CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

A. General description of project activity

B. Application of a baseline methodology

C. Duration of the project activity / Crediting period

D. Application of a monitoring methodology and plan

E. Estimation of GHG emissions by sources

F. Environmental impacts

G. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

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SECTION A.   General description of project activity

A.1   Title of the project activity:

Title: Yunnan Whitewaters Hydropower Development Project (白水江水电梯级开发项目)
                 ("Project")
Version: 0
Date: 2 May 2006

A.2.   Description of the project activity:

The Project is a set of three cascade hydropower stations located on the White Waters River (白水江 or *Bái Shuǐ Jiāng*) of Yunnan Province in southwestern China. The total installed capacity is 78 MW, with expected annual average electricity sales of 369 GWh to the Yunnan Provincial Grid, part of the China Southern Power Grid ("CSPG"). Through production of renewable power, the Project is expected to displace an average of 261,681 tCO_2e/yr from 1 May 2007 to 30 April 2017.

Construction began in 2004, with Station #2 breaking ground in January 2004, Station #3 in June 2004, and Station #1 in October 2004. The Project Company has been unable to fully raise the capital required to complete the Project domestically and is seeking debt financing from the International Finance Corporation ("IFC") and other international development banks, and has proposed selling CDM credits. The IFC is considering lending up to US$22 million and will help mobilize other long term funding from Deutsche Investitions- und Entwicklungsgesellschaft mbH ("DEG"), and Société de Promotion et de Participation pour la Coopération Economique ("Proparco") (all three parties are collectively referred to as "the Lenders"). CDM funding is needed because the Project: 1) was unable to attract sufficient funding from domestic financiers, and 2) the debt service capacity is substantially lower than other projects with similar risks that the Lenders have financed elsewhere before.

The Project will contribute to two of China's major developmental challenges. First, the Project will help satisfy increasing electricity demand in the CSPG feeding China's fast growing Pearl River Delta Region by exploiting China's untapped clean and renewable energy resources. This increasing demand has stimulated development of coal-fired power plants, which utilize China's most abundant fuel resource. The continued deployment of coal-fired power plants will aggravate the deleterious effects of air pollution on human health and increase greenhouse gas emissions. In addition, China's coal industry has a troubled safety record, with estimates of more than 5,000 coal miners killed annually.[1] The Project, by utilizing hydropower, will play a part in shifting power generation to more sustainable alternatives. To minimize its own environmental and social impact, the Project has limited the scale of its water reservoirs, and is implementing comprehensive environmental management and resettlement plans, which have been developed through extensive stakeholder consultation.

Secondly, the Project will introduce much-needed investment capital and employment to a poverty-stricken, remote mountainous region of Yunnan Province. Yanjin County is a "national level poverty county"[2], with limited development prospects owing to its remote location, inadequate infrastructure,

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[1] Associated Press (2006). "China Begins Coal Mine Safety Crackdown". 5 January 2006.

[2] Source: China State Council Leading Group Office of Poverty Alleviation and Development (国务院扶贫办).

limited cultivable land, and lack of non-farming employment opportunities. The Project will create approximately 600 locally filled construction jobs, and 50-60 permanent operating jobs thereafter.

A.3.   Project participants:

Name of Party involved	Private and/or public entity(ies) project participants	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (host)	Yunnan Zhongda Yanjin Power Generation Corporation Ltd. ("Project Company") (云南中大盐津发电有限公司)	No
Italy	International Bank for Reconstruction and Development ("World Bank") as Trustee of the Italian Carbon Fund (Public entity)	Yes

Introduction to the Project Company. The Project Company is Yunnan Zhongda Yanjin Power Generation Corporation, which operates six existing small hydropower stations in Yunnan Province, with a total installed generation capacity of 18.5 MW. The controlling shareholder is the privately owned Zhejiang Zhongda Sanchuan Hydropower Development Corporation (浙江中大三川水电发展有限公司) ("Zhongda Sanchuan"). Headquartered in the city of Hangzhou in Zhejiang Province, Zhongda Sanchuan is a Chinese power project developer with experience in the development and operation of small-sized hydropower stations. The local government, Yanjin County, is a minority shareholder through its holding company Yanjin State Assets Management Company Ltd. (盐津县国有资产经营有限公司).

Introduction to the Italian Carbon Fund. The Italian Carbon Fund ("ICF") was created in 2003 in an agreement between the Ministry of Environment and Territory of Italy and the World Bank, the Fund's manager. The ICF provides a government-endorsed alternative for Italian companies and public entities to obtain emission reductions. With a capital base of US$45 million, the ICF will purchase greenhouse gas emission reductions from projects in developing countries and countries with economies in transition that may be recognized under such mechanisms as the Kyoto Protocol's CDM and JI.

A.4.   Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1.   Host Party(ies):

Country: People's Republic of China

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

Province: Yunnan (云南)

Prefecture-level Municipality: Zhaotong Municipality (昭通市)
County: Yanjin County (盐津县)

A.4.1.3.	City/Town/Community etc:

The Project plants are sited in the following townships:

Station #1 and #2:   Miaoba Township (庙坝乡)
Station #3:   Shizi Township (柿子乡) and Miaoba Township

In addition to the townships listed above, the Project activities and inundation will affect other neighboring townships.

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

All three of the Project's hydropower stations are on the White Waters River (白水江) near the confluence of the White Waters River and Heng River (横江), as elaborated on the following maps.

Yunnan Province Map

Source: Project Company.

Station #3 is closest to nearby cities, at a distance of 471 km to Yunnan's provincial capital, Kunming (昆明), 154 km from Zhaotong City (昭通市), and about 7 km from Yanjin City (盐津县城). The following map indicates the proposed sites for Stations #1 (一级电站), #2 (二级电站), and #3 (三级电站).

White Waters River Map

Source: Project Company using map from Yunnan University.

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

The Project is categorized as:
Sectoral Scope Number:1
Sectoral Scope: Energy industries (renewable - / non-renewable sources)
Project Activity: Grid-connected renewable power generation project activities from run-of-river hydro power plants

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

Each of the three hydropower stations consists of a relatively low concrete gravity dam, a narrow reservoir, and an above-ground powerhouse to produce electricity that will be transmitted to the Yunnan provincial grid by high voltage transmission lines. Stations #1 and #2 are of the dam-gate run-of-river type, while Station #3 is of the dam-diversion mixed type with a 2660 m long water diversion tunnel, which will direct water flow from the dam site to the powerhouse at the bank of the Heng River. The Project reservoirs are largely confined within a steep narrow mountain gorge and provide only daily regulation capacity.

Hydropower equipment will be supplied by Nanning Generating Equipment General Works (南宁发电设备总厂) and Hangzhou Dalu Power Generation Equipment Co. Ltd. (杭州大路实业有限公司).

Selected Specifications of Project Hydropower Stations

	Station #1	Station #2	Station #3
Dam height (meters)	30.0	28.2	44.5
Total water level (meters above sea level)			
Design flood	527.3	490.3	468.1

Check flood	537.9	501.2	483.3
Flood discharge capacity (cubic meters per second)			
Design flood	3740	3810	5463
Check flood	6960	7180	8420
Storage Capacity of Project Reservoirs (in millions of cubic meters)			
Total capacity	5.6	6.0	17.4
Normal storage capacity	3.0	4.1	13.7
Regulation capacity	1.2	1.7	6.6
Power Density			
Installed capacity (W)	15,000,000	15,000,000	48,000,000
Flooded surface area (m^2)	532,677	629,600	1,160,000
Power density (W/m^2)	28.2	23.8	41.4
Technology			
Manufacturer	Nanning	Nanning	Hangzhou Dalu
Model number	ZZ580-LH-300	ZZ580-LH-300	HLA551-LJ-270
Hydraulic turbine type	Kaplan	Kaplan	Francis
Number of units	2	2	2
Capacity per unit (MW)	7.5	7.5	24.0
Rotational speed (rpm)	187.5	187.5	214.3
Draft head (m)	$\leq$ -0.2	-2	$\leq$ +0.53
Maximum head (mWC)	17.9	17.9	52.1
Minimum head (mWC)	8.7	8.7	38.0
Rated head (mWC)	16.0	16.0	45.0
Normal discharge (m^3/sec)	55.2	55.2	62.6

Source: Project Company and *Zhongda Hydroelectric Power Project* report by STUCKY Ltd.

Station #1 and #2 will be connected on one 110kV line, and Station #3 on a second line, both terminating at the Yanjin Central Hydropower Transformer Substation (盐津中坝变电站) to be built on the main regional power line. This substation will be constructed by the Yunnan Power Grid Corporation (云南电网公司) at Shizi Township, approximately 3 km from Station #3.

> **A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:**

The Project is a non-GHG emitting technology. In the absence of the Project, the CSPG would rely on operation and expansion of thermal and nuclear electricity generation. Hence, the Project will reduce anthropogenic GHG emissions through avoiding higher GHG emissions from thermal power generation by the CSPG. No additional emissions from Project construction and operation are being considered in the analysis as these emissions would be comparable to, if not lower than, the emissions from investment in the "without the Project" expansion alternative.

> **A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:**

Year	Annual estimation of emission reductions in tonnes of CO2e
2007	122,661
2008	251,636
2009	264,879
2010	264,879
2011	264,879
2012	264,879
2013	264,879
2014	264,879
2015	264,879
2016	264,879
2017	264,879
2018	264,879
2019	264,879
2020	264,879
2021	264,879
2022	264,879
2023	264,879
2024	264,879
2025	264,879
2026	264,879
2027	264,879
2028	88,293
Total estimated reductions (tonnes of CO_2e)	5,495,300
Total number of crediting years	21
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	261,681

A.4.5. Public funding of the project activity:

The Project is seeking US$44 million of debt finance, representing 60% of total capital requirements. The IFC, DEG, and Proparco are considering lending up to US$22 million, US$12 million, and US$10 million, respectively. This is not Official Development Assistance funding.[3]

SECTION B. Application of a baseline methodology

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

Revision to the approved consolidated baseline methodology ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 05 dated 03

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[3] While the Yanjin County government is a beneficial owner of the Project through its asset management company, it should be noted that the County was granted its ownership stake through an earlier fixed asset injection into the Project Company. No public funds or assets have been or will be provided for the current Project.

March 2006, Sectoral Scope 01), hereafter referred to as the "Methodology". The Methodology may be downloaded from http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

B.1.1.   Justification of the choice of the methodology and why it is applicable to the <u>project activity:</u>

The project activity is a grid-connected run-of-the-river hydropower project and meets all conditions stated in ACM0002:
- The project does not involve switching from fossil fuels to renewable energy;
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available

The Project meets the requirements of Annex 5 "Thresholds And Criteria For The Eligibility Of Hydroelectric Power Plants With Reservoirs As CDM Project Activities" issued at the 23rd Executive Board meeting, 22-24 February 2006. The estimated power densities of the three hydropower stations are 28.2, 23.8, and 41.4 W/m^2, respectively. All three power densities exceed the 10 W/m^2 minimum threshold required to use the approved Methodology.

B.2.   Description of how the methodology is applied in the context of the <u>project activity:</u>

The baseline scenario, based on using the additionality tool, is the electricity that would have been generated by the operation of grid-connected thermal power plants and the addition of new fossil fuel-based generating sources that the proposed Project will displace. Section B.4 discusses the choice of CSPG as the Project boundary. Following the ACM0002 Methodology, the baseline emission factor is calculated as a combined margin (*CM*), consisting of the simple average of the operating margin emission factor (*OM*) and the build margin emission factor (*BM*):

CM = 0.5 × OM + 0.5 × BM

The combined margin represents the tCO$_2$e/MWh that would have been emitted in the absence of the Project. Emissions reductions will be claimed based on the total CO$_2$e emissions mitigated by the Project, following the 4 steps described below.

Step 1 – Calculation of the Operating Margin Emission Factor (*OM*)
Step 2 – Calculation of the Build Margin Emission Factor (*BM*)
Step 3 – Calculation of the Baseline Emission Factor (*CM*)
Step 4 – Calculation of the Baseline Emissions Reductions (*ERs* generated)

Step 1: Calculation of the Operating Margin Emission Factor (*OM*)

Out of four options for the *OM* discussed in the Methodology, the Simple OM method was chosen, for the following two reasons:

1. Detailed hourly dispatch data is not available. The China Southern Power Grid Company runs the dispatch center and does not make this information available to the public.
2. Historical data available for the last five years show that the ratio of electricity generated by low operating cost and must run sources, identified in the CSPG as hydro- and nuclear power plants, to the total electricity generated in the CSPG are 33.86%, 34.23%, 33.72%, 32.98%, and 30.59%

from 1999 through 2003, respectively. Since these sources contribute much less than the 50% threshold specified in the Methodology, Simple OM is applicable for the Project.

As a result of these two factors and in accordance with the Methodology which states:

> *The Simple OM method (a) can only be used where low-cost/must run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production.*

the Simple OM has been used.

The Simple OM was calculated *ex-ante* using a three year average, based on the most recent statistics available at the time of PDD validation.

The Simple OM emission factor ($EF_{OM, simple, y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO$_2$e/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

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

$$(1)$$

$F_{i,j,y}$ is the total amount of fuel i (in a mass or volume unit) consumed by relevant power source j in year(s) y.

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.

$COEF_{i,j,y}$ is the CO$_2$ emission coefficient of fuel i (tCO$_2$e/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y.

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The CO$_2$ emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i$$

$$(2)$$

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i.

$OXID_i$ is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values).

$EF_{CO2, i}$ is the CO$_2$ emission factor per unit of energy of the fuel i.

In this PDD, NCV_i for different fuels i were taken from *China Energy Statistical Yearbook 2004* (most recent version available at time of PDD validation) and years 2000-2002. $EF_{CO2,coal}$ use the country-

specific values defined as 24.74 tC/TJ.[4] The $EF_{CO2, i}$ for other fuels are based on default values set by IPCC Good Practice Guidance. The fraction of carbon oxidized for coal is 0.98 and fraction of carbon oxidized for fuel oil/diesel is 0.99, both default values set by IPCC Good Practice Guidance.

$EF_{OM, simple, y}$ is calculated based on the electricity generation mix of the CSPG, not including low operating cost/must run power plants, such as wind power, hydropower, nuclear power, etc. It is calculated as a three year average based on the most recent statistics available at the time of PDD validation. Data on different fuel consumption for power generation in the CSPG are taken from the Energy Balance Table of Yunnan, Guizhou, Guangxi and Guangdong (Years 2001 through 2003) from the *China Energy Statistical Yearbook*.[5]

In China, the power plant efficiency indicators include Electricity Generation Coal Consumption (*EGCC*), the amount of standard coal consumed to *generate* one kWh (kg standard coal/kWh) to the grid, and Electricity Supply Coal Consumption (*ESCC*), the amount of standard coal consumed to *supply* one kWh (kg standard coal/kWh) to the grid. The *China Electric Power Yearbook* aggregates the *EGCC* and *ESCC* of all thermal power plants at the provincial grid level. Note that the expression ($EGCC_y \div ESCC_y$) is equivalent to the expression (1 – Parasitic Use Rate).

Ideally, the emission factor should be calculated using the actual electricity supplied to the grid instead of the electricity generated at plants. That is, because the Project is replacing electricity (excluding low cost/must run power plants) in the grid, the basis for the emission reduction calculation should be the electricity delivered directly to CSPG, $GEN_{Thermal, Grid, y}$. However, there is no data available that identifies $GEN_{Thermal, Grid, y}$ in China. Nevertheless, it is still possible to calculate total electricity delivered to the grid by fuel type with data available in China by using the following formula:

$$GEN_{Thermal, Grid, y} = GEN_{Thermal, Plants, y} \times (EGCC_y \div ESCC_y) \qquad (3)$$

$GEN_{Thermal, Grid, y}$ is the electricity energy delivered to the grid by coal-fired thermal power plants in year *y*.

$GEN_{Thermal, Plants, y}$ is the electricity energy generated by coal-fired thermal power plants in year *y*. The source data for $GEN_{Thermal, Plants, y}$ are published annually both in the *China Electric Power Yearbook* and the *China Energy Statistical Yearbook*. However, the data from these two books are slightly different. For consistency with fuel data, this calculation uses the electricity generation data from the *China Energy Statistical Yearbook*.

$EGCC_y$ is the average amount of standard coal consumed to generate one kWh of electricity at the thermal power plants in the CSPG. The source for this data is the *China Electric Power Yearbook.*

$ESCC_y$ is the average amount of standard coal consumed to supply one kWh of electricity at the thermal power plants in the CSPG. The source for this data is the *China Electric Power Yearbook.*

In CSPG, all hydro- and wind power plants are identified as having low operating costs and are must-run power plants. They are thus excluded from the total generation when calculating the Simple OM emission factor. Although some thermal power plants might also be considered "low cost, must run" plants, it is impossible to exclude them from the calculation, since there is no available data in China on

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[4] *China Climate Change Country Study*, p. 57-58.

[5] *China Energy Statistical Yearbook (2000-2002)*, pp. 376-383; 388-395; 432-439; 444-451. *China Energy Statistical Yearbook (2004)*, pp. 218-225; 238-245.

quantities of electricity generated from such plants. However, their inclusion in the calculation of the Simple OM emission factor actually improves the conservativeness of the emission reduction calculations, since newly built thermal power plants have higher generation efficiency and therefore lower emission factors. Thus the inclusion of some "low cost, must run" thermal plants in the $EF_{OM, simple, y}$ calculation will result in fewer emission reductions being allocated to the Project.

The CSPG a net exporter of electricity, 6896.4 GWh and 9314.5 GWh in the years 2003 and 2002, respectively[6]. According to the Methodology, electricity exports should not be subtracted from electricity generation data used for calculating and monitoring the baseline emission rate. As a result, the total electricity supplied to the CSPG is used as the basis for calculating emission factors.

Based on the formulae and data, the values for $EF_{OM, simple, y}$, in tCO_2e/MWh, are:

Operating Margin Emission Factor

2001	2002	2003	2001-2003 Average
0.980	0.956	0.925	0.954

Source: Baseline Study calculation. Detailed step-by-step calculations can be found in Annex III.

Therefore, the average operating margin emission factor is:

$$\boxed{OM = 0.954 \ tCO_2e/MWh}$$

Step 2: Calculation of the Build Margin Emission Factor (*BM*)

For calculating, the *BM*, we elect Option 1. The Build Margin emission factor ($EF_{BM, y}$) *ex-ante* is defined as the generation-weighted average emission factor of the greater annual generation of:

1. The five power plants that have been built most recently, or
2. The power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Both sets of plants exclude registered CDM project activities. Given the size of the CSPG, the annual generation of the most recently built 20% of capacity far exceeds the annual generation of the five most recently built plants. Therefore, we calculate *BM* using the most recently built 20% of capacity.

This PDD proposes a conservative approach for the variables used in calculating the *BM*. This is done by calculating the share of electricity supply from newly added thermal and hydro/wind power plants whose electricity supply represents 20% of electricity supply in the China Southern Power Grid in 2003, times the most conservative estimate of operating margin emission factors for these new thermal, hydro-, wind, and the nuclear power plants, respectively.

As the thermal power plants in CSPG is composed of both coal fired power plants and heavy fuel oil/diesel-fired power plants, the PDD calculated in the most conservative way the emission factors for both newly built coal fired power plant and heavy fuel oil/diesel fired power plants respectively.

The calculation of the *BM* is as follows (detailed step-by-step calculations can be found in Annex III):

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[6] *China Electric Power Yearbook (2003),* p. 688 and *China Electric Power Yearbook (2004),* p. 679.

1. Conservatively determine the emission factors of newly build coal-fired power plants in CSPG to be 0.854 tCO_2e/MWh.
2. Conservatively determine the emission factors of the newly build fuel oil/diesel-fired power plants in CSPG to be 0.713 tCO_2e/MWh.
3. Determine the weight of electricity supply by coal-fired power plants and fuel oil/diesel-fired power plants in CSPG to be 80%/20% and calculate weighted emission factors for these newly built thermal power plants to be 0.826 tCO_2e/MWh.
4. Calculate the share of electricity supply from newly added thermal, hydro-, and nuclear power plants whose collective electricity supply represents 20% of electricity supply in CSPG in 2003. The shares are 58.5%, 21.4%, 20.1%, respectively.
5. Multiply the shares determined in Step 4 by the most conservative estimate of emission factors for these new thermal power plants calculated in Step 3. Assuming the emission factors of the hydropower plants, and the nuclear power plants are all zero, the final *BM* is 0.483 tCO_2e/MWh.

$$\boxed{BM = 0.483 \text{ tCO}_2e/\text{MWh}}$$

Step 3: Calculation of the Baseline Emission Factor (*CM*)

The Baseline Emission Factor is calculated as a combined margin (*CM*), consisting of the simple average of the estimated *OM* and *BM*, using the default weights of 50% each:

CM = 0.5 × OM + 0.5 × BM
CM = 0.5 × (0.954 + 0.483)

$$\boxed{CM = 0.718 \text{ tCO}_2e/\text{MWh}}$$

Step 4: Calculation of the Baseline Emissions Reductions

The Project has no emissions or leakage, thus $PE_y = 0$ and $L_y = 0$. Thus, the emission reductions ER_y per year of the Project is obtained using the following formula:

ER_y = CM × (Estimated Annual Project Electricity Generation in MWh)   (7)

The emission reduction projected for the calendar year ending 31 December 2007 is:

0.718 tCO_2e/MWh × 170,737 MWh = 122,661 tCO_2e.

The total emission reductions estimated for the 21-year crediting period is 5,495,300 tCO_2e.

B.3.	**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 <u>project activity</u>:**

The following timeline provides background information that is helpful in appreciating the barriers the Project has and continues to face. In accordance with the CDM registration process, the Project Company can provide the CDM validator with documentation and access to the responsible persons to substantiate the timeline and assertions made in the PDD.

Timeline	Project Development Event
2000-2003	Yanjin County actively sought project developers to develop its hydropower resources. Substantial discussions ensued with at least three project developers, but

	the efforts did not culminate in an investment decision.
March 2003	Zhongda Sanchuan was invited to perform due diligence on hydropower development opportunities in Yanjin County.
April 2003	Yanjin Country and Zhongda Sanchuan signed a Memorandum of Understanding for Zhongda Sanchuan to evaluate a potential White Waters River hydropower project.
August 2003	A formal Project Development Agreement (白水江梯级电站开发协议书) was signed with Yanjin County and the Project Company formed. The parties agreed that prepatory design, engineering, and construction work would begin in parallel with the Project Company's efforts to raise the necessary capital. The agreement also stipulated that the Project Company complete construction milestones by certain dates or forfeit its development rights.
January 2004	Construction began on Station #2. It is common practice in China for development agreements to require groundbreaking prior to financial closure. This requires the project sponsor to assume significant risks in project development.
November 2004	The Project Company, having been unable to secure loans from local Chinese banks, approached the IFC for financing.
March 2005	After its initial review, the IFC informed the Project Company that it must strengthen Project cash flows, including the application of carbon finance, to make it attractive to international financiers.
April 2005	The Project Idea Note, a preliminary outline of the proposed CDM project, was submitted to the World Bank Carbon Finance Business unit and subsequently approved for further due diligence.
April 2006	The Project Company and the Lenders have agreed to financing terms based on expectations of CDM funding.

Source: Project Company.

To date, the Project's financial situation remains precarious. CDM funding is required for the possibility of completing Project construction, plant commissioning, and emission reductions.

Moving on to the Methodology requirements, Project additionality is demonstrated below using the "Tool for the demonstration and assessment of additionality (version 02)" dated 28 November 2005. The basic argument for additionality is that the Project parameters do not meet the standards required by prevailing market practice in international financing. Without debt finance, the Project is not financially viable and thus the emission reduction will not occur. The Tool was applied as follows:

Step 0: Preliminary screening based on the starting date of the project activity

This step is not applicable for the Project as its request for registration will occur after 31 December 2005.

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

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

Alternative 1: No Project activity, continuation of current situation. In this alternative, the Yunnan Provincial Grid continues to build power generation capacity in a manner similar to its recent past (as detailed in the Section B.2), using primarily thermal and nuclear, with some hydro (including large hydro) resources:

Generation Mix of New Capacity Added to South China Power Network Between 2000-2003

Thermal	59%
Hydropower	19%
Nuclear	22%

Source: Calculated from *China Electric Power Yearbook (2004)*.

While this alternative is possible, in the absence of the Project, the Project Company did not propose to undertake any other technology alternatives such as thermal power plants. The Project Company's principal business is developing small sized hydropower projects and does not possess the resources or expertise to pursue alternative technologies.

Alternative 2: The Project without CDM support. This alternative is ruled out because, as elaborated in this section, the Project is not financially viable without CDM support.

Sub-step 1b: Enforcement of applicable laws and regulations:

All alternatives, including the Project, are within applicable laws and regulations.

The most likely alternative to the Project is alternative #1, that of no Project. Thus, the Project is additional.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

Because the Project generates financial and economic benefits other than CDM income, Option I cannot be used. Benchmark analysis (Option III) has been selected.

Sub-step 2b: Option III. Apply benchmark analysis

The use of debt financing is standard practice for power projects in China. Most private power developers have a limited capital base and must borrow to do projects and achieve adequate equity returns. As will be elaborated in Step 3: Barrier Analysis, challenging Project-specific conditions and difficulties faced by hydropower projects generally in Yunnan Province have made raising local debt finance impossible, particularly long tenor debt (10+ years maturity) suitable for a hydropower project. Unsuccessful in their efforts to borrow from local banks, the Project Company then sought financing from international multilateral and bilateral development banks like the IFC, DEG, and Proparco.

The Lenders, consistent with international banking industry practice, use the Debt Service Coverage Ratio ("DSCR") as a key financial indicator in evaluating the Project's ability to service its debt. The calculations presented below demonstrate that the expected Project cash flows, when compared with its debt service, are well below benchmark levels for projects with similar risks. Without CDM funding, the Project will not be attractive to the Lenders.

Sub-step 2: Calculation and comparison of financial indicators

Calculation of financial indicator

Given the way the Project Company was set up, it proved difficult to separate the existing assets from the new assets. Therefore, in addition to Project's cash flows, the DSCR calculations presented here include the cash flows from the Project Company's operating power plants (the "Existing Plants") with 18.5 MW of installed capacity (although it should be noted that the Project Company's existing plants are not seeking CDM funding).

DSCR is defined as the ratio of cash flow available for debt service divided by the debt service.

EBIDA (Earnings Before Interest, Depreciation, and Amortization) is used as a proxy for cash flow available for debt service. Thus:

$$DSCR = \frac{EBIDA}{Debt\ Service}$$

EBIDA = Sales – Operating expenses – Taxes

Sales represents the revenues for selling electricity generated by the Project Company.

Operating expenses include wages, benefits, repairs, insurance, resettlement support, and other corporate overhead. In this PDD, *Operating expenses* do not include depreciation or amortization.

Taxes represent corporate income taxes.

Debt Service includes principal repayment and interest. An important piece of evidence for the Project's additionality is that even after special efforts by both the Lenders and Project Company to structure the loan terms to maximize DSCR, the resulting DSCR values are still unsatisfactory. These efforts include:

1. **Increasing loan tenor.** IFC normally provides 10 year loans to projects in China (it is also rare for a project to secure a loan with longer tenor than 10 years from local banks). In order to promote an emissions reductions project with good sustainability benefits, the Lenders have proposed a 15 year maturity for the Project loans. This reduces annual debt service and increases DSCR in all years.
2. **Mortgage-style repayment.** IFC normally requires an "equal principal repayment" schedule. To further enhance the viability of the Project, a "mortgage-style" repayment schedule that delays principal repayment farther into the future has been proposed. This reduces annual debt service and increases DSCR in the Project's early years.
3. **Mandatory pre-payment.** Finally, the Project Company agreed to a mandatory "cash sweep" in which a portion of excess cash generated by the Project, if any, will be used for early loan repayments instead of being entirely returned to Project shareholders in the form of dividends. This improved DSCR further.

While the Lenders and Project Company shareholders have both made sacrifices to make the Project more financially viable, the Project still fails to generate a DSCR that is adequate compared to international norms (as described in *Comparison of financial indicator*, below).

The table below provides selected financial projections from 2007 to 2017 for the variables used in calculating DSCR, representing the Project Company's estimates of the most likely Base Case scenario. For confidentiality reasons, financial figures have been disguised, with all figures presented based on an index of 100 = 2007 Net Revenue. These should allow knowledgeable observers to confirm that the

relative proportions are reasonable for a hydropower project comparable to the Project. The CDM validator will have access, under a confidentiality agreement, to the actual financial projections.

Project Base Case Financial Estimates (without CDM funding)

(All values indexed) (1)					Year ending December 31,						
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricty Sold (GWh)											
Existing plants	94	94	94	94	94	94	94	94	94	94	94
Project plants	171	350	369	369	369	369	369	369	369	369	369
Total electricity sold	265	444	463	463	463	463	463	463	463	463	463
Net revenue (2)	100	172	180	180	180	180	180	180	180	180	180
Operating expenses (3)	23	24	24	24	24	24	24	24	24	24	24
EBITDA	77	148	156	156	156	156	156	156	156	156	156
Taxes	2	1	2	3	3	6	7	8	9	10	15
EBIDA	75	147	154	153	153	150	149	148	147	146	141
Debt Service											
Existing plants	5	25	24	23	22	21	20	19	18	17	16
Project plants	29	88	87	86	84	83	81	80	79	78	76
Total debt service	34	113	111	109	107	104	102	100	97	95	93
DSCR	2.21x	1.30x	1.38x	1.40x	1.43x	1.44x	1.46x	1.49x	1.51x	1.54x	1.52x

					Year ending December 31,						
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Electricty Sold (GWh)											
Existing plants	94	94	94	94	94	94	94	94	94	94	94
Project plants	369	369	369	369	369	369	369	369	369	369	369
Total electricity sold	463	463	463	463	463	463	463	463	463	463	463
Net revenue (2)	180	180	180	180	180	180	180	180	180	180	180
Operating expenses (3)	24	24	23	23	23	23	23	23	23	23	23
EBITDA	156	156	157	157	157	157	157	157	157	157	157
Taxes	16	17	17	17	17	17	17	17	17	17	17
EBIDA	140	139	140	140	140	140	140	140	140	140	140
Debt Service											
Existing plants	-	-	-	-	-	-	-	-	-	-	-
Project plants	75	45	1	1	1	1	1	1	1	1	1
Total debt service	75	45	1	1	1	1	1	1	1	1	1
DSCR	1.87x	3.13x	119.25x	119.24x	119.23x	119.22x	119.22x	119.21x	119.20x	119.19x	119.19x

(1) Figures disguised using index of 100 = 2007 Net revenue.
(2) Figures presented after deducting VAT and surcharges.
(3) Excluding depreciation and amortization.
Source: Project Company.

The data show the Project Company's ability to service debt is at its nadir in 2008, with a minimum DSCR of 1.30x. Note that the 2007 DSCR appears relatively high because under the financing terms there is no principal repayment in 2007.

Comparison of financial indicator

The financial indicator is unsatisfactory compared to the appropriate referents, based on data supplied by the IFC.

First, it is important to note the nature of the Project's off-take arrangement. The IFC has financed over twenty *Independent Power Producer* ("IPP") projects globally. All of these IPPs have in place long term Power Purchase Agreements ("PPA") with their respective off-takers with terms for either: 1) fixed volume, fixed price off-take agreements, or 2) a fixed capacity payment to cover debt service and ensure

minimum, pre-agreed investor returns irrespective of the quantity of dispatch. These agreements transfer the market risk to the off-taker, leaving only the operational risk with the project. In addition to these contracts, in many cases the projects possess government guarantees backstopping the PPA payments. The average projected minimum DSCR for all the IPP projects that the IFC has financed is 1.45x.

In contrast, the Project is effectively a *Merchant Power Plant*. Unlike the IPPs as described above, the Project has the following drawbacks in terms of its risk profile: 1) the Project does not have a firm off-take agreement ensuring minimum price and quantity or a fixed capacity payment to cover debt service, and 2) like most run-of-the-river power projects, the Project has very limited regulating capacity (daily), which limits the Project Company's ability to compete in a deregulated market as a merchant plant. Furthermore, as elaborated below in Step 3: Barrier Analysis, the Project faces significant market risks that could jeopardize debt service. Because the Project is a merchant plant with substantially higher risk profile than an IPP project, it must have higher DSCRs to offset the additional risk associated with the Project. The Base Case minimum DSCR of 1.30x is disproportionally low for a merchant power plant.

Secondly, because the merchant plant risks are common to power generation projects in China at this time, the IFC has limited its China power sector lending activity to *holding companies*, each with a portfolio of projects. Risk in financing this kind of project is reduced through: 1) diversification, and 2) the fact that the holding companies own operating plants, meaning that investments in holding companies face much lower project completion risk than financing a greenfield project. According to IFC's experience, the average projected minimum DSCR has been 2.3x for projects with a holding company structure.

In contrast, the Project Company is effectively a *standalone greenfield power project*, not a diversified electric power holding company. The Project Company's six existing power plants are geographically concentrated in Yanjin County. The installed capacity of the Project, totalling 78 MW, would dwarf the existing installations, and the project completion risk is substantial.

Given the risk profile of financing a run-of-the-river power projects in China, the minimum projected DSCR of the Project is below the acceptable level of the Lenders. Without CDM revenues, the Project is not attractive to international financiers and thus additional.

Sub-step 2d: Sensitivity analysis

The conclusion in Sub-step 2c regarding the Project economic feasibility is unchanged with reasonable variations in the Project's projections.

The Lenders' concern is primarily with variations that reduce the Project's debt service capacity. Three downside scenarios were considered:

1. Dry Year. This scenario assumes that the driest year on record occurs again in 2009. The minimum DSCR of 1.04x in 2009 is lower, and thus worse, than the Base Case.

2. Oversupply to Yunnan Provincial Grid. Only 80% of energy produced is dispatched and sold in 2007 and 2008. The minimum DSCR of 1.11x in 2008 is lower, and thus worse, than the Base Case.

3. Project Delay. Commissioning is delayed six months. The minimum DSCR of 0.45x in 2007 and second-lowest DSCR of 1.24x in 2008 is intended to illustrate that all else being equal, the financial indicator would be lower, and thus worse, than the Base Case. In practice, if such a delay were to occur, the Project Company would be able to access a standby contingency reserve tranche.

Two upside scenarios were considered:

1. Very Wet Year. This scenario assumes that a very wet year on record occurs again in 2009, with power output 7.9% higher than the Base Case. The minimum DSCR in 2008 is equal to the Base Case.

2. Increased revenues. In this scenario, the Project is able to produce and sell 11% and 5% more energy to the Yunnan Provincial Grid in 2007 and 2008, respectively, than the Base Case. The minimum DSCR of 1.37x in 2008 is slightly higher than the Base Case.

Comparison of financial indicators

The sensitivity scenarios presented here confirm that potential variations in the Project's outlook do not change the conclusions about DSCR inadequacy.

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of type of the proposed project Activity

In addition to the factors affecting DSCR described in Step 2, the following Project barriers exist:

High market risk and regulatory uncertainty. As described in Step 2, the Project is a merchant plant with inherently higher market risks than IPPs with long-term PPAs. This situation is a reality of China's power markets. Until recently, China's power generation, transmission, and distribution were under the monopoly of the state-owned China State Power Corporation. In 2002, this monopoly was broken up, with the creation of separate grid companies and five generating companies that own about half of China's generation capacity. Each of these five state-owned enterprises has begun gradual privatization through selling shares of subsidiaries to the public.[7]

While China is making progress moving its power sector away from central planning, it has not fully completed establishing an environment with a well defined regulatory framework, transparent tariff setting mechanisms, and dispatch rules conducive for merchant plants. Power producers like the Project Company are required to sign a PPA to interconnect to the local grid.[8] These PPAs must be approved annually, and the applicable tariff is subject to the discretion of Pricing Bureau and the off-take volume is subject to market movements.

Magnifying the market risk is the uncertain evolution of China's regulatory regime. Referring to China's electricity policies, Stanford University researcher Pei Yee Woo summarized the situation[9]:

> *"So far, drastic policy changes and reforms in the power sector appear to demonstrate that they were in fact piecemeal changes in response to*

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[7] Scully, Vaughan (2005). "Standard & Poors Global Industry Surveys: Electric Utilities Asia". p. 7.

[8] Comments on tariffs are based on Woo, Pei Yee (2005). "China's Electric Power Market: The Rise and Fall of IPPs", Program on Energy and Sustainable Development Working Paper #45, accessed on 1 December 2005 at http://pesd.stanford.edu/, p. 18-19.

[9] Woo, p. 25.

> *short-run business fluctuations (or even experimental moves), and not*
> *part of a coherent long-term strategic change. In fact, some argue that*
> *speaking of China as being in a state of "transition" is not a useful way*
> *to characterize the flux in the country, because transition is a path from*
> *one state to another future (well-defined) state. From the present*
> *policies, it is hard to discern a well-designed blueprint for change or the*
> *future state that would be its objective."*

It is possible that throughout the Project's life, several tariff schemes (and even more tariff rates) representing a continuum from central planning to fully competitive markets may be applicable. This increases uncertainty and risks around Project cash flows. Finally, in case of difficulties, the Project cannot rely on government support because the power purchase obligation by the grid company is not guaranteed by the government and the county government shareholder in the Project Company is one of China's poorest counties.

Challenging local conditions. Yanjin County is one of China's poorest counties, having been designated a "national poverty level county". For years, it has struggled to attract investment to stimulate economic development. A key disadvantage is the county's remote, mountainous location - a bus ride to Yanjin County from the Provincial capital of Kunming takes over 12 hours on average. Lack of local skilled labor and difficulties transporting construction materials to the Project site have increased the Project's budget over comparable projects in Yunnan.

The White Waters River and its steep mountain gorges have also proven to be more challenging to develop than initially forecast by the Project Company's engineering surveys:

- **Flooding**. In April 2004, three months after construction began, the White Waters River experienced a 50-year flood (a flood with probability of 2% of being equalled or exceeded in a given year). This occurred two months before the flood season usually begins, and destroyed construction coffer dams that were being built at Stations #1 and #2. The damage cost over RMB 4 million and set back the Project at least four months.
- **Geology**. Several geological conditions were not anticipated by either of the Project's pre-feasibility or feasibility studies.

While the Project Company is an experienced hydropower developer, the unexpected construction problems have delayed the Project and increased its already high capital requirements.

Financing barriers. Despite two year's efforts, the Project Company has not been able to raise sufficient debt financing to complete construction and commission the Project. In addition to the risks and issues identified in Step 2, the following financing barriers exist:

- China's "territory principle" specifies that local banks should finance local power projects. The Project Company's controlling shareholder, based in Zhejiang Province, cannot utilize its existing banking relationships. This disadvantage has been compounded by the fact that Yunnan bankers discount the Project Company's credit history and track record outside Yunnan Province. This is true even though the local banks may be subsidiaries of larger, national financial institutions with which the Project Company has existing banking relationships.
- Of the local banks, the Bank of Agriculture (Yunnan Branch) is the leading financier of hydropower projects in the Project boundary. Their loan application review guidelines are difficult for the Project to meet. Specifically, the Bank of Agriculture's Guidelines specify that

capital investment costs should not exceed RMB 5000/kW of installed capacity. In the Project's case, the budgeted cost is far more, at RMB 7447/kW of installed capacity.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The aggregate weight of the factors enumerated above demonstrate that, under present conditions, the Project is unlikely to be completed without CDM support. The most likely alternative is for the Project not to proceed and continuation of the status quo.

Step 4: Common practice analysis

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

For this Step, we define similar activities as other hydropower plants in Zhaotong Municipality. Based on data from the Zhaotong Municipality Development and Reform Commission (昭通市发展和改革委员会), the installed hydropower capacity totalled 187.5 MW in 2003, the year in which the Project Company signed the Investment Agreement. This very small amount testifies to the significant barriers to hydropower development in the area, as elaborated in Step 3.

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

The similar options that are occurring in Zhaotong Municipality do not call into question the claims that the Project is financially unattractive to the Lenders (Step 2) and faces barriers discussed (Step 3). As with the installed base, the Project Company believes most projects under construction are significantly smaller than the Project, facing less risk and/or capital investment requirements. The financing needs and management capacity required to develop the Project are far greater than that required for much smaller plants. Finally, the validator can verify through on-the-ground interviews with local bankers and other project developers that installations like the Project are not common practice.

Step 5: Impact of CDM registration

Given the Project's unattractive financial indicator, market risk, challenging local conditions, and financing and construction difficulties to date, the Project would not be able to proceed without CDM funding. The Project is not within the baseline scenario, and thus additional.

CDM registration and carbon credit sales will partially mitigate the Project's financial unattractiveness by providing additional cash flows to help service debt. The following table illustrates the effect of CDM on Project financial estimates, assuming a CER sale at US$10/tonne of CO_2e and renewal of CDM crediting (using a constant baseline emission factor). As with before, financial figures are indexed to 100 = 2007 Net Revenue.

Project Base Case Financial Estimates with CDM Funding

(All values indexed) (1)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Electricty Sold (GWh)											
Existing plants	94	94	94	94	94	94	94	94	94	94	94
Project plants	171	350	369	369	369	369	369	369	369	369	369
Total electricity sold	265	444	463	463	463	463	463	463	463	463	463
Net revenue (2)	100	172	180	180	180	180	180	180	180	180	180
CER sales	20	41	43	43	43	43	43	43	43	43	43
Operating expenses (3)	23	24	24	24	24	24	24	24	24	24	24
EBITDA	97	190	199	199	199	199	199	199	199	199	199
Taxes	2	1	3	6	6	12	13	14	15	16	21
EBIDA	95	189	196	193	193	187	186	185	184	183	178
Debt Service											
Existing plants	5	25	24	23	22	21	20	19	18	17	16
Project plants	29	88	87	86	84	83	81	80	79	78	76
Total debt service	34	113	111	109	107	104	102	100	97	95	93
DSCR	2.80x	1.67x	1.76x	1.77x	1.80x	1.79x	1.83x	1.86x	1.89x	1.93x	1.92x

Year ending December 31,

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Electricty Sold (GWh)											
Existing plants	94	94	94	94	94	94	94	94	94	94	94
Project plants	369	369	369	369	369	369	369	369	369	369	369
Total electricity sold	463	463	463	463	463	463	463	463	463	463	463
Net revenue (2)	180	180	180	180	180	180	180	180	180	180	180
CER sales	43	43	43	43	43	43	43	43	43	43	14
Operating expenses (3)	24	24	23	23	23	23	23	23	23	23	23
EBITDA	200	200	201	201	201	200	200	200	200	200	171
Taxes	22	23	24	24	24	24	24	24	24	24	19
EBIDA	177	176	177	177	177	177	177	177	177	177	152
Debt Service											
Existing plants	-	-	-	-	-	-	-	-	-	-	-
Project plants	75	45	1	1	1	1	1	1	1	1	1
Total debt service	75	45	1	1	1	1	1	1	1	1	1
DSCR	2.36x	3.96x	150.73x	150.73x	150.72x	150.72x	150.72x	150.72x	150.71x	150.71x	129.69x

(1) Figures disguised using index of 100 = 2007 Net revenue.
(2) Figures presented after deducting VAT and surcharges.
(3) Excluding depreciation and amortization.
Source: Project Company.

CER revenue significantly raises the minimum DSCR to 1.67x (from 1.30x in the Base Case without CER revenue), and DSCRs are expected to improve and reach a comfortable range of 1.7-1.9x during the first ten years. CDM funding will thus enable the Lenders to extend the required debt on a prudent basis and on terms that compensate for the risks in development and operation of the Project. As a result, the Lenders have included the execution of a carbon finance Emission Reduction Purchase Agreement ("ERPA") as a condition of loan disbursement.

B.4. **Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:**

In the Emission Reduction calculation, the only greenhouse gas included is CO_2, and the the spatial extent of the Project boundary is the China Southern Power Grid (中国南方电网). This grid includes the Hong Kong Special Administrative Region, the Macao Special Administrative Region, and five provincial grids: Guangdong, Guangxi, Guizhou, Yunnan, and Hainan. Hainan is separated from the main CSPG

grid, which interconnects the other four provinces through 4200 km of 220 kV and 500 kV transmission lines.[10] The main load centers are located in the Pearl River Delta Region. Energy flows from the west to Guangdong by two high voltage AC circuits. The Yunnan provincial grid is an integral part of the CSPG. According to the *China Electric Power Yearbook (2004)*, Yunnan transmitted 6532 MWh electricity to the CSPG in 2003, accounting for 14.2% of the CSPG's total generation. As a result, the CSPG excluding Hainan is chosen as the Project boundary, which is consistent with p.3 of the Methodology:

> *"In large countries with layered dispatch systems (e.g. state/provincial/ regional/national) the regional grid definition should be used. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity."*

The CSPG is a net exporter of electricity, with exports of 9314.5 GWh and 6896.4 GWh for the years 2002 and 2003, respectively[11].

B.5.	**Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:**

The baseline study was completed on 24 February 2006 by:

Ms. Nuyi Tao
Carbon Finance Business
The World Bank
1818 H. Street, NW
Washington, DC 20433
USA

Mr. Edward M. Chao
Frederick A. and Barbara M. Erb
Institute for Global Sustainable Enterprise
University of Michigan
701 Tappan St.
Ann Arbor, MI 48109
USA

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:**

The Project expects commissioning according to the following schedule:

- Station #1: 31 April 2007
- Station #2: 31 April 2007
- Station #3: 30 July 2007

For the purposes of the CDM project, the starting date of the project activity is 1 May 2007.

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[10] China Southern Power Grid. "南方电网概况" (Overview of the CSPG). Accessed 28 February 2006 from http://www.spsc.com.cn/nfdw.asp.

[11] *China Electric Power Yearbook 2003,* p. 679, 688.

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

The Project is expected to have a minimum operating life of 30 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:

1 May 2007.

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 as renewable crediting period will be used.

C.2.2.2. Length:

Not applicable as renewable crediting period will be used.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Revision to the approved consolidated baseline methodology ACM0002: "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources" (Version 05 dated 03 March 2006, Sectoral Scope 01), hereafter referred to as the "Monitoring Methodology".

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

The project activity is a grid-connected run-of-the-river hydropower project and meets all conditions stated in ACM0002:
• The project does not involve switching from fossil fuels to renewable energy;
• The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the <u>baseline scenario</u>

D.2.1.1. Data to be collected in order to monitor emissions from the <u>project activity</u>, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Being a run-of-river hydropower facility, the Project has no emissions. Therefore, the table above is not applicable.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

This is not applicable to the Project as there are no emissions.

D.2.1.3. Relevant data necessary for determining the <u>baseline</u> of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. EG_y	*Electricity supplied to the CSPG by the Project*	*China Southern Power Grid*	*MWh*	*Directly measured at the substation in Shizi Township*	*Hourly measurement and monthly*	*100%*	*electronic*	*Electricity supplied by the Project activity to the grid will also be recorded on sales receipts. Figures will represent electricity generation*

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

					recording			*after deducting for parasitic consumption and transmission loss.*

For the Simple Operating Margin, we use a three year data vintage to calculate a fixed and ex-ante figure. For the Build Margin calculation, we elected Option 1 of the Methodology. Following p. 14 of the Monitoring Methodology, at least EG_y must be monitored.

> **D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO$_2$ equ.)**

Detailed step-by-step calculations can be found in Annex III.

> **D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).**

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

This section is not applicable to the Methodology.

> **D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO$_2$ equ.):**

This section is not applicable to the Methodology.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

The table above is not applicable to the Methodology. According to p. 10 of the Methodology, "the main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects – see applicability conditions above). Project participants do not need to consider these emission sources as leakage in applying this methodology."

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

This section is not applicable to the Methodology.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The proposed project activity will generate GHG emission reductions by avoiding CO_2 emissions from electricity generated by fossil fuel power plants. The Project has no emissions or leakage, thus $PE_y = 0$ and $L_y = 0$. Thus, the emission reductions ER_y per year of the Project is obtained using the following formula:

$ER_y = CM \times EG_y$

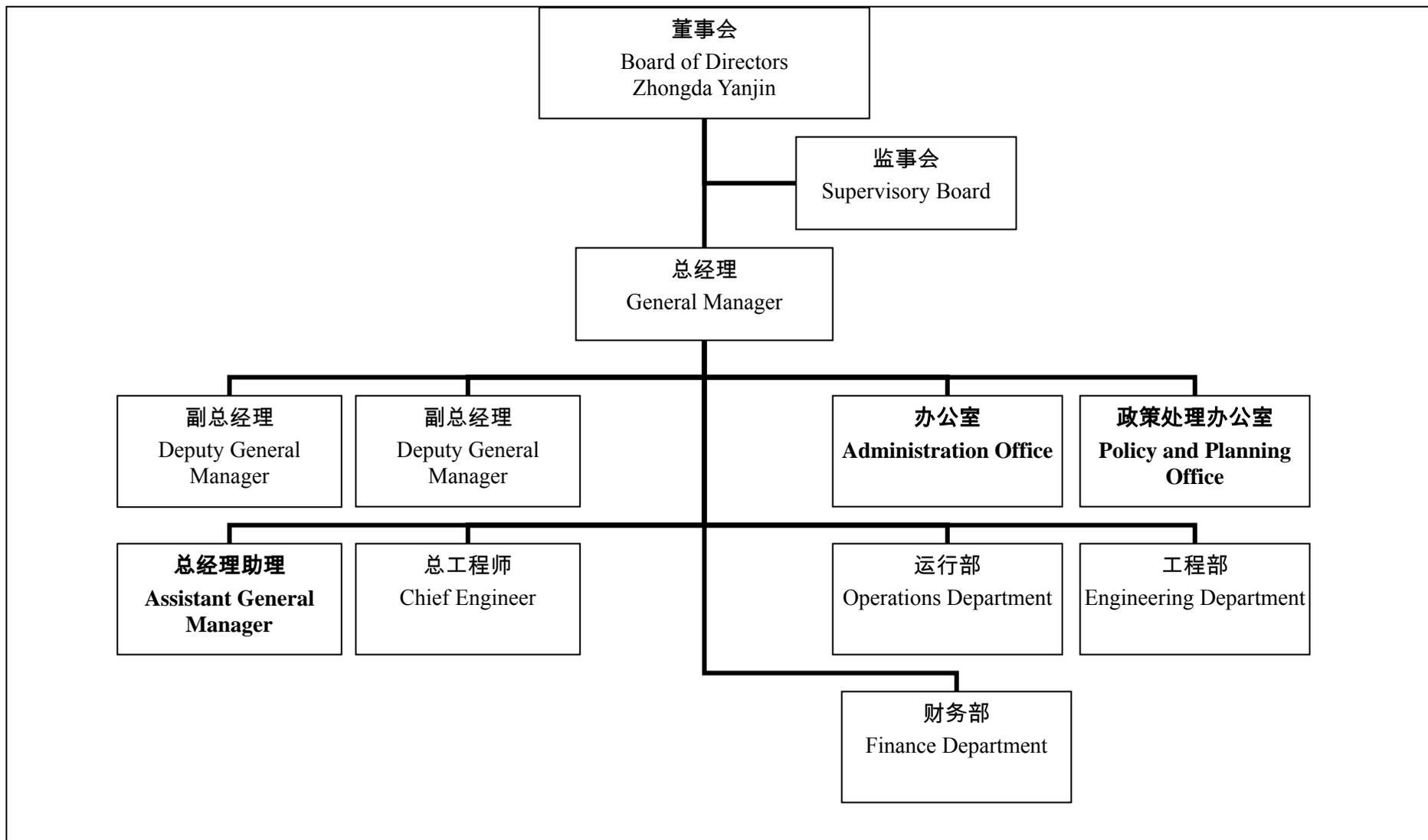Detailed step-by-step calculations can be found in Annex III.

D.3.	**Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored**	
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.3-1.	*Low*	*Records of power sales to the grid (Yunnan Power Grid Corporation) will be used. This data will be cross checked on a regular basis between the metering system at the Project stations to assure consistency.*

D.4   Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

The figure below outlines the Project's operational and management structure. The Assistant General Manager will be responsible for CDM activities including reporting, monitoring, quality control/assurance, and environmental monitoring and management activities. This person will be supported by the Administration Office and Policy and Planning Office (all highlighted in **bold** text). As of March 2006, Mr. Liu Hui (刘慧) will serve as the Assistant General Manager.

董事会
Board of Directors
Zhongda Yanjin

监事会
Supervisory Board

总经理
General Manager

副总经理
Deputy General Manager

副总经理
Deputy General Manager

办公室
Administration Office

政策处理办公室
Policy and Planning Office

总经理助理
Assistant General Manager

总工程师
Chief Engineer

运行部
Operations Department

工程部
Engineering Department

财务部
Finance Department

Source: Project Company.

Training is described in Section A.4. 3, and is therefore not repeated in this section.

D.5	Name of person/entity determining the <u>monitoring methodology</u>:

The monitoring methodology was determined by:

Ms. Nuyi Tao
Carbon Finance Business
The World Bank
1818 H. Street, NW
Washington, DC 20433
USA

Mr. Edward M. Chao
Frederick A. and Barbara M. Erb
Institute for Global Sustainable Enterprise
University of Michigan
701 Tappan St.
Ann Arbor, MI 48109
USA

SECTION E.   Estimation of GHG emissions by sources

E.1.   Estimate of GHG emissions by sources:

The Project will not generate GHG emissions. In addition, per the Methodology, a run-of-river hydropower plant is considered "zero emissions."

E.2.   Estimated leakage:

The Project will not cause any leakage.

E.3.   The sum of E.1 and E.2 representing the project activity emissions:

Total Project activity emissions are zero (0) as there are no anthropogenic emissions or leakage.

E.4.   Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

The Project calculates Emissions Reductions by multiplying the CSPG's *ex-ante* emission factor with the Project's *ex-post* electricity output. As described in Section D.2.4, this formula is:

$$ER_y = BE_y = EG_y \times CM$$

An explanation for the emission factor calculation method is provided in Section B.2 above. The combined margin emission factor *CM* is calculated *ex-ante* according to the method described in ACM0002 as follows:

$OM = 0.954$ tCO$_2$e/MWh
$BM = 0.483$ tCO$_2$e/MWh
$CM = 0.5 \times OM + 0.5 \times BM$
$CM = 0.5 \times (0.954 + 0.483)$
$\boxed{CM = 0.718 \text{ tCO}_2\text{e/MWh}}$

Over the 21-year crediting period, the Project will generate an average of 364.2 GWh per year. Multiplying this by *CM*, one obtains an average emission reduction of 261,681 tCO$_2$e per year.

E.5.   Difference between E.4 and E.3 representing the emission reductions of the project activity:

The Emission Reductions of the Project are equal to the baseline emissions because the Project does not produce any emissions.

E.6.   Table providing values obtained when applying formulae above:

Year	Estimated Project activity emission reductions (tCO$_2$e)	Estimated baseline emission reductions (tCO$_2$e)	Estimated leakage (tCO$_2$e)	Total estimated emission reductions (tCO$_2$e)
2007	0	122,661	0	122,661
2008	0	251,636	0	251,636

2009	0	264,879	0	264,879
2010	0	264,879	0	264,879
2011	0	264,879	0	264,879
2012	0	264,879	0	264,879
2013	0	264,879	0	264,879
2014	0	264,879	0	264,879
2015	0	264,879	0	264,879
2016	0	264,879	0	264,879
2017	0	264,879	0	264,879
2018	0	264,879	0	264,879
2019	0	264,879	0	264,879
2020	0	264,879	0	264,879
2021	0	264,879	0	264,879
2022	0	264,879	0	264,879
2023	0	264,879	0	264,879
2024	0	264,879	0	264,879
2025	0	264,879	0	264,879
2026	0	264,879	0	264,879
2027	0	264,879	0	264,879
2028	0	88,293	0	88,293
Total (tCO2e)	0	5,495,300	0	5,495,300

Source: Baseline Study calculations.

SECTION F.   Environmental impacts

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

An Environmental Impact Assessment ("EIA") was prepared by Yunnan University, under contract to the Project Company, to analyze and document the expected environmental impacts. Impacts considered significant by the EIA are highlighted in Section F.2, below. Copies of the EIA were made available to the public in project evaluation and review meetings attended by design institutes, academics, land/forestry resource management agencies, as well as villagers' representatives. Officially, the EIA was submitted to both the County and Provincial authorities, including the Yunnan Provincial Environmental Protection Bureau (云南省环境保护局) ("Bureau"), which has jurisdiction over the Project. The EIA received the Bureau's standard approval to proceed on August 30, 2004. The approval did not note any factors that would prevent the Project from proceeding on environmental grounds.

Aside from station-specific identifiers and specifications, and a note specifying minimum water flow at Station #3, the approval documents were identical. An English translation of the Bureau's approval for the Station #3 EIA is as follows:

Yunnan Province Environmental Protection Bureau Report

Document Number [2004] #669
Regarding Yunnan Province, Zhaotong Municipality, Yanjin County, White Waters River Hydropower Station #3
Comments on the Environmental Impact Assessment

To Yunnan Zhongda Yanjin Power Generation Company:

We have reviewed the following documents submitted by your Company:
- The "Yunnan Province, Zhaotong Municipality, Yanjin County, White Waters River Hydropower Environmental Impact Assessment" (Document [2004] #72) developed by Yunnan University;
- The Zhaotong Municipality Environmental Protection Bureau's Opinion of "Zhaotong Municipality, Yanjin County, White Waters River Hydropower Station #1 Environmental Impact Assessment" (Zhaotong Municipality Document [2004] #123);
- The Yunnan Province Construction Project Environment Verification Center's technical assessment (Yunnan Environmental Review Report Document [2004] #44).

Following the Bureau's research into the matter, we hereby make the following comments:

1. The White Waters River Hydropower Station #3 has been proposed for Yunnan Province, Zhaotong Municipality, Yanjin County, Miaoba Township. This will be the third of three cascade hydropower stations, located 9 km from Station #2 and 7 km from Yanjin County City. Power generation is the intended purpose of the station, which will have installed capacity of 48000 kW, water level of 480 m, reservoir storage capacity of 13.738 million cubic meters, and daily regulatory capacity. Based on the EIA, the construction will not interfere with natural protection, scenic, or environmentally sensitive areas. According to the environmental survey team, the Project will not be sited on areas where national or provincial protected plant or fish species exist. With implementation of serious environmental protection measures, the effects of construction on the environment can be mitigated. From the view of environmental protection, this Bureau approves this construction project and approves the Zhaotong Bureau's review.

2. During construction, the Project Company shall ensure construction waste and debris is deposited at appropriate designated areas to safeguard water quality. The workers' environmental awareness should be raised through training. Wildlife hunting or destruction of natural plants are prohibited. When construction is complete, the trash collection areas and construction staging areas should be levelled and restored to a natural state in a timely fashion.

3. During the dry season, the Station must maintain a minimum water flow rate of 0.1 cubic meters/second to ensure the survival of natural resources and some irrigation activities.

4. Introducing non-native fish species or overfishing in the area are prohibited. To that effect, no fishing zones and no fishing periods should be established. The Project should enhance fishery management, augment public environmental awareness, and protect aquatic resources, especially branch rivers. Power production is prohibited on small branch rivers, as is any behavior that adversely affects the area's water quality. The Participants may make the branch rivers conducive to fish habitation and reproduction during periods of fast water flow.

5. People displaced by the Project must be properly relocated. Deforestation or developing new farmland on sloping areas in excess of 25˚ are prohibited. At all times, land use changes should

avoid creating new environmental problems.

6. Pollution control measures must implemented for construction wastewater, household sewage, and other waste streams. All contaminated items must be properly disposed. According to White Waters River second category functional requirements, these items may not be directly discharged into the river. Wastewater must be processed to standard before being discharged, and it can subsequently be reused, or applied towards irrigation or landscaping.

7. The Project should strengthen management and enhance organizational structure. An engineering company should be hired to ensure that the Project complies with the environmental protection plan and the "three concurrent requirements."

8. We request that the Zhaotong Municipality, Yanjin County Environmental Protection Bureau increase their supervisory efforts during the construction period.

Approved August 30, 2004

Source: Yunnan Provincial Environmental Protection Bureau, unofficial English translation by Edward Chao.

The issues mentioned in the approval documents are addressed by the Project's construction plans and environmental monitoring plans, elaborated below.

> **F.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:**

Environmental Background. The Project is located in a remote, sparsely populated mountainous area. The following may help acquaint the reader with local conditions prior to the entrance of the Project.

Geology. There are no lower neighboring valleys near the three reservoirs on the White Waters River. There also exist no geological structures that connect with the downstream lower valley (in the Heng River). Hence, seepage toward neighboring or downstream valleys would not occur in the Project areas. The sides of the reservoirs are steep, covered with thin layers of alluvial soils over impermeable rocks.

Hydrology. The area climate changes seasonally, with wet and dry seasons. The multi-year average annual precipitation of the basin is usually between 1,000 mm and 1400 mm. Most rainfall occurs during the annual monsoon season, which commences in late April and finishes late September. The estimated basin areas for hydropower Stations #1, #2, and #3 are 2740 km^2, 2948 km^2, and 3154 km^2, respectively. The multi-year average water flow, measured from 1959-2004 by the Niujie Hydrologic Station on the White Waters River, is 73 m^3/sec. The meteorological and hydrological records show a slight negative drift over time of -0.9% year over year in annual precipitation and -0.3% for annual river runoff.

Water. The White Waters River's water quality is good, meeting State Grade II Groundwater standards. There are no industrial facilities, and thus no industrial effluents discharges upstream from the Project, but there are both agricultural and human habitation sources of pollution.

Flora. The three hydropower stations are located in the basin's lower valleys where human settlements have become established over the centuries. Habitation has resulted in the removal of native evergreen and deciduous broad leaf forests along the river margins. Most of the vegetation at the Project sites is now agricultural in nature, such as paddy fields and fruit trees, along with some natural shrubbery. Field

surveys have found that all terrestrial plants in the inundated areas and construction sites are among common species, with no rare, endangered, or protected species.

Fauna. Yanjin County's animal life is quite diverse, though no protected species are believed to live within the Project vicinity due to the lack of suitable cover and food sources.

Aquatic Organisms. The White Waters River supports a variety of fish species, including giant salamander, white-scaled fish, and small-scaled fish.

Other conditions. Based on the local official guidance, statistics, and field surveys, there are no exploitable mineral deposits, cultural relics, or historically significant sites in the reservoir basin.

Significant Environmental Impacts. While delivering tangible environmental benefits, the Project will generate certain negative environmental impacts. The impacts are common to infrastructure projects, concentrated during the construction period, and are confined within a limited geographical scope. Except for reservoir inundation and permanent land use changes for dams and power houses, many of the negative impacts can be effectively controlled and mitigated. The following significant environmental impacts were identified during Project planning and EIA development:

Reservoir Inundation and Permanent Land Use Changes. The power house structures and related facilities, and reservoir inundation totalling approximately 232 hectares, will permanently change the original land usage. A riverine aquatic environment for a cumulative length of 35 km will be replaced by a lacustrine environment. Finally, there is a possibility for dewatering in the short river segment downstream of Station #3 during dry season operations when the reservoir is being refilled.

Mitigating Factors: Inundation and permanent land use changes are inherent in hydropower projects of the scale envisaged by the Project, but small relative to the White Waters River's flow. Utilizing three, smaller hydropower stations with daily regulatory capacity instead of a single, large station is the most important design choice to minimize environmental impact.

Construction of the Project requires that land be acquired and 109 households be relocated. The Project Company developed a Resettlement Action Plan related to physical and economic displacement consistent with World Bank Group policies. The Project Company has committed to develop a livelihood restoration plan to ensure that long-term livelihood of the Project-affected people is protected.

Vegetation in the Project area will be lost. However, the vast majority of the affected areas are medium fertility, man-made agricultural lands. Therefore, the impact on natural terrestrial ecosystems is limited. Although each of the stations will result in some loss of riverine habitat, suitable habitats for spawning, rearing and refuge of these local fish species are still widely available within the upstream and downstream reaches of the river.

With respect to water flow, the Project will ensure a minimum water of 0.5 cubic meters per second at all times, exceeding the Bureau's requirement of 0.1 cubic meters per second. This will better address the needs of aquatic ecosystems and human users.

Erosion and Temporary Land Use Changes. During the construction period, it is necessary to conduct earth rock excavation and collect soil, sand, and gravel from quarries. Many temporary routes, residences, and supportive workshops will be built to process, transport, and store the needed construction materials and personnel. These activities will disturb land surfaces and aquatic ecosystems. Some erosion is likely to occur.

Mitigating factors: The Project plan includes measures for soil and water conservation, such as building support structures, drainage systems, and slope coverage. When construction ends, land reclamation will be carried out. Efforts will be made to restore and green reusable areas, such as quarries of soil and stone, dumping grounds, material stocking grounds, processing areas of concrete, camps for contractors and supporting enterprises, transportation routes, as well as the temporary resident areas for workers. In such ways, the Project construction zones can regain some of their original character.

Air Pollution During Construction. Most heavy construction activities for the three hydropower stations will be concentrated in dam sites, quarry sites, power house sites, and related ancillary service areas. Substantial surface excavations will be required. High-density dust, noise, and gases such as SO_2 and NO_X, will be emitted from performing excavations, setting off explosives, building the foundations and bodies of the dams and other structures, fragmenting and processing aggregate, mixing concrete, transporting materials, and operating construction machines. This pollution will affect both workers and neighboring residents.

Mitigating factors: Since the scope of the project is relatively small and the construction period is relatively short, these negative impacts are temporary and can be mitigated through adopting appropriate preventive measures. In dry seasons, sprinklers will be used on the roads at the construction sites to reduce the dust content in the air. Wet dust collection technology will be employed for excavation operations. Concrete mixing machines will be covered and equipped with dust collectors, and appropriate coverings will be placed over materials that may generate dust during transportation. Labor protection at the construction sites will be strictly implemented to prevent on-job injuries. Respirators will be supplied to and proper usage required of all workers susceptible to dust pollution. Workers near sources of noise shall wear earplugs or earmuffs. In addition, to reduce the impact of construction on local residents, noisy operations such as blasting will be done during the daytime only.

Wastewater During Construction. Wastewater will be produced from operations like excavation, processing sand and stone, mixing and pouring concrete, washing, and system maintenance. This wastewater can have a high concentration of suspended matter and high pH value but contains no poisonous pollutants.

Mitigating factors: The Project Company are sensitive to the fact that the White Waters River is known for, and indeed named after, its clean waters. Attempts will be made to treat all wastewater generated during the construction before discharge. The technology for lowering the concentration of suspended matter and reducing the pH value to meet legal discharge requirements is straightforward – basically through processes of desilting, settling, and adding acidic materials. For other scattered sources of wastewater generated during construction, simple settling ponds can be built to reduce the concentration of mud and sand.

The sanitary sewage at the construction sites mainly contains suspended matter, nitrogen, phosphorus, and other pollutants. This kind of sewage generally meets the relevant Chinese standards for discharge. But underground sewerage discharge ditches need to be built for hygiene, and medical sewage produced by the health center shall be sterilized before discharge. Garbage collection and transfer facilities and septic tanks for public toilets will be required in residence and office areas.

Solid Waste During Construction. According to the Project plans, excess excavated earth and stone from construction of dams, tunnels, and power houses will be dumped as waste residues. These residues are natural substances and do not consist of any poisonous pollutants. Domestic garbage will be generated.

Mitigating factors: Engineering measures and biological measures will be taken for water and soil conservation at the dumping grounds, to prevent residues from leaking or washing away during rainfall. First, properly designed dumping sites will be built, with walls at the foot of slope to contain wastes. Then a drainage system will be constructed at the top and two sides of the residue piles. At the end of the construction period, the top surface of the residue piles needs to be covered with grass lawns and planted with shrubs of deep roots. In addition, temporary storage grounds, which may be used for storing useful materials during the construction period, will also be installed with water-retaining structures to prevent from water and soil loss.

Environmental Management and Monitoring Resources. The budgets for environmental management and monitoring during the construction period were estimated according to the "National Standards on Designing, Planning and Computing Construction Costs for Hydropower Development Projects", while taking into consideration the actual situations at similar hydropower projects already in operation and the scope and planned environmental protection measures adopted for the Project's conditions.

The Project's Assistant General Manager has responsibility for implementing and monitoring environmental affairs. These duties include:

- Regular monitoring of potentially harmful emissions, including effluents and runoff, atmospheric pollutants and noise;
- Supervision of the safety and health aspects, such as: sanitation, workers' protection from job-related injury, prevention of epidemic disease, including control of insect and rodent pests;
- Restoration work such as decommissioning access roads and quarries, placing soil over re-contoured land, and seeding/planting vegetation; and
- Maintenance of environmental data, records and files, plus preparation of regular status reports.

During the operational period, the Assistant General Manager will continue to monitor environmental baseline conditions (primarily reservoir water quality and sediment) and other related environmental impacts, and to ensure good working conditions at the power houses.

A training program has been implemented as part of the environmental management component of the project, to enhance environmental awareness among key personnel involved with construction and operation of the hydropower stations. Staff directly engaged in the assessment and monitoring of environmental conditions will be given additional specialized training.

SECTION G.   Stakeholders' comments

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

Since the very first days of the Project, the Project Company and shareholders have worked closely with local authorities and representatives to ensure that the Project secures community support and proceeds smoothly. Over the course of the Project development, substantial public disclosure and consultation has occurred with the Project plans, EIA, Resettlement Action Plan, and individual land claim/resettlement agreements. To gather statistical data on the potential social impacts, a socioeconomic survey was conducted with households directly affected by the Project.

The Project Company's primary means to engage stakeholders was through direct contact with representatives at the Provincial, Municipality, County, Township, and Village levels. In addition, to

publicize the Project activities, the Project Company placed public notices on government building doors and public places in affected locales, and published a notice in the Zhaotong Daily (昭通日报) newspaper.

The following stakeholders were engaged in the Project development process:

Yunnan Province. As described in Section F, the Yunnan Provincial Environmental Protection Bureau reviewed and made comments on the Environmental Impact Assessment.

Yanjin County. Several Yanjin County agencies/officials were consulted on the Project, with particular focus on the needs and demographic profiles of households and businesses displaced by the Project.

- Environmental Protection Bureau (环保局) reviewed and approved the EIA.
- Statistical Bureau (统计局) provided statistics on socioeconomic development of Yanjin County and areas affected by project activities.
- Civil Administration Bureau (民政局) provided policy guidance on welfare payment disbursement and eligibility, and other related policies.
- Resettlement Planning Commission (移民安置领导小组) shared information on compensation and procedures for land claims and population displacement, resettlement plans for dislocated peasants, employment transition from agricultural to non-agricultural sectors, and procedures for reporting complaints.
- Poverty Reduction Office (扶贫办) shared information on Yanjin County's poverty situation and poverty reduction policies.
- Villager Representative Commissions (村委会) made comments on local income levels, economic organization; demographics, education levels, distribution of marginal groups, community building and networking, and public opinion on current water quality, land claims and relocation. They also made comments on Project construction design.
- Individual villagers also shared information on their economic situation and opinions of and requests for the proposed Project.

Township Stakeholder Consultations

Date (MM/DD/YYYY)	Location	Convener	Participants / (Number of attendees)	Key Issues Discussed	Negotiation Result
10/21/2004	Miaoba Township Government	Deputy County Governor of Yanjin	County Government, Urban Construction Bureau, Land and Resources Bureau, Environment Bureau, and Transportation Bureau (22)	Discussed relocation of displaced persons.	Agreement made.
01/16/2005	Yellow River Village, Niujie Township, Yiliang County	Project Company	Officer and Director of Land and Resources Office of Yanjin County, Chairman of Niujie Township, Village Governor and villagers (53)	Publicized land claim plans and process.	Village representatives agreed to the land claim plans.
03/09/2005	Taiping	Project	Chairman, Governor	Publicized land	Village

	Village, Shizi Township, Yanjin County	Company	and Deputy Governor of Shizi Township, Land and Resources Bureau, Forestry Bureau, local officials from Taiping Village and Sanhe village. (46)	claim plans and process.	representatives agreed to the land claim plans.
04/13/2005	Xiaozhai Village, Miaoba	Yunnan Zhongda Yanjin Power Generation Co., Ltd	Local Government officials, Director of Land and Resources Bureau (58)	Publicized land claim plans and process.	Village representatives were clear about the procedures and standards of land claim, and expressed support for the policy.
08/11/2005	Miaoba Township, Yanjin County	Miaoba Township	Local Government officials and villagers (32)	Updated public on progress of the land claim plan, held public consultation on compensation distribution.	Land claims fully distributed to individual households. Affected households were satisfied with the compensation.
10/24/2005	Huangcao Village, Miaoba Township, Yanjin County	Project Company	Local government officials and villagers (29)	Socio-economic survey of affected population.	Collected socio-economic data and information on 24 households in 2 villages.
10/26/2005	Taiping Village, Shizi Township, Yanjin County	Project Company	Local government officials and villagers (24)	Collected feedback on the disbursement of compensation funds and public opinions of resettlement.	All compensation funds had been distributed in a timely fashion to the individuals. Villagers requested more employment opportunities at the construction site.
10/26/2005	Miaoba Township, Yanjin County	Project Company	Local government officials and villagers (26)	Collected feedback on the disbursement of compensation funds and public opinions of resettlement.	All compensation funds had been distributed in a timely fashion to the individuals. Villagers requested more employment opportunities at the construction site.

Source: Project Company.

Land Claim Agreements and Resettlement Action Plan

As per local requirements, land claim agreements are signed between government agencies and local representatives. Individuals and households affected by the Project participate in measuring the affected

land and developing the written agreements. They then designate representatives who actually sign the agreements with government agencies. While a Resettlement Action Plan ("RAP") is not a local requirement, under the IFC's guidance, the Project Company engaged the Shanghai Academy of Social Sciences (上海社会科学院) to prepare a RAP, which has also been publicly disclosed.

Online Disclosure

In addition to local disclosures, copies of the Environmental Impact Assessment, Resettlement Action Plan, and other documents have been posted on the Web and can be found by searching for Project #24067 at the IFC's Web site at www.ifc.org/projects.

G.2.	Summary of the comments received:

All stakeholders expressed support for the Project, with no opposing comments received in either the public meetings or via written documents. There is consensus that the Project will advance the economic development of Yanjin County, and satisfaction with the administration of the resettlement plan and compensation funds, which has occurred in advance of construction activities.

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

Because no negative comments were received, the Project Company plans to continue the Project as described, and continue the public engagement process utilized to date. Some of the measures the Project Company has agreed to implement include:

- Continuing the public meetings used to inform local people of the resettlement process, and to solicit public opinions on related matters for proper compensation standards and strategies.
- Update of project activities in Zhaotong Daily.
- A deputy manager of the Project Company will be designated as a point person for public consultations.
- At least one individual from the resettled population should be selected to be facilitate communication between the resettled population, the Project Company, and government agencies.
- Copies of Resettlement Arrangement Plans shall be placed in county library and offices of county and township government to make it accessible to the affected population.
- During the implementation of the resettlement plan, the Project Company will conduct assessments every six months on the recovery of living situation of the resettled population to determine if adjustments are needed in financial assistance and/or program implementation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Zhejiang Zhongda Sanchuan Hydropower Development Co., Ltd. (云南中大盐津发电有限公司)
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State/Region:	Yunnan Province
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E-Mail:	pandaliu2004 at hotmail dot com
URL:	
Represented by:	
Title:	Assistant General Manager
Salutation:	Mr.
Last Name:	Liu (刘慧)
Middle Name:	
First Name:	Hui
Department:	
Mobile:	
Direct FAX:	
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Organization:	Designated National Authority of Italy, Ministry for the Environment and Territory
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Telephone:	+1 202 473 2928
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E-Mail:	wevans at worldbank dot org
URL:	www.carbonfinance.org
Represented by:	Mr. James Warren Evans
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Annex 2

The Project is seeking US$44 million of debt finance, representing 60% of total capital requirements. The IFC, DEG, and Proparco are considering lending up to US$22 million, US$12 million, and US$10 million, respectively. This is not Official Development Assistance funding.[12]

Annex 3

The following tables summarize results from the formulae in the ACM0002 Methodology for grid-connected electricity generation from renewable sources. The tables include data, data sources and the underlying computations.

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[12] While the Yanjin County government is a beneficial owner of the Project through its asset management company, it should be noted that the County was granted its ownership stake through an earlier fixed asset injection into the Project Company. No public funds or assets have been or will be provided for the current Project.

Tables A1 to A3 provide statistics from the China Southern Power Grid ("CSPG") for years 2001, 2002, and 2003, including installed capacity, annual electricity generation, and annual electricity supplied to the grid aggregated by different electricity generation sources, the Grid Average Electricity Generation Coal Consumption, the Grid Average Electricity Supply Coal Consumption. The CSPG is supplied by electricity from Yunnan, Guangxi, Guizhou, and Guangdong Provinces; data is presented first for the CSPG as a whole and then by Province.

Table A1: Basic Data of the China Southern Power Grid, 2001

China Southern Power Grid				Year 2001	
Plant data aggregated by fuel type	Installed capacity (MW)	$EGCC_y$ Electric Generation Coal Consumption (Standard Coal kg/MWh)	$ESCC_y$ Electric Supply Coal Consumption (Standard Coal kg/MWh)	$GEN_{Fuel, Plants, y}$ Electricity Generation (GWh)	$GEN_{Fuel, Grid, y}$ Electricity Supply (GWh)
Thermal power plant	34,715.90	350	374	162,910.00	152,181.24
Hydro power plant	18,951.70			67,895.00	
Nuclear Power	1,800.00			15,000.00	
Other	-			-	
Total	**55,467.60**			**245,805.00**	
Yunnan				Year 2001	
Thermal power plant	2,946.30	384	420	14,305.00	13,079
Hydro power plant	4,995.60		-	21,648.00	
Nuclear Power					
Other					
Sub-total	**7,941.90**			**35,953.00**	
Guangxi				Year 2001	
Thermal power plant	3,098.10	364	399	12,110.00	11,048
Hydro power plant	4,243.70		-	17,609.00	
Nuclear Power					
Other					
Sub-total	**7,341.80**			**29,719.00**	
Guizhou				Year 2001	
Thermal power plant	4,240.50	356	386	27,376.00	25,248
Hydro power plant	2,409.60		-	9,565.00	
Nuclear Power					
Other					
Sub-total	**6,650.10**			**36,941.00**	

Guangdong	Year 2001				
Thermal power plant	24,431.00	342	363	109,119.00	102,806
Hydro power plant	7,302.80		-	19,073.00	
Nuclear Power	1,800.00			15,000.00	
Other					
Sub-total	**33,533.80**			**143,192.00**	

Source: *China Electric Power Yearbook (2002)*, p. 616, p. 617 and p. 623.

Table A2: Basic Data of the China Southern Power Grid, 2002

China Southern Power Grid	Year 2002				
Plant data aggregated by fuel type	Installed capacity (MW)	$EGCC_y$ Grid Average Power Generation Unit Coal Consumption (Standard Coal kg/MWh)	$ESCC_y$ Grid Average Power Supply Unit Coal Consumption (Standard Coal kg/MWh)	$GEN_{Fuel, Plants, y}$ Electricity Generation (GWh)	$GEN_{Fuel, Grid, y}$ Electricity Supply (GWh)
Thermal power plant	35,969.20	345	369	185,168.00	173,223.39
Hydro power plant	20,401.00			70,121.00	
Nuclear Power	2,790.00			20,877.00	
Other	76.80			135.00	
Total	**59,237.00**			**276,301.00**	
Yunnan	Year 2002				
Thermal power plant	2,932.70	381	415	15,787	14,494
Hydro power plant	5,836.30		-	25,062	
Nuclear Power					
Other					
Sub-total	**8,769.00**			**40,849**	
Guangxi	Year 2002				
Thermal power plant	3,156.20	346	378	13,069	11,963
Hydro power plant	4,363.30		-	18,634	
Nuclear Power					
Other					
Sub-total	**7,519.50**			**31,703.00**	
Guizhou	Year 2002				
Thermal power plant	4,642.50	355	386	33,231.00	30,562
Hydro power plant			-	9,512.00	

	Installed capacity (MW)	EGCC (kg/MWh)	ESCC (kg/MWh)	Electricity Generation (GWh)	Electricity Supply (GWh)
	2,426.10				
Nuclear Power					
Other					
Sub-total	**7,068.60**			**42,743.00**	
Guangdong	Year 2002				
Thermal power plant	25,237.80	338	358	123,081.00	116,205
Hydro power plant	7,775.30		-	16,913.00	
Nuclear Power	2,790.00			20,877.00	
Other	76.80			135.00	
Sub-total	**35,879.90**			**161,006.00**	

Source: *China Electric Power Yearbook (2003)*, p. 584, p. 585 and p. 592.

Table A3: Basic data of the China Southern Power Grid, 2003

China Southern Power Grid	Year 2003				
Plant data aggregated by fuel type	Installed capacity (MW)	$EGCC_y$ Grid Average Power Generation Unit Coal Consumption (Standard Coal kg/MWh)	$ESCC_y$ Grid Average Power Supply Unit Coal Consumption (Standard Coal kg/MWh)	$GEN_{Fuel, Plants, y}$ Electricity Generation (GWh)	$GEN_{Fuel, Grid, y}$ Electricity Supply (GWh)
Thermal power plant	40,444.10	351	375	222,780.00	208,371.40
Hydro power plant	22,889.30			69,074.00	
Nuclear Power	3,780.00			28,930.00	
Other	83.40			159.00	
Total	**67,196.80**			**320,943.00**	
Low Operating Cost and Must Run as a % of Total	39.81%			30.59%	
Average Rate of Parasitic Use				6.47%	
Yunnan	Year 2003				
Thermal power plant	3,556.80	378	410	19,055.00	17,568
Hydro power plant	6,543.20		-	26,837.00	
Nuclear Power					
Other					
Sub-total	**10,100.00**			**45,892.00**	
Guangxi	Year 2003				
Thermal power plant	3,190.10	357	390	17,079.00	15,634
Hydro power plant	4,525.20		-	19,288.00	
Nuclear Power					
Other					
Sub-total	**7,715.30**			**36,367.00**	

Guizhou	Year 2003				
Thermal power plant	6,465.80	379	412	43,295.00	39,827
Hydro power plant	3,713.70			-	8,019.00
Nuclear Power					
Other					
Sub-total	**10,179.50**			**51,314.00**	
Guangdong	Year 2003				
Thermal power plant	27,231.40	338	358	143,351.00	135,343
Hydro power plant	8,107.20			-	14,930.00
Nuclear Power	3,780.00				28,930.00
Other	83.40				159.00
Sub-total	**39,202.00**			**187,370.00**	

Source*: China Electric Power Yearbook (2004)*, p. 670, p. 679 and p. 709.

The baseline scenario, based on using the additionality tool, is the electricity that would have been generated by the operation of grid-connected thermal power plants and the addition of new fossil fuel-based generating sources that the proposed Project will displace. Following the ACM0002 Methodology, the baseline emission factor is calculated as a combined margin (*CM*), consisting of the simple average of the operating margin emission factor (*OM*) and the build margin emission factor (*BM*):

$$CM = 0.5 \times OM + 0.5 \times BM$$

The combined margin represents the tCO_2e/MWh that would have been emitted in the absence of the Project. Emissions reductions will be claimed based on the total CO_2e emissions mitigated by the Project, following the 4 steps described below.

Step 1 – Calculation of the Operating Margin Emission Factor (*OM*)
Step 2 – Calculation of the Build Margin Emission Factor (*BM*)
Step 3 – Calculation of the Baseline Emission Factor (*CM*)
Step 4 – Calculation of the Baseline Emissions Reductions (*ERs* generated)

Step 1: Calculation of the Operating Margin Emission Factor (*OM*)

Out of four options for the *OM* discussed in the Methodology, the Simple OM method was chosen, for the following two reasons:

1. Detailed hourly dispatch data is not available. The China Southern Power Grid Company runs the dispatch center and does not make this information available to the public.
2. Historical data available for the last five years show that the ratio of electricity generated by low operating cost and must run sources, identified in the CSPG as hydro- and nuclear power plants, to the total electricity generated in the CSPG are 33.86%, 34.23%, 33.72%, 32.98%, and 30.59% from 1999 through 2003, respectively. Since these sources contribute much less than the 50% threshold specified in the Methodology, Simple OM is applicable for the Project.

As a result of these two factors and in accordance with p. 6 of the Methodology which states:

> *The Simple OM method (a) can only be used where low-cost/must run*

> *resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production.*

the Simple OM has been used.

The Simple OM was calculated *ex-ante* using a three year average, based on the most recent statistics available at the time of PDD validation.

The Simple OM emission factor ($EF_{OM, simple, y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO$_2$e/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

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

(1)

$F_{i,j,y}$ is the total amount of fuel i (in a mass or volume unit) consumed by relevant power source j in year(s) y.

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.

$COEF_{i,j,y}$ is the CO$_2$ emission coefficient of fuel i (tCO$_2$e/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y.

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The CO$_2$ emission coefficient $COEF_i$ is obtained as:

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i$$

(2)

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i.

$OXID_i$ is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values).

$EF_{CO2, i}$ is the CO$_2$ emission factor per unit of energy of the fuel i.

In this PDD, NCV_i for different fuels i were taken from *China Energy Statistical Yearbook 2004* (most recent version available at time of PDD validation) and years 2000-2002. $EF_{CO2,coal}$ use the country-specific values defined as 24.74 tC/TJ.[13] The $EF_{CO2, i}$ for other fuels are based on default values set by IPCC Good Practice Guidance. The fraction of carbon oxidized for coal is 0.98 and fraction of carbon oxidized for fuel oil/diesel is 0.99, both default values set by IPCC Good Practice Guidance.

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[13] *China Climate Change Country Study*, p. 57-58.

$EF_{OM, simple, y}$ is calculated based on the electricity generation mix of the CSPG, not including low operating cost/must run power plants, such as wind power, hydropower, nuclear power, etc. It is calculated as a three year average based on the most recent statistics available at the time of PDD validation. Data on different fuel consumption for power generation in the CSPG are taken from the Energy Balance Table of Yunnan, Guizhou, Guangxi and Guangdong (Years 2001 through 2003) from the *China Energy Statistical Yearbook.*[14]

In China, the power plant efficiency indicators include Electricity Generation Coal Consumption (*EGCC*), the amount of standard coal consumed to *generate* one kWh (kg standard coal/kWh) to the grid, and Electricity Supply Coal Consumption (*ESCC*), the amount of standard coal consumed to *supply* one kWh (kg standard coal/kWh) to the grid. The *China Electric Power Yearbook* aggregates the *EGCC* and *ESCC* of all thermal power plants at the provincial grid level. Note that the expression ($EGCC_y \div ESCC_y$) is equivalent to the expression (1 – Percentage Parasitic Loss).

Ideally, the emission factor should be calculated using the actual electricity supplied to the grid instead of the electricity generated at plants. That is, because the Project is replacing electricity (excluding low cost/must run power plants) in the grid, the basis for the emission reduction calculation should be the electricity delivered directly to CSPG, $GEN_{Thermal, Grid, y}$. However, there is no data available that identifies $GEN_{Thermal, Grid, y}$ in China. Nevertheless, it is still possible to calculate total electricity delivered to the grid by fuel type with data available in China by using the following formula:

$$GEN_{Thermal, Grid, y} = GEN_{Thermal, Plants, y} \times (EGCC_y \div ESCC_y) \qquad (3)$$

$GEN_{Thermal, Grid, y}$ is the electricity energy *supplied* to the grid by coal-fired thermal power plants in year *y*.

$GEN_{Thermal, Plants, y}$ is the electricity energy *generated* by coal-fired thermal power plants in year *y*. The source data for $GEN_{Thermal, Plants, y}$ are published annually both in the *China Electric Power Yearbook* and the *China Energy Statistical Yearbook*. However, the data from these two books are slightly different. For consistency with fuel data, this calculation uses the electricity generation data from the *China Energy Statistical Yearbook*.

$EGCC_y$ is the average amount of standard coal consumed to generate one kWh of electricity at the thermal power plants in the CSPG. The sources for these data are Tables A1-A3 above.

$ESCC_y$ is the average amount of standard coal consumed to supply one kWh of electricity at the thermal power plants in the CSPG. The sources for these data are Tables A1-A3 above.

In CSPG, all hydro- and wind power plants are identified as having low operating costs and are must-run power plants. They are thus excluded from the total generation when calculating the Simple OM emission factor. Although some thermal power plants might also be considered "low cost, must run" plants, it is impossible to exclude them from the calculation, since there is no available data in China on quantities of electricity generated from such plants. However, their inclusion in the calculation of the Simple OM emission factor actually improves the conservativeness of the emission reduction calculations, since newly built thermal power plants have higher generation efficiency and therefore

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[14] *China Energy Statistical Yearbook (2000-2002)*, pp. 376-383; 388-395; 432-439; 444-451. *China Energy Statistical Yearbook (2004)*, pp. 218-225; 238-245.

lower emission factors. Thus the inclusion of some "low cost, must run" thermal plants in the $EF_{OM, simple, y}$ calculation will result in fewer emission reductions being allocated to the Project.

The CSPG a net exporter of electricity, 6896.4 GWh and 9314.5 GWh in the years 2003 and 2002, respectively[15]. According to the Methodology, electricity exports should not be subtracted from electricity generation data used for calculating and monitoring the baseline emission rate. As a result, the total electricity supplied to the CSPG is used as the basis for calculating emission factors.

The following tables A4 through A6 provide data and calculations to estimate the CSPG's system $EF_{OM, simple, y}$ for years 2001, 2002, and 2003. The calculation in each table is performed as following:

1. Following (2), $COEF_i$ is determined for each CSPG fuel source by multiplying $EF_{CO2, i}$, NCV_i, $OXID_i$, and 44/12 ratio of CO_2 mass to carbon mass (C × D × E × 44/12).
2. Following (1), the $COEF_i$ is multiplied by the total fuel consumed by CSPG (B) to obtain total emissions from each fuel source in CSPG (F).
3. The emissions are summed to obtain "Total Emissions (tonnes)" for CSPG.
4. The "Total Electricity Generation (GWh)" of CSPG is calculated by summing the electricity generation of each CSPG Province, using data from the *China Energy Statistical Yearbook*.
5. "Total Electricity Generation (GWh)" is converted to "Total Electricity Supply (GWh)" using (3) and the data for $ESCC_y$ and $EGCC_y$ in tables A1-A3.
6. Finally, (1) is completed by dividing "Total Emissions (tonnes)" by "Total Electricity Supply (GWh)" and converting from GWh to MWh.

Table A4: China Southern Power Grid Simple OM Emission Factor, 2001

Fuel	Unit	Fuel Consumption				Emission Factor CTonne/Tj	NCV Tj/A	Fraction of Carbon Oxidized	Emissions Tonnes
		Yunnan	Guizhou	Guangxi	Guangdong				
	A	*B*				*C*	*D*	*E*	*F=B×C×D×E×44/12*
Raw Coal	10^4 tonnes	1012.5	1413.42	690.29	3629.09	24.73	209.08	0.980	125,324,327.77
Clean Coal	10^4 tonnes					24.73	263.44	0.980	-
Other Washed Coal	10^4 tonnes		32.49			24.73	83.63	0.980	241,453.46
Coke	10^4 tonnes					29.5	284.7	0.980	-
Coke Oven Gas	10^8 m^3					13	167.26	0.995	-
Other Gas	10^8 m^3	15.68			2.22	20.2	522.7	0.995	689,527.21
Crude Oil	10^4 tonnes				12.56	20	418.16	0.995	383,227.47
Gasoline	10^4 tonnes				0.01	18.9	430.7	0.995	296.98
Diesel	10^4 tonnes	1.61		0.5	92.5	20.2	426.52	0.995	2,973,872.35
Fuel Oil	10^4 tonnes			0.1	602.05	21.1	418.16	0.990	19,285,737.81
LPG	10^8 m^3					17.2	501.79	0.995	-
Refinery Gas	10^8 m^3					18.2	460.55	0.995	-
Natural Gas	10^8 m^3					15.3	3893.1	0.995	-
Other Petroleum Product	10^4 tonnes				1.01	20	401.9	0.995	29,618.56
Other Coking product	10^4 tonnes					29.5	280	0.995	-
Other Energy (Standard Coal)	10^4 tonnes				17.2	24.73	292.8	0.980	447,528.96
Total Emission (tonnes)									149,375,590.57
Total Electricity Generation (GWh)		14,305	26,855	12,110	109,891				163,161
Total Electricity Supply (GWh)									152,416
Simple OM Emission Factor (tCO2e/MWh)									0.980

Source: Baseline Study calculations using data from *China Energy Statistical Yearbook*.

[15] *China Electric Power Yearbook (2003),* p. 688 and *China Electric Power Yearbook (2004),* p. 679.

Table A5: China Southern Power Grid Simple OM Emission Factor, 2002

Fuel	Unit	Fuel Consumption				Emission Factor CTonne/Tj	NCV Tj/A	Fraction of Carbon Oxidized	Emissions Tonnes
		Yunnan	Guizhou	Guangxi	Guangdong				
	A		B			C	D	E	F=B×C×D×E×44/12
Raw Coal	10⁴ tonnes	1144.39	1430.68	711.35	4121.6	24.73	209.08	0.980	137,637,336.61
Clean Coal	10⁴ tonnes					24.73	263.44	0.980	-
Other Washed Coal	10⁴ tonnes	13.58	35.26			24.73	83.63	0.980	362,960.51
Coke	10⁴ tonnes	6.44				29.5	284.7	0.980	194,353.72
Coke Oven Gas	10⁸ m³					13	167.26	0.995	-
Other Gas	10⁸ m³				2.63	20.2	522.7	0.995	101,310.42
Crude Oil	10⁴ tonnes				5.8	20	418.16	0.995	176,968.10
Gasoline	10⁴ tonnes				0.01	18.9	430.7	0.995	296.98
Diesel	10⁴ tonnes	0.5		0.67	73.07	20.2	426.52	0.995	2,333,582.96
Fuel Oil	10⁴ tonnes			0.2	701.41	21.1	418.16	0.990	22,471,255.50
LPG	10⁸ m³				0.09	17.2	501.79	0.995	2,833.92
Refinery Gas	10⁸ m³				1.42	18.2	460.55	0.995	43,424.12
Natural Gas	10⁸ m³					15.3	3893.1	0.995	-
Other Petroleum Product	10⁴ tonnes				7.91	20	401.9	0.995	231,963.15
Other Coking product	10⁴ tonnes					29.5	280	0.995	-
Other Energy (Standard Coal)	10⁴ tonnes				79.28	24.73	292.8	0.980	2,062,796.26
Total Emission (tonnes)									165,619,082.26
Total Electricity Generation (GWh)		16,396	32,559	13,069	123,081				185,105
Total Electricity Supply (GWh)									173,164
Simple OM Emission Factor (tCO2e/MWh)									0.956

Source: Baseline Study calculations using data from *China Energy Statistical Yearbook*.

Table A6: China Southern Power Grid Simple OM Emission Factor, 2003

Fuel	Unit	Fuel Consumption				Emission Factor CTonne/Tj	NCV Tj/A	Fraction of Carbon Oxidized	Emissions tonnes
		Yunnan	Guizhou	Guangxi	Guangdong				
	A		B			C	D	E	F=B×C×D×E×44/12
Raw Coal	10⁴ tonnes	1405.27	2169.11	831.84	4491.79	24.73	209.08	0.980	165,320,611.65
Clean Coal	10⁴ tonnes				0.05	24.73	263.44	0.980	1,170.51
Other Washed Coal	10⁴ tonnes	20.37	36.38			24.73	83.63	0.980	421,744.65
Coke	10⁴ tonnes	0.5				29.5	284.7	0.980	15,089.57
Coke Oven Gas	10⁸ m³	0.04				13	167.26	0.995	317.31
Other Gas	10⁸ m³	11.27			3.21	20.2	522.7	0.995	557,785.14
Crude Oil	10⁴ tonnes				6.85	20	418.16	0.995	209,005.43
Gasoline	10⁴ tonnes				0.02	18.9	430.7	0.995	593.97
Diesel	10⁴ tonnes	0.76			31.9	20.2	426.52	0.995	1,026,600.48
Fuel Oil	10⁴ tonnes			0.3	627.22	21.1	418.16	0.990	20,098,291.43
LPG	10⁸ m³					17.2	501.79	0.995	-
Refinery Gas	10⁸ m³				2.85	18.2	460.55	0.995	87,154.04
Natural Gas	10⁸ m³					15.3	3893.1	0.995	-
Other Petroleum Product	10⁴ tonnes				11.35	20	401.9	0.995	332,842.19
Other Coking product	10⁴ tonnes	13.35				29.5	280	0.995	402,305.37
Other Energy (Standard Coal)	10⁴ tonnes	22.35			93.21	24.73	292.8	0.980	3,006,770.14
Total Emission (tonnes)									191,480,281.89
Total Electricity Generation (GWh)		19,390	43,273	17,028	141,738				221,429
Total Electricity Supply (GWh)									207,108
Simple OM Emission Factor (tCO2e/MWh)									0.925

Source: Baseline Study calculations using data from *China Energy Statistical Yearbook*.

Averaging the three years' Simple OM Emission Factor, the $EF_{OM, simple, y}$ (or *OM*) used in this PDD is:

OM = 0.954 tCO$_2$e/MWh

Step 2: Calculation of the Build Margin Emission Factor (*BM*)

For calculating, the *BM*, we elect Option 1. The Build Margin emission factor ($EF_{BM, y}$) *ex-ante* is defined as the generation-weighted average emission factor of the greater annual generation of:

1. The five power plants that have been built most recently, or
2. The power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Both sets of plants exclude registered CDM project activities. Given the size of the CSPG, the annual generation of the most recently built 20% of capacity far exceeds the annual generation of the five most recently built plants. Therefore, we calculate *BM* using the most recently built 20% of capacity.

The calculation of *BM* follows the steps below:

1. Determine the emission factors of newly built coal-fired power plants in CSPG.

$COEF_{standard\ coal}$ is calculated using formula (2) and IPCC default values and China-country specific values.

Table A7: Calculation of $COEF_{standard\ coal}$

	A	B	C	D	$A \times B \times C \times D \div 1000$
Variable	Net Calorific Value	Carbon Emission Factors	Fraction of Carbon Oxidized	Conversion Factor	$COEF_{standard\ coal}$
Unit	GJ/tonne	tC/TJ	Fraction	tCO$_2$/tC	tCO$_2$/tonne of standard coal
Source	Revised 1996 IPCC guidelines for National GHG Inventories: Reference Manual	Page 53, China Climate Change Country Study	Revised 1996 IPCC guidelines for National GHG Inventories: Reference Manual	Constant value	Calculated value
Value	29.28	24.73	0.98	3.67	2.602

As a result, $COEF_{standard\ coal}$ is 2.602 tCO$_2$/tonne of standard coal.

It is conservatively assumed that all of the coal-fired power plants recently added to CSPG are 600 MW sub-critical power generators, which have an ESCC of 328.4 kg/MWh[16]. This value is commonly accepted in the power sector in China. By comparison, the China Southern Power Grid average ESCC was 374, 369, and 375 kg/MWh in 2001, 2002, and 2003, respectively. The carbon emission factor for the newly built coal-fired power plants are therefore calculated as 0.854 tCO2/MWh based on the following formula:

$$EF_{Coal\text{-}fired\ new\ plants} = ESCC_{Coal\text{-}fired\ new\ plants} \times COEF_{standard\ coal} \tag{4}$$
$$EF_{Coal\text{-}fired\ new\ plants} = 328.2 \times 2.602$$

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[16]Jianhua Mi (米建华). (June 2005). "Analysis on Energy Saving Condition in China Power Industry" (我国电力工业布能节能状况分析). *Electrical Equipment* (电力设备). Vol. 6. No. 6, Jun 2005, p. 2.

$EF_{Coal\text{-}fired\ new\ plants}$ = 0.854 tCO$_2$/MWh

2. Determine the emission factors of the newly built fuel oil/diesel fired power plants in CSPG.

$COEF_{fuel\ oil/diesel}$ is calculated using formula (2) and IPCC default values and China-country specific values. The *China Electric Power Yearbook* does not distinguish between fuel oil-fired generation and that from diesel. The PDD uses the lower carbon emission factor from diesel (20.2 tC/tJ) and applies it to fuel oil, which is originally 21.1 tC/tJ.

Table A8: Calculation of $COEF_{fuel\ oil/diesel}$

	A	B	C	D	$E=A \times B \times C \times D \div 1000$
Variable	Net Calorific Value	Carbon Emission Factors	Fraction of Carbon Oxidized	Conversion Factor	$COEF_{fuel\ oil/diesel}$
Unit	GJ/tonne	tC/TJ	Fraction	tCO$_2$/tC	tCO$_2$/tonne of fuel oil/diesel
Source	Page 302, China Energy Statistical Yearbook, edition 2004	Revised 1996 IPCC guidelines for National GHG Inventories: Reference Manual	Revised 1996 IPCC guidelines for National GHG Inventories: Reference Manual	Constant value	Calculated value
Value	41.816	20.2	0.99	3.67	3.07

As a result, the $COEF_{fuel\ oil/diesel}$ is 3.07 tCO$_2$/ton of fuel oil/diesel.

Because only Guangdong Province has fuel oil/diesel fired power plants, it is conservatively assumed that all of the fuel oil/diesel power plants recently added to the CSPG have 37% plant efficiency. This assumption was also made by the registered CDM project "Yuzaikou Small Hydropower Station," which shares the same project boundary with the Project. The carbon emission factor for the newly built fuel oil/diesel fired power plants are therefore calculated using the following table, which continues the process started in Table A8:

Table A9: Calculation of $EF_{fuel\ oil/diesel\text{-}fired\ new\ plants}$

	A	F	G	$H=A \times F \div G$	$E \div H$
Variable	Net Calorific Values	Power Plant Electricity Supply Efficiency	Conversion factor	Electricity Supplied to grid/ton of fuel oil/diesel	$EF_{fuel\ oil/diesel\text{-}fired\ new\ plants}$
Unit	GJ/tonne	%	Gj/MWh	MWh/tonne of Fuel oil	tCO$_2$/MWh
Source	Page 302, China Energy Statistical Yearbook, edition 2004	Registered Yuzaikou PDD - Page 22	Constant value	Calculated value	Calculated value
Value	41.816	37%	3.6	4.298	0.713

3. Determine the weight of electricity supply by coal-fired power plants and fuel oil/diesel fired power plants and calculate weighted emission factors for these newly built thermal power plants.

The composition of electricity supply of thermal power plants by different fuel source are as follows: [17]

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[17] *China Electric Power Yearbook (2004)*, p. 679.

Table A10: Fuel Mix in China Southern Power Grid (Excluding Hainan)

Electricity Generation (GWh)	Guangdong	Guangxi	Yunnan	Guizhou	Total	Weight
Coal	104,459	17,077	19,055	43,295	183,886	82.54%
Fuel oil/Diesel	38,828	2			38,830	17.43%
Natural Gas						0.00%
Landfill Gas	64				64	0.03%
Total (GWh)	143,351	17,079	19,055	43,295	222,780	100.00%

Based on the figures above, assuming an 80:20 ratio for electricity supply by coal plants to that by fuel oil/diesel plants is conservative. Using this weighting, the weighed emission factor for the newly built thermal power plants is calculated as follows:

$$EF_{Thermal\ new\ plants} = 80\% \times EF_{Coal\text{-}fired\ new\ plants} + 20\% \times EF_{fuel\ oil/diesel\text{-}fired\ new\ plants} \quad (5)$$
$$EF_{Thermal\ new\ plants} = 80\% \times 0.854 + 20\% \times 0.713$$
$$EF_{Thermal\ new\ plants} = 0.826\ tCO_2/MWh$$

4. Calculate the share of electricity supply from newly added thermal and hydro/nuclear power plants whose electricity supply represents 20% of electricity supply in the China Southern Power Grid in 2003.

Because $EF_{Hydro\ new\ plant}$ and $EF_{Nuclear\ new\ plant}$ are 0, the *BM* is the percentage weight of thermal electricity supplied to CSPG multiplied by $EF_{Thermal\ new\ plants}$. To determine the share of electricity supplied by newly added hydro, nuclear, and thermal power plants, the PDD made two important assumptions:

1. All capacity additions from the thermal, hydro, and nuclear power plants were added at an even rate from 2000 to 2003.
2. The newly built thermal, hydro, and nuclear power plants have the same plant operating hours as existing power plants in their respective fuel group.

It is believed that the first assumption is reasonable and neutral with regards to its impact on emission factors. The second assumption is conservative because normally new power plants have higher operating hours than older ones and thus supply a higher proportion of electricity to the grid. Using the second assumption results in a higher *BM* than if actual operating hours were used.

The following process is used to estimate the *BM*. First, the CSPG's installed capacity at the "Baseyear" is estimated, in MW. The Baseyear is a point in time, and is defined such that power plants installed after the Baseyear were responsible for generating 20% of the CSPG's electricity energy in 2003. In this case, the Baseyear installed capacity was estimated at 55,670.55 MW, implying that 11,442.85 MW of capacity was installed between the Baseyear and the end of 2003.

Table A11: Calculating Fuel Mix of the 20% of Total Electricity Supplied by New Capacity

	A	B	C	D	E
	Installed Capacity 2000	Installed Capacity 2003	Baseyear - Installed Capacity	New Capacity Additions	Average Generation Hours in 2003
Data Source	Calculated from China Electric Power Yearbook (2000) - Page 666	China Electric Power Yearbook (2004) - Page 709	Calculated value to set the new capacity to generate 20% of total electricity supply in 2003	B - A	China Electric Power Yearbook (2004) - Page 679
Thermal power plant	32,440.60	40,444.10	34,079.23	6,364.87	5,889

Hydro power plant	18,484.00	22,889.30	19,385.94	3,503.36	3,685
Nuclear Power	1,800.00	3,780.00	2,205.38	1,574.62	7,653
Total	52,724.60	67,113.40	55,670.55	11,442.85	

Assuming that newly added power plants run the same operating hours as the grid average for their respective fuel group, the electricity supplied from plants by each type of fuel (Column G, below) can be obtained by multiplying the newly added capacity with the respective grid operating hours. Note that the total electricity supplied to the grid from new capacity of 60,037.11 GWh is exactly 20% of the total electricity supplied to the CSPG in 2003. Box 1 below describes the process used to estimate the electricity supplied to the CSPG in 2003. Once column G is known then the respective percentage of electricity supplied from each fuel source can be obtained.

Table A12: Calculation of Weighted average Build Margin Emission Factor

	F	G	H	I	J
	Parasitic Use Rate	Electricity Supplied to grid from new capacity (GWh)	Split of electricity supplied from New Capacity	Emissions Factor of newly built power plants (tCO$_2$e/MWh)	Weighted Average Build Margin Emissions Factor, *BM*
Data Source	China Electric Power Yearbook (2004) - Page 679	D×E×(1-F) ÷1000	G by fuel type÷ (Total of Column E)	Calculated above	I×H
Thermal power plant	6.29%	35,125.05	58.5%	0.826	0.483
Hydro power plant	0.38%	12,860.83	21.4%	-	-
Nuclear Power	0.50%	12,051.23	20.1%	-	-
Total		60,037.11	100.0%		0.483

Thus, Table A12 indicates that thermal power plants added in the period between the Baseyear and the end of 2003 were responsible for 58.5% of the electricity supplied by all plants added in the period between the Baseyear and the end of 2003. Multiplying this 58.5% share by $EF_{Thermal\ new\ plants}$ yields the *BM* of 0.483 tCO$_2$/MWh.

The above calculations were performed using Microsoft Excel™ whose Goal Seek function determined the total Baseyear installed capacity (55,670.55 MW) that resulted in a electricity supplied figure (by newly installed capacity) equalling 20% of CSPG's 2003 supply.

$$BM = 0.483\ tCO_2e/MWh$$

Box 1: Estimating China Southern Power Grid Electricity Supply in 2003

This PDD estimates the amount of electricity supplied by CSPG in 2003 (that is, electricity generated less parasitic use) by the following formula:

$$GEN_{Grid,\ 2003} = GEN_{Plants,\ 2003} \times [\ 1 - (GEN_{Thermal,\ Grid,\ 2003} \div GEN_{Thermal,\ Plants,\ 2003})\ ]$$

Referring to data in Table A3, the following calculation is made:

$$GEN_{Grid,\ 2003} = 320,943 \times [\ 1 - (208,371.40 \div 222,780.00)\ ]$$
$$GEN_{Grid,\ 2003} = 300,185\ GWh$$

Step 3: Calculation of the Baseline Emission Factor (*CM*)

The Baseline Emission Factor is calculated as a combined margin (*CM*), consisting of the simple average of the estimated *OM* and *BM*, using the default weights of 50% each:

$CM = 0.5 \times OM + 0.5 \times BM$
$CM = 0.5 \times (0.954 + 0.483)$
$\boxed{CM = 0.718 \text{ tCO}_2\text{e/MWh}}$

Step 4: Calculation of the Baseline Emissions Reductions

The Project has no emissions or leakage, thus $PE_y = 0$ and $L_y = 0$. Thus, the emission reductions ER_y per year of the Project is obtained using the following formula:

$ER_y = CM \times (Estimated\ Annual\ Project\ Electricity\ Generation\ in\ MWh)$ (7)

The emission reduction projected for the calendar year ending 31 December 2007 is:

$0.718 \text{ tCO}_2\text{e/MWh} \times 170,737 \text{ MWh} = 122,661 \text{ tCO}_2\text{e}.$

The total emission reductions estimated for the 21-year crediting period is 5,495,300 tCO$_2$e.

<div align="center">Annex 4</div>

In accordance with the Monitoring Methodology ACM0002, there is one key type of information that must be monitored *ex-post* since the emission factor has been calculated *ex ante*, namely the electricity supply to the grid from the Project Activity EG_y.

All three hydropower stations will interconnect with the regional grid at an electrical substation in Shizi Township owned by the Yunnan Power Grid Corporation. Electricity sales invoices from the commercial metering system that will be installed at this substation will be the source data for EG_y. For quality assurance, invoices will be cross-checked against meters installed at the Project hydropower stations.

Procedures for ensuring effective monitoring of the proposed project are described in a document "CDM Project Management and Operating Procedures" that the Project Company will utilize. The document contains the following sections:

1.0 Introduction
2.0 Overall Project Management
3.0 CDM Project Management and Calculations
      3.1 Data to be Monitored and Recorded (as per the PDD)
      3.2 Emissions Reduction Calculation for the Project
4.0 Procedures to be followed
      4.1 Monitoring Procedures
      4.2 Calibration Procedures
      4.3 Maintenance Procedures
      4.4 Procedure for Training of Personnel Engaged in this Monitoring and Verification Plan
5.0 Records Keeping, Error Handling and Reporting Procedures
      5.1 Records Keeping and Internal Reporting Procedure
      5.2 Error Handling Procedure
      5.3 External Reporting Procedure