directors made a formal decision to go ahead with implementation of the Project Activity by applying for CDM revenue to help mitigate the low financial attractiveness of the project and high risks involved in proceeding with construction and operation in the future.
17	12/10/2005	CDM consultancy agreement is signed with Tsinghua Coway International Tech Transfer Co. Ltd.
18	20/10/2005	Having previously refused a loan, the covering letter for the new loan agreement from the China Construction Bank CCB stated support for the Board of Directors decision to restart the Project Activity with the help of the CDM and agreed to provide a loan for the project.
19	25/10/2005	Partial construction recommences, as the start-date of the CDM Project Activity (in consistency with CDM Glossary of terms, the starting date of the project activity which, according to the project implementation history needs to be defined as a re-start of the activities following project cessation)
20	1/11/2005	Loan contract with Bank of China to provide further financing
21	4/12/2005	New contractors for C3-2 and C3-3 sections of water tunnel construction are assigned
22	30/12/2005	Second loan contract with CCB
23	3/2006	PIN finished (Project Idea Notes, start of search for buyers of CERs)
24	7/2006	Exclusive confidentially agreement (NDA, non-disclosure agreement) with CER Buyer (Trading Emissions Plc.)
25	3/2007	Term sheet of Sinanjiang Hydropower station CDM project with CER Buyer
26	7/2007	Application for LoA
27	11/2007	Signing of the CER sales contract (ERPA)
28	1/2008	LoA of host country obtained
29	30/4/2008	PDD published for GSP

As per CDM Glossary of Terms (p28) project cessation and re-commencement, it could be identified that project construction activity mainly stopped on November 2004 (suspension of water tunnel construction, key event 7 and 8 in timeline), and later was entirely ceased after March 2005 (suspension of dam construction and equipment purchase, key event 11 and 12 in timeline) due to the construction area's unanticipated weak geological structure. The financial commitments made by April 2005 were audited by a registered accountant (see below). The project recommenced later in October 2005 under the framework of the CDM.

It should be noted that before the restart of the project under the CDM in October 2005, no contractor was appointed for the power house and transformer station. Those related contracts⁶ were signed only on November 2005. Another contract for the end tunnel and penstock pipe amounting to RMB 50 million was not signed until 20 December 2005 (not in list).

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

Sub step 1a. Identify alternatives to the project activity:

Plausible and credible alternatives available that provide outputs or services comparable with the proposed CDM Project Activity include:

⁶ Sinanjiang Hydropower Station Main and Accessorial Powerhouse, Transformer station Construction and Electrical Equipment and installation Contract - Contract code: SNJ/C6 between Yunnan Dianneng Sinanjiang Hydropower Development Co., Ltd. and The 3rd Construction Company of Sino-Hydro Corporation



- (1) The proposed hydropower plant development not undertaken as a CDM project activity;
- (2) Construction of a fossil fuel power plant with the same amount of annual electricity generation;
- (3) Construction of a power plant using other renewable energy sources with the same annual electricity generation;
- (4) The CSPG as the provider for the same amount of electricity generation as the Project Activity.

From the perspective of technical feasibility, there are no usable wind resources near the site of the Project Activity; biomass generation needs a plentiful supply of biomass material which is lacking in the area surrounding the project site. Alternative (3) is therefore not feasible.

Sub step 1b. Consistency with mandatory laws and regulations:

Since the annual utilization hours of a fossil fuel power plant is far higher than that of a hydropower project, therefore, the installed capacity should be below 201MW when a fossil fuel power plant with the same amount of annual electricity generation as the Project Activity is constructed. According to “*Guidance on Industrial Structural Adjustment*”⁷, that the construction of a conventional fossil fuel power unit with a single capacity below 300MW is restricted except for the regions of Tibet, Xinjiang and Hainan where connection to the larger power grid is not available. Therefore, alternative (2) is not in line with the national rule and therefore cannot be considered as the baseline scenario.

Alternative (1) and alternative (4) is in compliance with current laws and regulations.

Step 2. Investment Analysis

Comparing with other alternatives, the Project Activity has no advantages in terms of economy and finance if the sales revenue of CERs is not considered. The investment analysis is as follows.

Sub step 2a. Determine appropriate analysis method

The “*Tool for the demonstration and assessment of additionality*” suggests three analysis methods, i.e. simple cost analysis (option I), investment comparison analysis (option II) and benchmark analysis (option III). The simple cost analysis is not applicable because the Project Activity will yield profits (electricity revenue) other than CER revenues. Investment comparison analysis method (option II) is applicable to projects whose alternatives are also investment projects. Only on such basis, comparison analysis can be adopted. The alternative baseline scenario of the Project Activity is continued supply of electricity by the CSPG rather than a specific replaceable investment project, thus option II is not a suitable method in this decision-making context. This PDD will therefore use the benchmark analysis (option III) method based on the consideration that the benchmark IRR on total investment of the power industry is available.

Sub step 2b. Benchmark Analysis Method (Option III)

With reference to the *Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects*⁸, the minimum financial benchmark rate of return (after tax) of Chinese power industries is specified as 8% of IRR on total investment. This financial benchmark rate of return is applicable to most of the electric power projects and conservatively chosen as it is the lowest available. On the basis of the above benchmark, the calculation and comparison of financial indicators are carried out in sub-step 2c.

⁷ Published by National Development and Reform Committee in 2005
http://www.ndrc.gov.cn/zcfb/zcfbl/zcfbl2005/t20051222_54304.htm

⁸ National State Power, 10/9/2002

**Sub step 2c. Calculation and comparison of financial indicators***(1) Basic parameters for calculation of financial indicators***Table 7. Basic parameters for calculation of financial indicators are as follows:**

Parameter	Value	Reference
Installed capacity	201MW	FSR
Gross annual electricity output⁹	919.6GWh	FSR
Effective electricity intake coefficient	90%	FSR
Project lifetime	35 years	FSR
Total static investment (only including recoverable financial commitments prior to project recommencement, see the discussion below)	1,306.25 million RMB	Assets Evaluation Report ¹⁰ , FSR and Design Modification Reports
Annual O&M cost	28.16 million RMB for the first 10 years operation	FSR
	27.29 million RMB for the rest	
Liquid Capital	10RMB/kw	FSR
Tariff price	0.2208 RMB /kWh (VAT incl.)	FSR
Tax rate	17% (VAT)	FSR, Official regulation ^{11, 12, 13, 14}
	8% (Surtax: City maintenance & construction tax & education)	
	33% (Income tax)	
Crediting period	3 × 7 years (renewable)	
Expected CERs price	8 EUR /tCO ₂ e	
Exchange Rate	10:1(RMB:EUR)	

Financial commitments made at the time of project suspension and consideration of the same as per EB 41, Annex 45, Section 7.

The Project Entity was aware of the different financial options available to it before the recommencement of the project under the framework of the CDM in October 2005. The Financial Capital Stock-taking Report¹⁵ reported on the project's financial situation in September 2005. This report indicated that a total RMB 230.2393 million had been committed by the Project Entity by August 2005. In addition, the report includes details of the progress of construction from which it can be deducted that a large portion of costs incurred were recoverable.¹⁶ The report also detailed the financial implications should the Project Entity proceed with the implementation of the project.

⁹ The load factor (52.2%) for the Project Activity can be derived from the official approval of the Yunnan DRC and is therefore consistent with EB 48 Annex 11 §3(a).

¹⁰ Assets Evaluation Report of Sinanjiang Hydropower Project, Yunzheng Zixunzi 2008082, Kunming Pingzheng Assets Appraisal Consultancy, 10, 2008. Note: the estimates in the Assets Evaluation Report were more conservative than the Financial Capital Stock-taking Report (based on FSR and Design Modification Reports), therefore the former was adopted for the financial analysis in line with CDM guidance.

¹¹ VAT Regulation of China P.R. 1993, <http://www.mfa.gov.cn/chn/lbfbw/lbdtnew/t24004.htm>

¹² National Tax Regulations. 1985, http://www.53tax.gov.cn/showNews.jsp?info_id=1985

¹³ Corporate Income Tax Temporary Terms of People's Republic of China published on 23/12/1993

¹⁴ Notes on enhancing Development of the West Regions, published on 31/12/2000

¹⁵ *Financial Capital Stock-taking Report* (13 September 2005) Kunming Hydropower Investigation, Design and Research Institute

¹⁶ In the report non-recoverable items amount to RMB 93.34 million (i.e. 40.5% of the total committed)



To further meet the requirements of EB 41 Annex 45 section 7, registered accountant, Pingzheng Assets Appraisal¹⁷, is entrusted to independently audit the capital expense incurred and estimate the recoverable value of fixed assets before cessation of the project. Pingzheng conducted an on-site investigation, market research and financial assessment to complete the Assets Evaluation Report of Sinanjiang Hydropower Project¹⁸ issued on October 2008. This report explains in detail the financial commitments made by April 2005 and presents an assessment of their recoverable value. The original investment cost before cessation was estimated by Pingzheng as RMB 225.4547 million. The recoverable value of the invested capital cost was estimated in the Pingzheng report as RMB 134.6127 million (i.e. 59.7% of the committed costs were deemed recoverable). A construction cost increase (65.75 million RMB, 4.8% of estimated total investment) suggested by the modified tunnel-design was taken into account for the total investment as well.¹⁹ The relevant figures from the Asset Evaluation Report are summarized in Table 8 below:

Table 8: Recoverable cost outlined in the Assets Evaluation Report (million RMB)

Sum	Pre-construction work	Main project	Electrical system project
134.6127	65.5053	63.4187	5.689

Notes: It has been clarified that pre-construction work mainly consists of road, river diversion structure; Main project consists of Dam, water tunnel and equipment purchase.

In line with EB 41, Annex 45 only these recoverable costs were considered for the financial analysis in the PDD.

The official final accounts²⁰ of the completed Project Activity indicate the actual investment in fixed assets has reached RMB 1,558.3206 million. It is noted that even if all the recoverable value of the investments undertaken before cessation of the project as estimated in the Assets Evaluation Report is subtracted from the actual cost of the project, the resulting figure of RMB 1,332.8659 million²¹ is still substantially higher than that used in the PDD. Therefore it's confirmed that the total investment of RMB 1,306.25 million adopted in this PDD was estimated conservatively.

The above confirms that investment in the fixed assets have been adequately substantiated and is in line with requirements stated in EB 41 Annex 45 section 7.

Additional input value analysis

The input values based on the FSR are valid and applicable at the time of the investment decision. The following four key parameters were particularly analyzed in more detail due to their potential to have a substantial impact on the financial attractiveness of the project: a) Investment in Fixed Assets; b) Annual O&M cost; c) Tariff Price; d) Electricity Output.

With regards to a) Investment in fixed assets: this input value could be comparable with the investment cost of nine registered CDM projects²² above 50 MW capacity in Yunnan province (hereafter as "nine similar projects") and the validation team found that the range of unit investment cost of these similar CDM projects is about 4,900~10,100 RMB/kW, with an average value of about

¹⁷ Copy of the Pingzheng's Qualification License has been checked by the local auditor. Also available publicly at <http://cxmd.xxgk.yn.gov.cn/newsview.aspx?id=345297>

¹⁸ Yunzheng Zixunzi 2008 No.82, Kunming Pingzheng Assets Appraisal Consultancy, October 2008.

¹⁹ The tunnel design modification was confirmed prior to the investment decision and because the increased power output led to a net gain of the Project Activity's financial performance it is considered conservative to include this item.

²⁰ HuaKungongshenzi [2009] 146, Kunming Huaxing Huakun Accounting Firm, August 2009.

²¹ Actual cost: RMB 1,558.3206 million – All investments before cessation (recoverable + non-recoverable): RMB 225.4547 million = RMB 1,332.8659 million.

²² Registered project activities No. 2133, 2052, 2010, 2151, 2086, 2037, 1570, 1451, 0841.



6,500 RMB/kW. The unit cost investment cost used for the Project Activity is about 6,499 RMB/kW which is well within the range of these nine similar projects. This input value could be confirmed with the financial audit carried out by the designated independent accounting institute²³ which showed the investment is conservative.

Regarding b) Annual O&M costs: this parameters are based on recognized assumptions for its main components such as salary and welfare costs, material, maintenance and reservoir costs.²⁴ The items constituting O&M costs can be broken down into more detail as follows:

Table 9. O&M cost breakdown

Item	Formula from FSR	Reference
Repair costs	1% of total Investment cost	Notice of Financial Evaluation Interim Provisions of Hydropower Projects (Page 254)
Salary and Premium	146 staff, 12000RMB/year salary including 14% for welfare and 36.5% for insurance	The average salary for Yunnan province in 2002 was 999 RMB. ²⁵ 14% welfare is refer to page 254 of Notice of Financial Evaluation Interim Provisions of Hydropower Projects and 36.5% is the basic labor charge rate. ²⁶
Material	5 RMB/kW, Capacity 201 MW	Notice of Financial Evaluation Interim Provisions of Hydropower Projects ²⁷ (Page 274)
Maintenance on reservoir	0.001 RMB/kWh, annual electricity yield	Notice of Financial Evaluation Interim Provisions of Hydropower Projects (Page 254)
Fund for land occupation & Migration community development	400RMB/person annual, 2170 migrants	Notice of Establishment of Migration Late-stage Support Fund of Hydropower Station and Reservoirs
Insurance	0.25% of total Investment cost	The typical insurance rate for housing is 0.2~4% and for river dams is around 0.3%~0.6%. ²⁸
Miscellaneous expenditure	24 RMB/kW, Capacity 201 MW	Management costs, Training, and other Administrative costs (Notice of Financial Evaluation Interim Provisions of Hydropower Projects, Page 274)

The above inputs lead to an average O&M cost 2.16% of the total investment. A similar ratio is reasonable and even conservative when compared with other nine similar projects in Yunnan province. In particular, O&M cost per installed capacity (RMB/kW) for these projects ranges between approximately 104~624 RMB/kW, resulting in an average value of 208 RMB/kW. The proposed project activity presents an O&M cost per installed capacity of only 140 RMB/kW. If compared in

²³ This official audit for the project by Kunming Huaxing Huakun Accounting Firm will be used for internal shareholder reporting and will be submitted to the Provincial tax authorities. It is therefore considered reliable.

²⁴ Unless stated otherwise these assumptions are based on the Methods and Parameters for Economic Assessment of Construction Projects published by the National Development and Reform Commission and Construction Ministry

²⁵ Average monthly wage according to China Labor Information Web (<http://www.51labour.com/lawcenter/lawshow-25713.html>) According to official figures by the Yunnan Government the average monthly wage in 2007 had increased to 1,707 RMB (<http://www.yn.gov.cn/yunnan.china/73184645113446400/20081027/1176302.html>)

²⁶ 36.5% in PDD consists of 12% housing fund, 19% social security insurance and medicine insurance 4% and unemployment fund 1.5%. In 2007-2009 the actual rates are 10% housing fund (<http://buy.invest.china.cn/chinese/flzc/dtzc/8659.htm>); 20% social security insurance (<http://zhidao.baidu.com/question/44187229.html>); 10% medicine insurance (http://www.ahhb-l-tax.gov.cn/Article_Show.asp?ArticleID=192); 2% unemployment fund (http://www.ahhb-l-tax.gov.cn/Article_Show.asp?ArticleID=192). As this figure amounts to 42%, the 36.5% base rate adopted in PDD is conservative.

²⁷ The Notice of Financial Evaluation Interim Provisions of Hydropower Projects is available in Chinese at: <http://www.cqzxht.com/uploadfile/200909/20090929131743867.pdf>

²⁸ Xu Fei Engineering Budget Information Website (available in Chinese at: <http://www.xfwy.com/bxf.asp>)



terms of O&M costs per total investment, the proposed project is below the average of these nine similar projects presenting a value of 2.16% compared to 3.18%. The assumptions made in Feasibility Study Report lead to a plausible and valid figure for this parameter.

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

In accordance with benchmark analysis (Option III), if the financial indicators (i.e. IRR) of the Project Activity without CER revenue is lower than the benchmark, the project is considered as financially unattractive. The IRR of the project, with and without CDM revenues, are shown in Table 10.

Table 10. Financial indicators with CER revenue

	IRR(total investment) benchmark=8%
Without CDM	6.58%
With CDM	10.17%

As shown in Table 10, without CDM revenue, the project IRR on total project investment is 6.58%, which is lower than 8% (benchmark IRR). The Project Activity without the CDM is therefore financially unattractive to investors. With participation in the CDM, revenue derived from the sale of CERs will significantly improve the IRR of the Project Activity to 10.17%, which exceeds 8% (benchmark IRR) making the Project Activity with CDM revenue financially attractive to investors.

Sub step 2d. Sensitivity analysis

The four key parameters that can have a substantial impact on the financial attractiveness of the project were subjected to sensitivity analysis within a range of -10% to +10%²⁹ and are identified as follows:

- 1) Investment in Fixed Assets³⁰
- 2) Annual O&M cost
- 3) Tariff Price (VAT incl.)
- 4) Electricity Output

The corresponding impacts on IRR of the Project Activity are shown in Table 11 and Figure 3:

Table 11. IRR sensitivity to different financial parameters (project IRR without CDM revenue)

	-10%	-5%	0	+5%	+10%
Investment in Fixed Assets	7.30%	6.91%	6.58%	6.26%	5.96%
Annual O&M cost	6.73%	6.66%	6.58%	6.50%	6.45%
Tariff Price (VAT incl.)	5.81%	6.19%	6.58%	6.97%	7.33%
Electricity output	5.81%	6.20%	6.58%	6.96%	7.33%

²⁹ As per EB 41, Annex 45 (para 17) As a general point of departure for variations in the sensitivity analysis should at least cover a range of +10% and -10%

³⁰ The non-recoverable investment in fixed assets incurred prior to recommencement of the project were identified and excluded for the financial analysis in accordance with the *Guidance on the Assessment of Investment Analysis (version 02)*

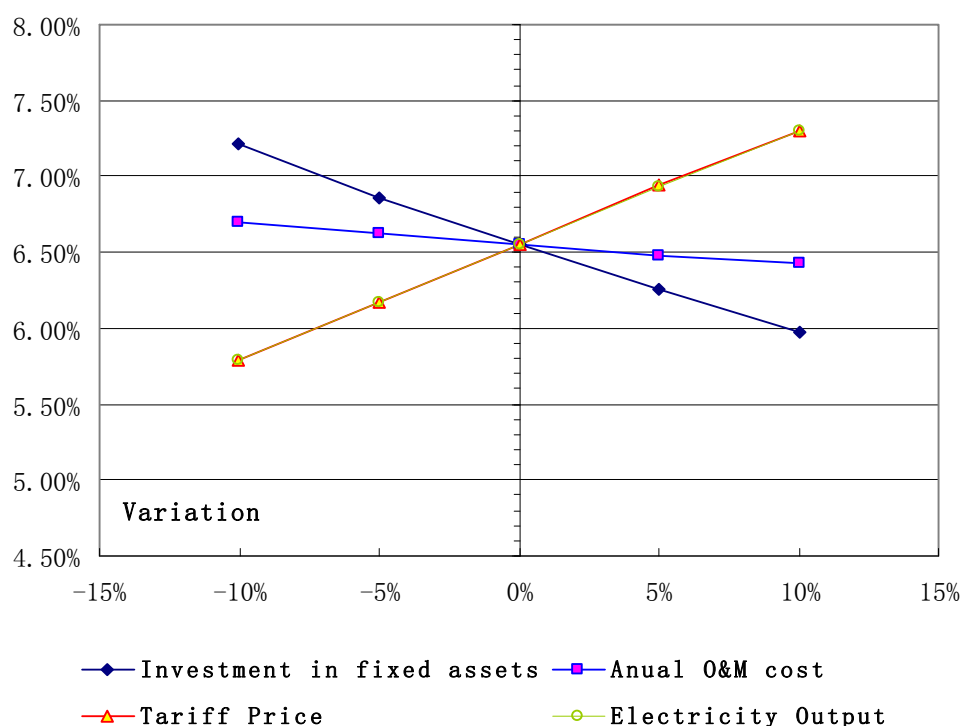


Figure 3. Project IRR sensitivity analysis of the Sinanjiang Hydropower Project (without CDM)

Investment in fixed assets & Annual O&M cost

The local price index of investment in fixed assets (Yunnan, 1997-2007³¹) and the local price index of general product (Yunnan, 2000-2007³²) indicate a rising trend in prices and within a limited variation range (coefficients of variation are less than 10%³³). It is very unlikely that the investment in fixed assets and O&M costs could reduce. Cross-checking with the available accounts of the Project Activity, the actual investment in fixed assets has reached RMB 1,558.3206 million, representing a 13.7% increase of the expected investment cost even before construction cease (RMB 1,369.5149 million).³⁴ Therefore the total investment of RMB 1,306.25 million adopted in this PDD was estimated very conservatively.

Electricity output

Electricity output would have to increase 19.1% to reach the benchmark. As electricity output is primarily determined by the river flow rate it is unlikely to vary by much. The hydraulic record (Sinanjiang River, 1956-2000¹³) of the river where the Project Activity lies shows an annual flow rate of 43.2 m³/s and short-term variation coefficient not exceeding 19%. The possibility that flow rate remains a +19.1% increment during the entire project life time is therefore small. The net electricity output is further established with reference to the effective electricity intake of 90% which, according to the FSR, is physically limited by the intake capacity of the Yunnan Power grid. The final parameter used to determine the net electricity output is the auxiliary power consumption which, with a value of

³¹ National Bureau of Statistic of China, <http://www.stats.gov.cn/tjsj/> Price Index of Investment in Fixed Assets

³² National Bureau of Statistic of China, <http://www.stats.gov.cn/tjsj/> These Price Indexes include retail price index, consumer price index, Ex-Factory Price index of industrial products, Price Indices of Raw Mater, Fuels and Power

³³ The study on price index variation is provided for validation

³⁴ The total investment figure from the draft accounts has been provided to the DOE and are still being processed by the Kunming Huaxing Huakun Accounting firm. These draft accounts do not include the O&M costs as the Project Activity has yet been commissioned for a full 12 months at the time of writing.



0.25%, is conservatively estimated in the FSR. It is noted that the net electricity output is further made conservative it does not take into account transmission line loss.³⁵

Electricity tariff

In the FSR the estimated hydropower electricity tariff by the design institute of 0.2208 RMB/kWh (VAT incl.) is estimated optimistically high. In reality the electricity tariff obtained by the Project Activity was set at 0.215 RMB/kWh (VAT incl.) in the Power Purchase Agreement (PPA) between the Project Entity and Grid Company which is consistent with provincial regulations³⁶. As the first electricity sales invoices are available the implemented tariff could be cross-checked by the DOE as having been implemented. As the tariff envisaged in the FSR is higher than the actual tariff obtained, the financial analysis is conservative. Furthermore, the electricity tariff is highly regulated by administrative policy and regulation. The government is responsible for setting of the tariff, and the possibility for variation over 10% is very small.³⁷

In conclusion, when the key parameters fluctuate within a reasonable range, the Project Activity will never be economically attractive.

Step 3. Barriers analyses

This step is not used to confirm the additionality of this project

Step 4. Common practice analyses

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

Yunnan Province, with an area of 394,000 km² is considerably larger than many countries. As verified through third party sources as the UN ESCAP, the access to finance and technology is a challenge in Yunnan as it is one of the poorest provinces in China.³⁸ Furthermore, due to the scale of its provinces and location-specific challenges it is China's central government policy that regional governments propose their own investment incentives and to specify the sectors and industries where investments are encouraged;³⁹ Consequently, it can be concluded that Yunnan province has its own set of policies including in the areas of environmental regulatory policy and investment climate. It could be demonstrated by independent sources such as the website of "The Regional Environmental Forum"⁴⁰ and the Official website of the Yunnan Province Government.⁴¹

In addition, according to the Shanxi Economic Information Institute⁴², within the region covered by the China Southern Power Grid (CSPG), Yunnan province comprises around 70% of the hydro resource available to the geographical boundary covered by the CSPG and that although the provincial

³⁵ Should net electricity output be increased by 10.25% (i.e. ignoring effective electricity intake capacity constraints 10% and auxiliary consumption 0.25%) the IRR increases to 7.43%, below the benchmark.

³⁶ Yunnan tariff regulation by Yunnan Development and Reform Commission (2006) in which a benchmark tariff

(0.215 RMB/kWh) is referred to. The PPA was validated by the DOE.

³⁷ Notice on the Printing and Issuing of the Implementing Measures for the Reform of Electricity Tariffs on 28 March 2005, available at: http://www.hg.org/articles/article_805.html

³⁸ http://www.unescap.org/tid/publication/t&ipub2336_part2vii.pdf: while Yunnan accounts for about 3.4% of the population of China, its share in national GDP is only about 2.2%. Its share of industrial production is considerably lower at 1.8%. Also, its share in national exports and imports (0.4 per cent) as well as foreign investment (0.4 per cent) is much lower compared with its share in the population.

³⁹ http://www.unescap.org/tid/publication/t&ipub2336_part2vii.pdf

⁴⁰ <http://www.ref-msea.org/yunnan.pdf>

⁴¹ Official Website of People's Government of Yunnan Province (Investment section)

<http://www.eng.yn.gov.cn/yunnanEnglish/146092109982597120/index.html>

⁴² Shaanxi Economic Information Institute <http://www.sei.gov.cn/ShowArticle.asp?ArticleID=69073>



grids in the CSPG are interconnected, each provincial grid is individually managed by its respective provincial power grid company.⁴³ And Yunnan Development and Reform Commission sets its own tariff policies which means that the incentives for hydro power developments in other provinces differ. Therefore Yunnan was confirmed as the only relevant geographic boundary for the common practice analysis.

At the beginning of 2002 wholesale electricity industry reforms took place in China.⁴⁴ Hydropower with an installed capacity of 50-300MW is classified medium-size scale and is subject to specific national standards.⁴⁵ Therefore similar operational projects were identified as built since 2002 and with an installed capacity of between 50 and 300MW.

In order to determine to what extent these similar operational projects have been undertaken in reference was made in the first instance to the annual Yearbook of China Water Resources. The resource is a valid to identify possible similar operational projects in a comprehensive manner. The following four hydropower projects could be considered as similar operational projects: Gaoqiao, Malutang, Ajiutian, and Dayingjiang.

Table 12: Relevant publicly available parameters of similar project activities

Name	Capacity (MW)	Construction (year)	Annual operation time (hour)	Elect. output (10 ⁸ KWh)	Total investment (10 ⁸ RMB)
Gaoqiao	90 ⁴⁶	2002 ⁴⁷	5000 ⁴⁷	4.56 ⁴⁶	4.5 ⁴⁶
Malutang	100 ⁴⁸	2002 ⁴⁸	6970 ⁴⁸	6.97 ⁴⁸	4.47 ⁴⁹
Ajiutian	105 ⁵⁰	2003 ⁵⁰	5670 ⁵⁰	5.95 ⁵⁰	4.928 ⁵⁰
Dayingjiang	98 ⁵¹	2003 ⁵¹	7153 ⁵¹	7.01 ⁵¹	4.853 ⁵¹

The primary data listed in the table above were used make two ratios which allow comparison of the project activities: the investment/capacity ratio and the investment/electricity output ratio. The results, listed in Table 13 below, show that the Sinanjiang CDM project is as much as 40% and 54% higher in terms of investment/capacity and investment/electricity output ratios respectively compared to the most similar non-CDM project.

Table 13: Comparative ratios of similar project activities

Name	Investment/ Capacity (10 ⁴ RMB/kW)	Investment/ Elect. output (RMB/KWh)
Gaoqiao Hydropower	491	0.99
Malutang Hydropower	447	0.64
Ajiutian Hydropower	469	0.83

⁴³ "Structure of Organization" CSPG website <http://eng.csg.cn/topic.php?channelID=1&topicID=25>

⁴⁴ "Notes on Reform of Power industry" issued by State Department of PRC, 2002; These reforms separated electrical power enterprises into grid operators and those focused specifically on electricity generation.

⁴⁵ National standards on Hydro power project classification and security, DL5180-2003

⁴⁶ Website of Kunming Huaan Engineering & Technology Co.Ltd: www.kmha.cn/Html/yj/sh/34094560.html

⁴⁷ Website of the Yunnan Office for Western Development: www.xb.yn.gov.cn/tzjh-b.htm#

⁴⁸ Introduction to Malutang Hydropower Dam design, Volume 21, the 5th of Yunnan Hydropower Company

⁴⁹ Yunnan Water Recouse Department, alternate link: <http://www.wcb.yn.gov.cn/news/1144.html> (the link in the PDD www.cjstbc.com/POArticle/80/1617.Html of China Changjiang Water Resources Commission is invalid now but was validated by DOE and a PDF copy was kept on record by the PPs)

⁵⁰ Website of Yunnan Baoshang Supahe Hydropower Company: <http://www.ynsph.com.cn/column/466.whhtml> (the link www.fengdianzhan.com/data/2007/0310/article_1367.htm news website for renewable energy project is invalid now but validated by DOE and a PDF copy was kept on record by the PPs)

⁵¹ Website of Yingjiang Prefecture Commerce Department:

www.yjzs.gov.cn/yjzs/Article/xxdt/chxw/200612/150.html



Dayingjiang Hydropower	495	0.69
Sinanjiang Hydropower	695	1.52

These findings show the complementarity of the Common Practice Analysis to the Investment Analysis which confirmed that the 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:

According to baseline and monitoring methodology (ACM0002, Version 07), the emission reduction ER_y by the proposed project during a given year y is:

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

Where,

ER_y emission reduction in year y ;

PE_y project emissions in year y ;

LE_y emissions due to leakage in year y ;

BE_y baseline emissions in year y .

The steps to calculate PE_y , L_y and BE_y to confirm ER_y are detailed in the following:

Step 1: estimate the project emission PE_y

The main emission in hydropower project is methane caused by inundation when reservoir formed. The inclusion of the emission is determined by the project power density. The formula is below:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (2)$$

PD power density (W/m^2);

Cap_{PJ} install capacity after project activity (W);

Cap_{BL} installed capacity before project activity (W), for new project the value is zero.

A_{PJ} Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2);

A_{BL} Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new project the value is zero.

As specified in the FSR, when nominal water level reached the surface of reservoir is 8.168 km^2 and the installed capacity is 201MW. Thus the power density is 24.61 W/m^2 , which is greater than 10 W/m^2 . The project emission therefore does not include emissions by inundation.

Step 2: Estimate the leakage (LE_y)

ACM0002 (version 7) specifies no leakage should be included for new grid connected electricity project by renewable energy. Therefore $LE_y = 0$.

**Step 3: estimate the baseline emission (BE_y)**

Based on the conclusion of B.4, the baseline scenario is that the connected grid provides the identical amount of electricity which would otherwise be provided by the Project Activity. The baseline emission contains the only the carbon dioxide exhausted by all the fossil fuel fired plant connected to the grid (CSPG).

$$BE_y = (EG_y - EG_{baseline}) \times EF_{grid,CM,y} \quad (3)$$

Where,

BE_y	Baseline emissions in year y (tCO ₂ /yr).
EG_y	Electricity supplied by the project activity to the grid (MWh).
$EG_{baseline}$	The electricity supplied to the grid before the project activity (MWh). For new project the value is zero.
$EF_{grid,CM,y}$	Combined margin CO ₂ emission factor for grid connected power generation in year y

The *Tool to calculate the emission factor for an electricity system* provides for a step-wise approach to calculate the $EF_{grid,CM,y}$. The calculation would employ it.

Step 1. Identify the relevant electric power system

The China DNA (NDRC) provides a regularly updated description of the relevant electric power system. The CSPG as the project electricity system that the Project Activity is directly connected contains four provincial power grids: the Guangdong, Guangxi, Yunnan and Guizhou grids. The CCPG which delivers electricity to the CSPG, as connected electricity system, covers Henan province, Hubei province, Hunan province, Jiangxi province, Sichuan province and Chongqing city.

Step 2. Select an operating margin (OM) method

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

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

Simple OM is applicable when low operating cost/ must-run resources constitute less than 50% of total grid generation. In the most recently available five years (2002~2006, for details see table A1, Annex 3), electricity generated in the CSPG by the hydropower and other renewable energy is less than 50% of the total power generation. Simple OM method is therefore employed. Method (a) is used to calculate the OM emission factor of the CSPG. For the emission factor of the net electricity imports from the CCPG, Simple OM method is also to be employed.

Data vintage selection

In accordance with the “Tool to calculate the emission factor for an electricity system”, the OM is calculated according to the “ex ante option”: a 3-year generation weighted average, based on the most recent data available at the time of submission of the CDM-PDD for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

**Step 3. Calculate the operating margin emission factor according to the selected method**

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

- Based on data on fuel consumption and net electricity generation of each power plant / unit (Option A), or
- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit (Option B), or
- Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option C).

In China, power grids and power plants keep specific net electricity generation and the fuel consumption data as business secrets, so they will not publicly release these data, thus only option (C) is feasible.

$$EF_{grid,OM,simple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_y} \quad (4)$$

Where,

$EF_{grid,OM,simple,y}$	Simple operating margin CO ₂ emission factor in year y (tCO ₂ /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).
$EF_{CO_2,i,y}$	CO ₂ emission factor of fossil fuel type i in year y (tCO ₂ /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).
i	All fossil fuel types combusted in power sources in the project electricity system in year y .
y	The three most recent years.

The $EF_{grid,OM,y}$ is 1.0119tCO₂e/MWh. for calculation details, see table A2-A8, annex 3.

Step 4. 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 either:

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

Sample group (b) is chosen to calculate the build margin as the power units described in (b) as it comprises the larger annual generation

In terms of vintage of data, we choose the following options: for the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For



the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Step 5. Calculate the build margin emission factor

Under the current circumstance in China the data of sampling power units group m are not available. Therefore, the formula provided in ACM0002 version 7 is not practical and the CDM EB approves the following methodology deviation⁵²:

- (1) Use of capacity additions during last 1- 3 years for estimating the build margin emission factor for grid electricity.
- (2) Use of weights estimated using installed capacity in place of annual electricity generation and use of the efficiency level of the best technology commercially available in the provincial/regional or national grid of China, as a conservative proxy.

Methodology AM0005 has been replaced by the consolidated methodology ACM0002, thus the deviation above is also applicable to the consolidated methodology ACM0002.

Because the generation capacities of coal, oil and gas fuelled power cannot be separated from the current statistical data, the following steps are adopted in the calculation: firstly the PDD make use of the latest energy balance data to calculate all sorts of emission scale in total emission from coal, oil and gas fuelled power; then based on the emission factor under the level of best commercialized technical efficiency, calculate the fuelled power emission factor of the grid; last multiply the fuelled power emission factor and fuelled power proportion of the total power, then comes the resulting BM of the grid.

The detailed procedure and formula are as follows:

Sub-step 1. Calculate the specific proportions of CO₂ emission induced by solid, liquid and gaseous fuels in local grid with the following formulas:

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

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (6)$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO_2,i,j,y}} \quad (7)$$

⁵² EB guidance for “Request for guidance: Application of AM0005 and AMS-ID in China, 2005.10.7” : Request for clarification on use of approved methodology AM0005 for several projects in China. <http://cdm.unfccc.int/Projects/Deviations>.



Where,

$F_{i,j,y}$ Amount (in volume or mass unit) of fuel i consumed by province j in year(s) y ;

$NCV_{i,y}$ Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit).

$EF_{CO_2,i,y}$ CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ)

The subscripts, Coal, Oil and Gas indicates the Coal, liquid and gaseous fuel.

Sub-step 2. Calculate the emission factor of fossil fuel plants

$$EF_{Thermal,y} = \lambda_{Coaly} \times EF_{Coal,Adv,y} + \lambda_{Oily} \times EF_{Oil,Adv,y} + \lambda_{Gasy} \times EF_{Gas,Adv,y} \quad (8)$$

Where,

$EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ refers to the emission factor of the efficiency of the best coal, oil and gas fuel fired electricity generation technology commercially employed.

Sub-step 3. Calculate the $EF_{BM,y}$ of the grid

$$EF_{Grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y} \quad (9)$$

$EF_{grid,BMsimple,y}$ Build margin emission factor of a grid in year y (tCO₂/MW h);

$CAP_{Total,y}$ Increase of installed capacity of a grid in year y (MW);

$CAP_{Thermal,y}$ Increase of fuel fired generation capacity of a grid in year y (MW).

According to the calculation in table A9-A12, annex 3. The build margin emission factor of the CSPG is 0.6748tCO₂e /MWh.

Step 6. Calculate the combined emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{Grid,CM,y} = EF_{Grid,OM,y} \times w_{OM} + EF_{Grid,BM,y} \times w_{BM} \quad (10)$$

Where:

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

$EF_{grid,BM,y}$ Build 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 (%).

Both weighting w_{OM} and the weighting w_{BM} are 0.5 in default for the first crediting period. For the second and third crediting period, these would be updated according to methodology.

Thus the baseline emission factor of the CSPG is 0.84335tCO₂e/MWh. For the calculation, see table A13, annex 3.

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

The data and parameters used in the baseline calculation are as follows, the detailed data are listed in Annex 3.

Data / Parameter:	1. $EF_{CO_2,i,y}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor of fossil fuel <i>i</i> in year <i>y</i>
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2
Measurement procedures(if any):	-
Monitoring frequency:	OM: Once for each crediting period using the most recent three historical years, for which data is available at the time of submission of the PDD to the DOE for validation (ex-ante option), following the guidance in step 2. BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	
Any comment:	-

Data / Parameter:	2. $EG_{import,y}$
Data unit:	MWh
Description:	Net electricity imported to the project electricity system from exported electricity system (CCPG in this case) in year <i>y</i>
Source of data:	2004-2006 China Electric Power Yearbook
Measurement procedures (if any):	
Monitoring frequency :	OM: Once for each crediting period using the most recent three historical years, for which data is available at the time of submission of the PDD to the DOE for validation (ex-ante option), following the guidance in step 2. BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	

Data / Parameter:	3. EG_y
Data unit:	MWh
Description:	Net electricity generated and delivered in the project electricity system in year <i>y</i>
Source of data:	2004-2006 China Electric Power Yearbook



Measurement procedures (if any):	
Monitoring frequency :	OM: Once for each crediting period using the most recent three historical years, for which data is available at the time of submission of the PDD to the DOE for validation (ex-ante option), following the guidance in step 2. BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	

Data / Parameter:	4. $NCV_{i,y}$
Data unit:	GJ/t or MJ/m ³
Description:	Net calorific value (energy content) of fossil fuel <i>i</i> in year <i>y</i>
Source of data:	2004-2006 China Electric Power Yearbook
Measurement procedures (if any):	-
Monitoring frequency:	OM: Once for each crediting period using the most recent three historical years, for which data is available at the time of submission of the PDD to the DOE for validation (ex-ante option), following the guidance in step 2. BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	5. $FC_{i,y}$, $F_{i,j,y}$
Data unit:	ton, m ³
Description:	The amount of fossil fuel <i>i</i> consumed of grid in year <i>y</i> ; The amount of fossil fuel <i>i</i> consumed in province <i>j</i> in year <i>y</i>
Source of data used:	2004-2006 China Energy Statistics Yearbook
Measurement procedures (if any):	-
Monitoring frequency:	OM: Once for each crediting period using the most recent three historical years, for which data is available at the time of submission of the PDD to the DOE for validation (ex-ante option), following the guidance in step 2. BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	-



Data / Parameter:	6. $EF_{Coal,Adv,y}$, $EF_{Oil,Adv,y}$ and $EF_{Gas,Adv,y}$
Data unit:	%
Description:	the best efficiency of coal, oil and gas fuel fired commercially employed electricity generation technology
Source of data used:	Data published by NDRC – China's DNA
Measurement procedures (if any):	-
Monitoring frequency:	BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	7. $CAP_{Total,y}$, $CAP_{Thermal,y}$
Data unit:	MW
Description:	The installed capacity increase of total plants in grid in year y; The installed capacity increase of the fuel fired plants in grid in year y.
Source of data used:	Data published by NDRC – China's DNA
Measurement procedures (if any):	-
Monitoring frequency:	BM: Once ex-ante for the first crediting period, following the guidance included in step 4. For the second and third crediting period, only once ex-ante at the start of the second crediting period.
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	8. EF_{Res}
Data unit:	kgCO ₂ e/MWh
Description:	Default emission factor for emissions from reservoirs.
Source of data:	The default value as per EB23 is 90 kgCO ₂ e/MWh.
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter:	9. Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.



Source of data:	Project site.
Measurement procedures (if any):	Recognized standards.
Any comment:	-

Data / Parameter:	10. A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data:	Project site.
Measurement procedures (if any):	Measured by topographical surveys, maps etc.
Monitoring frequency :	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	11. W_{OM} , W_{BM}
Data unit:	%
Description:	Weighting of operating margin emissions factor (OM) and build margin (BM) emissions factor
Source of data:	Methodology ACM0002 (Version 07).
Measurement procedures (if any):	-
Monitoring frequency :	Both weighting w_{OM} and the weighting w_{BM} are 0.5 in default for the first crediting period. For the second and third crediting period, these would be updated according to methodology.
QA/QC procedures:	
Any comment:	-

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

According to B.6.1, the emission reduction by the project activity during a given year y is the difference between baseline emissions and project emissions and emissions due to leakage, as follows:

$$ER_y = BE_y - PE_y - LE_y$$

According to B6.1, under the condition of neglecting the leakage during the construction period, the emissions by the project activity (PE_y) and emissions due to leakage within the Project Activity boundary (LE_y) equal zero. Therefore, the emission reduction of the Project Activity is numerically equal to the baseline emissions (BE_y), i.e.:



$$BE_y = (EG_{y,out} - EG_{y,in} - EG_{baseline}) \times EF_{grid,CM,y}$$

According to the calculation of the combined margin baseline emission factor of the power grid in section B.6.1, the baseline emission factor is 0.84335tCO₂e/MWh.

According to the feasibility report of the Project Activity, the annual amount of electricity generation delivered to the Grid is 825.6GWh. Therefore, the ex-ante annual emission reduction (ER_y) of the Project Activity is estimated to be 696,245tCO₂e.

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

The overall emission reduction induced by the Project Activity in the first crediting period is estimated to be 4,873,715tCO₂e. The starting day of the first credit period is expected to be 01/11/2009, or the registration date, whichever is later. Then the last day of the first credit period is postponed accordingly.

Table 14. The ex-ante estimated emission reduction for the first crediting period

Year (dd/mm/yy)	Project activity emissions (tonnes of CO ₂ e)	Baseline emissions (tonnes of CO ₂ e)	Leakage (tonnes of CO ₂ e)	Emission reductions (tonnes of CO ₂ e)
01/11/ 2009 -31/10/ 2010	0	696,245	0	696,245
01/11/ 2010 -31/10/ 2011	0	696,245	0	696,245
01/11/ 2011 -31/10/ 2012	0	696,245	0	696,245
01/11/ 2012 -31/10/ 2013	0	696,245	0	696,245
01/11/ 2013 -31/10/ 2014	0	696,245	0	696,245
01/11/ 2014 -31/10/ 2015	0	696,245	0	696,245
01/11/ 2015 -31/10/ 2016	0	696,245	0	696,245
Total (tonnes of CO ₂ e)	0	4,873,715	0	4,873,715

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

B.7.1. Data and parameters monitored:

Data / Parameter:	1. $EG_{y,out}$
Data unit:	GWh
Description:	Net electricity delivered to the power grid by the Project Activity in year y
Source of data to be used:	Gateway ammeter (Grid side) as default, when not available then checking ammeter (project side).
Value of data applied for the purpose of calculating expected emission reductions :	825.6
Description of measurement	Electricity supplied to the grid by the Project will be hourly measured by 0.2s ammeter and will be electrically recorded on a monthly basis.



methods and procedures to be applied:	“Standards on electricity measurement device technology, DL/448-2000”
Monitoring frequency	Hourly measurement and monthly recording
QA/QC procedures to be applied:	Check whether the reading is consistent with the sales receipt.
Any comment:	More details in B.7.2

Data / Parameter:	2. $EG_{y,in}$
Data unit:	GWh
Description:	Electricity supplied to the project for internal use from grid in year y.
Source of data to be used:	Gateway ammeter (Grid side) as default, when not available then checking ammeter (project side).
Value of data applied for the purpose of calculating expected emission reductions :	0
Description of measurement methods and procedures to be applied:	Electricity supplied to the grid by the Project will be hourly measured by 0.2s ammeter and will be electrically recorded on a monthly basis. “Standards on electricity measurement device technology, DL/448-2000”
Monitoring frequency	Hourly measurement and monthly recording
QA/QC procedures to be applied:	Check whether the reading is consistent with the sales receipt.
Any comment:	More details in B.7.2

Data / Parameter:	3. TEG_y
Data unit:	GWh
Description:	Total electricity produced by the project generation, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh).
Source of data to be used:	Project activity site.
Description of measurement methods and procedures to be applied:	Electricity supplied to the grid by the Project will be hourly measured and will be electrically recorded on a monthly basis. “Standards on electricity measurement device technology, DL/448-2000”
Monitoring frequency	Hourly measurement and monthly recording
QA/QC procedures	Check whether the reading is consistent with the sales receipt.



to be applied:	
Any comment:	More details in B.7.2

Data / Parameter:	4. Cap_{PJ}
Data unit:	W
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:	201×10^6
Monitoring frequency:	-Yearly
Description of measurement methods and procedures to be applied:	Determined by commonly recognized standards.
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	5. 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 (m^2).
Source of data to be used:	Project site.
Value of data applied for the purpose of calculating expected emission reductions:	8168000
Monitoring frequency:	Yearly
Description of measurement methods and procedures to be applied:	Measured from topographical surveys, maps, etc.



applied:	
QA/QC procedures to be applied:	-

B.7.2. Description of the monitoring plan:

The monitoring plan will be carried out by the Project Entity; it will ensure that emission reductions of the Project Activity are measurable and verifiable during the crediting period. The Monitoring plan described here is proposed based on the FSR, previous practices, power monitoring standards and CDM methodology/ tools. Although the actual plan can be modified if needed, it will be ensured that it remains consistent with CDM methodology requirements.

1. Monitoring data

The baseline emission factor is calculated ex-ante, and the monitoring data for each crediting period includes: net electricity delivered to the grid by the Project Activity (EG_y), total electricity produced by the project generation (TEG_y), and the relevant data (Cap_{PJ} , A_{PJ}) to power density. Modification on the generator system which induces change of Cap_{PJ} (installed capacity) will be recorded, if no modification occurs to Cap_{PJ} the latest value validated or verified by the DOE is applicable. A_{PJ} (area of the reservoir) measurement will be done by the appointed qualified professional institute. The electricity delivered by the project to the CSPG is defined as the key data to be monitored. The monitoring plan is drafted to focus on monitoring the electricity delivered.

2. Monitoring device installation

The electric energy metering devices of the Project Activity will be installed according to relevant national regulations and standards⁵³. Before the electric energy measurement equipment is in operation, the Project Entity and Grid Company will co-check the equipment (see Figure 4).

Two 0.2s bidirectional ammeters will be installed to monitor the electricity delivered to the grid. The Gateway Ammeter (M1) will be installed at the inlet of the power grid as the main ammeter to measure electricity generated by the Project Activity to the grid ($EG_{y,out}$) as well as electricity supplied to the Project Activity from the grid ($EG_{y,in}$). Another ammeter (M3, Checking Ammeter) will be installed at the outlet of the transformer of the hydropower station serving as backup for the Gateway Ammeter. Ammeters (M2-1, M2-2, M2-3, Generator Ammeters) are installed to measure the electricity output of each generator (TEG_y). A connection with identical ammeters to the grid shown in Figure 4 will be built as backup. These two ammeters ($M1'$, $M3'$) function the same when the main connection (left one) is unavailable, thus the measurements of it on $EG_{y,in}$ and $EG_{y,out}$ are identical for the emission reduction calculation.

⁵³ National Standards on electricity measurement device technology, DL/448-2000

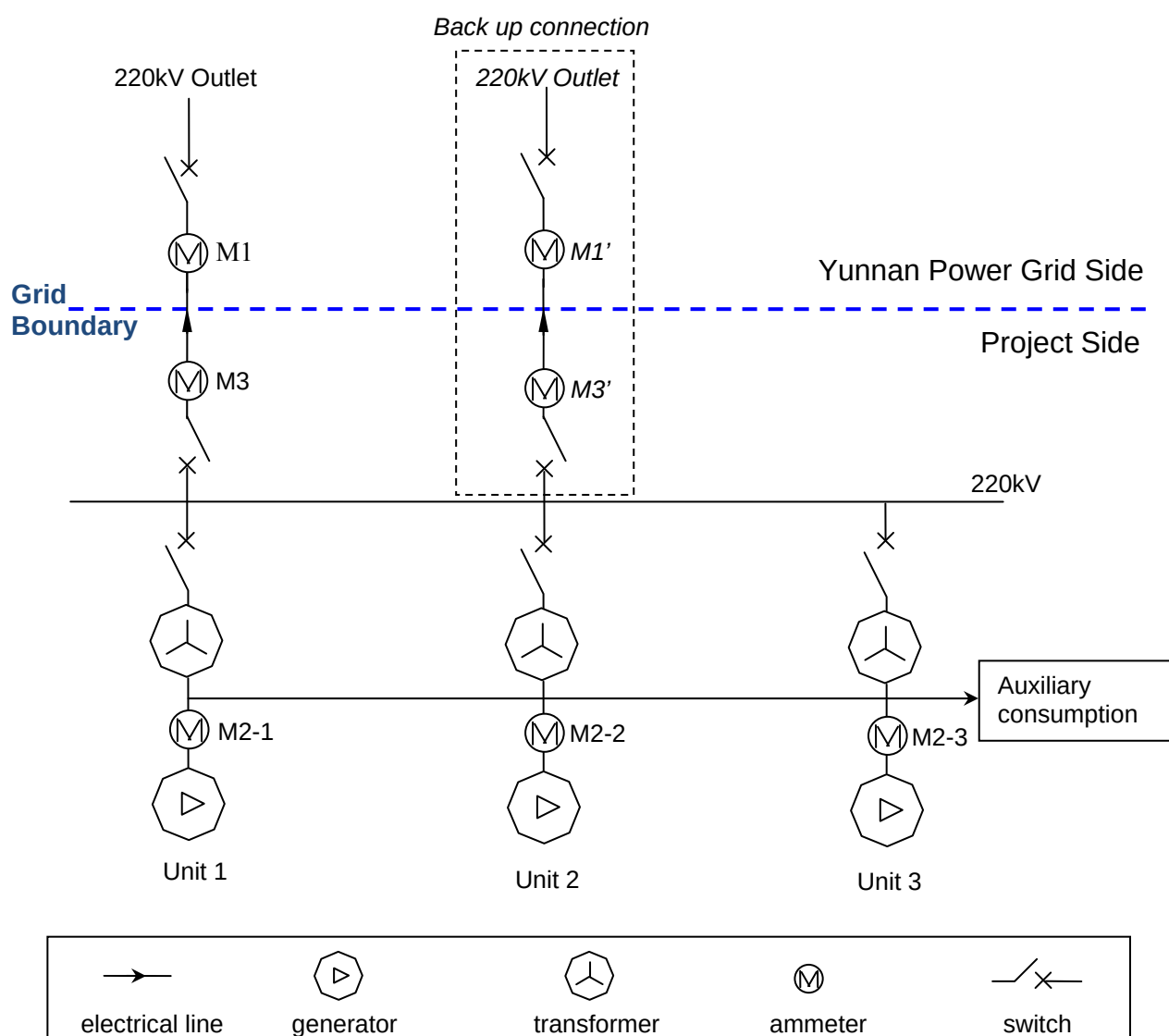


Figure 4. Electrical monitoring connection diagram

3. Data reading and archiving

Data collection and archive keeping from relevant ammeters will be compliant to relevant national regulations and standards (i.e. *Standards on electricity remote measurement system*, DL/T743-2001). Normally, the electricity delivered to the grid by the hydropower station is subject to data measured by the Gateway Ammeter. Should a fault on ammeter occur, the amount of the electricity delivered to the grid can be determined by the Checking Ammeter. The discrepancy on measurement validity would be arbitrated by the Yunnan Electrical Power Experiment and Research Institute.

Data will be electronically archived at the end of every month; electronic documents will be archived in CD format. Data collected as part of monitoring will be archived electronically and be kept for at least two years after the end of the last crediting period. The Quality Assurance and Quality Control procedures for recording, maintaining and archiving data shall be improved as part of this CDM project activity according to CDM EB rules and real practice in terms of the need for verification of the emission reductions on an annual basis according to this PDD. The electricity delivered to the grid will be double-checked with the sales invoice/receipt provided by the Project Entity to the Grid Company.

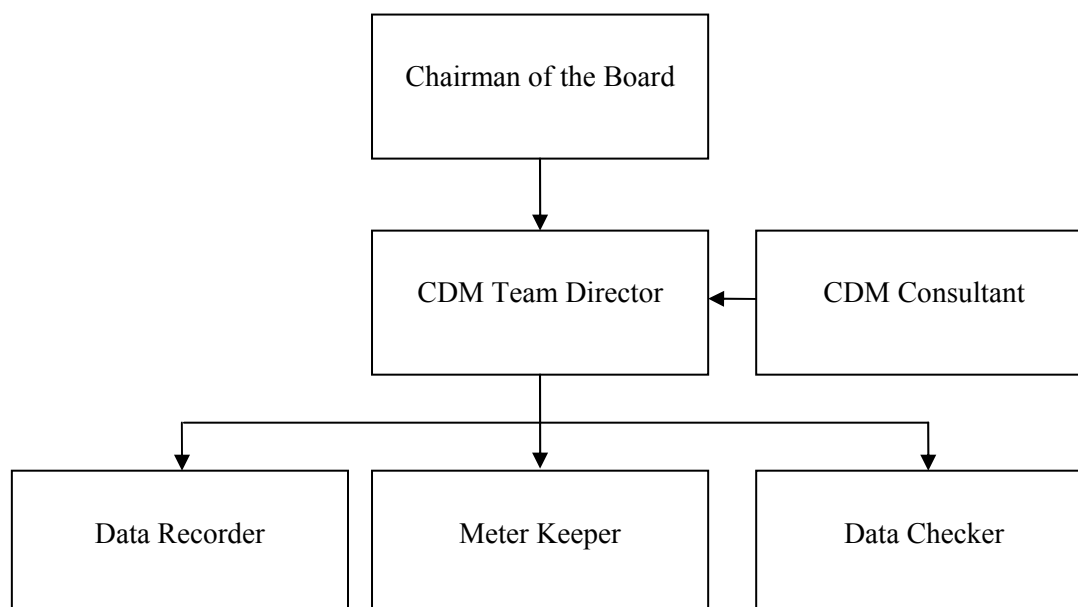


4. Calibration and maintenance

The calibration on (checking ammeter and gateway ammeter) the will be done by a professional entity under supervision of both Project Entity and grid company at least twice a year. After inspection and on-site check, ammeters must be sealed; either party can't remove the seal or modify the ammeter when the other party (or its authorized representative) is absent. The regular ammeter inspection and on-site check should be implemented according to national standards and regulations²⁵.

5. Monitoring organization

The Project Entity will set up a dedicated CDM group to take charge of data collection, archiving, verification and supervision. The Data Recorder will execute the route data read and archiving. The Data Checker will verify the data for validity. The Meter Keeper is in charge of maintenance to ensure sound measurement. The CDM Team Director will be trained and get support on the CDM by the professional consultant when needed.



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)
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The study of the baseline and the monitoring methodology was completed on 30/05/2007:

The key organizations involved in the baseline study include:

Coway International TechTrans Co., Ltd. Room 2206, Huaye Building, Tsinghua University, Beijing, China Tel: (008610) 62795171 Tax: (008610)62795182

The above organization and individual is 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:**

25/10/2005 on which partial construction restarted and the Project Activity recommenced.

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

35 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:**

01/11/2009, or the registration date, whichever is later.

C.2.1.2. Length of the first crediting period:

7 years

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

Not applicable

C.2.2.2. Length:

Not applicable

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

According to the requirement of the national environmental protection rules and regulations, the Project Activity completed the environmental assessment report on environmental impact in April 2004, and on the 9th of Oct. 2004 Yunnan Environment Protection Bureau has ratified the environmental assessment report.

The impacts on environment made by the Project Activity are as follows:

◆ Ecological effect

According to environment impact assessment, the construction of the Project Activity will have some impacts on the local ecological environment. Through investigation, there is no valuable and rare species in the construction area and migrant settlement area. The project participant will enhance the monitoring and management of environmental protection, instruct workers to raise their awareness of environmental protection. The vegetation destroyed during the construction period should be resumed after the operation starts.

The ecology impact during operation is on aquatic ecology and it would be permanent. The river would be altered by hydropower project operation in respect to flow rate and flow tide. Certain amount of ecological water should be discharged from the reservoir to the lower reaches of the dam



during the dry period. The operation would be compliant to relevant environment protection regulation of China.

◆ Waste water

The waste water of the Project Activity mostly comes from household and construction process. The construction unit shall set up a waste water disposal system in the process of sand machining, to reduce the discharge amount of waste water waster, and according to the condition of landform, simple sand basin and catch-water basin shall be dig to decrease sand content and then discharge waste water to the river. Sewerage disposal establishment and sub drain should be setup in the living area and the encampment of owner; Sewerage from medicine use should be discharge after disposal; Cesspool should be built in the public toilet in the area of living and office. By means of above measures, it shall not impact the quality of surface water in the period of construction.

Because there is less activity occurred and less people on the project site, the waste water discharged during operation decreased comparing to construction period.

◆ Air pollution

During the period of construction, environmental pollution caused by the Project Activity is mainly from various powders and the emission of fired coal and fuel. A wet method operation is adopted by the Project Activity to prevent dust through regularly sprinkling on construction site, duly sprinkling during loading and unloading; Dust catching equipment should be installed in the drilling machine, concrete mixing machine should be sealed and equipped with dust catcher; Measures of labours safeguard should be carried out for the workers.

There is no obvious air pollutant causing activity during operation. This type of pollution would be trivial.

◆ Noise

The noise during the construction mainly comes from operation machines and vehicles. The builders should be under the protection, such as, wearing sound insulation earplugs and helmet. Lower noise equipment should be chosen when select the equipment; an insulation chamber should be built in case of bigger fixed noise resources, and a muffle should be used in case of lesser noise resources.

The transform station and generator is the main noise of source during the operation period. The noise would be ensured below the national standards by good maintenance and other measures.

◆ Solid Waste

The Project Activity will produce waste residue in amount of $264.70 \times 10^4 \text{m}^3$ during the construction, 13 residue deposits are planned in the project design. A measure on engineering and biology shall be adopted to prevent residue collapse; temporary block measure should be taken during the construction. In order to avoid environmental pollution by living waste, a container for waste collection, metal bins and equipment for transportation should be setup in the area of living and office. Waste should be transported to an appointed plot on a fixed date, and disposed by backfill after the construction.

During the operation the solid waste is less. Waste bin should be set at the household area to collect household waste which should be regularly disposed every day.

◆ Migration settlement

The construction of the Project Activity will have bad impact on local economy and residents' life. The Project Entity will compensate for the migrants according to Yunnan Land Management Regulations and Yunnan Woodland Management Regulations. Besides, the Project Entity has set up migrant's settlement plan which includes measures to build and re-build the facilities so as to avoid from affecting the routine work and life of local residents and migrants by the construction.



In general, the Project Activity has limited negative impact on the environment, and has less impact on the ecological environment and the residents' living. All impacts can be resolved by several measures.

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 participants and the host party all consider that the Project Activity's environment impacts are not significant. No instruction is needed.

SECTION E. Stakeholders' comments

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

In Aug. 2003, public opinion survey was carried out at the main counties, villages, social communities which are involved in Sinanjiang Hydropower Station and the residents in the area of the project construction.

The survey was carried out by distributing and collecting questionnaires. The participants who fulfilled the questionnaire are mainly local governments, social communities and publics who will be possibly directly affected by the Project Activity. The content of questionnaire:

Name: _____ Address: county _____ town _____ Gender _____

Age: _____ Education: _____ Family member: _____

Occupation: ☐ Industry, ☐ Agriculture, ☐ Education, ☐ public service, ☐ no fixed job

1. Do you know Sinanjiang hydropower station will be constructed in your hometown?

(Yes; No)

2. Do you approval the project construction?

(Yes; No; not express an opinion)

3. Are you aware of migration since the reservoir submerging?

(Yes; No)

4. What do you think about standard of living after migrating?

(Better than before; the same as before; worse than before; Unclear)

5. What are your suggestions and requests on settle down plan for migrant, migrating place and environmental protection round the Hydropower Station?

6. What is the impact in general of the Project Activity construction?

(More benefit than harm; No impacts basically; Less benefit than harm)

E.2. Summary of the comments received:

The survey had a 95.83% effective response rate (46 questionnaires returned out of 48 effective questionnaires). The following is a summary of the key findings from the stakeholders:

- 1) 100% of the informants supported the establishment of Sinanjiang hydropower plant in an overall perspective and hope it will go into construction soon; 93.1% know that they need to move to



other place because of the reservoir submerging and they would like to do; only 6.9% will decide whether they move or not after the moving place and the settle down fee are all put into effect.

- 2) Prediction of the living standard after the migrating, 38% of the informants thought that it will be improved; 52% answer unknown, but hope it will be improved; 3% thought it will be lower than before at the beginning, and 7% thought it will be worse than before forever.
- 3) Social communities thought the Project Activity will benefit in finance revenue, expanding employment and facilitating the local economy development; benefit in regulating industry configuration, enhancing the value in use of soil and water resources, increasing the sightseeing sites; benefit in promoting culture development of the countryside, accelerating the exchange with external.
- 4) Social communities thought the Project Activity will bring some negative effects which include: more farmland occupation, effects on the survival condition of the farmers, migration of local residents; destroy of environment and water surrounding, erosion of water and soil and geologic disaster.

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

The Project Entity will adopt the following measures to solve every question or issue concerned by local stakeholders.

- ◆ Avoid bad impacts by means of reasonable layout and the project design optimization, reduce the loss to minimal extent by taking measures on construction and biology.
- ◆ Standardize the management during the construction which should be conducted according to regulations, while control pollution.
- ◆ Take measures to conserve water and soil in order to prevent water and soil loss caused by project construction.
- ◆ Properly settle migrants and compensate according to national policy and try to enhance local employment.



Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex 1 countries is provided for the Project Activity.



ANNEX 3

BASELINE INFORMATION

Please refer to annex 3 of the “*Bulletin on the Baseline Emission Factors of the China’s Regional Grids*” reviewed by Director Office of National Climate Change Coordination of National Development and Reform Commission (NDRC) of China (DNA of China) on Jul. 18th, 2008.

Table A1 Proportion of the electricity generation from low operating cost/must-run power plants among the total electricity generations of the China Southern Power Grid

	<i>Fuel-fired (10⁸kWh)</i>	<i>Hydropower (10⁸kWh)</i>	<i>Nuclear (10⁸kWh)</i>	<i>Others (10⁸kWh)</i>	<i>Total of all the power plants (10⁸kWh)</i>	<i>Total of low operating cost/must-run power plants (10⁸kWh)</i>	<i>Percentage of the electricity generation from low operating cost/must-run power plants</i>
2002	1837.33	639.31	208.77	1.35	2686.76	849.43	31.62%
2003	2227.79	810.64	289.30	23.65	3351.3	1123.59	33.53%
2004	2195.41	809.66	284.81	32.55	3322.43	1127.02	33.92%
2005	2871.86	916.26	304.76	34.33	4127.21	1255.35	30.42%
2006	3377.15	1045.16	312.13	35.86	4766.3	1393.15	29.23%

Remark:

1、 *Low cost and must run resources in this case include hydro, nuclear and others.*

2、 *Data resource: 2003-2007 China electric power yearbook*

According to the data above, we can use the simple OM method to calculate operation margin emission factor.

**Table A2 Power generation from fuel-fired power of CSPG in 2003**

	Power generation (10⁸kWh)	Power generation (MWh)	Internal consumption rater (%)	Power supply to grid (MWh)
GuangDong	1433.51	143351000	5.5	135,466,695
GuangXi	170.79	17079000	8.43	15,639,240
GuiZhou	432.95	43295000	7.4	40,091,170
YunNan	190.55	19055000	8.01	17,528,695
Total				208,725,800

Data resource: 2004 China electric power yearbook



Table A3. Simple OM calculation sheet of CSPG in 2003

Fuel sort	unit	Guangdong	Guangxi	Guizhou	Yunnan	subtotal	Emission factor (tc/TJ)	Oxidation rate (%)	Average caloric value (MJ/t,km ³)	Emission of CO ₂ (tCO ₂ e) I=G*H*F*E*44/12/10000 (quality) I=G*H*F*E*44/12/1000 (volume)
		A	B	C	D	E=A+B+C+D	F	G	H	
Raw coal		4491.79	831.84	2169.11	1405.27	8898.01	25.8	100	20908	175,993,455.05
Wash extractive coal	10 ⁴	0.05				0.05	25.8	100	26344	1,246.07
Other wash coal	ton			36.38	20.37	56.75	25.8	100	8363	448,971.84
Coke					0.5	0.5	25.8	100	28435	13,449.76
Coke oven gas	10 ⁸ m ³				0.04	0.04	12.1	100	16726	2,968.31
Other coal gas		3.21			11.27	14.48	12.1	100	5227	335,797.81
Crude oil		6.85				6.85	20	100	41816	210,055.71
Gasoline		0.02				0.02	18.9	100	43070	596.95
Diesel oil	10 ⁴	31.9			0.76	32.66	20.2	100	42652	1,031,759.27
Fuel oil	ton	627.22	0.3			627.52	21.1	100	41816	20,301,304.48
LPG						0	17.2	100	50179	0.00
Refine dry gas		2.85				2.85	18.2	100	46055	87,592.00
Nature gas	10 ⁸ m ³					0	15.3	100	38931	0.00
Other oil production	10 ⁴	11.35				11.35	20	100	38369	319,357.98
Other coke	ton					0	25.8	100	28435	0.00
Other energy	10 ⁴ tce	93.21			22.35	115.56	0	100	0	0.00
Total										198,746,555.23
Net import electricity from CCPG								11,100		
CM of CCPG in 2005								0.797442		
Total emission of CO ₂ from CSPG in 2005								0.797442*11,100+198,746,555=198,755,407		
Electricity delivered to grid generated by fuel-fired Power ,2005 CSGP								208,725,800+11,100=208,736,900		
2005 Emission factor of CSPG								0.952181		

Data source: 2004 China Energy Statistics Yearbook

**Table A4 Power generation from fuel-fired power of CSPG in 2004**

	Power generation (10⁸kWh)	Power generation (MWh)	Internal consumption rater (%)	Power supply to grid (MWh)
GuangDong	1693.89	169389000	5.42	160,208,116
GuangXi	201.43	20143000	8.33	18,465,088
GuiZhou	497.2	49720000	7.06	46,209,768
YunNan	243.22	24322000	7.56	22,483,257
Total				247,366,229

Data resource: 2005 China electric power yearbook



Table A5. Simple OM calculation sheet of CSPG in 2004

Fuel sort	unit	Guangdong	Guangxi	Guizhou	Yunnan	subtotal	Emission factor (tc/TJ)	Oxidation rate (%)	Average caloric value (MJ/t,km ³)	Emission of CO ₂ (tCO ₂ e) I=G*H*F*E*44/12/10000 (quality) I=G*H*F*E*44/12/1000 (volume)
		A	B	C	D	E=A+B+C+D	F	G	H	
Raw coal		6017.7	1305	2643.9	1751.28	11717.88	25.8	100	20908	231,767,574
Wash extractive coal	10 ⁴	0.21				0.21	25.8	100	26344	5,233
Other wash coal	ton					0	25.8	100	8363	0.00
Coke						0	25.8	100	28435	0.00
Coke oven gas	10 ⁸ m ³					0	12.1	100	16726	0.00
Other coal gas		2.58				2.58	12.1	100	5227	59,831
Crude oil		16.89				16.89	20	100	41816	517,933
Gasoline						0	18.9	100	43070	0.00
Diesel oil	10 ⁴	48.88			1.83	50.71	20.2	100	42652	1601975
Fuel oil	ton	957.71				957.71	21.1	100	41816	30,983,494
LPG						0	17.2	100	50179	0.00
Refine dry gas		2.86				2.86	15.7	100	46055	75,825
Nature gas	10 ⁸ m ³	0.48				0.48	15.3	100	38931	104,833
Other oil production	10 ⁴	1.66				1.66	20	100	38369	46,708
Other coke	ton					0	25.8	100	28435	0.00
Other energy	10 ⁴ tce	79.42				79.42	0	100	0	0.00
Total										265,163,407
Net import electricity from CCPG								10,951,240		
Average emission rate of CCPG in 2004								0.82732		
Total emission of CO ₂ from CSPG in 2004							265,163,407+10,951,240*0.82732=274,223,576			
Electricity delivered to grid generated by fuel-fired Power ,2004 CSGP							10,951,240+247,366,229=258,317,469			
2004 Emission factor of CSPG								1.06158		

Data source: 2005 China Energy Statistics Yearbook

**Table A6. Power generation from fuel-fired power of CSPG in 2005**

	Power generation (10⁸kWh)	Power generation (MWh)	Internal consumption rater (%)	Power supply to grid (MWh)
GuangDong	1764.53	176453000	5.58	166,606,923
GuangXi	250.23	25023000	7.95	23,033,672
GuiZhou	584.3	58430000	7.34	54,141,238
YunNan	272.81	27281000	6.94	25,387,699
Total				269,169,531

Data resource: 2006 China electric power yearbook



Table A7. Simple OM calculation sheet of CSPG in 2005

Fuel sort	unit	Guangdong	Guangxi	Guizhou	Yunnan	subtotal	Emission factor (tc/TJ)	Oxidation rate (%)	Average caloric value (MJ/t,km ³)	Emission of CO ₂ (tCO ₂ e) I=G*H*F*E*44/12/10000 (quality) I=G*H*F*E*44/12/1000 (volume)
		A	B	C	D	E=A+B+C+D	F	G	H	
Raw coal		6696.47	1435	3212.31	1975.55	13319.33	25.8	100	20908	263,442,602
Wash extractive coal	10 ⁴				0.15	0.15	25.8	100	26344	3,738
Other wash coal	ton			10.39	33.88	44.27	25.8	100	8363	350,238
Coke		4.79			8.05	12.84	29.2	100	28435	390,906
Coke oven gas	10 ⁸ m ³				0.79	0.79	12.1	100	16726	58,624
Other coal gas		1.87			15.96	17.83	12.1	100	5227	413,486
Crude oil		10.91				10.91	20	100	41816	334,556
Gasoline		0.68				0.68	18.9	100	43070	20296
Diesel oil	10 ⁴	31.96	2.02		1.81	35.79	20.2	100	42652	1,130,639
Fuel oil	ton	887.21				887.21	21.1	100	41816	28,702,703
LPG						0	17.2	100	50179	0.00
Refine dry gas		4.92				4.92	15.7	100	46055	130,441
Nature gas	10 ⁸ m ³	0.93				0.93	15.3	100	38931	203,115
Other oil production	10 ⁴	1.7				1.7	20	100	38369	47,833
Other coke	ton					0	25.8	100	28435	0.00
Other energy	10 ⁴ tce	104.66	133.15		59.72	297.53	0	100	0	0.00
Total										295,229,177
Net import electricity from CCPG								20,264,000		
CM of CCPG in 2005								0.77216		
Total emission of CO ₂ from CSPG in 2005							0.77216*96,363,000+295,229,177=			310,876,215
Electricity delivered to grid generated by fuel-fired Power ,2005 CSGP							20,264,000+269,169,531=			289,433,531
2005 Emission factor of CSPG								1.07409		

Data source: 2006 China Energy Statistics Yearbook

**Table A8. Weighted average emission factor of CSPG in the past 3 years**

		2003	2004	2005	Remark
1	Total generation(MWh)	208,736,900	258,317,469	365,532,531	832,586,900 (2003-2005)
2	Total emissions (tCO ₂ e)	198,755,407	274,223,576	369,521,975	842,503,498 (2003-2005)
	Weighted average emission factor	Total emissions/Total generation (2003-2005)			1.011911



Calculation for BM:

Table A9. λ_{Coal} , λ_{Oil} , λ_{Gas} calculation, 2005 CSPG

Fuel sort	unit	Guangdong	Guangxi	Guizhou	Yunnan	subtotal	Emission factor (tc/TJ)	Oxidation rate (%)	Average caloric value (MJ/t,km3)	Emission of CO ₂ (tCO ₂ e) $I=G*H*F*E*44/12/10000$ (quality)
		A	B	C	D	E=A+B+C+D	F	G	H	$I=G*H*F*E*44/12/1000$ (volume)
Raw coal		6696.47	1435	3212.31	1975.55	13319.33	25.8	100	20908	263442601.85
Refined coal					0.15	0.15	25.8	100	26344	3738.21
Other washed coal	10 ⁴ ton			10.39	33.88	44.27	25.8	100	8363	350237.59
Coke		4.79			8.05	12.84	25.8	100	28435	345389.71
Total										264,141,967
Raw Oil	10 ⁴ ton	10.91				10.91	20	100	41816	334555.88
Gasoline	10 ⁴ ton	0.68				0.68	18.9	100	43070	20296.31
Coal Oil							19.6	100	43070	0
Diesel Oil	10 ⁴ ton	31.96	2.02		1.81	35.79	20.2	100	42652	1130638.84
Fuel Oil	10 ⁴ ton	887.21				887.21	21.1	100	41816	28702703.26
Other petroleum products	10 ⁴ ton	1.7				1.7	20	100	38369	47833.35
Subtotal										30,236,028
Natural gas	10 ⁸ m ³	0.93				0.93	15.3	100	38931	203114.71
Coke oven gas	10 ⁸ m ³				0.79	0.79	12.1	100	16726	58624.07
LPG	10 ⁴ ton					0	17.2	100	50179	0.00
Refinery dry gas	10 ⁴ ton	4.92				4.92	18.2	100	46055	151211.46



Other coke products	10 ⁸ m ³	1.87	15.96	17.83	12.1	100	5227	413485.84
Subtotal								826,436
Total								295204431.07

Data source: 2006 China Energy Statistics Yearbook

According to the table above: $\lambda_{\text{Coal},y} = 89.48\%$, $\lambda_{\text{Oil},y} = 10.24\%$, $\lambda_{\text{Gas},y} = 0.28\%$

Table A10. Efficiency Level of the Best Power Generation Technology Commercially

Table A11. Percentage of the CO₂ emission from different type of fossil fuel among total CO₂ emission

	Coal	Oil	Gas	Emission factor of fuel-fired power (tCO ₂ e/MWh) ($\lambda_{\text{Coal}} * \text{EF}_{\text{coal,Adv}} + \lambda_{\text{Oil}} * \text{EF}_{\text{oil,Adv}} + \lambda_{\text{Gas}} * \text{EF}_{\text{gas,Adv}}$)
λ	89.48%	10.24%	0.28%	0.9117
EF _{Adv}	0.9508	0.5843	0.4237	



Table A12. BM calculation of CSPG

	Installed Capacity in 2003 A	Installed Capacity in 2004 B	Installed Capacity in 2005 C	New Added Installed Capacity in 2003~2005 D=C-A	% of New Added Installed Capacity
Fuel-fired Power (MW)	40444.1	46659.7	54507	14062.9	74.01%
Hydro Power (MW)	25409.3	27580.1	30347.1	4937.8	25.99%
Nuclear Power (MW)	3780	3780	3780	0	0.00%
Wind Power (MW)	83.4	83.4	83.4	0	0.00%
Total (MW)	69716.8	78103.3	88717.5	19000.7	100.00%
% of Installed Capacity in 2006	78.58%	88.04%	100%		

$$EF_{BM,y} = 0.9117 \times 74.01\% = 0.6748 \text{ tCO}_2\text{e/MWh}$$

Calculation of CM:

Table A13. Calculation Sheet of CM Emission Factor of CSPG

	OM Emission Factor (tCO ₂ e/MWh)	BM Emission Factor (tCO ₂ e/MWh)	CM Emission Factor =(OM+BM)/2 (tCO ₂ e/MWh)
CSPG	1.0119	0.6748	0.84335

Formula: CM Emission Factor = (BM + Simple OM) / 2 (Weights ω_{OM} and ω_{BM} , by default, are 0.5.)



Annex 4

MONITORING PLAN

There is no supplementary information about the monitoring plan. For detailed information about the plan, please refer to Section B.7.2.