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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>
-China Xiaogushan Hydropower Project.
-Version 2 of the PDD
- February 10, 2006.

A.2. Description of the project activity:

>>
The Xiaogushan Hydropower Project ("XHP" or the "Project") is a run-of-river hydro project consist of a diversion weir, an intake power tunnel (9.1 km), water fall of 117 m, a powerhouse, line a 110 kV high voltage switchyard and 27 km of 110 kV transmission lines. It is located on the Heihe River in the Sunan Yugu Autonomous County of Zhangye City, Gansu province, China. The original engineering design proposed the project has an installed capacity of 98MW with expected output of 380 gigawatt-hours per year and a net supply of 357 gigawatt-hours per year to Gansu grid in long-term average.[1] Based on refined study on hydrological conditions of the river, the XHP company upgraded the generation capacity to 102 MW, resulting in an increased output of 394 gigawatt-hours per year, and a net supply of 370 gigawatt-hours per year to the Gansu grid in long-term average terms.

The 102 MW Project will provide additional capacity to the interconnected Gansu Power Grid, which is part of the Northwest Power Network in China. XHP will be supplying reliable power to the Zhang Ye prefecture, which the current capacity is only 94.5MW thus heavily depends on daily import from the Gansu Power Grid. The XHP transmission lines, in addition to going to the Gansu Power Grid, will connect the nearby townships and villages in a highly impoverished area dominated (98%) by the Zang (Tibetan) minority.

The XHP will reduce 3,128,919 tons CO2 equivalent of anthropogenic emissions of greenhouse gases (GHGs) by avoiding operation of existing thermal power plant and future capacity expansion of fossil fuel-based generation by the regional Gansu Power Grid in Northwest China. The privately owned hydropower plant will sell electricity to the grid as well as supplying reliable power to nearby villages. The proposed XHP project is considered under the CDM modalities as a renewable energy project.

The XHP is one of China's first proposed CDM activities given its combination of positive environmental, economic, and sustainable development benefits. Given this combination of socio-economic and environmental benefits, the Xiaogushan Hydropower Project is the first-ever renewable energy power loan provided for the Northwest region of China from the Asian Development Bank (ADB). In terms of environmental and power benefits, the Project supports China's policy of harnessing zero-impact renewable energy resources and avoiding investment in high-GHG emission coal power plants.

In addition to the power expansion attributes, the project also includes vital poverty reduction benefits. Zhangye City is one of the province's poorest areas, with Gansu being the second poorest province in China. The Zang, who inhabit the general region around the project, have an average poverty level of

[1] Source: Xiaogushan Preliminary Engineering Design, Page 10, The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute

94% and a total 2001 population of over 1,150 people. The specific sustainable development benefits of the project include:

- Supply of reliable, zero-emitting renewable energy to the provincial grid
- Increased energy and decreased load-shedding for several nearby poor villages that will allow expansion of villagers' household, educational, health, and public facilities
- Promotion of private power development managed by local entrepreneurs
- Local income, new skills and job generation (3,000 jobs during the construction period and 100 permanent staff positions during operation)
- Improved access roads that will foster better transport routes for the villagers for the marketing of local goods throughout the year rather than seasonally
- Energy efficiency enhancements in the nearby areas

These social, economic and environmental benefits underscore the important sustainable benefits of this proposed CDM activity to the country and region.

A.3. Project participants:

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The following organizations and individuals make up the primary project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Peoples' Republic of China (host)	Private entity A: Xiaogushan Hydropower Co. Ltd.	No
Netherlands	International Bank for Reconstruction and Development (public entity) as trustee of The Prototype Carbon Fund	Yes

Xiaogushan Hydropower Co. Ltd. (XHC) is registered as a limited liability company, which is jointly funded by Gansu Heihe Hydropower Development Shareholding Co. Ltd. (HHDC), Zhangye Municipal Water & Power Bureau and the Gansu Silver Dragon Construction Company Limited. It is the sole developer, operator, and shareholder of The Project.

The Prototype Carbon Fund
The Prototype Carbon Fund (PCF) is the World Bank's first carbon fund. The PCF was created as a response to the need to understand and test the procedures for creating a market in project-based emission reductions under the Kyoto Protocol's flexible mechanisms. The PCF has played a pioneering role in developing the market for greenhouse gas emission reductions, while promoting sustainable development, and offering a learning-by-doing opportunity to its stakeholders; it has paved the way for the additional carbon funds established by the World Bank. Operational since April 2000, the Prototype Carbon Fund functions as an innovative public/private partnership – up to date the partnership is between 17 companies

and 6 governments - aimed at mitigating climate change. The PCF's mission is to pioneer the market for project-based greenhouse gas ERs.

The PCF pilots production of ERs within the framework of the JI and the CDM. The PCF invests contributions made by companies and governments in projects designed to produce ERs fully consistent with the Kyoto Protocol and the emerging framework for JI and the CDM. Contributors, or "Participants" in the PCF, receive a pro rata share of the Emission Reductions, verified and certified in accordance with agreements reached with the respective countries "hosting" the projects.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>

People's Republic of China

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

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Gansu Province

A.4.1.3. City/Town/Community etc:

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Sunan Yugu Autonomous County of Zhangye City, Gansu Province, China.

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

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The map below shows the location of the regional power grids and the proposed project area. The project is located in the Gansu's northwest "panhandle", about 600 Km from the provincial capital of Lanzhou. It is in the northwest corner of the province in the Xishui township, near Zhangye City. The Xishui township covers a large area of 894 sq km but is sparsely populated because of the harsh natural conditions. The site is in a highly mountainous, barren region with little vegetation due to the high elevation (1,500-5,000 m). The proposed site of the project's diversion weir is on the Heihe River, with all of its tunnel and dits, dumpsites, surge towers, powerhouse and transmission yard, and road widening improvements within the Xishui Tibetan Autonomous Township. Itinerant herdsmen populate the surrounding area during the summer months on the communal lands nearby the site.

Diagram A.1 Xiaogushan Hydropower Project (XHP), NWP Network and Gansu Grid

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

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The Project falls into:
Sectoral Scope Number: Energy industries (renewable - / non-renewable sources)
Project Activity: Grid-connected renewable power generation; electricity capacity addition from a run-of-river hydro power project with reservoir whose storage capacity is 1.3 million cubit meters but there is no methane generation from submerged biomass due to local sparse vegetation and China's regulation to clear the biomass before inundating the reservoir.

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

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The project consists of :

- a 102 MW run-of-river hydropower plant,
- construction of an intermediate substation,
- extension of a 110kV transmission lines up to the Gansu's Zhangye 110/330kV substation,
- building an additional 110kV line to surrounding villages to supply them with more reliable power, and
- expansion of the Zhangye substation to eventually accommodate additional lines from the Xiaogushan Hydropower Company (XHC).

The key technical data for the equipment within the project are summarised in the following table.

Summary of key equipment in the project[2]

Parameter	Unit	Amount	Comment
Floodgate length	m	2061,5	
Floodgate height	m	26,5	
Maximum length of construction for stored water	m	93,7	
Floodgate size	m	8 x 8	
Designed Flood discharge capacity	m^3/s	1750	
Proven flood discharge capacity	m^3/s	2960	
Size of main station building	m	55×18×35.65	Length x Width x Height
Size of substation	m	43.7×18×16.5	Length x Width x Height
Size of Transformer station	m	65 x 58	Length x Width
Large Turbine Capacity	MW	41,67	2 x Turbines with number HL180－LJ－208 (375 r/min)
Small Turbine capacity	MW	22.92	1 x turbine with number HL180－LJ－154 (500 r/min)

The project will be located on the Heihe river. The general hydrology of the Heihe river is measured at the Yingluoxia Hydrographic Station and is summarised in annual hydrology reports kept by the

[2] Source: Xiaogushan Preliminary Engineering Design, Page 14 and Page 18, The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute

Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute. A summary of the hydrology is presented in the following table:

Summary of Heihe River Hydrology[3]

Parameter	Unit	Amount	Comment
River basin/Watershed	km^2	69 000	
Engineering works	km^2	9 427.8	
Annual Hydrological Report	Annual	57	Published between 1944 – 2000
River Flow			
Average water flow	m^3/s	47.7	Average = 50%
Greatest recent water flow	m^3/s	1310	1996
Greatest ever recorded water flow	m^3/s	2300	1919 (record pre-dates annual hydrological report)
Greatest flood	100 million m^3	0.73	
Silt			
Average yearly suspended solid silt discharge	Wan (i.e. 10 000) tons	221	
Average yearly silt discharge content	kg/ m^3	1.4	
Highest recorded silt discharge content	kg/ m^3	140	

The hydropower plant shall have an installed capacity of 102 (2 units x40 MW + 1 unit x22MW) MW. Annual generation is expected to be approximately 396 million kWh of clean power over an expected operational lifetime of 30 years. Since some of the power will be used by the XHP and some power will be used for plant operation and lost in transmission, total available electricity for sale to the Gansu Power Grid is estimated to be about 370 million kWh[4]. Based on the preliminary design, the hydropower plant project the components include:

- Diversion weir with an active storage capacity of 1.3 million cubic meters (m^3)
- Intake power tunnel (9,100 m) with intake flow of 105.5 (m^3/s), providing a rated water head of 117 m
- Surface power station at Xishuigou for three units 2 units of hydro turbine (SF40000—16/4600, each with 40 MW of generation capacity), and one unit of hydro turbine (SF22000—12/3350

[3] Source: Xiaogushan Preliminary Engineering Design, Page 4 and Page 11, The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute

[4] Source: Xiaogushan Preliminary Engineering Design, Page 40, The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute

with 22 MW of generation capacity) and a 110 kV high voltage switchyard and 27 km of 110 kV transmission lines[5]

The diversion weir will increase the water level by about 20m at the diversion weir site. The reservoir extends about 800 m upstream of the diversion structure site. The reservoir will inundate only 18 hectares of the riverbanks. The capacity of the diversion weir is very small and stores a minimal amount of water compared with daily average water flow of 4 million m^3 in the Heihe River. The small reservoir is necessary to ensure that the intake pipe is submerged.

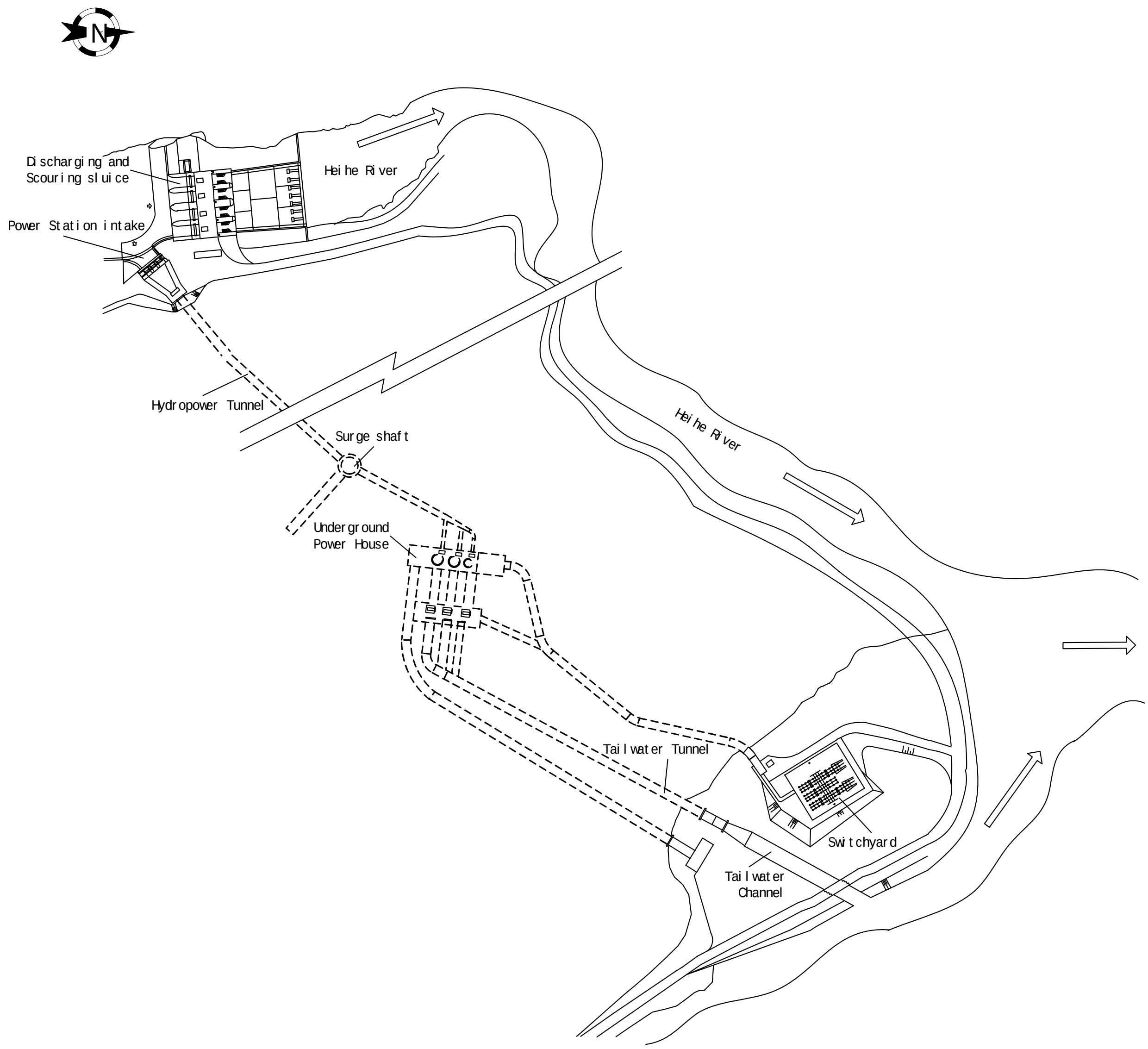
Technical details of the wier are described in the following table which is followed by a schematic of the project:

Technical Summary of the Wier[6]

Parameter	**Unit**	**Amount**	**Comment**
Wier			
Normal water storage level	m	2060	
Dead water level	m	2049	
Normal water table area	km^2	0.22	
Backwater length	km	3,055	
Total Capacity	Million $m^{3)}$	1.30	

[5] Source: Xiaogushan Preliminary Engineering Design, Page 27, The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute

[6] Source: Xiaogushan Preliminary Engineering Design, Page 9, The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute



Schematic View of Xiaogushan run-of-river power plant

With hardly any trees and shrubs on the riverside mountains along the river section, grass vegetation covers only 15% of the project area. Most of the river bank slope to be submerged is bare, and there is scarce vegetation and few shrubs. As a result of the barren ecological system, the biomass to be submerged by the reservoir will be minimal. Clearing the reservoir area and approval by relevant Government authorities is one of the mandatory procedures that the project developer must follow before reservoir impoundment. Since there is limited vegetation and shrubbery and the reservoir area will be cleared, it is assumed that the potential methane emission is negligible. The monitoring of leakage in terms of emissions from the reservoir are therefore excluded from the baseline calculation.

The Gansu Province Water Conservancy & Hydraulic Power Survey Design Institute has collected detailed monthly flow data for the project site over the full period from 1944 to 2000 on which the technological power system designs were made upon and approved by the relative financing agencies. It is not expected that the technology to be used will result in any adverse environmental impacts given the run-of-river design and lack of vegetation in the region.[7] The ADB and World Bank required independent environmental assessments also agreed with these conclusions.

Extensive initial training for all relevant staff involved in the project has been conducted in Xiaogushan company following ADB's recommendation to strengthen its management capacity in the areas of financial management, project execution, environmental monitoring, and project management, procurement and contract administration.[8] 29 person-months of International consultants have been hired to supervise the civil works, installation, environmental monitoring, financial management, and institutional strengthening.

Additionally the Quality Assurance Group is to be established, which will be responsible for running suitable quality assurance systems and procedures in all operations of XHC, including the provision of training to staff on the quality assurance system and the relevant procedures. The Quality Assurance Group will also be responsible for liaising with external agencies to develop XHC operations to relevant ISO qualifications

The maintenance of the Hydro Project is described in section D. 4 and is therefore not repeated here.

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

>>

The Project is a non-GHG emitting technology. In the absence of the project, the Gansu grid network would rely on operation and expansion of coal-based electricity generation. Hence, XHP will reduce anthropogenic GHG emission reductions due to the avoidance of higher GHG emissions from coal-fired thermal power generation by the regional grid. No additional emissions from project construction and

[7] Source: <<Measures to Clear Up Inundated Area of Reservoir>>, November 19, 1986, the Ministry of Water Resources

[8] Source: ADB TA No. 3730 – PRC: Gansu Hydropower Project Final Report (May 2003, Section 10, SMEC INTERNATIONAL PTY LTD, AUSTRALIA

operation are being considered in the analysis as these emissions would be comparable to, if not lower than, the emissions from investment in the "without the Project" expansion alternative.

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

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The Project is estimated to reduce 312,891 tCO_2e annually, generating an expected total of approximately over 3,128,919 tCO_2e for the duration of the 10-year crediting period.

Year	Annual estimation of emission reductions in tonnes of CO2e
2006	255,422
2007	319,277
2008	319,277
2009	319,277
2010	319,277
2011	319,277
2012	319,277
2013	319,277
2014	319,277
2015	319,277
Total estimated reductions	3,128,919
Total Number of crediting years	10
Annual Average over the crediting period of estimate reductions (tonnes of CO_2e)	312,891

A.4.5. Public funding of the project activity:

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The foreign portion of the underlying financing for this project is provided by the Asian Development Bank, however, this finance is not part of an international Official Development Assistance (ODA) effort.

SECTION B. Application of a baseline methodology

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

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Approved consolidated baseline methodology ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources ("The Methodology")

The Methodology will be used in conjunction with the approved monitoring methodology ACM0002 ("The Monitoring Methodology")

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

>>
The Project is a grid-connected zero-emission renewable power generation activity and meets all the conditions stated in The Methodology (ACM0002). These conditions are:

- The Project is a run-of-river hydro power plant
- The Project is not an activity that involves switching from fossil fuels to renewable energy at the Project site
- The geographic and system boundaries for the Gansu Power Grid is clearly identified and information on the characteristics of this grid at aggregate level is available.

Justification for the use of the simple OM option within ACM0002 is provided in section B.2 below.

B.2. Description of how the methodology is applied in the context of the project activity:

>>
The GHG emission reductions generated by the proposed project were calculated according to the approved methodologyACM0002.

The baseline scenario, selected using the Tool for additionality, is the continued operation of existing grid connected power plants and future expansion of thermal power power plants that would be used to generate increased demand in the absence of the XHP project. Because the project uses renewable sources to produce electricity, there are no additional emissions from the project activity. Therefore the emission reductions are created by the displaced fossil fuel generation.

Hence, the baseline scenario is that electricity would have been generated by the operation of grid-connected thermal power plants and by the addition of new fossil fuel based generating sources. Following The Methodology, the baseline emission factor is calculated as a combined margin (CM) consisting of the simple average of the operating margin emission factor (OM) and the build margin emission factor (BM) by utilizing an *ex-ante* 3 (three) years data vintage for the Gansu Power Grid. All margins are expressed in tCO_2/MWh.

CM= 0.5*OM + 0.5*BM

In accordance with The Methodology, the combined margin is deemed to represent the tCO_2/MWh that would have been emitted in the absence of the Project. Emissions reductions will be claimed based on the total CO_2 emissions mitigated by the Project, following the 4 steps described below.

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

Step 1 – Calculation of the Operating Margin Emission Factor

Out of four options for the OM, the Simple Operating Margin Emission Factor (S-OM) was chosen for the following two reasons.

1. Detailed hour dispatch data is not available. In China, the China Grid Power Company run the dispatch center and do not make this information available to the public.

2. From historical data that are public available, the ratio of electricity generated by hydro power plants against the total electricity generated in the Gansu grid has been declining over the past five years: 45%, 42%, 37%, 31%, and 25% for,1999, 2000, 2001, 2002, and 2003[9] And this trend will continue as more coal-fired power plants will be constructed and commissioned as indicated in the system expansion plan. Therefore using the average of the five most recent years it can be shown that low-cost/must run hydro resources constitute less than 50% of total grid generation in the Gansu grid.

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

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

the simple OM has been used.

Simple OM. The Simple OM Emission Factor (EF-OM,y) is calculated as the generation-weighted average emissions per electricity unit (tCO2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

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

where

Fi, j, y is the total amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y, j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.

COEFi,j y is the CO2 emission coefficient of fuel i (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and GENj,y is the electricity (MWh) delivered to the grid by source j.

The CO2 emission coefficient COEFi is obtained as

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

where:

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[9] Source: Page 617, China Electric Power Yearbook 2002, Page593, China Electric Power Year Book 2003, Page 709, China Electric Power Year Book 2004, China Electric Power Yearbook Compilation Committee, Yearbooks are available from the China Electric Power Press (www.cepp.com.cn) – Beijing, No 6 SanLiHe Road, 100044, Tel:：(010) 68358031-326

NCVi is the net calorific value (energy content) per mass or volume unit of a fuel i, OXIDi is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values), $EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel i.

In this PDD, NCV_i for different fuels i were taken from China Energy Statistical Yearbook 2004 and 2000-2002. $EF_{CO2,coal}$ use the country-specific values defined as 24.74tC/TJ.[10] $EF_{CO2,i}$ for other fuels . Fraction of Carbon Oxidised for coal is 0.98, a default value set by IPCC Good Practice Guidance.

The Simple OM Emission Factor ($EF_{OM, Simple, y}$) of the proposed project is calculated based on the electricity generation mix of the Gansu Power Grid, not including low operating cost/must run power plants, such as wind power, hydropower etc. It is calculated as a 3-year average, based on the most recent statistics available at the time of PDD submission. The data on installed capacity and electricity generation of different power generation sources are taken from the *China Electric Power Yearbook* (2002, 2003, 2004 editions). The data on different fuel consumptions for power generation in the Gansu Power Grid are taken from the *Energy Balance Table of Gansu province* (Year 2001 to year 2003) from the *China Energy Statistical Yearbook* (2000-2002 edition and 2003 edition).[11]

In China, the power plant efficiency indicator is the Electricity Generation Coal Consumption (EGCC), and Electricity Supply Coal Consumption (ESCC), the amount of standard coal that needs to be consumed to generate one kwh (g/kwh), and supply one kwh (g/kwh) to the grid. The *China Electric Power Yearbook* aggregates the EGCC and ESCC of all the thermal power plants at the provincial grid level .

Ideally, the emission factor should be based on the electricity supplied to the grid instead of the electricity generated at the plants. Therefore, because the XHP project is replacing electricity excluding low cost/must run power plant in the grid, the basis for the emission reduction calculation should be the electricity delivered directly to the Gansu grid. However, there is no available data that identifies the electricity delivered to the grid in China. The best official data regarding electricity is provided in the *China Electric Power Yearbook*, however it only provides information on total electricity generated at the thermal/hydro plants ($GEN_{thermal, plants}$ and $GEN_{hydro, plants}$). Nevertheless, it is still possible to calculate total electricity delivered to the grid by fuel type with the data available in China by using the following formula:

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

Where
$GEN_{Thermal, Grid\ y}$ is the electricity (Gwh) delivered to the grid by coal-fired thermal power plants in year y
$EGCC_{,y}$ is the average amount of standard coal that needs to be burned to generate one kwh of electricity at the thermal power plants in at the thermal power plants in the Gansu grid.
$ESCC_{,y}$ is the average amount of standard coal that needs to be burned to supply one kwh of electricity at the thermal power plants in at the thermal power plants in the Gansu grid.

[10] Source: China Climate Change Country Study, P57-58

[11] Source: China Energy Statistical Yearbook, China Statistical Bureau and China National Reform and Development Commission, available from the China Electric Power Press (www.cepp.com.cn) – Beijing, No 6 SanLiHe Road, 100044, Tel:：(010) 68358031-326

The data needed for calculating the electricity delivered to the grid are published annually in the China Electric Power Yearbook.

The XHP project is replacing electricity generation sources excluding low cost/must run power plant in the grid. In Gansu grid, all hydro power plants are identified as the low operating cost and must-run power plants and are thus excluded from the total generation when calculating the simple OMEF . Although some thermal power plants might also be considered as low cost must run plants, it is impossible to exclude them from the calculation since there is no available data in China on quantities of electricity generated from thermal-fired power plants. However, their inclusion in the calculation of the OMEF actually improves the conservativeness of the calculations of emission reductions since newly build thermal power plants have higher generation efficiency and therefore have lower emission factors which reduce the overall emission factor. Thus the inclusion of some must run low operating thermal plants in the $EF_{OM, simple, y}$ calculation will result in fewer emission reductions being allocated to the project.

Gansu Power Grid is connected to the Northwest Power Grid in China. Data for imported electricity are not publicly available in Gansu. According to the technical report by the Asian Development Bank based on interview with experts, Gansu grid is almost self-sufficient, it only imported 1010 Gwh from Qinghai Grid in 2001, less than 3% of total electricity generation of year 2001 (29,529 Gwh) in the Gansu grid.[12] Imports from the Qinghai Grid have continued, but no data is available to the project developer in the preparation of this PDD. However, since the Qinghai power grid has a much higher EGCC (413 kg standard coal/kwh, 412 kg standard coal/kwh, 400 kg standard coal/kwh for year 2001, 2002, and 2003) than that of Gansu grid (357 kg standard coal/kwh, 352 kg standard coal/kwh, 351 kg standard coal/kwh for year 2001, 2002, and 2003) the carbon emission factors is higher in Qinghai grid than in Gansu Grid.[13] Thus by excluding consideration of imports from the Qinghai grid, the emission factor is more conservative. Therefore, the lack of data on imports does not impair the quality of the emission factor in this project case, rather it results in a more conservative result.

For estimation purposes and based on these factors and on the operation of the Gansu power system in 2001, 2002, and 2003, the following value for the system emission factor is obtained, using the Simple OM methodology:

	Year 2001	Year 2002	Year 2003	Simple OM
tCO2 / MWh	0.933	0.999	1.013	0.982

Step 2 – Calculation of the Build Margin Emission Factor

According to the Methodology, the BM is defined as the generation-weighted average emission factor of either the 5 most recent or the most recent 20% of power plants built (in generation), whichever group's annual generation is greater. Both lists of plants exclude CDM-Status Plants. In Gansu grid, the 20% of total electricity which was generated from the total installed capacity as of 2003 is 7,468 Gwh.

[12] Source: ADB TA No. 3730 – PRC: Gansu Hydropower Project Final Report (May 2003, Page 9 of Section 9, SMEC INTERNATIONAL PTY LTD, AUSTRALIA

[13] Source: China Electric Power Yearbook, Page 623, Yearbook 2002, Page 592, Yearbook 2003, Page 671, Yearbook 2004,

(37,341*20%). The total generation of the five existing power plants build most recently is 6798 Gwh.[14] As a result, the 20% of total generation was selected as the basis for calculating Build Margin Emission Factor. The ex-ante method is selected to calculate BM for the fix crediting period.

This is done by calculating the share of electricity supply from newly added thermal and hydro power plants whose electricity supply represents 20% of electricity supply in Gansu grid in 2003, times the most conservative estimate of operating margin emission factors for these new thermal power plants and the hydro power plants respectively.

The emission factor of standard coal is calculated using formula (2) and based on IPCC default value.

Key Parameters	Net Calorific Values	Carbon Emission Factors	Fraction of Carbon Oxidised	Conversion Factor	$COEF_{standard\ coal}$
Unit	TJ/10^3 ton	tC/TJ	Fraction	tCO2/tC	tCO2/ton of standard coal
Formula	A	B	C	D	A*B*C*D/1000
	29.28	24.73	0.98	3.67	2.602

As a result, the $COEF_{standard\ coal}$ is 2.602 tCO2/ton of standard coal.

It is conservatively assumed that all of the power plants recently added to the Gansu grid are 600 MW sub-critical power generators which have an ESCC of 328.4kg/Mwh.[15] This value is commonly accepted in the power sector in China. By comparison, the Gansu grid average ESCC from 2001 to 2003 is 386, 377, 376kg/Mwh.[16] The carbon emission factor for the newly build coal-fired power plants is therefore calculated as 0.854 tCO2/Mwh using the following formula:

$$EF_{Coal\text{-}fired\ new\ plants} = ESCC_{Coal\text{-}fired\ new\ plants} * COEF_{standard\ Coal} \quad (4)$$

The following are the key parameters for the calculation of $EF_{Coal\text{-}fired\ new\ plants}$

Key Parameters	Power Plant Efficiency	$COEF_{standard\ coal}$	$EF_{Coal\text{-}fired\ new\ plants}$
Unit	ESCC Kg/Mwh	tCO2/ton of standard coal	tCO2/Mwh
	F	H	F*H/1000
	328.4	2.602	0.854

14 Source: Interview with the Gansu Power Corporation, August 30, 2004

15 Source: Analysis on Energy Saving Condition in China Power Industry, Page 2, Vol. 6. No. 6, Jun 2005, Electrical Equipment.

16 Source: China Electric Power Yearbook, Page 623, Yearbook 2002, Page 592, Yearbook 2003, Page 671, Yearbook 2004,

Because the 98.2% of thermal electricity generation in Gansu grid in 2003 is coal-fired,[17] the difference between the EF of coal and that of other source of fuel is negligible, so it is reasonable to apply the ESCC to all thermal electricity generation. Because $EF_{hydro\ new\ plant}$ is 0, BMEF is effectively equivalent to the weight of thermal electricity in the grid multiplied by $EF_{coal\text{-}fired\ new\ plants.}$ The formula to calculate BMEF can thus be approximated as follows:

$$BMEF = \frac{GEN_{coal\text{-}fired\ new\ plants,\ grid\ \ y} * EF_{coal\text{-}fired\ new\ plants}}{GEN_{new\ plants\ in\ grid\ \ y}} \qquad (5)$$

To determine the share of hydro electricity and thermal electricity supplied by newly added hydro and thermal power plants, two important assumptions are made in this PDD:

1. All capacity additions from the thermal and hydro power plant were added evenly between 2000 to 2003.
2. The newly build thermal/hydro power plants have the same plant operating hours as the existing power plants in there respective groups.

It is believed that the first assumption is reasonable and neutral with regards to its impact of emission factors. The second assumption is conservative because new power plants have higher operating hours thus can make up for higher share of electricity supply to the grid resulting in a higher build margin emission factor. Based on the above two assumptions, this PDD estimated a point of time at which the electricity supplied by the new installed power plant constitute 20% of electricity supply in Gansu grid in 2003.

The share of electricity supplied by newly added thermal power plants is 86.8% of total electricity supply from added new capacity in Gansu power grid in 2003. Detailed calculations can be found in Annex 3, Baseline study. Multiplying this share by the conservatively estimated emission factor for new thermal power plants (0.854tCO2/Mwh), the resulted Build Margin Emission Factor is 0.742 tCO2/Mwh.

Step 3 – Calculation of the Baseline Emission Factor

The Baseline Emission Factor was calculated as a combined margin (CM), consisting of the simple average[18] of both the resulting OM and the resulting BM. All margins expressed in tCO2/MWh.
CM = 0.5*OM + 0.5*BM
CM = 0.5 * (0.982 + 0.742) = 0.862 tCO_2 / MWh

The BLS's resulting Baseline Emission Factor was 0.862 tCO2/MWh.

Step 4 – Calculation of the Baseline Emissions Reductions

The estimated CER per year for The Project, were obtained from the following multiplication:

ERs per year = CMEF* (Estimated Annual Project Electricity Supply in MWh)

Since the annual generation of Xiaogushan 's first phase is 370 GWh, we conclude this project avoids emitting ERs per year, first phase: 0.862* 370,395 = 319,277 tCO2 per year.

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[17] Source: Annex III, Table A6, calculated based on China Energy Statistic Yearbook, 2004,,

[18] The default weights (50%,50%) were kept

It is conservatively assumed that 80% of expected average electricity will be generated for the first reporting year due to testing and installation schedule. As a result, the ER for the first reporting year is 319,277*80%=255,422 tCO2.

The ERs for the first crediting period:

3,128,919 tCO2 of ERs

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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The following steps are used to demonstrate the additionality of the project according to <<Tool for the demonstration and assessment of additionality applicable for The Methodology>

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

Following is the timeline and milestone involved in the XHP Project development:

Table 1: The timeline and milestone in the XHP Project development

	Timeline	**Milestone**
1	August 28th, 2001	The Gansu Provincial Development and Reform Committee approved the XHP project proposal to proceed with feasibility study
2	January 28th, 2002	XHP applies for ADB technical assistance funding for XHP project preparation and ADB loan of $ 50 million.
3	March 20th, 2002, and November 20th, 2002	Loan Application was submitted to Bank of China and Bank of Agriculture, Gansu Branch without any positive response
4	April 4th, 2002	The Gansu Provincial Development and Reform Committee approved the feasibility study of XHP project.
5	September 9th, 2002	The project sponsor issued application letter for CDM project
6	October 30, 2002	The shareholder of XHP company reached the agreement for equity contribution
7	December 2nd, 2002	In the meeting with project financer, ADB, the project Guarantor, Gansu provincial Finance Bureau, it was agreed that Gansu provincial Finance Bureau will provide Guarantee to ADB on condition that CDM revenue be granted to reduce the project risk.
8	September 15, 2003	Government of China recommended XHP as one of the first three CDM candidate projects for PCF's consideration of potential emission reduction transaction. PCF subsequently approved the XHP project into its pipeline for further preparation.

9	September 27th, 2003	The Gansu provincial Development and Reform Committee approved the XHP project design, budget and procurement plan
10	October 20th, 2003	XHP project started construction of civil work
11	November, 2003	The proposed $35 million of XHP loan was recommended to the president of ADB for approval

It is clear that the starting date of XHP project activity falls between 1 January 2000 and the date of its registration. The incentive from the CDM was seriously considered in the decision for all relevant parties including the financier, the domestic guarantee agency, and the project sponsor to proceed with the XHP project activity.

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

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

China Power Sector Background China's power sector has been undergoing a regulatory and institutional reform that was launched at the end of 2002. Power generation assets (thermal, hydro, and nuclear) which used to be owned by the former State Power Corporation, are now being separated and assigned to five separate nationwide state-owned power generation companies. The grid facilities for electricity transmission and distribution are assigned to the State Grid Corporation (SGC) and China South Grid Corporation (CSPGC).

Early in 2003, the State Electricity Regulatory Commission (SERC) was set up to oversee the new power market. SERC has the leading role for the implementation of the overall power reform and completed an initial draft of regional market rules. It was anticipated that-at the national level-separating power generation from the electricity grid would have been achieved by 2004 and that the set-up of regional power markets would follow thereafter. However, regulatory framework for the Chinese power sector is still evolving. The tariff determination and approval of power project investments are still centrally controlled by the National Development and Reform Commission (NDRC). Given the rule based on which the power generating assets will be competing is not clear, risk is still perceived high for independent power producer to invest in China's power sector.[19]

At present, China power sector favors coal-fired power plants since it has proven, domestically available technology and fuel source, shorter construction period, and lower upfront unit capital investment, and is close to load center.

Gansu Power Grid has a mix of hydro power and thermal power. At the end of 2003, the Gansu Power Grid's installed capacity was 8047 MW with the fuel source break up of thermal power: 4745MW (59%), hydro power: 3281 MW (41%), and wind power: 22MW power. The mix of thermal-hydro power has changed from 55%/45% of thermal-hydro plant in 2001 to 59%/41% of thermal/hydro plant in 2003 and demonstrated that the power sector is in favour of thermal power as a means for power grid expansion. It is foreseen that this trend of increasing thermal power plant in Gansu grid will continue in the next decade.[20]

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[19]. Source: Clean Development Mechanism in China, World Bank

[20] Source: Gansu Electricity System 10-year Expansion Plan, provided by Gansu Reform and Development Commission

As a result of above sectoral issues and the Gansu Power Grid's situation, the alternative available to the project would be:

- The proposed hydropower plant development not undertaken as a CDM project activity,

- Implement Coal-fired power plants (300 MW or above) to meet growing electricity demand of Gansu Power Grid.

Sub-Step 1b. Enforcement of applicable laws and regulations

In the context of power sector transformation to market-oriented system, whether to invest in power generation project within the government laws and regulations will be more an individual power project developer's decision based on the project return and risk profile, thus all the alternatives identified in sub-step 1a are in compliance with all applicable laws and regulations.[21]

<u>Step 2. Investment analysis</u>

The purpose of this step is to determine whether the proposed project activity is economically or financially less attractive than other alternatives without an additional revenue funding, possibly from the CDM project activities. The investment was conducted in the following steps:

Sub-Step 2a: Determine appropriate analysis method

This project generates electricity revenue as the economic benefit other than CDM related income, thus the simple cost analysis (Option I) is not applicable. From the XHC's perspective, as a local hydro project developer with limited capacity and resources, its main business is to develop small-medium hydro project in Gansu. In this context, its options are whether to invest or not on the XHP project. Investing in thermal power plant, is beyond its business scope. Whether the XHP provides higher investment return than the thermal power project is irrelevant for the XHC to make a go-or-no-go decision to invest in the Project. The investment comparison analysis (Option II) is thus not suitable for the project type and decision-making context. The proposed project will therefore use the benchmark analysis method since data on on the benchmark IRR and NPV are available.

Sub-step 2b. Benchmark Analysis Method (Option III)
With reference to *Interim Rules on Economic Assessment of Electrical Engineering Retrofit Projects*, the financial benchmark rate of return (after tax) of Chinese Power Industries is to be 8% of the total investment IRR, which are widely used for the power project investments in China.

Sub-step 2c. Calculation and comparison of financial indicators.
The key assumptions are summarized in the following table:

Table 2: Key Assumptions for investment comparison analysis[22]

Key Parameters	Value	Unit

[21] Source: State Council's Decision on Reforming Investment Approval Process, July 16, 2004. State Council
[22] Data source: Key financial model assumption provided by Gansu Hydropower Design Institute and verified by the World Bank Energy Specialist (2004 May)

Gross Capacity	98	MW
Annual Electricity Supplied to Gansu Grid[23]	357.8	GWh
Tariff (as in PPA)	0.290	CNY/kwh
Annual revenue	103.8	Million CNY
Build Period	3	years
Life of Plants	30	Years
Variable O&M Cost	27	Million CNY/Year
Investment Cost	699.76	Million CNY
Interests capitalised during construction	54.47	Million CNY
Income Tax	0% for the first two year, 15% for the next three year 33% for the remaining years	

Comparison of IRR and NPV for the proposed project and the financial benchmark
In accordance with benchmark analysis (Option III), if the financial indicator (Such as IRR and NPV) of the proposed project are lower than the benchmark, the proposed project is not considered as financially attractive. Without the CDM revenue, the project IRR is lower than the benchmark 8% and the NPV is negative, thus the proposed project is not financially attractive. With the CDM revenue, the project IRR and the NPV are significantly improved and exceed the benchmarks. Therefore, the proposed project, with the CDM revenue, can be considered as financially viable to the investors.

Table 3: Financial indicators of the Xiaogushan Hydropower project

	FIRR	NPV (Million CNY) Discounted by 8%
Without CDM	7.2%	-44.3
With CDM at ER price of $10/tCO2e	9.3%	68.9

Sub-step 2d. Sensitivity analysis
The critical assumptions for investment analysis of XHP hydro project is the tariff, initial investment cost, electricity generation, and exchange rate. A sensitivity analysis was conducted to test whether the

[23]. The financial projection was based on the preliminary engineering design. The final technical configuration of upgrading the installed capacity from 98 MW to 102 MW in 2005 was not reflected in the calculation of financial indicator as the project's additionality should be reviewed back in 2003 when the final investment decision was made by the project sponsor and the lending institution

conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis based on benchmark method provides a valid argument in favour of additionality because it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be financially attractive with FIRR under various adverse situation less than the benchmark IRR (8%)

Table 4: Sensitivity test of Xiaogushan Hydropower Project

Sensitivity Analysis	Change in Variable	FIRR (%) without carbon revenue	FIRR (%) with carbon revenue @ $10/tCO2e
Base Case		7.2%	9.3%
1. Capital Cost Overrun	10%	6.4%	8.3%
2. Energy Generation Reduction	-10%	6.4%	8.4%
3. Tariff Reduction	-10%	6.0%	8.1%
4. RMB (Exchange Rate) Depreciation	-10%	6.4%	7.3%
5. Combination of 1) and 2)		5.6%	7.5%
6. Combination of 1), 2), and 3)		4.6%	6.4%
7. Combination of 1), 3) and 4)		4.8%	5.4%

Step 3. Barrier Analysis

The small-medium hydro project in a remote area, when developed by the county-level investor as in the XHP's case, faces prohibitive barriers of high project risk, access to financing, and uncertain tariff combined with weak enforcement of the PPA. The key barriers and strong evidence to support the barrier argument were found as follows:

I. High project risk:

As XHP is a county-level developer with limited equity reserve and track record (only developed four small hydro projects prior to the XHP, Longqu: I 7.2 MW, Longqu: II 4.8MW, Rongqu: III, 3.8 MW and Ying Ke: 1.3 MW), it lacks proven capacity to develop medium-scale hydro projects thus is exposed to the risk of construction delay and capital cost overrun. In addition, the project faces resource risk as the hydrological flow has uncertainty, electricity generation might fluctuate.

XHP's moderate FIRR and NPV, XHP's unit power capacity cost (7.0 million CNY/ MWh) and levelized unit cost (0.258CNY/kwh) power plant, indicates a high capital investment compared to the amount of power generated, and the perceived cost disadvantage of the Project. As disclosed in the Barrier III discussion, the tariff of any single power project is normally determined by the NDRC based on its assessment of the overall electricity market situation, and more competition will be brought into the power generation sector, thus means XHP's relatively high unit cost indicates that the Project is exposed to high regulatory risk of lower than expected tariff at a later stage. Because 40% of the project capital investment is financed by ADB loan denominated by US dollar, this project is exposed to significant foreign exchange risk.[24]

As the investment benchmark analysis and the sensitivity analysis consistently proved, the project has quite high risk profile, any adverse change in the above four risk factors, individually or combined together, will put this project financially unattractive.

II. Access to Financing.

The XHP is located in Xishui, one of the poorest townships (more than 94% of the population are below the China poverty line) of Zhangye Prefecture in Gansu Province, which itself is the second poorest provinces in China in terms of GDP per capita. Zhangye Prefecture also has a very high poverty incidence - more than 27% of its rural population of almost 1 million are below the China Poverty line.

Located in a very remote poor area, the Project faces prohibitive barriers related to access to financing. At the early stage of project preparation, the major shareholder, Heihe River Hydro Development Ltd, had limited equity to even start the project preparation. It was evident that, to solve the problem of lacking the preparation funding, the company employees, led by the management team, had to put their savings to the company as an equity contribution in July 2001. *(Evidence: the document of equity offering to employee of HHDC).* The shortage of funds and capacity has also delayed the preparation of XHP and resulted to the exclusion from the province's 10th - Five – Year – Grid – Expansion - Plan. (*Evidence: Gansu 10th 5-year power system expansion plan*).

Gansu Province doesn't have well-established financial services sector that provide a wide range of financial instruments for project finance at different risk levels. The project sponsor faced very few choices of debt financing and has been struggling to secure financing ever since it obtained the license to develop this project. As the long-term loan in China normally require third-party guarantee or collateral from the borrowing entity, XHC's main founder, Heihe Hydro Development Shareholding Co., Ltd, didn't qualify for domestic bank's loan with limited assets of only 108 million CNY prior to ADB getting involved. As indicated by the table of Timeline and Milestone for XHP development, during the stage of seeking for project financing, the XHP has contacted the local branch of the Bank of Agriculture, Bank of China, the main financier in Gansu Province, with no positive response (*Evidence: Loan application letter to BOA and BOC*).

When XHC was negotiating with ADB for an US dollar-denominated loan in 2002, the perceived high project risk as well as the unmatched cash flow from financing and cash flow from operation caused serious concerns for the project guarantee agency, the Gansu Finance Bureau. It required US dollar-denominated CDM fund to be seriously sought as a way to mitigate the high project risk and insisted on this as the condition to approve and provide guarantee to the proposed ADB loan. (*Evidence, the minutes of the meeting held on Dec 2, 2002 in Lanzhou Feitian Hotel*).

It was originally expected that registration of the XHP as a CDM activity and final negotiation of an emissions reduction purchase agreement with international carbon credit buyers (ADB or other international agency) will make it possible for the developer to secure financing and allow the XHP to proceed. The meeting minutes soundly established that the CDM incentives were clearly and seriously considered at the beginning of project financing.

[24] Source: ADB's Loan Appraisal document. December 2003. http://www.adb.org/Documents/RRPs/PRC/rrp_prc_34476.pdf#page=9

Sufficient documents (loan application letter, the document of equity offering to employee of HHDL, meeting minutes with ADB and Gansu Finance Bureau) exist to demonstrate in a transparent manner that XHP is subject to prohibitive barriers, and when it was seeking financing, the prospect of its registration as a CDM project was a condition to the loan approval by its guarantor- Gansu Finance Bureau, and has enable it to overcome the financing barriers.

III. **Weak enforcement of a Power Purchase Agreement (PPA):**

Prior to the power sector reform, the state-owned power company was the party that could make investment decisions regarding hydro development projects. As a result the tariff structure in China favored the development of hydro power projects, and such projects were assured full-cost recovery and a small rate of return on investment. However, in the transitional period of power sector transformation to market-oriented system, the tariff structure has changed making it uncertain whether all costs can be recovered for renewable energy projects. The anticipated removal of subsidies for renewable energy in the power market will result in higher power generation costs for development of renewable energy projects and higher prices for the respective electricity. The uncertainty of merit-based competition will place an additional financial burden and present a significant risk to renewable energy project investors.

For any investors interested in renewable energy development, these uncertainties present serious risks and present significant barriers to project development. In Gansu Province, a formal PPA is set aside for the generator and the grid operator to work out in detail after the tariff authorization letter. The tariff is calculated based on recovering project cost in a certain period plus a low return on equity. Indications are that the terms of payment for electricity are very simple and probably do not protect either party arising from default by the other party. Any default appears to be assessable by the price bureau which can then pass judgment as their conclusions are binding on both parties. The tariff is reviewed every 3 – 5 years by the price bureau, hence they are determined to set returns that will remain stable for 3 – 5 years.

In the off-taking agreement signed on June 16th, 2003, Gansu Power Grid Company Zhangye Branch, as the off-taker, promises to purchase the electricity generated by XHP at a price of 0.29CNY/kWh. However, the reality is that it doesn't have the authorization to define the tariff.[25] As introduced above, the tariff defined in the PPA will most likely be overridden by the latest tariff set by the Price bureau. Following is the table of average tariff that the Gansu Grid Power Company paid to the power generators since 2000.

Table 5: Average Tariff in Gansu Power Grid since 2000

Year	Tariff – Hydro (CNY/kwh)	Tariff – Thermal (CNY/kwh)
2000-2004	0.29-0.34	0.29-0.36
Since 2004	0.227-0.24	0.227-0.256

Data source: The respective regulatory documents, issued by the NDRC dated April of 2000, June of 2004.

It is evident that the increased competition in the power market will expose XHP to greater financial risk due to the expected lower tariff. The sensitivity analysis indicates that at the tariff of 0.227 CNY/kwh which is the latest and lowest tariff for the Gansu Power Grid connected electricity published by NDRC on June 23, 2004, XHP will not be able to make the investment viable with negative NPV of -185 million

[25] Source: NDRC's Decision on Resolving the Tariff Issues for Northwest Grid, #(2004)1125, regulatory document published by National Development and Reform Commission

CNY (discounted by 8% as the hurdle rate) and FIRR of 4.5% lower than the benchmark required rate of return (8%) . The carbon finance will make a difference in this case by injecting additional hard-currency denominated cash flow into the XHP and make it financially more viable to mitigate the significant risk brought by the less predictable tariff and increased market competition.

Table 6: Sensitivity Test to Change of Tariff

Tariff Scenario	IRR Without carbon revenue	IRR with carbon revenue at different ER price ($/tCO2e)			
		$4.50	$6	$10	$25
Ideal-energy sales at the tariff of PPA 0.29 CNY/kwh	7.2%	8.1%	8. 4%	9. 3%	12. 5%
Realistic-Upper range 0.24 CNY/kwh	5.1%	6.0%	6. 3%	7. 2%	10. 5%
Realistic-energy sales at the tariff of comparative hydro power plant 0.227 CNY/kwh	4.5%	5.4%	5. 7%	6. 6%	9. 9%
Breakeven point- Tariff to make the XHP meet 8% of threshold return of investment	0.309 CNY/Kwh	0.287 CNY/Kwh	0. 279 CNY/Kwh%	0. 259 CNY/Kwh	0. 184 CNY/Kwh

Data source: Financial model assumption provided by the Gansu Provincial Hydropower Design Institute

The applicable tariff for the XHP is scheduled to be finalized by the price bureau ahead of its proposed partial commissioning at the beginning of 2006. The energy part of Xiaogushan's tariff is likely to be no more than the upper range of current purchase price of electricity at RMB 0.24 /KWh from the grid[26].

Sub-step 3. b. The identified barriers, however, will affect the alternatives to less extent, because the thermal power plants have shorter construction period, lower capital investment cost per unit of capacity, and are closer to the load center. The thermal power plants invested by state-or-provincial-level power generating company, as a viable alternative, is coming as actually a common practice.

Step 4. Common Practice Test

Sufficient information exists to demonstrate in a transparent and conservative manner that the type of activity and the location of project undertaken in the XHP project is not common practice at the time that the project was prepared and the investment decision was made. All projects except XHP have been undertaken by large state or province level company before the power sector reform strated in 2002 and the principle of seeting tariff was full-cost recovery with reasonable return.

[26] Source: Annex 5, NDRC's Decision on Resolving the Tariff Issues for Northwest Grid, #(2004)1125, regulatory document published by National Development and Reform Commission

It is evident from Table 7 below that the XHP is the very first project in the Gansu Power Grid to be developed by a county-level developer with size over 50 MW since the power sector reform started in 2002.

Table 7: Gansu Hydro Power Plants (above 50 MW) commissioned since 2000 and the developer's background.

Gansu hydro power plant	Installed Capacity	Year to start construc-tion*	Year to start commis-sioning	Project Company	Major Shareholder and its Background
Longshou I*	52 MW	1998	2000	Hexi Hydropower Development Company.	Gansu Electricity Investment company: **Province level 100% state-owned company**
Longshou II	59 MW	2000	2004, Aug	Same as above	Same as above
Xiaogushan	102 MW	2003	2006	Xiaogushan Hydropower Company Ltd.	Heihe Hydropower Development Shareholding Co., Ltd. (HHDC) company **County-level**
Xiaoshanxia hydropower development Company	230	2001	2004 September.	China Electricity Power Ltd.	**State-level State-owned public company**
Dalahe Longlan district. Western Taohe	52	2001	2004	Huiyuan Investment Company	Gansu Mingzhu Electricity Development Company **Province-level , state-owned public company**

Data source: Interview with the Gansu Power Grid Company expert

As a matter of background, Ganzhou district power bureau, the predecessor of HHDC, initiated the development of another smaller size project, Longshou I, but wasn't able to continue due to financing problem. Their early-stage input was acknowledged and evidenced by their 10% of equity share in the Longshou I whose development license was transferred to the Gansu Electricity Investment Company. [27]

Step 5. Impact of CDM registration

As indicated in Table 5, carbon revenue significantly increases the project's financial attractiveness by improving the key financial indicators and makes it more resilient to various risks, such as resources availability risk, foreign exchange risk and risk of tariff change which is out of XHC's control.

[27] Source: Interview with Xu Qingnian, Xiangushan Hydropower Development Company

The financial benefit of the revenue obtained by selling ERs (assuming price is $10/tCO2e) is significant as follows:

- The Net Present Value of ER revenue accounts for 25% of total capital investment of the Project.
- Increase the project IRR by 2.1% and turn it into a financially attractive investment
- Provides 0.051 CNY/kWh of additional revenue stream to the project making it more resilient to tariff changes since the project breaks even (assuming 8% as the hurdle rate) at a lower tariff of 0.258 CNY/kWh rather than at a tariff of 0.309 CNY/kWh.

As shown in the barrier analysis, XHC faces serious financing barrier. It has applied for loan from the branch offices of state-owned banks twice without any positive response. Perceiving the weak capacity of the project sponsor, the guarantee agency, Gansu Provincial Finance Bureau requested CDM revenue being granted as the condition for it to approve and provide guarantee for the ADB loan. As a result, it is clear that the Project to contain ER sales under the CDM is critical to help XHC overcome the investment barriers and reach financial closure.

The ADB loan is denominated in US$ whereas the revenue from the project is in Chinese Yuan. This means there is a mismatch between the loan and revenue thus the project is exposed to significant foreign exchange risk. The hard-currency revenue from CDM helps to mitigate this risk.

As the project sponsor is a county-level private developer who didn't have experience before in developing medium-sized hydro projects, the carbon revenue also strengthen the project's capacity in operating and maintaining the medium-sized hydro power asset.

In summary, all the above Step 0 to Step 5 analysis clearly establish that the XHP faced significant barriers including high project risk, access to financing, and weak enforcement of PPA. A hydro development in a remote poor area conducted by independent private developer with limited capacity is not a common practice given China's electricity sector transformation toward market-oriented, merit-based system. The Project to contain ER sales under the CDM was a condition for the project developer to secure foreign-currency denominated loan and bring significant financial benefit to the project to make it more resilient to various risks unique to this project. Therefore, it is concluded that the XHP is additional.

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

>>

The only GHG included in the ER calculation is CO_2. The project boundary considered is the Gansu Power Grid where all power plants physically connected without any significant transmission constraints to the electricity system that the XHP power plant is connected to. Gansu Power Grid is also connected to the Northwest Power System whereas there are less than 3% of annual electricity imports from the Northwest Power System. Thus the project boundary is set as the Gansu Power Grid. The average emission factor of the exporting grid is calculated as part of the operating margin using the imported electricity as its % of the Gansu Power Grid as the weighing factor. No leakages or indirect emissions were identified for the Project.

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

>>
The baseline study was completed on February 10, 2006.

Contact information:
The World Bank Carbon Finance Unit
1818 H Street, NW
Washington D.C., 20433, USA
ibrd-carbonfinance@worldbank.org

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:

>>
July 1, 2006

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

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

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

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
The project will start partial commissioning in March 2006 and become fully operational on July 1st, 2006

C.2.2.2. Length:

>>
10 years.

SECTION D. Application of a monitoring methodology and plan

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

>>
"Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources (ACM0002)"

The above methodology is hereafter referred to as the "Monitoring Methodology".

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

>>

The Project is a grid-connected zero-emission renewable power generation activity and meets all the following conditions that are stated in the Monitoring Methodology (ACM0002):

- The Project supplies electricity capacity addition from hydropower source from a run-of-river hydropower plant resource;
- The Project is not an activity that involves switching from fossil fuels to renewable energy at its Project site;
- The electricity grid is clearly identified (as the Gansu Power Grid) and information is publicly available on the characteristics of the grid.

No leakages were identified and hence will not be monitored.

The following variables will be monitored as stipulated by the Monitoring Methodology:

- Electricity generation from the Project (double checking through quality control/assurance procedures).

In addition, a detailed Environmental Management and Monitoring Plan (EMMP) has been developed by East China Investigation and Design Institute in May 2004 and is currently implemented by Xiaogushan Hydropower Company. The EMMP responds to requirements of the Chinese Environmental Impact Assessment as well as World Bank Standards. This EMMP was made publicly available via the World Bank Infoshop at its website on June 21, 2004 and an English version of the EMMP can be presented to the validator on request . The progress report for the EMP shall be submitted on a quarterly basis within one month after the quarter, and the report of the 4th quarter shall include a summary report for the whole calendar year. The task team at the World Bank will carry out annual supervision mission to monitor environmental management practice according to the monitoring plan.[28]

Additional information regarding maintenance and calibration procedures can be found in Section D.4 .

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[28] Source:

http://wdsbeta.worldbank.org/external/default/WDSContentServer/IW3P/IB/2004/06/21/000160016_20040621115347/Rendered/PDF/E9660vol03.pdf

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

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

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

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

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Being a run-of-river hydro power project, no emissions from the Project Activity were identified. There are therefore no formulae included here.

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

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

1. EGy	*Electricity supplied to the Grid by The Project*	*Gansu Power Grid*	*MWh*	*Directly Measured at the 330KV substation of ZhangyePrefecture*	*Hourly measurement and monthly recording*	*100%*	*electronic*	*Electricity supplied by The project activity to the grid monitored by the receipts of sales.. Double check with electricity generation after deducting parasitic consumption and transmission loss*
2. EFy	*CO2 emission factor*	*Own elaboration*	*tCO2/MWh*	*c*	*yearly*	*100%*	*electronic*	*Calculated as a weighted sum of the OM and BM emission factors*
3. EF-OMy	*CO2 Operating Margin Emission Factor of the grid*	*Own elaboration*	*tCO2/MWh*	*c*	*yearly*	*100%*	*electronic*	*As indicated in the relevant OM baseline method Simple-OM, calculated as TEMy divided by TGENy)*
4. EF_BMy	*CO2 Build Margin emission factor of the grid in year y*	*Own elaboration*	*tCO2/MWh*	*c*	*yearly*	*100%*	*electronic*	*Calculated as per the ACM0002, taking into account local data availability*
5. TEMy	*Total Emissions of the grid in year y*	*Own elaboration*	*tCO2 eq/ Year*	*c*	*yearly*	*100%*	*Electronic*	*Calculated as the sum of GHG emissions of all plants in year y*
6. TGENy	*Total electricity generation of the grid excluding zero or low operating cost sources in year y*	*Gansu Power Grid*	*MWh*	*c*	*yearly*	*100%*	*Electronic*	*Calculated as the sum of electricity generated of the grid excluding zero or low operating cost sources in year y and obtained from the China Electric Power Yearbook*
7. Fi,j,y	*Amount of fossil fuel i consumed by power plant j at year y in the grid*	*Own Elaboration*	*tons*	*c*	*yearly*	*100%*	*electronic*	*Obtained from the China Energy Statistical Yearbook*
8. NCVi	*Net Calorific Value of fuel i consumed in the Gansu Grid*	*IPCC default value*	*Tj*	*c*	*yearly*	*100%*	*electronic*	*Obtained from, IPCC default values*

9. COEFi	*GHG emission coefficient of each fuel i*	*Own elaboration*	*tC/eq (physical unit of fuel)*	*c*	*yearly*	*100%*	*electronic*	*Obtained from, IPCC default values*
10. EGCCj,y	*Average Electricity Generation Coal Consumption of power plants by fuel j in Gansu Grid*	*Gansu Power Grid*	*Standard Coal g/kwh*	*m*	*yearly*	*100%*	*electronic*	*Obtained from the China Electric Power Yearbook*
11. ESCCj,y	*Average Electricity Supply Cooal Consumption of power plants by fuel j inGansu Grid*	*Gansu Power Grid*	*Standard Coal g/kwh*	*m*	*yearly*	*100%*	*electronic*	*Obtained from the China Electric Power Yearbook*
12. EGCC Coal fired new plants	*Electricity Generation Coal Consumption of coal-fired new power plants in Gansu grid*	*Own elaboration*	*Standard Coal g/kwh*	*e*	*yearly*	*100%*	*electronic*	*Estimated by China Power sector expert*
13. ESCC Coal fired new plants	*Electricity Supply Coal Consumption of coal-fired new power plants in Gansu grid*	*Own elaboration*	*Standard Coal g/kwh*	*e*	*yearly*	*100%*	*electronic*	*Estimated by China Power sector expert*
14. GEN Thermal, Grid, y	*Electricity Supply to the Gansu grid by new thermal plants*	*Own elaboration*	*Gwh*	*c*	*yearly*	*100%*	*electronic*	*Estimate based on formular describe in Annex III, Baseline Study*

15. GENi,y	*Annual electricity generation by fuel source i in the grid*	*Gansu Power Grid*	*MWh/year*	*m*	*Annual measured by monthly recording*	*100%*	*electronic*	*Obtained from the China Electric Power Yearbook*
16. HOUR i, operation, y	*Average operating hours for plants by fuel i in year y*	*Average operating hours for plants by fuel i in year y*	*Hours/year*	*c*	*yearly*	*100%*	*electronic*	*Calculated by the total generation by fuel i divided by installed capacity by fuel i*
17. GENimports	*Electricity imports to The Project's electricity system*	*Gansu Power Grid*	*KWh*	*m*	*yearly*	*100%*	*electronic*	*Obtained from the ADB technical report. Imports are excluded in OM calculation as the grid efficiency is lower in the exporting grid thus it is conservative to assume the emission factor of the importing grid is the same as the exporting grid*
18. EG_{plant}	*Electricity generated by The Project*	*Monitored at the hydro plant*	*MWh*	*Directly Measured at the plant*	*Monthly recording*	*100%*	*electronic*	*Electricity generation monitored by the engineering department*
19. ES_{plant}	*Electricity consumption of the project*	*Monitored at the hydro plant*	*MWh*	*Directly measured at the plant*	*Monthly recording*	*100%*	*electronic*	*Electricity used on site monitored by the engineering department*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

See Section E.4. for baseline emission calculations

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

Option 2 is not selected as it is not appropriate to ACM0002

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

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

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

D.2.3. Treatment of leakage in the monitoring plan

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

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

According to ACM0002, the main indirect emissions potentially giving rise to leakage in the context of electric sector projects resulted from power plant construction, fuel handling (mining, processing, and transportation), and land inundation (for ydroelectric projects). The project develop does not need to consider such indirect emissions when applying the methodology. Project activities using this baseline methodology shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario. So the proposed project can take no account of such leakage, $L_y = 0$

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

>>

As described above, the proposed project can take no account of leakage, $L_y = 0$

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

>>

The proposed project activity will generate GHG emission reductions by avoiding CO2 emissions from electricity generated by fossil fuel power plants. The emission reductions ER, during a given year y is the difference of baseline emission BE_y, deduce the project emission PE_y, and the leakage L_y, calculated as

$$ER_y = BE_y - PE_y - L_y$$

Since the project emission PE_y for the proposed project and the leakage L_y is considered as zero, the emission reduction is equal to baseline emission BE_y, i.e.

$$ER_y = BE_y = EG_y \times EF_y$$

Where BE_y is (in the absence of the proposed project activitity) the GHG emission of the baseline GHG emission from electricity generation (EG_y), which is equivalent to that of the proposed project, of the Gansu Power Grid, i.e. annual emission reductions of the proposed project

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.3-1	*Low*	*Sales record to the grid (Gansu Power Grid) or final client (XHP) and other records are used to ensure consistency. Namely, data will be cross checked between the metering system at the plant site, and the grid to assure correctiveness.*
Others	*Low*	*In accordance with national and sectoral criteria with detailed monitor plan (see Annex 4). Data is acquired from the China Electric Power Yearbook, (published by State Power Grid Corporation), IPCC Guideline and China Energy Statistical Yearbook. These sources will be checked against other sources.*

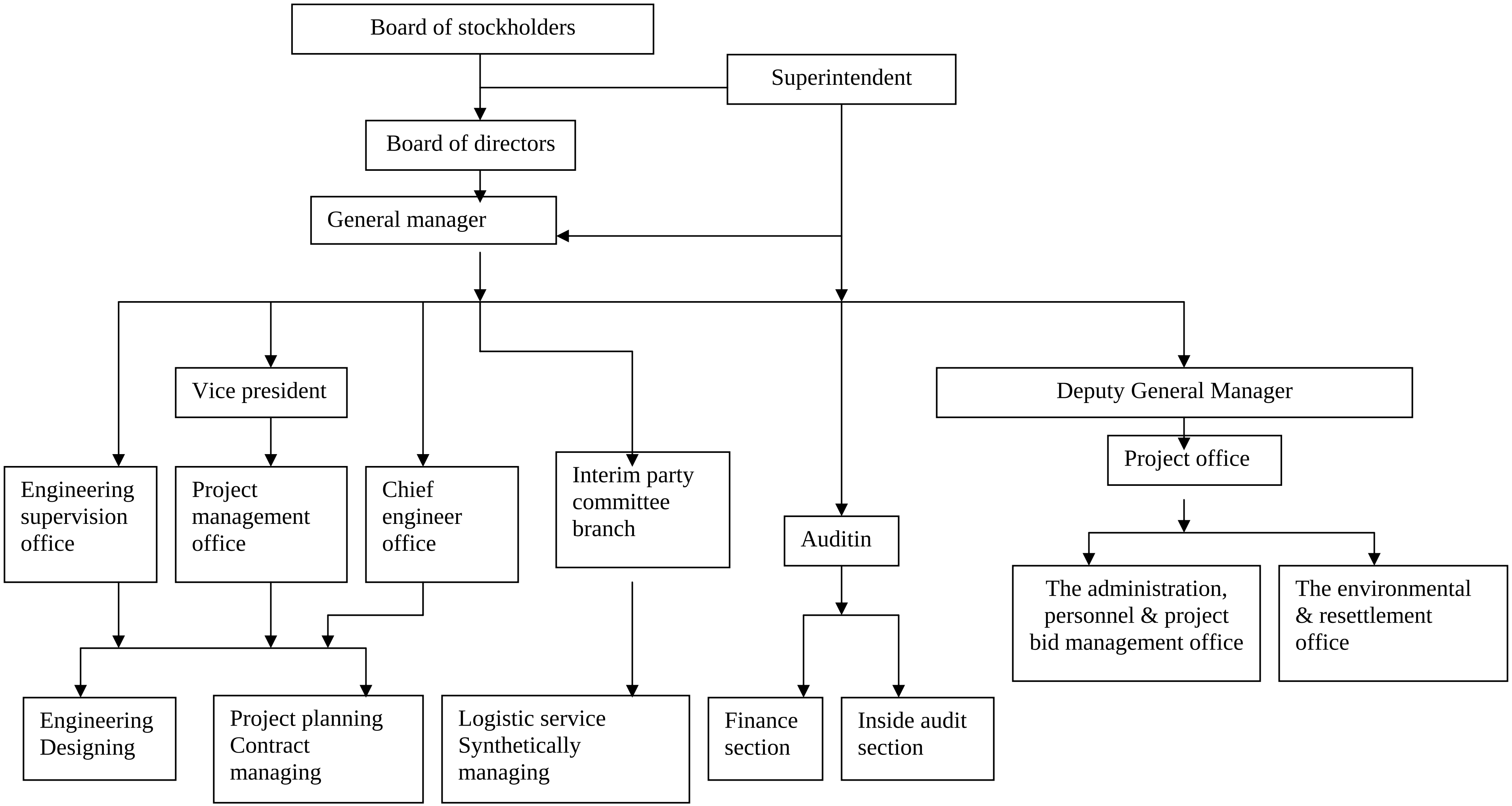
D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

Figure 1 outlines the operational and management structure that the project owner will implement for the Project Activity and for the monitoring of project emissions and any leakage effects. The nominated CDM responsible person for the Project who will ensure that the Monitoring and Verification Plan are implemented is initially Mr. Ding Jianjun, Deputy General Manager of Xiaogushan Project Activity.

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

Organization Chart of Xiaogushan HPP (Fig.6-1)



The PCF will provide XHP with a Monitoring Plan and pre-programmed spreadsheets so the operator will just need to collect the information as described and apply the formulas as directed in the Monitoring Plan. The collection sources of the data will not be in any case the Project's own records but the final client records of monthly production to keep the highest transparency and accuracy of the data. The Project staff designated will confirm these data with own records and own records will be double checked with sales receipts.

Electricity supply to the Gansu power grid will be measured continuously by ammeter and be read once every month in the Zhangye Heihe Substation, which is 20 kilometers from Xiaogushan hydropower station. Both the substation and Xiaogushan hydropower station use "Weishen DSSD-331"ammeter model's that are produced by Hunan-based Changsha Wasion Electronics Co., Ltd. The ammeters are recalibrated once every year and will be replaced once every three years. The meter reading of electricity supply at Xiaogushan hydropower station and Zhangye Heihe substantiation will take place on the same day. A three-person team with representatives from the Gansu Power Company, its Zhangye branch, and Xiaogushan will record the electricity supply by reading the same record on the ammeter. Xiaogushan Company will read the meter in its station for double-checking purpose. Staff responsible for monitoring will be trained in the use of ammeters.

Xiaogushan company installed an ammeter in its plant to record the electricity used for plant operation. The company has a detailed generator maintenance schedule set according to the variance of water flow for different seasons. This document can be presented to the validator on request. All three generators have regular maintenance twice every year, scheduled before and after the peak season that lasts for 15 days. Scheduled major maintenance of the generators takes place once every 5-6 years and last 45 days. The three generators will be scheduled for major maintenance in different years. The Engineering Department will be in charge of recording and monitoring the electricity supply to the Gansu power grid, electricity generated at the plant, electricity used for plant operation and maintenance schedule.

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

>>

The World Bank Carbon Finance Unit
1818 H Street, NW
Washington D.C., 20433, USA
ibrd-carbonfinance@worldbank.org

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>
Zero.
The project is a run-of-the-river hydropower project and it does not increase the GHG emissions.

E.2. Estimated leakage:

>>
Zero.
No leakage had been identified for this kind of project.

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

>>
Project emissions are calculated as follows:

GHG Emissions from Project + leakage = Project Emissions

Since the Project is not responsible for any project activity emissions. Project activity emissions are zero (0) because there are no anthropogenic emissions or leakage. i.e. in applying the above formula:

0 + 0 = 0

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

>>
The Project calculates, on the basis of ex-ante data for grid emission factor and ex-post monitored data of electricity output, the actual emissions reductions due to its operation. Justification for the calculation method is provided in section B.2 above. The combined margin emission factor is calculated ex-ante as according to the method described in ACM0002 as follows:

Emission Factor	Tons/MWh
OM=	0.982
BM2=	0.742
CM=	0.862

Using the method in ACM0002 expected emissions reductions can be calculated. (Since ACM0002 defines how to calculate the emission reductions the calculation procedure is not described again. ACM0002 provides more information regarding how these calculations were made.),

The initial estimate of emission reductions are presented in the following table:

Project	MWh in the year

Xiaogushan	370,395

Ers of the Year (CM-OM - BM2):

Project	MWH in the year*Combined Margin
Xiaogushan	319,277

Projects	CERs of first crediting period (10 years)
Xiaogushan	3,128,919

The baseline scenario is defined and the emission factor is calculated for the Gansu Power Grid. In defining the baseline scenario, it is clear that the impact of the proposed XHP's project activity is dispersed throughout the electric sectors ongoing operation and expansion in a manner that can not be characterised as the deferral of a specific alternative investment. Furthermore, the estimated ex-ante baseline scenario should account for the effects of the Project Activity on both the operating margin (reducing electricity generation from the existing power plants excluding low cost/must run power plant) and the build margin (delaying or avoiding construction of future power plants).

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

>>

The emission reductions are calculated as follows:

Project Emissions – Baseline Emissions = emission reductions

Since the emissions reductions of the Project is equal to the baseline emission because the Project itself does not produce any emissions. Thus, in applying the equation above it can be shown that:

0 – 3,128,919 = - 3,128,919.

The annual reductions are therefore estimated to be 3,128,919 tCO2e.

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

The baseline emissions and project emissions were calculated in accordance with the ACM0002 method. The methodology for calculating these emissions is not therefore repeated here. Further information regarding the method for calculating baseline emissions, project emissions and final emission reductions can be found in ACM0002.

Year	Total baseline emissions (tCO_2e)	Total Project emissions (tCO_2e)	ERs(tCO_2e)
2006	255,422	0	255,422
2007	319,277	0	319,277
2008	319,277	0	319,277
2009	319,277	0	319,277
2010	319,277	0	319,277
2011	319,277	0	319,277

2012	319,277	0	319,277
2013	319,277	0	319,277
2014	319,277	0	319,277
2015	319,277	0	319,277
Total	3,128,919	0	3,128,919

SECTION F. Environmental impacts

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

>>

1. The project implemented an environmental impact assessment (EIA), to ensure that the project complied with national, regional and local environmental regulations. The results of the EIA were positive. The EIA for this project was carried out by Gansu Environment Science Design Institute (GESDI) with the assistance of the ADB. GESDI is an EA consultant certified by the State Environmental Protection Agency (SEPA) and is independent from the project owner, ZXHC, in terms of financial and personnel management. The EIA report is over one hunded pages long. What follows is therefore a summary of the key aspects. A copy of the full report can be presented to the validator on request.

B. Brief Project Description

2. Xiaogushan Hydropower retention weir is the sixth retention weir among the planned 11 retention weirs in the Heihe River. The project comprises (1) a 26.5-meter-high retention weir to divert water; and (2) a 9.8-kilometer-long underground tunnel; (3) a 102-megawatt power house; (4) a 26-kilometer long, 35-kilovolt transmission line; and (5) a 19-kilometer long 110-kilovolt transmission line. The EIA and SEIA cover all these components.

3. The retention weir will diverse more than 80 percent of the river water into the tunnel. After generating power, the water will be backed to the Heihe River again. Upstream of the retention weir, the water level will be raised 19 meters, and the reservoir will be extended about 2.5 kilometers upstream. Because the river is in the bottom of a steep gorge, the inundated area will be rather small, 21 hectares. Downstream from the retention weir, about the 15 kilometers of river flow will be affected by this project. After the powerhouse, the water flow will remain the same as the existing flow.

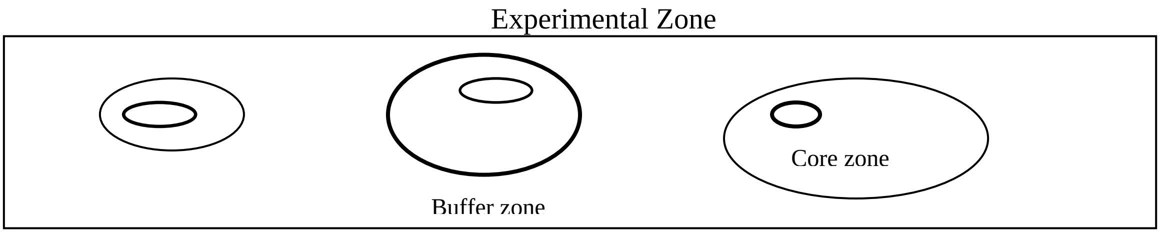
4. The 35-kilovolt transmission line goes through some residential area to provide power, while the 110-kilovolt one directly goes to the transformer substation.

C. The Existing Environment

5. **Qilianshan Natural Reserve (QNR).** The project is located in an experimental zone of the QNR. The area of the natural reserve is categorized to core, buffer, and experimental zones according to the quality of nature. The core zones are prohibited to make any development, while the experimental zones include industrial areas, commercials areas, and residential areas. An experimental zone is defined so as to connect scattered core and buffer zones together and to protect them as a single geological area; and (2)

the boundary of an experimental zone is drawn on the historical borderlines of forest, which has been under the management of Qilianshan Forest Administration, which is the upper organization of QNRA.

6. **Climate and vegetation.** The project area belongs to the semi-desert mountain area, which extends between 2,000 to 2,350 meters in the altitude. Annual average temperature is 8.5 ^{0}C, and annual precipitation is 175 millimeters, while annual evaporation on the surface of the water is 1,378 millimeters. The river is located in the bottom of a steep gorge. Accordingly, ecological diversity and vegetation around the project site is very limited. According to the EIA, neither critical natural habitats nor protected flora species were found during the field surveys.



7. **Aquatic Species.** The ecological survey in the EIA was conducted by Biology Department of Zhangye Environmental Monitoring Station, which is an auxiliary of GEPB. They invited as an advisor Dr. Zhang Yong, associate professor of Hexi College, who is famous as aquatic ecological expert of the Heihe River. They have conducted fish surveys four times and concluded that there is no fish in the area. In the supplemental EIA, Professor Zhao Wenzhi, a famous expert on QNR and a staff member of the Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, reviewed in May 2004 the original and the draft supplemental EIAs and fully agreed with the results of ecological survey. QNRA was also consulted with on the EIA, and they approved the EIA.

8. **Animals.** The EIA report concluded that no critical natural habitats of animals or protected species were found in the project area according to their field survey and the results were endorsed by QNRA.

9. **Residential area.** Except for the 35-kilovolt transmission line, there are no residential areas around the project sites.

10. **Cultural Relics.** According to a survey by the local Archeological Institute, there are no cultural relics in the project sites. The results were confirmed by the local archeological authority.

D. Potential Environmental Impacts and Their Mitigation Measures

(1) Design Phase

11. **Cumulative impacts of 11 retention weirs.** The SEIA analyzes cumulative impacts of 11 retention weirs in the upper reach of the Heihe River. Except for two retention weirs, all retention weirs are runoff or diversion retention weirs. There are no core zones or buffer zones along the river, or no large residential areas. The report concludes that the cascade retention weir construction will have positive impacts to the ecology and agriculture in the middle or lower reach of the Heihe River through

efficient use of limited water resources, while, as the upper reach is poor in biodiversity in fauna and flora, ecological impacts will be small.

12. **Alternatives Analysis**. During the preparation of the project, four alternatives including three different locations and a non-project alternative were studied. The proposed project site is selected because of geological situation, which the environmental impacts are identical for three locations. No project alternative would results additional power generation in the local coal power station, which would pollute air and increase carbon dioxide.

13. **Dumping sites.** Dumping sites were carefully selected from barren lands and not to make impacts to the river.

14. **Transmission Lines.** Transmission lines will not cut through core or buffer zones. Transportation of construction materials will be carried man force and no access road will be constructed. The lime will be well away from houses and other facilities.

(2) Construction Phase

15. **Water Pollution**. Wastewater from tunnel construction and sand and rock processing will be retained in the sedimentation pond before discharged into the river. Wastewater from concrete mixing will be recycled by a spiral water and sediments separator. Wastewater including oils should be treated by oil separator before discharged into the river.

16. **Vegetation**. Rehabilitation of vegetation will be conducted after the construction work.

17. **Construction Camp**. Wastewater from the construction camps will not be discharged into the river. After simple treatment, it will be applied to the recovery of vegetation. Solid wastes will be collected regularly transported into the designated dumping site.

18. **Transmission Lines.** The construction materials will be transported by workers to limit the impacts to the vegetation as little as possible. No pesticides will be used.

19. **Cultural Relics.** It is not anticipated, but if any cultural relics are found during construction, excavation will be stopped immediately, and the local cultural authority will be informed of the discovery. Construction will not resume until the cultural relics have been identified by the authorized institution and necessary preservation measures have been taken.

(3) Operation Phase

20. **Water Pollution**. Wastewater from power station will be treated by septic tanks before discharged. Wastewater including oils should be treated by oil separator before discharged into the river.

21. **Vegetation and Soil Erosion**. Land for temporary use will have been cleaned up after construction. After cleaning, grass seed will be sown both on temporarily used land and at borrowing pits. Those sites will be covered by straw so that vegetation will be able to recover easily and quickly.

22. **Ecological Compensation.** ZXHC paid initial ecological compensation to QNRA, the amount of which is RMB 140,000 yuan, which is calculated according to relevant national compensation standard and is deemed sufficient to recover the same area of vegetation elsewhere in the experimental zone. In

addition, it was agreed that from the first year of the operation, the local government would earmark five percentages of the fiscal revenue from the Xiaogushan Hydro Power for the improvement of the management of the natural reserve for 10 years. The estimated annual amount is estimated about RMB 300,000 yuan.

23. The current annual budget for ecological forestry recovery in Xishui Administration Station, where the project is located, is about RMB300,000 yuan and the additional earmarked allocation from the XHP's fiscal contribution to the local government will double this budget and be used to increase the rehabilitated, achieving 40 hectares per year.

E. Environmental Monitoring

During the construction and operation phases, environmental monitoring will be carried out to verify the project's actual impacts on the environment, identify unexpected environmental problems at an early stage, and adjust environmental measures as appropriate. Environmental monitoring will be conducted by the Environmental Monitoring Center of Zhangye Environmental Protection Office. The results of monitoring will be reported quarterly to the Bank and local environment authorities. The monitored items include water quality, air pollution, noise, waste dumping, terrestrial ecology, aquatic ecology, and soil erosion.

The Environmental Management and Monitoring Plan EMMP based on the comments received during the EIA has been made publically available via the World Bank Infoshop website on June 21, 2004. [29] Progress reports for the EMP will be submitted on a quarterly basis within one month after the quarter, and the report of the 4th quarter shall include a summary report for the whole calendar year. The task team at the World Bank will carry out annual supervision mission to monitor environmental management practice according to the monitoring plan. An English version of the EMMP is attached as an annex to this PDD.

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

>>

The project site is located in an experimental area of Qilianshan Natural Reserve (QNR) ,one of the top 40 natural reserves in China. Accordingly the Chinese national regulation requested (a) more detailed EIA than ordinary hydropower projects, (b) approval by the QNR authority, and (c) consultation with State Environmental Protection Administration before the local environmental bureau approves the project. The quality of EIA is ensured by (a) involvement of the Biology Department of Zhangye Environmental Monitoring Station of Gansu Environmental Protection Bureau and an local ecological expert from Hexi College, (b) external review of the EIA by a professor of the Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences. All the necessary national legal procedures have been finished and the national and local environmental authorities have approved the project. In addition, the EIA has been reviewed by national external experts. An Environmental Monitoring Plan(EMP) was prepared satisfactory to the Bank.

The project involves construction of a concrete gravity retention weir and associated hydraulic structures on the Heihe River in Gansu Province. The maximum height of the structure from the general foundation

29

level of 2,035.0 meters to the crest of the non-overflow section at 2,061.5 meters is 26.5 meters; hence this structure would be classified as a large weir. A Dam Safety Plan has been prepared and four-member POE appointed. The POE conducted its first review in may 2004 and confirmed the implementation of the Dam Safety Plan and project construction so far.

SECTION G. Stakeholders' comments

>>

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

>>

During the preparation for the ADB-financed project, RAP preparation, and the SA, several rounds of consultation have been conducted with important stakeholders. The SA team held intensive meetings with local villagers, local officials in the project affected area, local universities and other academic institutions, and Lama in Mati Temple that is the regional center of Tibetan Buddhism and ZhuanLunSi Temple that is close to the project site, and lengthy interviews with 161 households (more than a half of the total population) in Xishui Tibetan Autonomous Township. Comments and recommendations received from the consultation have been included in the project design, the RAP, and the EMDP.

The final draft RAP, the draft SA report, and the draft EMDP have been sent to InfoShop for disclosure on June 9, 2004. Two copies of the final RAP and EMDP (both in Chinese) will also be made available locally in ZXHC Office and the Xishui Township Achieves on May 20, 2004. The public disclosure will be announced through posts, as well as booklets that will be distributed to Bajiaowan village and each affected household.

G.2. Summary of the comments received:

>>

The Social Assessment confirms that The project is widely supported by local people regardless their backgrounds. Most of the local people (including local religious leaders) interviewed by the SA or presented at the consultation meetings were aware of the project and believed that the project would bring significant benefits to local people and communities.

The interviewees also expressed their concerns and suggested some areas for improvement. Followings are the summaries of the comments and improvement suggestions.

All the local people, including the herdsmen, the women, ethnic minority people, teachers in school, doctors in the clinic, lamas in the monastery and government officials confirm the project has the following benefits to the locality:

1). Developing clean energy, raising the tax revenue of the local government and booming the local development.
2). Cutting down the power price and improving the quality of life.
3). Improving the communication and rendering convenience to life.
4). Booming the diversified industry and residents' income.

According to the opinions from 655 informants (570 Tibetans, 87% of the total), over 90% response positively to the project (Table 4-1).

Table Attitude of the Residents toward the Project

Items	Options	Number of People）	%
Project	Extremely Important	431	66%
	Important	149	22．6%
	Quite Important	52	8%
	Not very Important	10	1．5%
	Unimportant	13	2．2%

Local people have shown some concern over the negative impacts since the project construction. They are responses and requests are summarized as the following five points:

1 Land Acquisition and compensation. The herdsmen who lost land to the project require that the mode of compensation should be geared up with their future means of subsistence and the employment of their children in the future.
2 Other rights and Interests of the local people. The construction team should pay more attention to minimizing the adverse impact of construction on the local people's daily life, especially in terms of noise, dust, waste disposal.
3 Social security and public health. The inflowing of over a thousand construction workers bring risk to the local social security and to the public health. The XHP Company should improve the management of the construction workers.
4 Religion and folk beliefs. Local people believe in Lamaism and pay attention to the worship of the gods of mountains and rivers. They want the XHP company to take due measures to worship the god.
5 Suggestions for bringing developmental benefits to the local ethnic group. The local people hope the project should help to improve the condition of the only local school for developing ethnic education. Residents in the Xishui Township want the project company to promise them favorable price of electricity in the future.

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

>>

Based on the assessment and public consultation, an Evironmental Management Plan (EMP) was prepared to specify activities and monitoring to mitigate potential environmental impacts. This document is publicly available on the World Bank Infoshop. Two additional important documents have been prepared to mitigate identified adverse impact: (1) The Resettlement Action Plan (RAP), which is in compliance with both Bank's policy and Chinese laws and regulations on land acquisition and resettlement, defines compensation and rehabilitation measures for the six directly affected households and their village; and (2) The Ethnic Minority Development Plan (EMDP), as part of the project, to address additional development concerns of local ethnic minority groups, through activities that will directly bring them culturally or religiously compatible benefits.

Special attentions have been paid to the following two issues:

(a) Additional rehabilitation measures to ensure that affected households will maintain their original production scale. Through consultation, ZXHC, Bajiaowan village, and the six affected households reached an agreement that ZXHC will purchase spring grass equal to loss for each affected household annually until reallocation of grass land takes place in the village in 2012. In addition, ZXHC agrees to offer one to two job opportunities and some temporary jobs to affected families and to provide technical training for all local villagers.

(b) Full respect to and protection of local religion and ethnic beliefs. ZXHC and local governments are committed to implementing the EMDP, which focuses on protection of local ethnic culture, promotion of culturally compatible economic development, and empowerment of local ethnic groups in the development process. ZXHC held a pacifying ritual ceremony preceded by lamas from Mati Lama Temple, the regional religious center, on May 21, 2004, for construction works that have caused adverse impacts on local communities.

XHC has agreed to implement RAP and EMDP which are in accordance with the Bank safeguard policies. XHC also agreed to take remedial actions described in an Improvement Action Plan to address outstanding social issues related to resettlement implementation and construction of the hydropower station.

Implementation of the RAP and EMDP will be monitored regularly by XHC, relevant government agencies, and an independent external monitor. An internal monitoring report and an external monitoring report will be submitted the Bank every year during the project implementation.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

40% of The XHP project construction cost is financed by the Asian Development Bank through a 20 year long-term loan. However, this is not Official Development Assistance funding

Annex 3

BASELINE INFORMATION

The following tables summarise the results from the formulas listed in the ACM0002 Baseline methodology for grid-connected electricity generation from renewable sources. The information provided by the tables includes data, data sources and the underlying computations.

Table A1 to A3 are the basic data of the Gansu Power Grid in year 2001, 2002, 2003, including installed capacity, annual electricity generation, and annual electricity supplied to the Gansu grid aggregated by different electricity generation sources, the Grid Average Electricity Generation Coal Consumption,the Grid Average Electricity Supply Coal Consumption, and the parasite use rate.

Table A1: Basic data of the Gansu Power Grid, 2001

Plant data aggregated by fuel type	Installed capacity (MW)	Grid Average Electricity Generation Coal Consumption (Standard Coal kg/Mwh)	Grid Average Power Supply Unit Coal Consumption (Standard Coal kg/Mwh)	$GEN_{Fuel, Plants, y}$ Electricity Generation (Gwh)	$GEN_{Fuel, Grid, y}$ Electricity Supply (Gwh)	Parasite Use Rate
Year 2001						
Thermal power plant	3,875	357	385	18,485	17,141	7.33%
Hydro power plant	3,118	-		11,030	10,988	0.38%
Wind Power	8	-		14	14	
Import					1,010	
Total	**7,002**			**29,529**	**29,153**	

Data Source: China Electric Power Yearbook 2002, P623-625

Table A2: Basic data of the Gansu Power Grid, 2002

Plant data aggregated by fuel type	Installed capacity (MW)	Grid Average Electricity Generation Coal Consumption (Standard Coal kg/Mwh)	Grid Average Electricity Supply Coal Consumption (Standard Coal kg/Mwh)	$GEN_{Fuel, Plants, y}$ Electricity Generation (Gwh)	$GEN_{Fuel, Grid, y}$ Electricity Supply (Gwh)	Parasite Use Rate
Year 2002						
Thermal power plant	3,882	352	377	23,504	21,945	6.83%
Hydro power plant	3,239	-		10,759	10,719	0.37%
Wind Power	8	-		18	18	
Import						
Total	**7,129**			**34,281**	**32,683**	

Data Source: China Electric Power Yearbook 2003, P584,585,592

Table A3: Basic data of the Gansu Power Grid, 2003

Plant data aggregated by fuel type Year 2003	Installed capacity (MW)	Grid Average Electricity Generation Coal Consumption (Standard Coal kg/Mwh)	Grid Average Power Supply Unit Coal Consumption (Standard Coal kg/Mwh)	$GEN_{Fuel, Plants, y}$ Electricity Generation (Gwh)	$GEN_{Fuel, Grid, y}$ Electricity Supply (Gwh)	Parasite Use Rate
Thermal power plant	4,745	351	376	29,494	27,533	6.65%
Hydro power plant	3,281	-		9,812	9,776	0.37%
Wind Power	22	-		33	33	
Import						
Total	**8,047**			**39,339**	**37,342**	

Data Source: China Electric Power Yearbook 2004, P709

The baseline scenario, selected using the Tool for additionality, is the continued operation of existing grid connected power plants and future expansion of thermal power power plants that would be used to generate increased demand in the absence of the XHP project. Because the project uses renewable sources to produce electricity, there are no additional emissions from the project activity. Therefore the emission reductions are created by the displaced fossil fuel generation.

In accordance with The Methodology, the baseline emission factor is calculated as a combined margin (CM), consisting of the simple average of the operating margin emission factor (OM) and the build margin emission factor (BM) by utilizing an *ex-ante* 3 (three) years data vintage. All margins are expressed in tCO2/MWh.

CM= 0.5*OM + 0.5*BM

In accordance with The Methodology, the combined margin is deemed to represent the tCO2/MWh that would have been emitted in the absence of the Project. Emissions reductions will be claimed based on the total CO2 emissions mitigated by the Project, following the 4 steps described below.

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

Step 1 – Calculation of the Operating Margin Emission Factor

Out of four options for the OM, the Simple Operating Margin Emission Factor (S-OM) was chosen for the following two reasons.

1. Detailed hour dispatch data is not available. In China, the China Grid Power Company run the dispatch center and do not make this information available to the public.
2. From historical data that are public available, the ratio of electricity generated by hydro power plants against the total electricity generated in the Gansu grid has been declining over the past five years: 45%, 42%, 37%, 31%, and 25% for 1999, 2000, 2001, 2002, and 2003. And this trend will continue as more coal-fired power plants will be constructed and commissioned as indicated

in the system expansion plan.. Therefore using the average of the five most recent years it can be shown that low-cost/must run hydro resources constitute less than 50% of total grid generation in the Gansu grid.

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

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

the simple OM has been used.

Simple OM. The Simple OM Emission Factor (EF-OM,y) is calculated as the generation-weighted average emissions per electricity unit (tCO2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad \text{(A1)}$$

where
Fi, j, y is the total amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y, j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.

COEFi,j y is the CO2 emission coefficient of fuel i (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and GENj,y is the electricity (MWh) delivered to the grid by source j.

The CO2 emission coefficient COEFi is obtained as

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

where:

NCVi is the net calorific value (energy content) per mass or volume unit of a fuel i, OXIDi is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values), $EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel i.

In China power sector, the NCV*i* for different fuels I were taken from China Energy Statistical Yearbook 2004 and 2000-2002. EF_{CO2} for coal use country-specific values defined as 24.73 ton of carbon/Tj. set by.China Climate Change Country Study. Fraction of Carbon Oxidised for coal is 0.98.

The Simple OM Emission Factor ($EF_{OM, Simple, y}$) of the proposed project is calculated based on the electricity generation mix of the Gansu Power Grid, not including low operating cost/must run power plants, such as wind power, hydropower etc. It is calculated as a 3-year average, based on the most recent statistics available at the time of PDD submission. The data on installed capacity and electricity generation of different power generation sources are taken from the *China Electric Power Yearbook* (2002, 2003, 2004 editions). The data on different fuel consumptions for power generation in the Gansu Power Grid are taken from the *Energy Balance Table of Gansu province* (Year 2001 to year 2003) from the *China Energy Statistical Yearbook* (2000-2002 edition and 2003 edition).

In China, the power plant efficiency indicator is the Electricity Generation Coal Consumption (EGCC), Electricity Supply Coal Consumption (ESCC), and the amount of standard coal that needs to be consumed to generate one kwh (g/kwh), and supply one kwh (g/kwh) to the grid. The *China Electric Power Yearbook* aggregates the EGCC and ESCC of all the thermal power plants at the provincial grid level.

Ideally, the emission factor should be based on the electricity supplied to the grid instead of the electricity generated at the plants. Therefore, because the XHP project is replacing electricity excluding low cost/must run power plant in the grid, the basis for the emission reduction calculation should be the electricity delivered directly to the Gansu grid. However, there is no available data that identifies the electricity delivered to the grid in China. The best official data regarding electricity is provided in the China Electric Power Yearbook, however it only provides information on total electricity generated at the thermal/hydro plants ($GEN_{thermal,\ plants}$ and $GEN_{hydro,\ plants}$). Nevertheless, it is still possible to calculate total electricity delivered to the grid by fuel type with the data available in China by using the following formula:

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

Where

$GEN_{Thermal,\ Grid\ y}$ is the electricity (Gwh) delivered to the grid by coal-fired thermal power plants in year y

$EGCC_{,y}$ is the average amount of standard coal that needs to be burned to generate one kwh of electricity at the thermal power plants in at the thermal power plants in the Gansu grid.

$ESCC_{,y}$ is the average amount of standard coal that needs to be burned to supply one kwh of electricity at the thermal power plants in at the thermal power plants in the Gansu grid.

The data needed for calculating the electricity delivered to the grid are published annually in the China Electric Power Yearbook.

The XHP project is replacing electricity generation sources excluding low cost/must run power plant in the grid. In Gansu grid, all hydro power plants are identified as the low operating cost and must-run power plants and are thus excluded from the total generation when calculating the simple OMEF . Although some thermal power plants might also be considered as low cost must run plants, it is impossible to exclude them from the calculation since there is no available data in China on quantities of electricity generated from thermal-fired power plants. However, their inclusion in the calculation of the OMEF actually improves the conservativeness of the calculations of emission reductions since newly build thermal power plants have higher generation efficiency and therefore have lower emission factors which reduce the overall emission factor. Thus the inclusion of some must run low operating thermal plants in the $EF_{OM,\ simple,\ y}$ calculation will result in fewer emission reductions being allocated to the project.

Gansu Power Grid is connected to the Northwest Power Grid in China. Data for imported electricity are not publicly available in Gansu. According to the technical report by the Asian Development Bank, the interview with the Gansu Grid expert reveals that the Gansu grid is almost self-sufficient, it only imported

1010 Gwh from Qinghai Grid in 2001, less than 3% of total electricity generation of year 2001 (29,529 Gwh) in the Gansu grid. Imports from the Qinghai Grid have continued, but no data is available to the project developer in the preparation of this PDD. However, since the the Qinghai power grid has a much higher EGCC (413 kg standard coal/kwh, 412 kg standard coal/kwh, 400 kg standard coal/kwh for year 2001, 2002, and 2003) than that of Gansu grid (357 kg standard coal/kwh, 352 kg standard coal/kwh, 351 kg standard coal/kwh for year 2001, 2002, and 2003) the carbon emission factors is higher in Qinghai grid than in Gansu Grid. Thus by excluding consideration of imports from the Qinghai grid, the emission factor is more conservative. Therefore, the lack of data on imports does not impair the quality of the emission factor in this project case, rather it results in a more conservative result.

Therefore using data from the Gansu power system from 2001, 2002, and 2003, the system emission factor can be obtained using the Simple OM methodology:

Table A4: Calculation of Operating Margin Emission Factors in 2001 for the Gansu Grid

Fuel	Unit	Fuel Consumptions	Emission Factor	NCV	Fraction of Carbon Oxidised	Emissions	% of total Emissions by fuels
			CTon/Tj	Tj/A		Tons	
	A	B	C	D	E	F=B*C*D*E*44/12	
Raw Coal	104 Tons	846.37	24.73	209.08	0.98	15,725,134.73	98.6%
Coke Oven Gas	108 M3	0.14	20.2	1672.6	0.995	17,257.03	0.1%
Other Gas	108 M3		20.2	522.7	0.995	-	0.0%
Crude Oil	104 Tons	0.06	20.2	426.52	0.995	1,885.98	0.0%
Diesel	104 Tons						0.0%
Fuel Oil	104 Tons	2.08	20.2	426.52	0.99	65,052.01	0.4%
LPG	108 M3					-	0.0%
Refinary Gas	108 M3					-	0.0%
Natural Gas	108 M3	0.62	15.3	3893.1	0.995	134,732.76	0.8%
Other Petroleum Product	104 Tons					-	0.0%
Other Coking product	104 Tons					-	0.0%
Other Energy (Standard Coal)	104 Tons	0.43	24.73	292.8	0.98	11,188.22	0.1%
Total Emission for Gansu Grid (tons)						15,955,250.73	
Total Electricity Generation of Gansu Grid (Gwh)						18,447.00	
Total Electricity Supply of Gansu Grid (Gwh)	Total Electricity Generation*(1-rate of parasite use)					17,094.83	
Simple OM Emission Factor for Gansu Grid (TCO2e/Mwh)						0.933	

Source: China Energy Statistical Yearbook, 2001-2003

Table A5: Calculation of Operating Margin Emission Factors in 2002 for the Gansu Grid

Fuel	Unit	Fuel Consumptions	Emission Factor	NCV	Fraction of Carbon Oxidised	Emissions	% of total Emissions by fuels
			CTon/Tj	Tj/A		Tons	
	A	B	C	D	E	F=B*C*D*E*44/12	
Raw Coal	104 Tons	1156.02	24.73	209.08	0.98	21,478,278.12	98.5%
Cleaned Coal	105 Tons	0.91	24.73	263.44	0.98	21,303.19	0.1%
Coke Oven Gas	108 M3	0.04	20.2	1672.6	0.995	4,930.58	0.0%
Other Gas	108 M3	0.08	20.2	522.7	0.995	3,081.69	0.0%
Crude Oil	104 Tons					-	0.0%
Diesel	104 Tons						0.0%
Fuel Oil	104 Tons	1.7	20.2	426.52	0.99	53,167.51	0.2%
LPG	108 M3					-	0.0%
Refinary Gas	108 M3					-	0.0%
Natural Gas	108 M3	0.53	15.3	3893.1	0.995	115,174.77	0.5%
Other Petroleum Product	104 Tons					-	0.0%
Other Coking product	104 Tons					-	0.0%
Other Energy (Standard Coal)	104 Tons	5.07	24.73	292.8	0.98	131,916.97	0.6%
Total Emission for Gansu Grid (tons)						21,807,852.83	
Total Electricity Generation of Gansu Grid (Gwh)						23,426.00	
Total Electricity Supply of Gansu Grid (Gwh)	Total Electricity Generation*(1-rate of parasite use)					21,826.00	
Simple OM Emission Factor for Gansu Grid (TCO2e/Mwh)						0.999	

Source: China Energy Statistical Yearbook, 2001-2003

Table A6: Calculation of Operating Margin Emission Factors in 2003 for the Gansu Grid

Fuel	Unit	Fuel Consumptions	Emission Factor	NCV	Fraction of Carbon Oxidised	Emissions	% of total Emissions by fuels
			CTon/Tj	Tj/A		Tons	
	A	B	C	D	E	F=B*C*D*E*44/12	
Raw Coal	104 Tons	1479.62	24.73	209.08	0.98	27,490,605.59	98.2%
Coke Oven Gas	108 M3	1.54	20.2	1672.6	0.995	189,827.31	0.7%
Other Gas	108 M3	0.12	20.2	522.7	0.995	4,622.53	0.02%
Crude Oil	104 Tons					-	0%
Diesel	104 Tons						
Fuel Oil	104 Tons	1.19	20.2	426.52	0.99	37,217.26	0.1%
LPG	108 M3					-	0%
Refinary Gas	108 M3					-	0%
Natural Gas	108 M3	0.54	15.3	3893.1	0.995	117,347.88	0.4%
Other Petroleum Product	104 Tons					-	
Other Coking product	104 Tons					-	
Other Energy (Standard Coal)	104 Tons	5.86	24.73	292.8	0.98	152,472.08	0.5%
Total Emission for Gansu Grid (tons)						27,992,092.64	
Total Electricity Generation of Gansu Grid (Gwh)						29,595.00	
Total Electricity Supply of Gansu Grid (Gwh)	Total Electricity Generation*(1-rate of parasite use)					27,627.25	
Simple OM Emission Factor for Gansu Grid (TCO2e/Mwh)						1.013	

Source: China Energy Statistical Yearbook, 2004

The system emission factor is obtained, using the average of the emission factors of Gansu grid from year 2001 to 2003.

	Year 2001	Year 2002	Year 2003	Simple OM
tCO2 / MWh	0.933	0.999	1.013	0.982

Step 2 – Calculation of the Build Margin Emission Factor

According to the Methodology, the BM is defined as the generation-weighted average emission factor of either the 5 most recent or the most recent 20% of power plants built (in generation), whichever group's annual generation is greater. Both lists of plants exclude CDM-Status Plants.

In Gansu grid, the 20% of total electricity which was generated from the total installed capacity as of 2003 is 15,263 Gwh. (76,316*20%). The total generation of the five existing power plants build most recently is 6798 Gwh.[30] As a result, the 20% of total generation was selected as the basis for calculating Build Margin Emission Factor. The ex-ante method is selected to calculate BM for the fix crediting period.

This is done by calculating the share of electricity supply from newly added thermal and hydro power plants whose electricity supply represents 20% of electricity supply in Gansu grid in 2003, times the most conservative estimate of operating margin emission factors for these new thermal power plants and the hydro power plants respectively.

The emission factor of standard coal is calculated using formula (2) and based on IPCC default value.

Key Parameters	Net Calorific Values	Carbon Emission Factors	Fraction of Carbon Oxidised	Conversion Factor	$COEF_{standard\ coal}$
Unit	$TJ/10^3$ ton	tC/TJ	Fraction	tCO2/tC	tCO2/ton of standard coal
Formula	A	B	C	D	A*B*C*D/1000
	29.28	24.73	0.98	3.67	2.602

As a result, the $COEF_{standard\ coal}$ is 2.602 tCO2/ton of standard coal.

It is conservatively assumed that all of the power plants recently added to the Gansu grid are 600 MW sub-critical power generators which have an ESCC of 328.4kg/Mwh.[31] This value is commonly accepted in the power sector in China. By comparison, the Gansu grid average ESCC from 2001 to 2003 is 386, 377, 376kg/Mwh.[32] The carbon emission factor for the newly build coal-fired power plants is therefore calculated as 0.854 tCO2/Mwh using the following formula:

$$EF_{Coal\text{-}fired\ new\ plants} = ESCC_{Coal\text{-}fired\ new\ plants} * COEF_{standard\ Coal} \quad (4)$$

The following are the key parameters for the calculation of $EF_{Coal\text{-}fired\ new\ plants}$

[30] Source: Interview with the Gansu Power Corporation, August 30, 2004

[31] Source: Analysis on Energy Saving Condition in China Power Industry, Page 2, Vol. 6. No. 6, Jun 2005, Electrical Equipment.

[32] Source: China Electric Power Yearbook, Page 623, Yearbook 2002, Page 592, Yearbook 2003, Page 671, Yearbook 2004,

Key Parameters	Power Plant Efficiency (ESCC)	$COEF_{standard\ coal}$	EF $_{Coal-fired\ new\ plants}$
Unit	kg of standard coal /Mwh	tCO2/ton of standard coal	tCO2/Mwh
	F	H	F*H/1000
	328.4	2.602	0.854

Because the 98.2% of thermal electricity generation in Gansu grid in 2003 is coal-fired,[33] the difference between the EF of coal and that of other source of fuel is negligible, so it is reasonable to apply the ESCC to all thermal electricity generation. Because $EF_{hydro\ new\ plant}$ is 0, BMEF is effectively equivalent to the weight of thermal electricity in the grid multiplied by $EF_{coal\text{-}fired\ new\ plants.}$ The formula to calculate BMEF can thus be approximated as follows:

$$BMEF = \frac{GEN_{coal\text{-}fired\ new\ plants,\ grid\ \ y} * EF_{coal\text{-}fired\ new\ plants}}{GEN_{all\ new\ plants,\ y}}$$

Because coal-fired electricity generation accounts for 98.5% and 98.2% of total thermal electricity generation in Gansu grid in 2002 and 2003, there are only very minor changes in terms of electricity generated by other fuels in 2003. The impact on BMEF of the difference between the EF of coal and that of other source of fuel is negligible, so it is reasonable to assume the ESCC is applied to all thermal electricity generation. Because $EF_{hydro\ new\ plant}$ is 0, BMEF is effectively equivalent to the weight of thermal electricity in the grid multiplied by $EF_{coal\text{-}fired\ f\ new\ plants.}$.

To determine the share of hydro electricity and thermal electricity supplied by newly added hydro and thermal power plants, the PDD made two important assumptions:

1 All capacity addition from the thermal and hydro power plant was added evenly from 2000 to 2003.
2 The newly build thermal/hydro power plants have the same plant operating hours as the existing power plants in its respective group.

It is believed that the first assumption is reasonable and neutral with regards to its impact on emission factors. The second assumption is conservative because normally new power plants have higher operating hours and thus supply a higher proportion of electricity to the grid resulting in a higher build margin emission factor. Based on the above two assumptions, it was estimated that electricity supplied by the new installed power plant constitutes 20% of electricity supply in Gansu grid in 2003.

The share of electricity supplied by newly added thermal power plants is 86.8% of total electricity supply from added new capacity in Gansu power grid in 2003. Multiplying this share by the conservatively estimated emission factor for new thermal power plants (0.854 tCO2/Mwh), the resulted Build Margin Emission Factor is 0.742 tCO2/Mwh.

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[33] Source: Table A5 and Table A6, Calculated from China Energy Statistics Yearbook 2000- 2002, 2004,

The following table shows the calculation of the base-year installed capacity, the composition of new capacity addition by fuel types, data source and the calculation process.

Table A8: Calculation of fuel mix of the 20% of total electricity supplied by new capacity

	A	B	C	D	E
	Installed Capacity 2000	Installed Capacity 2003	Baseyear - Installed Capacity	New Capacity Additions	Average Generation Hours in 2003
Data Source	Calculated from China Electric Power Yearbook 2001 - Page 666	China Electric Power Yearbook 2004 - Page 709	Calculated value to set the new capacity to generate 20% of total electricity supply in 2003	B-A	Calculated Generation/installed capacity by fuel type
Thermal power plant	3,600.00	4,745.00	3,634.92	1,110.08	6,216
Hydro power plant	2,952.00	3,280.60	2,962.02	318.58	2,991
Wind Power		21.60	-	21.60	1,528
Nuclear Power				-	
Total	6,552.00	8,047.20	6,597.60	1,449.60	
Capacity as of Installed Capacity of 2003	81%	100%	82%	18%	

Assuming that newly added power plants run the same operation hours as the grid average for each fuel, the electricity supplied from plants by each type of fuel can be obtained by multiplying the new added capacity with the respective grid operation hours.

Table A9: Calculation of Weighted average Build Margin Emission Factor

	F	G	H	I	J
	Parasite Use Rate	Electricity Supplied to grid from new capacity (Gwh)	Split of electricity supplied from New Capacity	Emissions Factor of newly built power plants (tCO2e/MWh)	Weighted Average Build Margin Emissions Factor, EF_BMy
Data Source		D*E*(1-F)/1000	G by fuel type/ (Total of Column G)		I*H
Thermal power plant	6.00%	6,486.02	86.8%	0.854	0.742
Hydro power plant	0.37%	949.31	12.7%	-	-
Wind Power		33.00	0.4%	-	-
Nuclear Power				-	-
Total		7,468.33	100%		0.742

Total Electricity supply in 2003 (Gwh)	37,341.66
Electricity supplied from new capacity (G) as % of total Electricity supply in 2003	20%

The build margin emission factor as a result of above computation is 0.742 tCO2e/Mwh.

Step 3 – Calculation of the Baseline Emission Factor

The Baseline Emission Factor was calculated as a combined margin (CM), consisting of the simple average[34] of both the resulting OM and the resulting BM. All margins expressed in tCO2/MWh.

CM = 0.5*OM + 0.5*BM

CM = 0.5 * (0.982 + 0.742) = 0.862 tCO2 / MWh

[34] The default weights (50%,50%) were kept

The BLS's resulting Baseline Emission Factor was 0.862 tCO_2/MWh.

Step 4 – Calculation of the Baseline Emissions Reductions

The estimated CER per year for The Project, were obtained from the following multiplication:

ERs per year = CMEF* (Estimated Annual Project Electricity Supply in MWh)

Since the annual electricity supply of Xiaogushan 's first phase is 370 GWh, we conclude this project avoids emitting ERs per year, first phase: 0.862 * 370,395 = 319,277tCO_2 per year.

It is conservatively assumed that 80% of expected average electricity will be generated for the first reporting year due to testing and installation schedule. As a result, the ER for the first reporting year is 255,422 tCO_2

The ERs for the first crediting period:

3,128,919 tCO_2 of ERs

The ERs of The Project were deemed to be equal to the baseline emissions because The Project itself does not produce any other emission.

Annex 4

MONITORING PLAN

In accordance with the monitoring methodology ACM0002, there is one key type of information that must be monitored ex-post since the emission factor has been calculated ex ante, namely:

- The electricity supply to the Gansu Grid from the Project Activity EGy

Electricity sales invoices from the commercial metering system that is installed in the 330 Kv Zhangye transformer station will be obtained. Because the metering system is owned and maintained by the Gansu Power Grid Company, the qualified staff of XHP company will collect the electricity sales invoice on a monthly basis to monitor the generated electricity sold to the grid.

It is confirmed that these meters for the main electricity supplied to the grid operate in compliance with the National Guidelines for accuracy and reliability.

To double check the monitored data from the metering system at the transformer substation, the output generated from each turbine will also be monitored. Because it is assumed 1% of electricity generated will be consumed on-site and 5% lost in transmission, only 94% of the output measured by the meters installed in each turbine will be taken as a reference for monitoring whether the generation output read from the transform station is within reasonable range and consistent with direct hydro electricity output on the site.

Procedures for ensuring effective monitoring of the proposed project are described in a CDM manual that the Project Owner and Project Developer has developed. The manual contains the following sections:

1.0 Introduction
2.0 Overall Project Management
3.0 CDM Project Management and Calculations
    3.1 Data to be monitored and recorded (as per the PDD)
    3.2 Emissions Reduction calculation for the Project
4.0 Procedures to be followed
    4.1 Monitoring Procedures
    4.2 Calibration Procedures
    4.3 Maintenance Procedures
    4.4 Procedure for Training of Personnel engaged in this MVP
5.0 Records Keeping, Error Handling and Reporting Procedures
    5.1 Records Keeping and Internal Reporting Procedure
    5.2 Error Handling Procedure
    5.3 External Reporting Procedure
    5.4 Procedure for corrective actions arising
    5.5 Change of CDM Responsible Person
6.0 Confirmation of the adoption of these CDM Operating Procedures