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

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SECTION A. General description of project activity

A.1 Title of the project activity:

Project title: Hubei Xuan'en Dongping Hydropower Station
PDD Version: 2.2
Completion date PDD: 03/07/2007

Revision History of the PDD

Version	Date	Comments
Version 1.0	13 February 2007	Complete version of the PDD, prepared for the host country approval process
Version 2.0	25 February 2007	Revised draft PDD; prepared for validation, incorporating the latest NDRC emission factors information
Version 2.1	05 June 2007	Revised draft PDD, prepared on the basis of corrective action requests in the Validation protocol of TUV SUD.
Version 2.2	03 July 2007	Revised PDD, prepared on the basis of additional requests from certification body of TUV SUD.

A.2. Description of the project activity:

The Hubei Xuan'en Dongping Hydropower Station Project (hereafter referred to as 'the project' or 'project') involves the construction and operation of a mixed type hydropower station with annual regulating capacity at the downriver of Zhongjian River in Xuan'en County of Enshi Tujia and Miao Autonomous Prefecture in Hubei Province, China.

The main objective of the project is to generate power from clean renewable hydro power in Hubei Province and contribute to the sustainability of power generation of the Central China Grid.

The hydropower station will have a total installed capacity of 110 MW. The surface area of the reservoir is 8.12 km^2, thus the project has a power density of 13.5 W/m^2. The average annual operating hours is 2,928 hours, the average annual electricity generation is 322,000 MWh, and the electricity supplied to the grid is 317,360 MWh.

The electricity generated will be transmitted to Qifengba transformer substation which connects to the Enshi Grid and finally to the Central China Grid.

The project activity's contributions to sustainable development are:

- Reducing the dependence on exhaustible fossil fuels for power generation;
- Reducing air pollution by replacing coal-fired power plants with clean, renewable power;
- Bridging the gab between power supply and demand and reducing the deficiency of the local grid;
- Reducing the adverse health impacts from air pollution;
- Reducing the emissions of greenhouse gases, to combat global climate change;
- Contributing to local economic development through employment creation and improving the local energy generation infrastructure

.

This project fits with the Chinese government objective to reduce the dependence on exhaustible fossil fuels for power generation, make the energy sector in general and the power sector in particular more sustainable.

A.3. Project participants:

The parties involved in the project are shown in Table A.1:

Table A.1 Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	the Party involved wishes to be considered as project participant (Yes/No)
China (host)	Private entity: Hubei Xuan'en Dongping Hydropower Co., Ltd. (as the project owner)	No
Germany	Private entity: RWE Power AG (as the CER buyer)	No

For more detailed contact information on participants in the project activities, please refer to Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

People's Republic of China

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

Hubei Province

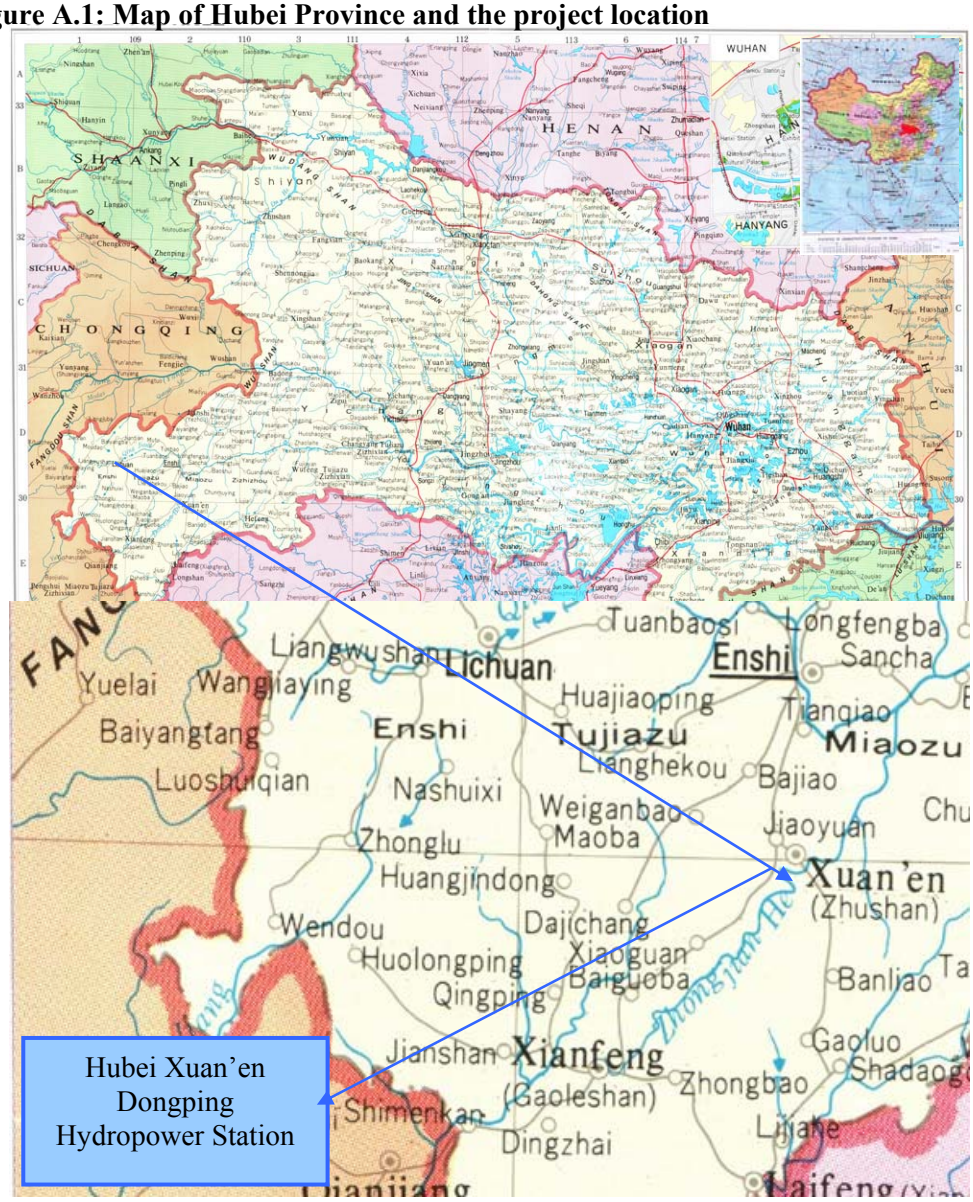
A.4.1.3. City/Town/Community etc:

Zhongjianhe Village, Xuan'en County, Enshi Tujia and Miao Autonomous Prefecture

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

The project site is located at the downriver of Zhongjian River near Zhongjianhe Village, Xuan'en County, Enshi Tujia and Miao Autonomous Prefecture, Hubei Province, China.
The project site is 33km away from Xuan'en County Seat. The dam site is 3.3km away from Zhongjianhe Village and the plant site is about 0.3km from the dam site. The Zhongjian River drainage area, on which the project is located, is the largest branch at the right bank of Qing River in the south-west of Hubei Province. The proposed project's exact geographical coordinates are latitude 30°08′34″N and longitude 109°37′00″E. Figure A.1 shows the location of the project.

Figure A.1: Map of Hubei Province and the project location



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

The project activity falls within Sectoral Scope 1: Energy Industries.
- Electricity generation from renewable energy (hydropower)

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

The construction of the power station consists mainly of a water retaining structure, a water release structure, diversion structures, a power station and a transformer substation. The dam is designed as a concrete arch dam and the maximum height of the dam is 135 meters. The flux for power generation is 135.96 m^3/s. Normal water level of the reservoir is 490 meters above sea level, total surface area at full reservoir level is 8.12 km^2 and the storage capacity of reservoir is 308 million m^3 with annual regulating capacity.

The project is a mixed type hydropower station with a total installed capacity of 110 MW. The power will be generated by two units of HLD294-LJ-272 turbines, and two units of SF55-22/6000 generators will be matched with the turbines. The specific technical data of the turbines / generators are listed in Table A.2.

Table A.2 Technical data of the turbine / generator units

Main Technical Data		Value
Turbines	Units	2
	Type	HLD294-LJ-272
	Manufacture	Dongfang Electrical Machinery Co., Ltd.
	Capacity	55MW
	Rated flow rate	67.97m^3/s
	Rated water head	90m
	Type	mixed flow type
Generators	Units	2
	Type	SF55-22/6000
	Manufacture	Dongfang Electrical Machinery Co., Ltd.
	Capacity	55MW
	Rated voltage	10.5 kV
	Rated current	900 A
	Type	suspended type

The project entity has been trained by the World Bank (which was mandatory to receive the commercial loan, mentioned in section A.4.5) and has also undergone training by the manufacturer of the turbines and the generators. Additionally, the project entity employs some experts with over twenty years of experience in operating a hydropower plant, so the project is well prepared.

The project will connect to Qifengba transformer substation via one circuit. Qifengba transformer substation connects to Enshi Grid and finally to the Central China Grid.

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

A 7-year renewable crediting period (renewable twice) is selected for the proposed project activity. The estimation of the emission reductions in the crediting period is presented in Table A.3.

Table A.3 The estimation of the emission reductions in first crediting period

Year	The estimation of annual emission reductions (tCO_2e)
Year 1: 1 February 2008 – 31 January 2009	299,731
Year 2: 1 February 2009 – 31 January 2010	299,731
Year 3: 1 February 2010 – 31 January 2011	299,731
Year 4: 1 February 2011 – 31 January 2012	299,731
Year 5: 1 February 2012 – 31 January 2013	299,731
Year 6: 1 February 2013 – 31 January 2014	299,731
Year 7: 1 February 2014 – 31 January 2015	299,731
Total estimated reductions (tons of CO2e)	**2,098,117**
Total number of crediting years in 1st crediting period	7
Annual average over the 1st crediting period of estimated reductions (tons of CO2e)	299,731

A.4.5. Public funding of the project activity:

There is no public funding from Annex I countries available to the proposed project. The World Bank loan for this specific project is a commercial loan, therefore, it does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of Annex I countries.

SECTION B. Application of a baseline and monitoring methodology

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

Baseline methodology:

Approved consolidated baseline and monitoring methodology ACM0002 (Version 6): Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources (approved on 24th CDM EB conference on 19th of May, 2006)

The methodology draws upon the "Tool for the demonstration and assessment of additionality" (version 03, approved at EB29).

Monitoring methodology

Approved consolidated monitoring methodology ACM0002 (Version 6): Consolidated monitoring methodology for grid-connected electricity generation from renewable sources

For more information on the baseline and monitoring methodology we refer to the UNFCCC website: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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

The baseline and monitoring methodology ACM0002 is applicable to the proposed project, because the project meets all the applicability criteria stated in the methodology:

- The proposed project is a grid-connected renewable power generation project.
- The project is a capacity addition from a renewable energy source, i.e. a new hydro electric power project.
- The project has a power density greater than 10 W/m^2 (see also section B.3.)
- The project does not involve an on-site switch from fossil fuels to a renewable source.
- The geographic and system boundaries for the relevant electricity grid, the Central China Power Grid, can be clearly identified and information on the characteristics of the grid is available.
- The methodology will be used in conjunction with the approved consolidated monitoring methodology ACM0002 (Consolidated monitoring methodology for grid-connected electricity generation from renewable sources).

The latest version of ACM0002 (version 6) has been applied.

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

The project's boundary is Central China Power grid. The sources and gases included in the project boundary are described in Table B.1 as below:

Table B.1 Inclusion of gases and sources in the calculation of the emission reductions

	Source	Gas	Included?	Justification / explanation
Baseline	Fossil fuel-fired Power plants connected to the Central China Power grid	CO_2	Yes	Included as per the ACM0002 methodology
		CH_4	No	Excluded as per ACM0002.
		N_2O	No	Excluded as per ACM0002.
Project Activity		CO_2	No	Excluded, the project activity is a renewable energy project which will not create emission itself.
		CH_4	No	Excluded, the project activity is a renewable energy project which will not create emission itself. The power density is above 10 W/m2, and reservoir emissions do not have to be taken into account.
		N_2O	No	Excluded, the project activity is a renewable energy project which will not create emission itself.

In line with the methodology, the only greenhouse gas accounted for in the calculation of the emission reductions is CO_2. The baseline emission sources are the power plants connected to the Central China Power Grid, as defined below. The project's spatial boundary is the Central China Power Grid, and the Hubei Xuan'en Dongping Hydropower Station

In accordance with the ACM0002 methodology, project emissions from the reservoir have to be taken into account in case the power density of the project is between 4 and 10 W/m^2. The power density of the proposed project activity can be calculcated as follows:

Reservoir surface area at full reservoir level: 8,120,000 m^2
Total installed capacity: 110,000,000 W
Power Density (Surface level / installed capacity): 110,000,000 / 8,120,000 = 13.5 W/m^2

From above calculation it is clear that the power density is substantially greater than 10 and therefore, in accordance with the ACM0002 methodology, emissions from the reservoir are not taken into account in the calculation of emission reductions. In agreement with the methodology, other leakage (arising from power plant construction, fuel handling, etc.) is ignored. The project participants also do not claim emission reductions resulting from a reduction of these emissions under the baseline level.

According to the ACM0002 (version 6) methodology, the relevant grid definition should be based on the following considerations:
1. Use the delineation of grid boundaries as provided by the DNA of the host country if available; or
2. Use, where DNA guidance is not available, the following definition of boundary:
In large countries with layered dispatch system (e.g. state/provincial/regional/national) the regional grid definition should be used.

According to above requirements, the regional grid (Central China Grid) is selected as the project boundary.

The project connects to the Hubei Power Grid via the Enshi Grid. The Hubei Power Grid is part of the Central China Power grid, which includes the provinces Chongqing, Sichuan, Henan, Hubei, Jiangxi, and Hunan.

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

There are only a few scenarios that are prima facie realistic and credible in the context of the Central China Grid:

1. Scenario 1. The electricity is supplied by the proposed project activity without the support of CDM;
2. Scenario 2. The electricity is supplied by the thermal power plant with equivalent installed capacity or equivalent annual power generation;
3. Scenario 3. The electricity is supplied by a wind farm with equivalent installed capacity or equivalent annual power generation;
4. Scenario 4. The electricity is supplied by Central China Grid.

Scenario 1

The first scenario is in compliance with Chinese relevant laws and regulations, but as we will argue in Section B.5 step 2 and 3 (Investment barrier analysis), Scenario 1 is not feasible as baseline scenario because of insurmountable economic barriers.

Scenario 2

Scenario 2 is not consistent with Chinese laws and regulations. According to Chinese regulations, coal-fired power plants of less than 135MW are prohibited for construction in the areas covered by the large grids such as provincial grids[1], while construction of thermal power units under 100MW[2] is strictly controlled. As the proposed project's capacity of 110 MW does not exceed the threshold of 135MW, we conclude that the second scenario is not in accordance with Chinese laws and regulations and therefore is not a feasible alternative to the propose project activity.

Scenario 3

The project area is poor in wind energy resources[3], so it is not provided with conditions for constructing wind power plant with the equivalent installed capacity. At present, there are no wind farms in this area. Furthermore, note that the windparks that have been constructed in China generally do so with the support of CDM, soft loans provided by foreign governments, or (previously) support measures by the Chinese government. Therefore, the third scenario is not feasible.

Scenario 4

[1] Notice on Strictly Prohibiting the Installation of Fuel fired Generators with the Capacity of 135MW or below issued by the General Office of the State Council, Decree No. [2002]6.

[2] The Temporary Stipulation of the Construction Management of Small Scale Units of Fuel-fired Power Generation (August, 1997)

[3] The China new energy net: http://www.newenergy.org.cn/html/2006-2/2006217_7650.html. See also Shi Pengfei (3/23/2006), Statistics of Windpark Installed Capacities in China of 2005, revised edition, Chinese Wind Energy Association, http://www.cwea.org.cn/download/display_info.asp?id=2. Finally, also note that Table B.7 does not include any windfarms connected to the Central China Power Grid.

Scenario 4 is in compliance with relevant Chinese laws and regulations and does not meet insurmountable economic barriers.

From above analysis we can conclude that the fourth scenario is the only feasible and credible baseline scenario. Therefore, the baseline scenario of this project is: electricity delivered to Central China Grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

The project activity involves a construction of a zero-emission power source. Thus, the emission reductions are equal to the baseline emissions.

In accordance with the ACM0002 methodology, baseline emissions are equal to power generated by the project activity and delivered to the grid, multiplied by the baseline emission factor. The baseline emission factor is equal to the combined margin: a weighted average of the operating margin emission factor and the build margin emission factor. See Section B.6 for details.

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

The additionality of the project activity is demonstrated using the steps described in the 'Tool for the demonstration and assessment of additionality' (version 03). See UNFCC website:

http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

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

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

The methodology requires a number of sub-steps to provide realistic and credible alternatives to the project activity. There are only a few alternatives that are prima facie realistic and credible in the context of the Central China Power Grid:

1. Scenario 1. The electricity is supplied by the proposed project activity without the support of CDM;
2. Scenario 2. The electricity is supplied by the thermal power plant with equivalent installed capacity or equivalent annual power generation;
3. Scenario 3. The electricity is supplied by a wind farm with equivalent installed capacity or equivalent annual power generation;
4. Scenario 4. The electricity is supplied by Central China Grid.

These alternatives are in accordance with the description of the methodology (the additionality tool requires that the proposed project activity be included as an alternative, without the benefit from CDM).

Thermal power generation is the dominant power supply option in China. In the case of the Central China Power Grid, both thermal power generation and hydropower are common options. In 2004, thermal power accounted for 56% of total installed capacity and 62% of total power generation. Hydropower accounted for 44% of total installed capacity and 38% of power generation.

Continuation of the present situation (no capacity addition to the project electricity system) is not realistic in the context of this project, because power demand has been increasing rapidly over the last few years. China has experienced severe power shortages, spurned by fast demand for power; and hence the grids have been expanding rapidly. For example, the total supply of the Central China Power Grid grew by 40.8 % between 2002 and 2004 (295,697 GWh in 2002 to 416,336 GWh in 2004). [4]

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

The second sub-steps involve the confrontation of the alternatives with China's applicable laws and regulations. Three of the four alternatives, all except for scenario 2, identified above are in compliance with China's relevant laws and regulations. [5] This may be demonstrated by referring to statistics, which show that each of these power supply options is used in China.

The proposed project activity is consistent with national policies for environmental protection, energy conservation and sustainable development. However, there are no binding legal and regulatory requirements for this project type. The Renewable Energy Law adopted by the National People's Congress on 28 Feb. 2005 encourages and supports renewable-based power generation, but does not stipulate specific goals for local air quality improvement.

Conclusion: We conclude that three of the alternatives are in compliance with the relevant Chinese laws and regulations. As there are alternatives to the project activity that are in compliance with the relevant Chinese laws and regulations, the project may be additional. However, the third scenario, power to be delivered by a windfarm, is not credible in absence of sufficient wind resources in Hubei, and the first scenario is not feasible as a baseline scenario as we will argue in B.5, step 2 and 3.

Step 2. Investment analysis

Sub-step 2a: Determine appropriate analysis method

The analysis will be analyzed through Option III of the additionality tool, i.e. Benchmark analysis. This method is applicable because:

- Option I: Simple cost analysis, does not apply as the project generates economic returns through the sales of electric power to the grid.
- Option II: Investment comparison analysis is not appropriate as, the only realistic alternative to the project not being implemented as a CDM project activity involves the delivery of power by the grid, which is not a project.
- Option III, benchmark analysis is appropriate. It provides the most simple method of analysis which is the least demanding in terms of data availability. This method has also been used in other PDDs of grid connected renewable energy projects in China.

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[4] China Statistical Press (2003) 'China Electric Power Yearbook' p. 584-585 and 591-591, and China Statistical Press (2005) 'China Electric Power Yearbook' p. 472-474.

[5] Conventional coal-fired power plants are consistent with regulations although the construction of small-scale power plants with a capacity under 135 MW has been prohibited, see General Office of the State Council (2002), *Notice of the General Office of the State Council concerning the Strict Prohibition of the Construction of Thermal Power Units with a Capacity of 135MW or Below*, Guo Ban Fa Ming Dian [2002] Document No.6.

Conclusion: We conclude that only option III is appropriate for the analysis of the additionality of the project activity.

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

We conduct the benchmark analysis through a calculation of the Internal Rate of Return (IRR) of the project and compare this with a benchmark of 8%. An IRR of 8% for investments in the areas of power supply and transmission projects is in line with the Interim Rules of Electrical Engineering Retrofit Projects issued by the State Power Corporation of China.

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

The project faces a barrier to implementation due to the poor returns on investment. The project's returns on investment are below the benchmark of 8%. To illustrate this, we performed a benchmark analysis. Table B.2 summarizes the data used in the calculation of the project IRR. The data are from the Feasibility study report, with the exception of the grid price, which has been provided by the project owner on the basis of current power prices in the region. The static investment is also provided by the owner based on the actual cost since the project has been finished. Furthermore, the annual operational cost was calculated by an expert from Tianqing.

Table B.2 Main parameters used in the calculation of the project IRR.

Installed capacity (MW)	Annual Power supplied to Grid (MWh)	Static Investment (10,000 Yuan RMB)	Estimated Grid Price (Yuan RMB/ kWh, with VAT)	Operation Period (years)	VAT	Income Tax	Annual O&M Cost (10.000 Yuan RMB)
110	317,360	83,496.72	0.367	30	17%	33%	1,882.08

We calculate an IRR of 6.97% for this project without CDM revenues and an IRR of 8.64% with CDM revenues, based on a CER price of €8/tCO_2e.[6] From this result we can conclude that without CDM, the project is economically and financially unattractive. The revenues from CDM, through the sale of CERs, are necessary to raise the project IRR above the benchmark of 8%. A cash flow table used for the calculation of the IRR is provided in a separate attachment.

Sub-step 2d: Sensitivity analysis

The tool for the demonstration and assessment of additionality requires that a sensitivity analysis is conducted to check whether, under reasonable variations in the critical assumptions, the results of the analysis remain unaltered. We have used as critical assumptions:

- Power sale revenues[7]
- Static total investment

[6] The Chinese DNA has set a minimum price necessary to obtain host country approval for CDM projects. Although the minimum price has not been published, commonly 8 EUR/tCO2 is regarded as the minimum price the NDRC will accept. The CER price agreed for this project is either equal to or above 8 EUR/tCO2, but is considered a commercial secret.

[7] The impact of a variation in power sale revenues is equivalent to a variation of either the grid price or the annual operation time and therefore only the product of these parameters (i.e. power sale revenues) has been included in the sensitivity analysis.

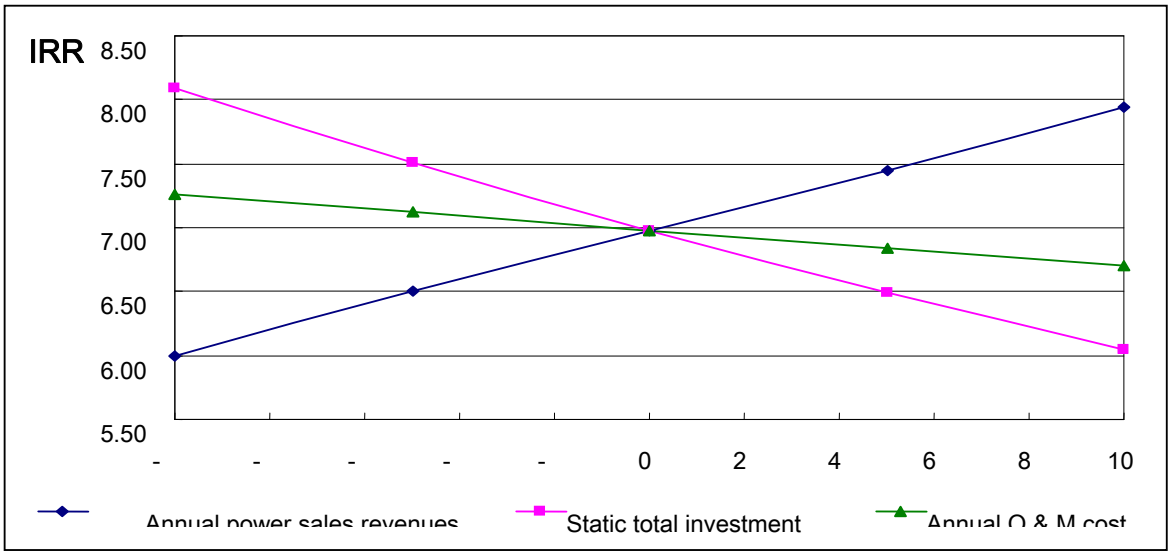
- Annual O&M costs

In the sensitivity analysis, variations of ±10% have been considered in the critical assumptions. The results of the sensitivity analysis for the IRR are shown in Table B.3, while Figure B.1 provides a graphic depiction.

Table B.3 Results of the Sensitivity Analysis for project IRR

	Percentage variation				
Variable	**-10%**	**-5%**	**0%**	**5%**	**10%**
Power sale revenues	5.99%	6.49%	6.97%	7.45%	7.92%
Tot investment cost	8.08%	7.50%	6.97%	6.48%	6.03%
O&M cost	7.26%	7.12%	6.97%	6.83%	6.69%

Figure B.1 Results of the sensitivity analysis for the IRR



The benchmark analysis showed that the IRR of this project without CDM revenues, 6.97%, is substantially below the benchmark rate of 8%. Changes in annual O&M costs have little impact on the IRR; if the annual O&M costs fall by 10%, the IRR reaches only 7.26%, far under the benchmark rate. Changes in the annual revenues from power sales and the investment amount have a more significant impact on the IRR: with a 10% increase in the annual revenues from power sales or a decrease in investment costs of 10%, the IRR increases to 7.92% respectively 8.08%. Only in the case of a decrease of 10% in total investment would the proposed project's IRR surpass the benchmark of 8%. This is however unlikely due to new regulations increasing compensations for migrants. On the contrary, static total investment costs are more likely to be higher than estimated rather than substantially lower.

The conclusion may be clear that with reasonable modifications in the critical assumptions, the main results remain unaltered: the project remains economically and financially unattractive without the revenues from the sale of CERs through CDM, as evidence by an IRR that is substantially below the threshold of 8% for reasonable variations in the critical parameters.

The results of the sensitivity analysis therefore confirm that the project faces significant economic and financial barriers.

Step 3. Barrier analysis

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

Apart from the investment barrier, the proposed project activity also faces a number of other barriers that prevent the implementation of the project without the benefits from CDM.

Investment Barrier
According to the *Regulation on Compensation of Land Requisition and Resettlement of Migrants for Large and Medium Resources and Hydropower Projects Construction* announced on March 29, 2006[8], the compensation for land requisition and the resettlement subsidy for migrants is 16 times the average annual production value of the past three years. Compared to the previous regulation of November 25, 1991, which stated this factor should be 8 times, the costs for compensation and resettlement subsidies have increased significantly. The increased investment costs will raise the price of a unit kilowatt-hour and decrease the advantage of competing for grid price, which will add further financial risks.

Uncertainty of electricity sale
Hydropower is strongly affected by hydrological conditions making it difficult to achieve the estimated annual operating hours. The generation of electricity is unstable.
In addition, the power generation is largest during the flooding season, at a time the electricity supply to the grid operating company may exceed demand. The Grid Company will distribute the electricity supplied to the grid according to the operation schedule of hydropower station. Therefore it is difficult for newly built stations to supply electricity to the grid. Thus the full-load operation is very difficult to achieve during the flooding season. The uncertainty concerning actual sales reduces the attractiveness of the project.

Uncertainty of Grid Price
The price of electricity is different depending on demand. The Grid Company will adjust the grid price according to the actual demand and supply. Power generated by the project will be greater during the flood season, when the grid price is likely to be lower. The uncertainty of the grid price further increases the risk of the project, and will result in lowest supply when the grid price is highest.

We conclude that without CDM, the project faces several barriers, preventing the construction and implementation of the proposed project activity. CDM financing lowers these barriers. If the project is not implemented, electrical power will be supplied by the Central China Grid, which partly depends on thermal power as its energy source. Thermal power has GHG emissions associated with it.

The proposed project activity will not be implemented without the registration as a CDM project and will reduce GHG emissions below the baseline. Therefore, the proposed project activity is additional.

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

The barriers to implementation mentioned in sub-step 3a impact the economic attractiveness of investments in hydropower in Hubei Province, China. All alternatives identified in step 1, except for

[8] *Regulation on Compensation of Land Requisition and Resettlement of Migrants for Large and Medium Resources and Hydropower Projects Construction*, State Council of the P.R.China, Decree of the State Council, No.471

the proposed project activity undertaken without the support through CDM, will not be affected by these barriers.

Step 4. Common practice analysis

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

For the common practise analysis, we will analyse similar hydropower projects to the proposed project. Table B.4 lists all hydropower stations with an installed capacity between 50 and 200 MW that started operations since 2000 or are still under construction in Hubei province.

Table B.4 Similar Hydropower stations in Hubei Province

Name of hydropower plant	Location	Capacity (MW)	Operation date	Annual operation hours	Applying for CDM	Project Owner
Doulingzi Hydropower Station	Yunxi County, Shiyan City, Hubei Province	70.5	2002	6,012	NO	Shiyan Doulingzi Hydropower Co., Ltd.
Cuijiaying Hydropower Station	Xiangyang County, Hubei Province	85	Under construction	-	NO	Hubei Hanjiang Cuijiaying ship and electricity Hinge Engineering construction and management Bureau
Wangfuzhou Hydropower Station	Xiangfan City, Hubei Province	109	2000	5,330	NO	Hubei Power Development Company Ltd.
Najitan Hydropower Project	Laifeng County, Hubei Province	51	2007	3,237	Yes	Laifeng Najitan Hydro-electric Development Co., Ltd.
Longqiao Hydropower Station	Lichuan City, Hubei Province	70	2007	2,978	Yes	Lichuan Yu River Hydropower Co., Ltd.

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

As shown in Table B.4, the annual operating hours of the Doulingzi Hydropower Station and the Wangfuzhou Hydropower Station are much higher than that of the proposed Dongping Station which has average annual operating hours of 2,928 hours. Consequently, the power generated will be significantly higher making the projects more attractive. In addition, the Doulingzi Hydropower Station is the first middle-sized station in Shiyan City and could therefore obtain special support from local government, such as finance and policy.
The Cuijiaying Hydropower Station has received government financing. Therefore, this project does not face the same barriers to attract financing as the proposed project activity and it has subsequently been easier to implement.

We conclude that similar hydropower stations do exist in Hubei Province. However, these projects either benefit from government support or enjoy preferable conditions increasing the projects'

attractiveness compared to the proposed project. It is clear from the analysis in step 2 that the project is financially and economically unattractive.

Impact of CDM registration

Registration of the project as a CDM project would result in additional revenues for the project, significantly improving the economic attractiveness of the project. This is the most important contribution of CDM to the project realization, removing the crucial barrier towards its realization. The income through CDM will raise the IRR for the project with from 6.97% to 8.64%, raising the project's IRR above the benchmark of 8% and making the project more attractive.

The start of the project activity was in January 2006. At this time the project entity, Hubei Xuan'en Dongping Hydropower Co., Ltd., was very knowledgeable about the possibilities offered by CDM. An overview of key events is given in table B.5.

Table B.5: Overview of key events in the development of the project

Date	Key Event
November 2002	Directorate decided to apply for CDM status
March 2003	Start of construction activities
June 2003	Discussion between the project owner and a CDM advisor on CDM application
September 2003	A study report was finished by the Global Climate Change Institute, Tsinghua University
September 2003	Preparation of first carbon asset documentation (PIN) by CDM advisors
April 2005	First contact between the project entity and Beijing Tianqing Power International CDM Consulting, Co., Ltd.
March 2006	Start of preparing the Project Design Document (PDD)
December 2006	Preparation of signing of Emission Reductions Purchase Agreement (ERPA) with RWE power AG

The above events clearly demonstrate that the Project Entity was aware about the potential for CDM before the start of the CDM activity, and that it played a crucial role in overcoming the barriers towards the implementation of the proposed project activity.

If the project is not implemented, electrical power will be supplied by the Central China Grid, which partly depends on thermal power as its energy source. Thermal power has GHG emissions associated with it. The proposed project activity will not be implemented without the registration as a CDM project and will reduce GHG emissions below the baseline. Therefore, the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

In accordance with the ACM0002 methodology, the baseline emission factor is calculated as a combined margin: a weighted average of the operating margin emission factor and the build margin emission factor. The latter is in this particular case calculated *ex ante* on the basis the latest additions to the grid.

This PDD refers to the Operating Margin (OM) Emission Factor and the Build Margin (BM) Emission Factor published by the Chinese DNA on 15 December 2006. We will refer to these emission factors as the 'published emission factors'.

For more information on the published OM and BM emission factors, please refer to:

http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2006/20061215144550669.pdf: calculation result of the baseline emission factor of Chinese power grid.
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2006/20061215144641643.xls: calculation process of the baseline OM emission factor of Chinese power grid
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2006/20061215144747182.pdf: calculation process of the baseline BM emission factor of Chinese power grid

The description below focuses on the key elements in the calculation of the published emission factors and the subsequent calculation of emission reductions. The full process of the calculation of the emission factors and all underlying data are presented in English in Annex 3 to this PDD.

Selection of values for net calorific values, CO2 emission factors and oxidation rates of various fuels.

As mentioned above, the Chinese DNA has entrusted key experts with the calculation of the grid emission factors. In these calculations choices have been made for the values of net calorific values, CO2 emission factors, and oxidation rates. The net calorific values are based on the China Energy Statistical Yearbook, and the oxidation rates and the CO2 emission factors are based on IPCC default values. Their use in the calculation of the published emission factors means that these values are deemed appropriate by the Chinese authorities for the calculations of the Chinese emission factors. The following table summarizes the values used. Note that the table lists the carbon emission factor of the fuels, the CO2 emission factor has been obtained by multiplying with 44/12. Rounded figures have been reported but exact figures have been used in the calculations in this PDD.

Table B.6. Default values used for net calorific values, oxidation factors, and CO2 emission factors of fuels

Fuel	Unit	NCV	Oxidation factor	Carbon emission factor	CO2 emission factor
		(TJ/unit)	(Fraction)	(TC/TJ)	(TCO2/TJ)
Raw coal	10^4 Tons	209.08	0.980	25.8	94.6
Clean coal	10^4 Tons	263.44	0.980	25.8	94.6
Other washed coal	10^4 Tons	83.63	0.980	25.8	94.6
Briquettes	10^4 Tons	83.63	0.980	25.8	94.6
Coke	10^4 Tons	284.35	0.980	29.5	108.2
Coke oven gas	10^8 m^3	1672.6	0.995	13.0	47.7
Other gas	10^8 m^3	522.7	0.995	13.0	47.7
Crude oil	10^4 Tons	418.16	0.990	20.0	73.3
Gasoline	10^4 Tons	430.7	0.990	18.9	69.3
Diesel	10^4 Tons	426.52	0.990	20.2	74.1
Fuel oil	10^4 Tons	418.16	0.990	21.1	77.4
LPG	10^4 Tons	501.79	0.995	17.2	63.1
Refinery gas	10^4 Tons	460.55	0.995	18.2	66.7
Natural gas	10^8 m^3	3893.1	0.995	15.3	56.1
Other petroleum products	10^4 Tons	383.69	0.990	20.0	73.3
Other coking products	10^4 Tons	284.35	0.980	25.8	94.6
Other E (standard coal)	10^4 Tce	292.7	0.980	0.0	0.0

Data source: All data are from the files mentioned above, and have been crosschecked against the original sources cited, as follows:

- Net calorific values: China Energy Statistical Yearbook, 2004 p. 302;
- Oxidation factors: IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.8;
- Carbon emission factors: IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.6.
- CO2 emission factors: calculated from carbon emission factors

Description of the calculation process

The key methodological steps are:
1. Calculation of the Operating Margin (OM) Emission Factor
2. Calculation of the Build Margin (BM) Emission Factor
3. Calculation of the Baseline Emission Factor
4. Calculation of the Baseline emissions
5. Calculation of Emission Reduction

The methodology is applied to the Central China Power grid which is defined as including the grids of Hunan, Hubei, Jiangxi, Sichuan, Chongqing and Henan, as is further elaborated in Section B.3. Section B.3 also describes how the project boundary is decided.

Step 1. Calculation of the Operating Margin Emission Factor

The ACM0002 methodology offers several options for the calculation of the OM emission factor. Of these, the methodologically preferred one, dispatch analysis, cannot be used, because dispatch data, let alone detailed dispatch data, are not available to the public or to the project participants. For the same reason, the simple adjusted OM methodology cannot be used. The average OM cannot be used, because low cost/must run resources (hydropower and windpower) constitute less than 50% of total grid generation (see Table B.7). Therefore, the calculation method of simple OM is suitable for this project activity.

Table B.7 Installed capacity and electricity generation of the Central China Power Grid, 2000-2004[9]

Year	Installed capacity (MW)					Electricity generation (GWh)				
	Thermal	Hydro	Others	Total	% Low cost/must run	Thermal	Hydro	Others	Total	% Low cost/must run
2000	39,864.60	28,637.80	n.a.	68,502.40	41.81%	158,928.35	97,428.06	n.a.	256,356	38.00%
2001	42,569.20	30,397.00	n.a.	72,966.20	41.66%	178,156.00	103,554.00	n.a.	281,710	36.76%
2002	43,303.20	31,034.70	n.a.	74,337.90	41.75%	200,347.00	112,440.00	n.a.	312,787	35.95%
2003	46,893.50	36,557.00	n.a.	83,450.50	43.81%	240,839.00	126,448.00	n.a.	367,287	34.43%
2004	53,744.70	42,342.00	n.a.	96,086.70	44.07%	270,846.00	169,094.00	n.a.	439,940	38.44%

Source: China Electric Power Yearbook (editions 2001, 2002, 2003, 2004 and 2005).

Accordingly, the OM emission factor is calculated as the generation-weighted average emissions per unit of electricity (measured in tCO_2/MWh) of all generating sources serving the system, excluding the low-operating cost and must run power plants.

[9] Numbers are calculated on the basis of data for Hubei, Henan, Hunan, Jiangxi, Sichuan and Chongqing. The same is true in other places where we refer to Central China Power Grid.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (B.1)$$

With:

- $F_{i,j,y}$ the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*. *j* refers to the power sources delivering electricity to the grid, not including low operating costs and must-run power plants, and including imports to the grid[10].
- $COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of fuels used by relevant power sources *j* and the percentage oxidation of the fuel in year(s) *y*;
- $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The CO2 emission coefficient is equal to the net calorific value of fuel i, multiplied by the oxidation factor of the fuel and the CO2 emission factor per unit of energy of the fuel i.

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \quad (B.2)$$

With:

- 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,
- $EFC_{O2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i*.

Data vintage selection

In accordance with the ACM0002 methodology and the choice for an ex ante calculation of the OM Emission Factor, the formula (B.1) is applied to the three latest years for which data are available, and a full-generation weighted average value is taken for the OM Emission Factor.

Choice of aggregated data sources

The published OM emission factor calculates the emission factor directly from published aggregated data on fuel consumption, net calorific values, and power supply to the grid and IPCC default values for the CO2 emission factor and the oxidation rate. According to the ACM0002 methodology, the selection of aggregated data for the calculation of the emission factors should be used, but the disaggregated data needed for all three more preferred methodological choices is not publicly available in China.

Calculation of the OM emission factor as a three-year full generation weighted average

On the basis of these data, the Operating Margin emission factors for 2002, 2003 and 2004 are calculated. The three-year average is calculated as a full-generation-weighted average of the emission

[10] Information on electricity imports to the Central China Grid is not listed in the China Electric Power Yearbook. It is unclear whether no imports exist or no data on imports exist. Data on exports by the Central China Grid exists, so it assumed that the Central China Grid is a net exporter of power and therefore imports have not been included in the calculations.

factors. For details we refer to the publications cited above and the detailed explanations and demonstration of the calculation of the OM emission factor provided in Annex 3. We calculate the Operation Margin Emission Factor as 1.2526 tCO2/MWh.

The calculation of the OM emission factor is done once (*ex ante*) and will *not* be updated during the first crediting period. The ex ante approach has been used to increase the predictability of the total amount of emission reductions to be generated by the project. This is of value to both the project owner and the buyer of the CERs. Furthermore, the ex ante approach minimizes the amount of work required for the preparation of the monitoring report, and thus minimizes the transaction costs involved in the CER transaction as part of this CDM project activity.

Step 2. Calculation of the Build Margin Emission Factor ($EF_{BM,y}$)

The Build Margin Emission Factor is, according to ACM0002, calculated as the generation weighted average emission factor (measured in tCO_2/MWh) of a sample of *m* power plants:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \qquad \text{(B.3)}$$

$F_{i,m,y}$, $COEF_{i,m}$ *and* $GEN_{m,y}$ in the formula above are analogous to those in equation 1, except for the fact that the index *m* is over specific power plants rather than types of power plants, and that low cost/must run sources are not excluded. The sample, according to the methodology, should be over the latest 5 power plants added to the grid, or over the last added power plants accounting for at least 20% of power generation, whatever is the greater.

A direct application of this approach is difficult in China. The Executive Board (EB) has provided guidance on this matter with respect to the application of the AMS-1.D and AM0005 methodologies for projects in China on 7 October 2005 in response to a request for clarification by DNV on this matter. The EB accepted the use of capacity additions to identify the share of thermal power plants in additions to the grid instead of using power generation.

The calculation of the published BM Emission Factor is based on this approach and is described below:

First we calculate the newly–added installed capacity and the share of each power generation technology in the total capacity. Second, we calculate the weights of newly-added installed capacity for each power generation technology. Third, an advanced efficiency level for each power generation technology is defined and used to calculate Emission Factors.

Since the exact data are aggregated, the calculation will apply the following method: We calculate the share of the CO_2 emissions of solid fuel, liquid fuel and gas fuel in total emissions respectively by using the latest energy balance data available; the calculated shares are the weights.

Using the emission factor for advanced efficient technology we calculate the emission factor for thermal power; the BM emission factor of the power grid will be calculated by multiplying the emission factor of the thermal power with the share of the thermal power in 20% of the newly-added capacity of the power grid.

Detailed steps and formulas are as below:

First, we calculate the share of CO_2 emissions of the solid, liquid and gaseous fuels in total emissions respectively .

$$\lambda_{Coal} = \frac{\sum_{i \in COAL, j} F_{i,j,y} \times COEF_{i,j}}{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}} \quad (B.4)$$

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

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

with:

- $F_{i,j,y}$ the amount of the fuel i consumed in y year of j province (measured in tce;
- $COEF_{i,j,y}$ the emission factor of fuel i (measured in tCO2/tce) while taking into account the carbon content and oxidation rate of the fuel *i* consumed in year *y*;
- *COAL,OIL* and *GAS* subscripts standing for the solid fuel, liquid fuel and gas fuel

Second, we calculate the emission factor of the thermal power

$$EF_{Thermal} = \lambda_{Coal} \times EF_{Coal,Adv} + \lambda_{Oil} \times EF_{Oil,Adv} + \lambda_{Gas} \times EF_{Gas,Adv} \quad (B.7)$$

While $EF_{Coal,Adv}$, $EF_{Oil,Adv}$ and $EF_{Gas,Adv}$ represent the emission factors of advanced coal-fired , oil-fired and gas-fired power generation technology, see detailed parameter and calculation in Annex 3.

Third, we calculate BM of the power grid

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

While CAP_{Total} represents the total newly-added capacity and $CAP_{Thermal}$ represents newly-added thermal power capacity. The λs are calculated on the basis of the weight of CO2 emissions of each type of fuel in the total CO2 emissions from thermal power.

We obtain a Build Margin emission factor value of 0.6363 tCO2/MWh.[11] For details we refer to Annex 3.

The calculation of the BM emission factor is done once (*ex ante*) and will *not* be updated during the first crediting period. This has the advantage of simplifying monitoring and verification of emission reductions.

[11] Our own calculations result in a build margin emission factor of 0.63639. We have used the lower published value for the BM emission factor. This is conservative.

Step 3. Calculation of the Baseline Emission Factor (EF_y)

The Baseline Emission Factor is calculated as a Combined Margin, using a weighted average of the Operating Margin and Build Margin.

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

The latest version of ACM0002 (version 6) provides the following default weights: Operating Margin, $w_{OM} = 0.5$; Build Margin, $w_{BM} = 0.5$

Applying the default weights and the published emission factors, we calculate a Baseline Emission Factor of **0.94445** tCO2 / MWh. [12]

Step 4. Calculation of Baseline Emissions

Baseline Emissions are calculated by multiplying the Baseline Emission factor by annual power generation.

$$BE_y = (EG_y - EG_{baseline}) \cdot EF_y \quad (B.10)$$

With:

- BE_y the baseline emissions in year *y*, EG_y the electricity supplied by the project activity to the grid,
- $EG_{baseline}$, the baseline electricity supplied to the grid in the case of modified or retrofit facilities and
- EF_y the emission factor in year *y*, calculated according to formulas (B.1)-(B.5). As the project involves the construction of a new hydropower station, $EG_{baseline}$ is zero and formula B.10 can be simplified as:

$$BE_y = EG_y \cdot EF_y \quad (B.11)$$

The estimated baseline emissions (see Section A.4.4) are based on expected power generation and an *ex ante* calculation of the emission factor, and will hence be revised during the implementation of the project activity on the basis of actual power supply to the grid. The baseline emission factor, however, is left unchanged during the first crediting period.

Step 5. Calculation of emission reductions

Emission reductions are calculated according to the following formula:

$$ER_y = BE_y - PE_y - L_y \quad (B.12)$$

With:

- ER_y, emission reductions in year y,

[12] This baseline emission factor is based on the published OM and BM emission factors. Our own calculation yields a combined margin emission factor of 0.94449. We have used the lower value, which is conservative.

- BE_y, baseline emissions in year *y*,
- PE_y, project emissions in year *y*,
- L_y, leakage in year *y*

The project does not involve project emissions or leakage as further explained in section 6.3, and therefore project emissions are equal to baseline emissions. Using the results of the preceding sections, we can calculate the emission reductions using formula B.13

$$ER_y = EG_y \cdot 0.94445 \qquad \text{(B.13)}$$

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

Data / Parameter:	**Oxidation Factor**
Data unit:	Percentage
Description:	Oxidation factors for 18 different fuels
Source of data used:	1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.8
Value applied:	For detailed values see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 1996 default values are more conservative than the assumed default value of 100% which is used in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Any comment:	

Data / Parameter:	**Fuel Emission Coefficients**
Data unit:	Tons C/TJ
Description:	Carbon emission factors for 18 different fuels
Source of data used:	Data used are IPCC default values. See 1996 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied:	For detailed values see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the same data as used by the Chinese authorities for climate change.
Any comment:	

Data / Parameter:	**Net Calorific Value**
Data unit:	$TJ/10^4$ tons; $TJ/10^4$ tce; $TJ/10^8 m^3$
Description:	Net calorific values of 18 different fuels in TJ per unit.
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Energy Statistical Yearbook, (2004) p. 302.
Value applied:	For detailed values: see Annex 3
Justification of the choice of data or	These data are the best data available, and have been published by the Chinese authorities.

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**Electricity imports from connected grids**
Data unit:	MWh (per annum)
Description:	Electricity imports of power from other grids
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Electric Power Yearbook (Editions 2003, 2004 and 2005)
Value applied:	For detailed values: see Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	Imports are zero

Data / Parameter:	**Power generation by source**
Data unit:	GWh (per annum)
Description:	Provincial level power generation data by source
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Electric Power Yearbook (Editions 2003, 2004 and 2005)
Value applied:	For detailed values: see Annex 3, Tables A3a-c
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	**Internal power consumption of power plants**
Data unit:	Percentage
Description:	Internal consumption of power by source
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Electric Power Yearbook (Editions 2003, 2004 and 2005)
Value applied:	See Annex 3, Tables A3a-c
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	**Primary fuel input for thermal power supply**

Data unit:	10^4 tons, 10^8 m^3, 10^4 tce, depending on the specific fuel. We refer to Annex for details.
Description:	Physical amount of fuel input, for 18 different fuels
Source of data used:	See the downloadable files mentioned above for the full data set. Original data are from China Energy Statistical Yearbook 2000-2002, 2004 and 2005 editions
Value applied:	See Annex 3, Tables A4a-c
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	**Efficiency of advanced thermal power plant additions**
Data unit:	%
Description:	
Source of data used:	See the downloadable files mentioned above for the full data set. Data are based on the best technologies available in China.
Value applied:	Coal: 36.53%; Oil: 45.87%; Gas: 45.87%
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

Data / Parameter:	**Capacity by power generation source**
Data unit:	MW
Description:	For the different power generation sources, installed capacity in 2002, 2003 and 2004 in the Central China Grid. Calculated by summing provincial data.
Source of data used:	China Electric Power Yearbook (Editions 2003, 2004 and 2005)
Value applied:	See Annex 3, Tables A9
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are the best data available, and have been published by the Chinese authorities.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The annual net power supply to the Central China Grid is estimated to be 317,360 MWh.

Application of the formulae presented in Section B to the baseline data presented in Annex 3 yields the following results:
EFOM = 1.2526 t CO2/MWh

EFBM = 0.6363 t CO2/MWh
EFy = 0.5*1.2526 + 0.5*0.6363= 0.94445 tCO2/MWh

The annual emission reductions BE_y are thus calculated to be 299,731 tCO2. We obtain the values for the baseline emissions during the first crediting period provided in Table B.8:

Table B.8 The estimation of the emission reductions in crediting period

Year	Year	Annual net power supply to the grid (EGy) (MWh)	Baseline emission factor (tCO_2/MWh)	Baseline emissions (tCO_2e)
1	01/02/2008 - 31/01/2009	317,360	0.94445	299,731
2	01/02/2009 - 31/01/2010	317,360	0.94445	299,731
3	01/02/2010 - 31/01/2011	317,360	0.94445	299,731
4	01/02/2011 - 31/01/2012	317,360	0.94445	299,731
5	01/02/2012 - 31/01/2013	317,360	0.94445	299,731
6	01/02/2013 - 31/01/2014	317,360	0.94445	299,731
7	01/02/2014 - 31/01/2015	317,360	0.94445	299,731
	Total	**2,221,520**		**2,098,117**
	Average	317,360		299,731

For details we refer to the publications cited above.

In a given year, the emission reductions realized by the project activity (ER_y) is equal to baseline GHG emissions (BE_y) minus project direct emissions and leakages during the same year:

$$ER_y = BE_y - PE_y - L_y$$

Leakage:

The project activity involves the construction of a new hydropower station with a power density greater than 10 W/m2 and therefore emissions from the reservoir do not have to be taken into account.

The project will install an on-site diesel generator with a capacity of at most 255 kW which will be maintained for emergency purposes in case all power lines to the grid are cut off. Government regulations require that the diesel generator is started up before every flood season.[13] The emissions of the diesel generator are significantly less than 1% of total emission reductions and are considered negligible.[14] In case of emergencies the project will not claim emission reductions and the use of the

[13] The *Hydropower Operation Safety Management Regulations (SERC document No.3),* issued by the State Electricity Regulatory Commission of the People's Republic of China states that "The back-up power sources should be re-commissioned before each flood season annually". The regulation does not provide a guideline on the duration that the diesel generator should run each year, but the project entity has decided to operate the generator for one hour annually.

[14] Emissions by the diesel generator associated with the start-up for annual re-commissioning and maintenance requirements can be calculated as follows: The diesel generator will have a capacity of at most 255 kW. The project owner will run the diesel generator for 2 hour annually; the expected annual power generation can be calculated to be 510 kWh. For the emission factor of the diesel generator we refer to the AMS.ID (version 11) methodology which provides emission factors for diesel generator systems. We apply the highest value listed in the methodology which is 2.4 kgCO2e/kWh (generators below 15 kW), which is conservative considering the size of the generator used on-site. We estimate the annual emissions by the

generator will be monitored. We conclude that the project does not involve leakage due to the presence of the emergency diesel generator.

In accordance with the ACM0002 methodology, leakage and project emissions are equal to zero, and hence, the emission reductions due to the project are equal to the baseline emissions. The emission reductions will be calculated *ex post* on the basis of actual power supply to the grid, using the baseline emission factor presented above in Section B.6.1.

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

Table B.9 *Ex ante* estimate of emission reductions due to the project

Year	Project Emissions (tCO2)	Baseline emissions (tCO2)	Leakage (tCO2)	Emission Reductions (tCO2)
Year 1: 01/02/2008 - 31/01/2009	0	299,731	0	299,731
Year 2: 01/02/2009 - 31/01/2010	0	299,731	0	299,731
Year 3: 01/02/2010 - 31/01/2011	0	299,731	0	299,731
Year 4: 01/02/2011 - 31/01/2012	0	299,731	0	299,731
Year 5: 01/02/2012 - 31/01/2013	0	299,731	0	299,731
Year 6: 01/02/2013 - 31/01/2014	0	299,731	0	299,731
Year 7: 01/02/2014 - 31/01/2015	0	299,731	0	299,731
Subtotal	**0**	**2,098,117**	**0**	**2,098,117**
Average	0	299,731	0	299,731

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**1. EG_y**
Data unit:	MWh
Description:	Electricity supplied to the grid by the project
Source of data to be used:	Directly measured
Value of data applied for the purpose of calculating expected emission reductions in section B.5	317,360 MWh
Description of measurement methods and procedures to be applied:	The supply of power to the grid by the Hubei Xuan'en Dongping Hydropower Station project is measured through national standard electricity metering instruments. The metering instruments will be calibrated annually in accordance with the *"Technical administrative code of electric energy metering (DL/T448 — 2000)"*.
QA/QC procedures to be applied:	These data will be directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency.
Any comment:	The measured electricity supply will be double checked by receipts of sales to the grid. (see also Section B.7.2 for more details)

diesel generator as 1,224 tCO2e, which would reduce annual emission reductions with about 0.0004% and can therefore be considered negligible.

Data / Parameter:	8. surface area reservoir
Data unit:	m^2
Description:	Surface area at full reservoir level
Source of data to be used:	Measured
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8.120,000 m^2
Description of measurement methods and procedures to be applied:	The surface area will be calculated using the design schematics and area maps. Photographs of the reservoir at several key locations will be taken when the project becomes operational to check whether the actual reservoir does not deviate substantially for the design.
QA/QC procedures to be applied:	The power density of the project is well above 10 W/m^2 and therefore substantial deviations from the calculated design surface area will not affect the calculation of emission reductions by the project. Therefore no further QA/QC procedures will be applied.
Any comment:	

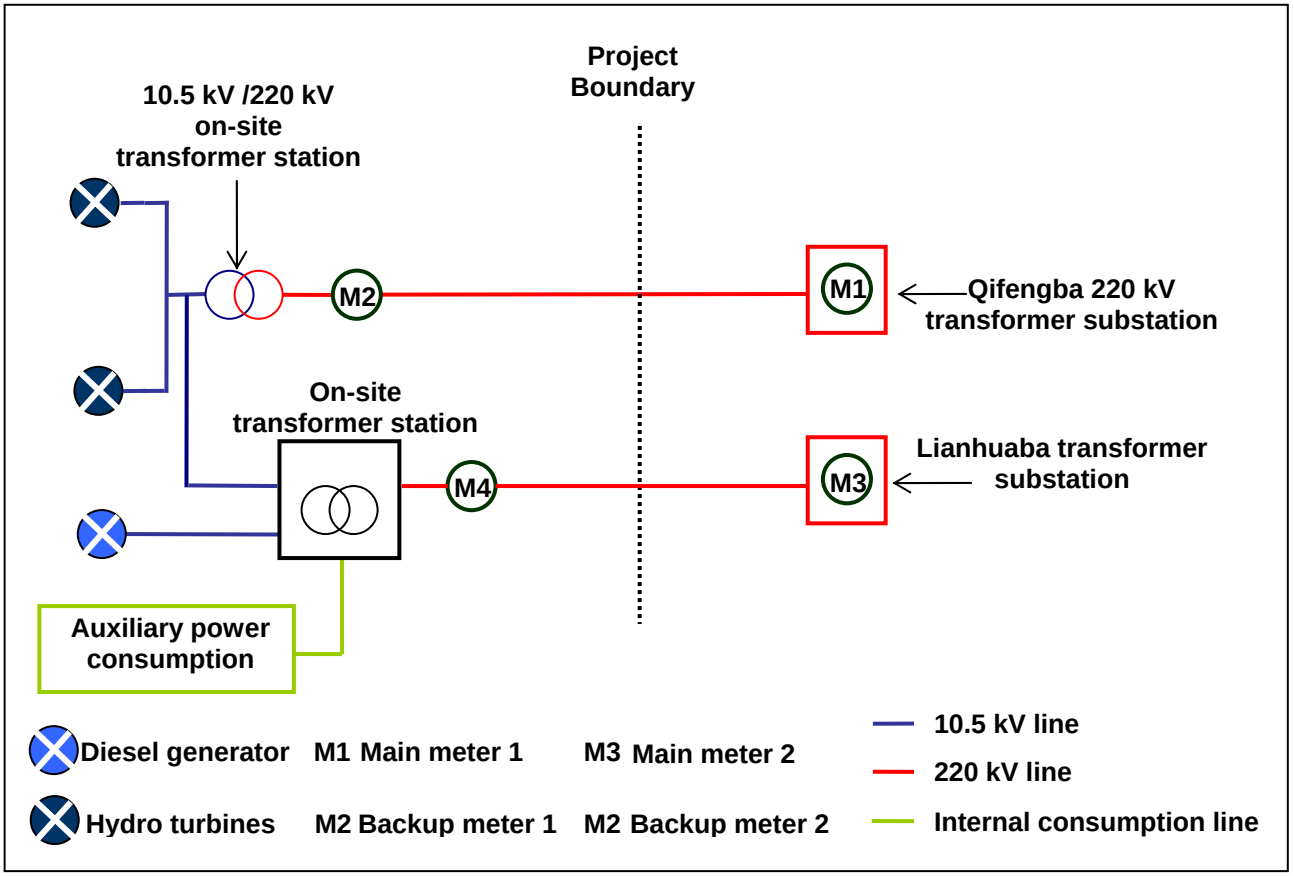
Data / Parameter:	Operational hours of emergency back-up diesel generator
Data unit:	Hours / year
Description:	Annual hours that the emergency back-up diesel generator is running either for the purpose of commissioning/maintenance or actual emergencies
Source of data to be used:	Estimated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2 hour / year. The Hydropower Operation Safety Management Regulations (SERC document No.3), issued by the State Electricity Regulatory Commission of the People's Republic of China states that "The back-up power sources should be re-commissioned before each flood season annually". The regulation does not provide a guideline on the duration that the diesel generator should run each year. The project entity has decided to operate the generator for two hours annually.
Description of measurement methods and procedures to be applied:	The project entity will record the operational hours in the daily operation logs.
QA/QC procedures to be applied:	The expected annual emissions associated with the operation of the emergency back-up diesel generator amount to about 0.0004% of total emission reductions and are therefore considered negligible. In case of actual emergencies the project entity will not claim emission reductions (see section B.7.2). Further QA/QC procedures are therefore not considered necessary.
Any comment:	

B.7.2 Description of the monitoring plan:

The project is connected to the grid through an on-site booster transformer station which increases the voltage to 220 kV. The project is then connected to the Qifengba 220 kV transformer substation which

functions as a switching station to connect the project to the grid. The power supplied to the grid is metered by the project entity at a point after power has been transformed to 220 kV (see figure B.2). Therefore, no further transformer losses will occur before the project is connected to the grid. In case of emergencies, the hydropower station could also receive power for auxiliary power consumption from the Lianhuaba transformer substation. Power supplied by the grid will be metered and deducted from gross power supply. If both options fail, the project has a back-up diesel generator to provide power for auxiliary power consumption.

Figure B.2. Simplified electrical grid connection diagram



The power supply of the project to the grid will be metered with meter M2, which is located at the high-voltage side of the step-up transformer station that will be constructed at the project site. The metering instrument M2 will record two readings, i.e. power delivered to the grid and power received from the grid. The project entity will log both readings and the difference, i.e. power delivered minus power received, will be taken as power supply through the main power line (note that for the calculation of total net supply.

The grid company will meter the power supply at Qifengba 220 kV transformer station with its own metering equipment, i.e. meter M1. The grid company will issue on the basis of the readings of M1 a sales receipt for power received from the project and a billing invoice for power supplied to the project. The regulations of the grid company require annual calibrations of both locations. Calibrations are carried out by the Grid Company and the results will be submitted to the project entity. After calibration, meters M1 and M2 will be sealed. The accuracy of the metering instruments M1 and M2 is

Accuracy Class 0.5S. If there are any substantial discrepancies between the readings of the metering instruments throughout the year, both instruments will be recalibrated.

Power supplied by the grid to the project through the Lianhuaba transformer substation will also be monitored. The project entity will record the readings of meter M4, while the grid company will record with meter M3.

The project entity will collect the sales receipts for power supplied to the grid and billing receipts for power received from the grid as evidence for the readings of meters M1 and M3. The net supply (i.e. gross supply minus supply by the grid to the project) will be used in the calculations. In case of discrepancies between the metering instruments of the grid company and the project entity, the readings of the grid company will prevail. All records of power delivered to the grid, sales receipts and the results of calibration will be collated in a central place by the project entity. The project entity will in principle report the monitoring data annually but may deviate to report at intervals corresponding to agreed verification periods and will ensure that these intervals are in accordance with CDM requirements. Data record will be archived for a period of 2 years after the crediting period to which the records pertain.

An overview of the recording frequency, calibration procedures and available documentation is provided in Table B.10. The numbering of the metering equipment refers to Figure B.3 which shows the location of each meter.

In addition to the monitoring of net power supply the project entity will also monitor the use of an emergency back-up diesel back-up by logging its operational hours in daily logs. The generator will be started-up for two hours every year for maintenance purposes in accordance with government regulations. The emissions associated with the diesel generator are calculated as 0.0004% of total emission reductions and are therefore considered negligible (see section B.6.3).

The project entity will monitor the surface area of the reservoir by collecting photographic evidence of the surface level when the project becomes operational. This photographic evidence will be compared with the design reservoir dimensions to confirm whether or not the actual surface area substantially deviates from the design surface area.

Table B.10 Details of metering instruments

Meter	Operated by	Electronic measurement	Manual measurement	Recording	Calibration	Accuracy	Documentation
M1	Grid company	-	-	Monthly	Grid Company (Annually)	Accuracy Class 0.5S or more accurate	Monthly sales receipts (for power delivered to grid) and billing invoices (for power received from the grid)
M2	Project entity	Hourly	Daily (optional)[15]	Monthly	Grid Company (Annually)	Accuracy Class 0.5S or more accurate	Print out of electronic record and optional paper log. Data will consist of two readings, i.e. power delivered to and power received from the grid.
M3	Grid company	-	-	Monthly	Grid Company (Annually)-	Accuracy Class 0.2S or more accurate	Monthly billing receipt by grid company
M4	Project entity	-	Daily (optional)	Monthly	Grid Company (Annually)-	Accuracy Class 0.2S or more accurate	Optional paper log will be kept to check plausibility of other readings.

[15] The project entity intends to log the readings of meters M2 manually in daily logs, but these logs will not form a formal requirement during verification. The ACM0002 methodology only requires hourly electronic measurement and these manual log records will only be maintained for back-up purposes. The project entity may deviate from this procedure during actual operation of the project. Manual daily paper logs are only required in case the diesel generator has been operated during a specific day.

PROCEDURES IN CASE OF DAMAGED METERING EQUIPMENT / EMERGENCIES

Damages to metering equipment:

In case metering equipment is damaged and no reliable readings can be recorded the project entity will estimate net supply by the proposed project activity according to the following procedure:

1. **In case metering equipment operated by project entity is damaged only:**
   The metering data logged by the grid company, evidenced by sales receipts will be used as record of net power supplied to the grid for the days for which no record could be recorded.
2. **In case both metering equipment operated by project entity and grid company is damaged:**
   The project entity and the grid company will jointly calculate a conservative estimate of power supplied to the grid. A statement will be prepared indicating
   ► the background to the damage to metering equipment
   ► the assumptions used to estimate net supply to the grid for the days for which no record could be recorded
   ► the estimation of power supplied to the grid
   The statement will be signed by both a representative of the project entity as well as a representative of the grid company.

The project entity will furthermore document all efforts taken to restore normal monitoring procedures.

Emergencies:

In case of emergencies, the project entity will not claim emission reductions due to the project activity for the duration of the emergency. The project entity will follow the following procedure for declaring the emergency period to be over:

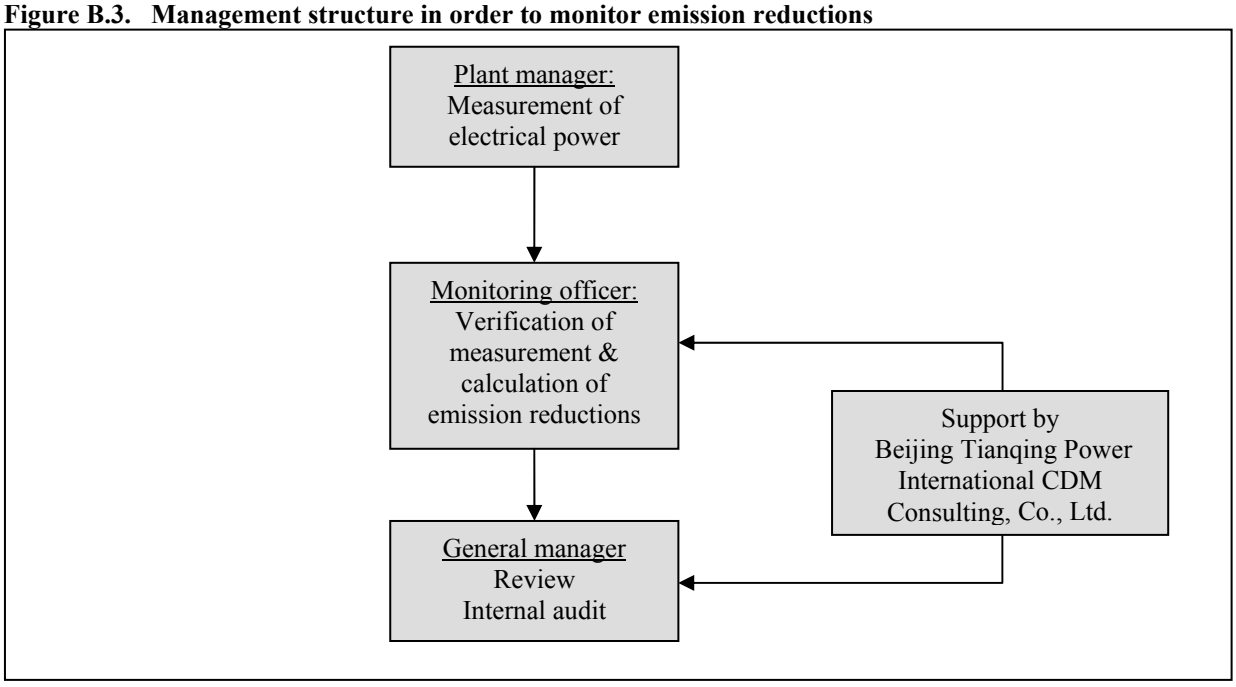
1. The project entity will ensure that all requirements for monitoring of emission reductions have been re-established.
2. The monitoring officer and the head of operations of the hydropower station will both sign a statement declaring the emergency situation to have ended and normal operations to have resumed.

OPERATIONAL AND MANAGEMENT STRUCTURE FOR MONITORING

The monitoring of the emission reductions will be carried out according to the scheme shown in Figure B.3. The General Manager will hold the overall responsibility for the monitoring process, but as indicated below parts of the process are delegated. The first step is the measurement of the electrical energy supplied to the grid and reporting of daily operations, which will be carried out by the plant manager.

The project entity will appoint a monitoring officer who will be responsible for verification of the measurement, collection of sales receipts, collection of billing receipts of the power supplied by the grid to the hydropower plant, and the calculation of the emissions reductions. The monitoring officer will prepare operational reports of the project activity, recording the daily operation of the hydropower station including operating periods, power generation, power delivered to the grid, equipment defects, operating hours of the diesel generator, etc. The selection procedure, tasks and responsibilities of the monitoring officer are described in detail in Annex 4. Finally, the monitoring reports will be reviewed by the General Manager of Hubei Xuan'en Dongping Hydropower Co., Ltd.

Figure B.3. Management structure in order to monitor emission reductions



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

Date of completion of the baseline study and monitoring methodology: 03/07/2007

NB. The baseline uses OM and BM emission factors calculated by experts from Tsinghua University in Beijing and published by the Chinese authorities for climate change on the internet.

Name of person determining the baseline study and the monitoring methodology:

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Beijing Tianqing Power International CDM Consulting, Co., Ltd and Caspervandertak Consulting are not project participants.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

15/03/2003 (starting date of construction)

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

30 years 0 months

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

C.2.1. Renewable crediting period

A renewable crediting period will be used.

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

01/02/2008 (or date of registration, whichever is later)

C.2.1.2. Length of the first crediting period:

7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

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

An Environmental Impact Assessment (EIA) was carried out and was approved by the National Environment Protection Bureau on 28 October 2002.[16] A summary of the main findings of the EIA is provided below.

SUMMARY OF ENVIRONMENTAL IMPACT ASSESSMENT

1. Impact on Ambient Air
The main air pollutant due to project construction is dust. However, the impact of this dust on local residents is negligible since the construction area is not located near local residential areas.

2. Impact on Aquatic Environment
The industrial wastewater produced by the project consists mainly of washing water for sand and stone and wastewater for mixing concrete. The washing water will be reused after treatment to achieve zero emissions. The wastewater for mixing concrete will be treated in a rectangular sedimentation tank and discharged after satisfying the standard. The domestic wastewater will be discharged into a biogas generating pit. The biogas generated will be used to heat buildings in order to effectively utilize resources. The slag and waste water produced during biogas generation could be used as fertilizer for peasants. Therefore, no domestic wastewater will be emitted.

3. Impact on Acoustic Environment
The construction area is located in a gorge in a remote mountain area so the noise does not affect local residents. Protective measures will be taken to reduce the impact of noise on construction workers to a minimum.

4. Impact on the Soil and Water Loss
Practical measures will be taken to prevent soil and water loss. The digging area will be backfilled and greened as soon as possible. Furthermore, economical woodland will be planted after earth up for the barren area affected by the construction In addition, the owner will use *Seal Mountain Pass and Foster* at a high altitude to reduce overland flow and prevent water and soil loss.

5. Impact of Land Requisition on Land Utilization and Immigration
A total of 1,059 individuals will be displaced due to the project, including 256 households and 54,008 m^2 of housing area. The project owner will make the best possible use of the reservoir to accelerate economical development of the local area and to ensure that the migrants' quality of life will be

[16] The EIA approval was received relatively early in the development of the project as the project owner preferred to make informed decisions and get approvals as early as possible. The EIA approval should not be considered as a commitment to the implementation of the project from the part of the project owner, but rather as part of initial work and research aiming to assess the feasibility of the project and to obtain the approvals necessary for the implementation of the project. Table B.5 illustrates that the project entity before the start of construction activities decided to apply for CDM project status in order to make the project attractive as an investment. As described in the additionality section, the proposed project activity encountered significant barriers and CER revenues were crucial for the decision of the project entity to implement the project activity.

improved. The flooded area of the reservoir is 639.7 hm^2 and the project owner will compensate the affected people according to national compensation standards.

6. Impact on ecosystem

Although there is a precious kind of wood (old Nan-wood) present in the migration area, the migration will not directly affect this wood.

Macaque is the main protected animal of the Gongshuihe provincial nature preservation zone. The macaque preservation area is 10km from the construction area. Therefore, the construction of the hydropower station has no negative impact on the macaque's habitat. Furthermore, because the surrounding mountains will attenuate the noise, machinery and blasting noise will not disturb the macaque's life.

There is no migrating fish such as eel, grass carp, herring, and bighead, therefore the project will not have a negative impact on migrating fish.

Concluding comment

In conclusion, the project will have some minor negative impacts on the environment. This impact is limited, since measures will be employed to reduce the negative impacts and most negative impacts are temporary. On the contrary, it is beneficial to encourage the local resident to *Substitute Electricity for Fuel,* protecting the ecological environment, reducing Greenhouse Gas emission, and reducing water and soil loss. From the perspective of saving coal resources and reducing air pollution, the construction of the project will bring environmental benefits that exceed the negative environmental impacts.

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

The environmental impacts of the project are not considered significant by the Chinese government and the project participants. The Environmental Impact Assessment Form (EIA) was approved by the National Environment Protection Bureau on 28 October 2002.

SECTION E. Stakeholders' comments

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

A special stakeholder consultation meeting for the project relating to CDM was organized from 08:00 to 12.00 on December 27th, 2006 on the 4th floor meeting room of Zhangyadong Dongping Corperation in Xuan'en County, Hubei Province, China, to collect opinions of all the potential stakeholders, such as local residents and so on. The aim of this meeting was to collect opinions concerning the influence the project would have on the local society, economy, and daily life.
To ensure all potential stakeholders received the information concerning the meeting, the project owner published a bulletin for the stakeholders' meeting on the public announcement board of the affected County, and made an announcement via a website www.tqcdmchina.com. Furthermore, questionnaires were distributed to residents who may be impacted by the project and 50 investigation questionnaires have been returned. At the meeting, the project owner and consultant invited the participants to comment and express their concerns concerning the project and CDM. The representatives asked the following questions:

1. Whether the construction of the project is good?
2. Did the project bring noise and other environmental impacts during construction period? And were measures taken during construction adequate?
3. How far is the project located away from the nearest local resident?
4. How do local residents earn a living? Did construction of the project have a positive impact on the local residents' incomes? If increase, how did incomes increase?
5. Whether the local government and local residents support the project?
6. What was the project site used for before the construction of the project?
7. Whether the local residents have additional questions, such as tilled land reduction? And if yes, have they been resolved? Does the compensation comply with national policies and regulations?
8. How much residents migrated? Are the migrants satisfied with the allocation and compensation?
9. Will the project impact cultural relics and historic sites?
10. Will the project have a negative impact on the local ecological environment, such as local animals, fish, and plants?
11. Did the project flood the local mine resource?
12. Do you approve of CDM and do you support the construction of the project?

E.2. Summary of the comments received:

Some residents who might be impacted by the project were asked to fill in investigation questionnaires. Of these questionnaires, a total of 50 were returned, all by individuals over twenty years old. 20% of them were women and 70% of them were senior high school graduates or lower educated. We obtained the following results:

- 70% of the investigated residents think Xuan'en County has an electricity shortage, of which 20% think that the electricity shortage is serious.
- 60% of the investigated residents use firewood for heating and cooking, and others use methane for heating and cooking.

- 100% of the investigated residents think the hydropower station will bring benefits to their lives and will not have a negative impact on their lives.
- 80% of the investigated residents think the construction of the project will not have a negative impact on local environment. The others, who think the project does impact the environment, think the project owner has taken the necessary environmental measures to solve the problems.
- 100% of the investigated residents agree with the construction of the project.

The main opinions articulated during the stakeholder meeting and in the questionnaires are the following:
With the exception of the residents who will migrate, the hydropower station is far away from residential areas, so the project will have little negative impacts on local residents. The migrants will be compensated according to national standards and are satisfied with the compensation. The project's environmental impact is very small due to effective measures taken.
On the contrary, the project will provide electricity for consumption and production, accelerate the development of local agriculture, and improve aquatic industries and tourism. The project will also increase local employment opportunities and incomes and improve the quality of life for local residents. Housing condition and standards of living for migrants will be improved. The new reservoir will improve humidity and irrigation, promoting the ecological environment.
All stakeholders were pleased with the development of the CDM project and support the construction of the station because the project will facilitate the development of the local economy and increase incomes and the quality of life for local residents.

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

Given the generally positive (or neutral) nature of the comments received, no action has been taken to address the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

The Project Entity:

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex I countries available to the proposed project. The World Bank loan for this specific project is a commercial loan, therefore, it does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of Annex I countries.

Annex 3

BASELINE INFORMATION

The baseline uses OM and BM emission factors published by the office of national coordination committee on climate change on the Internet. Full information can be found at:
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2006/20061215144550669.pdf : calculation result of the baseline emission factor of Chinese power grid.
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2006/20061215144641643.xls : calculation process of the baseline OM emission factor of Chinese power grid
http://cdm.ccchina.gov.cn/WebSite/CDM/UpFile/2006/20061215144747182.pdf : calculation process of the baseline BM emission factor of Chinese power grid

Below we provide the main data used in the calculation of the baseline emission factor as well as the calculation process.

Table A1. Calculation of the Combined Margin Emission Factor

	Emission factor A	Value and Source B	Weight C	Weighted value D = B * C
1	EF_{OM}	1.25259	0.5	0.62630
		Table A2		
2	EF_{BM}	0.63639	0.5	0.31819
		Table A10c		
3	CM			0.94449
				D1 + D2

Note that our calculated combined margin emission factor is higher than the combined margin emission factor that can be calculated on the basis of the published Operating Margin and Build Margin emission factor. The reason for the difference is that the data published in the files above contain some data that cannot be found in public sources. We recalculated the emission factors on the basis of information that is available in publicly available statistical sources but using exactly the same methodology, yielding a slightly higher combined margin emission factor. In the calculations of the main text of the PDD we have used the published Operating Margin emission factor and build margin emission factor. This is conservative.

Table A2. Calculation of the Operating Margin Emission Factor

	Variable	2002 A	2003 B	2004 C	Total D
1	Supply of thermal power to Central China grid (MWh)	183,733,385	225,987,719	249,074,186	658,795,290
		Table A3c, C7	Table A3b, C7	Table A3a, C7	D1 = A1 + B1 + C1
2	Imports of power from other grids (MWh)	0	0	0	0
		Files cited above	Files cited above	Files cited above	D2 = A2 + B2 + C2
3	Total power supply for calculation EF_{OM} (MWh)	183,733,385	225,987,719	249,074,186	658,795,290
		A3 = A1 + A2	B3 = B1 + B2	C3 = C1 + C2	D3 = D1 + D2
4	CO2 emissions associated with thermal power generation on Central China grid (tCO2)	215,083,238	270,902,650	339,216,283	825,202,170
		Table A4c, E	Table A4b, E	Table A4a, E	D4 = A4 + B4 + C4
5	CO2 emissions associated	0	0	0	0

	with power imports from other grids (tCO2)	NA	NA	NA	D5 = A5 + B5 + C5
6	Total CO2 emissions for calculation EF_{OM} (tCO2)	215,083,238	270,902,650	339,216,283	825,202,170
		A6 = A4 + A5	B6 = B4 + B5	C6 = C4 + C5	D6 = D4 + D5
7	EFOM (tCO2/MWh)	1.17063	1.19875	1.36191	1.25259
		A6 / A3	B6 / B3	C6 / C3	D6 / D3

Table A3a. Calculation of thermal power supply to Central China Grid, 2004

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Jiangxi	30,127,000	7.04	28,006,059
2	Henan	109,352,000	8.19	100,396,071
3	Hubei	43,034,000	6.58	40,202,363
4	Hunan	37,186,000	7.47	34,408,206
5	Chongqing	16,520,000	11.06	14,692,888
6	Sichuan	34,627,000	9.41	31,368,599
7	Central China			249,074,186
				C7 = C1 + C2 + C3 + C4 + C5 + C6

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2005, p. 472-474.

Table A3b. Calculation of thermal power supply to Central China Grid, 2003

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Jiangxi	27,165,000	6.43	25,418,291
2	Henan	95,518,000	7.68	88,182,218
3	Hubei	39,532,000	3.81	38,025,831
4	Hunan	29,501,000	4.58	28,149,854
5	Chongqing	16,341,000	8.97	14,875,212
6	Sichuan	32,782,000	4.41	31,336,314
7	Central China			225,987,719
				C7 = C1 + C2 + C3 + C4 + C5 + C6

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2004, p. 670, p. 709.

Table A3c. Calculation of thermal power supply to Central China Grid, 2002

	Grid	Thermal Power generation (MWh) A	Losses (%) B	Thermal power supply (MWh) C = A * (100 - B) / 100
1	Jiangxi	18,648,000	7.67	17,217,698
2	Henan	84,734,000	8.03	77,929,860
3	Hubei	34,301,000	7.73	31,649,533
4	Hunan	20,058,000	7.73	18,507,517
5	Chongqing	14,727,000	10.21	13,223,373
6	Sichuan	27,879,000	9.59	25,205,404
7	Central China			183,733,385
				C7 = C1 + C2 + C3 + C4 + C5 + C6

Source: Files mentioned above. Original data are from China Electric Power Yearbook 2003, p. 591-592.

Table A4a. Calculation of CO2 emissions from fuels for thermal power production, Central China Grid, 2004.

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	CentralChina Grid	NCV (TJ/unit)	Oxidation factor (Fraction)	Carbon coefficient (TC/TJ)	CO2 emissions (tCO2)
								A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	1,863.80	6,948.50	2,510.50	2,197.90	875.5	2,747.90	17,144.10	209.08	0.98	25.8	332,310,753
Clean coal	10^4 Tons	0	2.34	0	0	0	0	2.34	263.44	0.98	25.8	57,150
Other washed coal	10^4 Tons	48.93	104.22	0	0	89.72	0	242.87	83.63	0.98	25.8	1,883,012
Briquettes[17]	10^4 Tons	0	0	0	0.92	0	0	0.92	83.63	0.98	25.8	7,133
Coke	10^4 Tons	0	109.61	0	0	0	0	109.61	284.35	0.98	29.5	3,303,870
Coke oven gas	10^8 m^3	0	0	1.68	0	0.34	0	2.02	1672.6	0.995	13.0	160,244
Other gas	10^8 m^3	0	0	0	0	2.61	0	2.61	522.7	0.995	13.0	64,704
Crude oil	10^4 Tons	0	0.86	0.22	0	0	0	1.08	418.16	0.99	20.0	32,787
Gasoline	10^4 Tons	0	0.06	0	0	0.01	0	0.07	430.7	0.99	18.9	2,068
Diesel	10^4 Tons	0.02	3.86	1.7	1.72	1.14	0	8.44	426.52	0.99	20.2	263,961
Fuel oil	10^4 Tons	1.09	0.19	9.55	1.38	0.48	1.68	14.37	418.16	0.99	21.1	460,244
LPG	10^4 Tons	0	0	0	0	0	0	0.00	501.79	0.995	17.2	0
Refinery gas	10^4 Tons	3.52	2.27	0	0	0	0	5.79	460.55	0.995	18.2	177,060
Natural gas	10^8 m^3	0	0	0	0	0	2.27	2.27	3893.1	0.995	15.3	493,296
Other petroleum products	10^4 Tons	0	0	0	0	0	0	0.00	383.69	0.99	20.0	0
Other coking products	10^4 Tons	0	0	0	0	0	0	0.00	284.35	0.98	25.8	0
Other E (standard coal)	10^4 Tce	0	16.92	0	15.2	20.95	0	53.07	292.7	0.98	0.0	0
Total												339,216,283
												$\Sigma(E_i)$

Data source: Fuel consumption data are from China Energy Statistical Yearbook 2005, p. 254-257, 262-273, 286-293. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors are from the files mentioned above and crosschecked against IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.8; fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.6.

[17] This row is absent in the published emission factors.

Table A4b. Calculation of CO2 emissions from fuels for thermal power production, Central China Grid, 2003.

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Central China Grid	NCV (TJ/unit)	Oxidation factor (Fraction)	Carbon coefficient (TC/TJ)	CO2 emissions (tCO2)
								A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	1,427.41	5,504.94	2,072.44	1,646.47	769.47	2,430.93	13,851.66	209.08	0.98	25.8	268,492,109
Clean coal	10^4 Tons	0	0	0	0	0	0	0.00	263.44	0.98	25.8	0
Other washed coal	10^4 Tons	2.03	39.63	0	0	106.12	0	147.78	83.63	0.98	25.8	1,145,763
Briquettes	10^4 Tons	0	0	0	0	0	0	0.00	83.63	0.98	25.8	0
Coke	10^4 Tons	0	0	0	1.22	0	0	1.22	284.35	0.98	29.5	36,773
Coke oven gas	10^8 m^3	0	0	0.93	0	0	0	0.93	1672.6	0.995	13.0	73,776
Other gas	10^8 m^3	0	0	0	0	0	0	0.00	522.7	0.995	13.0	0
Crude oil	10^4 Tons	0	0.5	0.24	0	0	1.2	1.94	418.16	0.99	20.0	58,895
Gasoline	10^4 Tons	0	0	0	0	0	0	0.00	430.7	0.99	18.9	0
Diesel	10^4 Tons	0.52	2.54	0.69	1.21	0.77	0	5.73	426.52	0.99	20.2	179,206
Fuel oil	10^4 Tons	0.42	0.25	2.17	0.54	0.28	1.2	4.86	418.16	0.99	21.1	155,657
LPG	10^4 Tons	0	0	0	0	0	0	0.00	501.79	0.995	17.2	0
Refinery gas	10^4 Tons	1.76	6.53	0	0.66	0	0	8.95	460.55	0.995	18.2	273,694
Natural gas	10^8 m^3	0	0	0	0	0.04	2.2	2.24	3893.1	0.995	15.3	486,776
Other petroleum products	10^4 Tons	0	0	0	0	0	0	0.00	383.69	0.99	20.0	0
Other coking products	10^4 Tons	0	0	0	0	0	0	0.00	284.35	0.98	25.8	0
Other E (standard coal)	10^4 Tce	0	11.04	0	0	16.2	0	27.24	292.7	0.98	0.0	0
Total												270,902,650
												$\Sigma(E_i)$

Data source: Fuel consumption data are from China Energy Statistical Yearbook 2004, 2004, p. 198-201, 206-217, 230-237. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors are from the files mentioned above and crosschecked against IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.8; fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.6.

Table A4c. Calculation of CO2 emissions from fuels for thermal power production, Central China Grid, 2002.

Fuel	Unit	Jiangxi	Henan	Hubei	Hunan	Chongqing	Sichuan	Central China Grid	NCV (TJ/unit)	Oxidation factor (Fraction)	Carbon coefficient (TC/TJ)	CO2 emissions (tCO2)
								A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	1,062.63	4,679.02	1,710.00	1,113.78	398.57	1,964.32	10,928.32	209.08	0.98	25.8	211,827,874
Clean coal	10^4 Tons	2.72	0	0	0	0	0	2.72	263.44	0.98	25.8	66,431
Other washed coal	10^4 Tons	3.66	26.49	0	0	249.99	0	280.14	83.63	0.98	25.8	2,171,973
Briquettes	10^4 Tons	0	0	0	0	0	0	0.00	83.63	0.98	25.8	0
Coke	10^4 Tons	0	1.15	0	0	0	0	1.15	284.35	0.98	29.5	34,663
Coke oven gas	10^8 m^3	0	0	1.11	0	0	0	1.11	1672.6	0.995	13.0	88,055
Other gas	10^8 m^3	0	2.16	0	0	0	0	2.16	522.7	0.995	13.0	53,548
Crude oil	10^4 Tons	0	0.67	1.17	0	0	0.81	2.65	418.16	0.99	20.0	80,450
Gasoline	10^4 Tons	0	0	0	0	0	0	0.00	430.7	0.99	18.9	0
Diesel	10^4 Tons	1	1.34	1.08	2.19	0.51	0.51	6.63	426.52	0.99	20.2	207,353
Fuel oil	10^4 Tons	0.33	0.16	0.34	0.69	0	1.51	3.03	418.16	0.99	21.1	97,045
LPG	10^4 Tons	0	0.02	0	0	0	0	0.02	501.79	0.995	17.2	630
Refinery gas[18]	10^4 Tons	0.49	0	0	1.96	0	0	2.45	460.55	0.995	18.2	74,922
Natural gas	10^8 m^3	0	0	0	0	0	1.75	1.75	3893.1	0.995	15.3	380,294
Other petroleum products	10^4 Tons	0	0	0	0	0	0	0.00	383.69	0.99	20.0	0
Other coking products	10^4 Tons	0	0	0	0	0	0	0.00	284.35	0.98	25.8	0
Other E (standard coal)	10^4 Tce	0	3.38	0	0	0	0	3.38	292.7	0.98	0.0	0
Total												215,083,238
												$\Sigma(E_i)$

Data source: Fuel consumption data are from China Energy Statistical Yearbook 2000-2002, p. 320-323, 344-347, 356-359, 368-371, 412-415, 424-427. Net calorific values are from the files mentioned above and crosschecked against China Energy Statistical Yearbook, 2004 p. 302; Oxidation factors are from the files mentioned above and crosschecked against IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.8; fuel emission coefficients are from the files mentioned above and crosschecked against IPCC default values, see Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Workbook, p. 1.6.

[18] The published emission factor uses 1.9 for Henan. Our number is consistent with China Energy Statistical Yearbook.

Table A5. Calculation of the BM Emission Factor, Central China Grid

$EF_{thermal}$ (tCO2/MWh)	Share of thermal power in added capacity, 2004-2001	EF_{BM} (tCO2/MWh)
A	B	C = A * B
0.91167	69.80%	0.63639
Table A6	Table A9	

Table A6. Calculation of EF thermal

		λ A	EF_{adv} B	$EF_{thermal}$ calculation C = A * B
1	Coal	99.51%	0.91363	0.90917
		Table A8	Table A7	
2	Gas	0.26%	0.43809	0.00116
		Table A8	Table A7	
3	Oil	0.22%	0.60112	0.00135
		Table A8	Table A7	
4	$EF_{thermal}$			0.91167

Table A7. Calculation of Emission factors of fuel using advanced technologies

Fuel	Efficiency (%) A	Carbon coefficient (tc/TJ) B	Oxidation factor C	EF_{adv} (tCO2/MWh) D=(3.6/(A*1000))*B*C*44/12
Coal	36.53%	25.8	0.98	0.9136
Gas	45.87%	15.3	0.995	0.4381
Oil	45.87%	21.1	0.99	0.6011

Source: Files downloaded and mentioned above.

Table A8. Calculation of λs for the calculation of the BM, Central China Grid.[19]

Fuel	Unit	Central China Grid	NCV (TJ/unit)	Oxidation factor (Fraction)	Carbon coefficient (TC/TJ)	CO2 emissions (tCO2)
		A	B	C	D	E = A*B*C*D*44/12
Raw coal	10^4 Tons	17144.1	209.08	0.98	25.8	332,310,753
Clean coal	10^4 Tons	2.34	263.44	0.98	25.8	57,150
Other washed coal	10^4 Tons	242.87	83.63	0.98	25.8	1,883,012
Briquettes	10^4 Tons	0.92	83.63	0.98	25.8	7,133
Coke	10^4 Tons	109.61	284.35	0.98	29.5	3,303,870
Other coking products	10^4 Tons	0	284.35	0.98	25.8	0
Coal, total						***337,561,918***
Coke oven gas	10^8 m^3	2.02	1672.6	0.995	13	160,244
Other gas	10^8 m^3	2.61	522.7	0.995	13	64,704
LPG	10^4 Tons	0	501.79	0.995	17.2	0
Refinery gas	10^4 Tons	5.79	460.55	0.995	18.2	177,060
Natural gas	10^8 m^3	2.27	3893.1	0.995	15.3	493,296
Gas total						***895,304***
Crude oil	10^4 Tons	1.08	418.16	0.99	20	32,787
Gasoline	10^4 Tons	0.07	430.7	0.99	18.9	2,068
Diesel	10^4 Tons	8.44	426.52	0.99	20.2	263,961
Fuel oil	10^4 Tons	14.37	418.16	0.99	21.1	460,244

[19] Data are from Table A4a. As noted in a footnote attached to that table, there are some differences between the data in this table and those used in the calculation of the published emission factors.

Other petroleum products	10^4 Tons	0	383.69	0.99	20	0
Oil total						***759,061***
Total						***339,216,283***
						$\Sigma(E_i)$

Λcoal	99.51%
Λgas	0.26%
Λoil	0.22%

Note that λ is calculated as the share of coal, gas respectively oil in total CO2 emissions.

Table A9. Calculation of the share of thermal power in recently added capacity

Installed capacity	**2000** **A**	**2001** **B**	**2004** **C**	**Capacity added in 2000-2004** **D=C-A**	**Share in added capacity**
Thermal (MW)	39864.6	42569.2	53744.7	13880.1	69.80%
Hydropower (MW)	28637.8	30397	34642	6004.2	30.20%
Nuclear (MW)	0	0	0	0	0.00%
Other (MW)	0	0	0	0	0.00%
Total (MW)	68502.4	72966.2	88386.7	19884.3	100.00%
Percentage of 2004 capacity	77.50%	82.55%	100%		

Source: China Electric Power Yearbook 2005, p. 472-474; China Electric Power Yearbook 2004, p. 670, p.709; China Electric Power Yearbook 2003, p. 591-592.

Annex 4

MONITORING INFORMATION

Selection procedure:
The monitoring officer will be appointed by the general manager of Hubei Xuan'en Dongping Hydropower Co., Ltd. The monitoring officer will be selected from among the senior technical or managerial staff. Before he/she commences monitoring duties, he/she will receive training on monitoring requirements and procedures by Beijing Tianqing Power International CDM Consulting, Co., Ltd.

The selection of the initial monitoring officer has taken place and the following person was appointed:
Name: Mr Wu Xuefeng
Position: Product administrator

Tasks and responsibilities:
The monitoring officer will be responsible for carrying out the following tasks

- **Supervise and verify metering and recording:**
  The monitoring officer will coordinate with the plant manager to ensure and verify adequate metering and recording of data, including power delivered to the grid.
- **Collection of additional data, sales / billing receipts:**
  The monitoring officer will collect sales receipts for power delivered to the grid, billing receipts for power delivered by the grid to the hydropower station and additional data such as the daily operational reports of the hydropower station.
- **Calibration:**
  The monitoring officer will coordinate with staff of the project entity to ensure that calibration of the metering instruments is carried out periodically in accordance with regulations of the grid company.
- **Calculation of emission reductions:**
  The monitoring officer will calculate the annual emission reductions on the basis of net power supply to the grid. The monitoring officer will be provided with a calculation template in electronic form by the project's CDM advisors.
- **Preparation of monitoring report:**
  The monitoring officer will annually prepare a monitoring report which will include among others a summary of daily operations, metering values of power supplied to and received from the grid, copies of sales/billing receipts, a report on calibration and a calculation of emission reductions.

Support:
The monitoring officer will receive support from Beijing Tianqing Power International CDM Consulting, Co., Ltd. in his/her responsibilities through the following actions:

- Initial training on CDM, monitoring methodology, monitoring procedures and requirements and archiving
- Provide the monitoring officer with a calculation template in electronic form for calculation of annual emission reductions
- Continuous advice to the monitoring officer on a need basis
- Review of monitoring reports