Revision of the Monitoring Plan of Guangrun Hydropower Project in Hubei Province, P.R. China (Ref: 0904)
Version number: 01.1
Date: 09/02/2012

SECTION D. Application of a monitoring methodology and plan

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

The approved monitoring methodology ACM0002: "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".
This methodology is available on the following website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html .

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

The justifications of applying ACM0002 monitoring methodology to the project are as follows:

- The project is a grid-connected (connected with Hubei grid, then Central China Power Grid) hydro power project, then a grid-connected generation project from renewable source.
- The power density of the project is 32.3W/m^2 (15.87W/m^2 for Zhamushui hydropower plant and 75 W/m^2 for Hongwawu hydropower plant). According to the "Thresholds and criteria for the legibility of hydroelectric power plants with reservoirs as CDM project activities"(http://cdm.unfccc.int/EB/023/eb23_repan5.pdf), the project emissions from the reservoir may be neglected.
- The project is not an activity that involves switching from fossil fuels to renewable energy at the site.
- The power grid (the Central China Power Grid) which the project is to be connected to is clearly identified and information on the characteristics of this grid is publicly available.
- The ACM0002 monitoring methodology shall be applied in conjunction with ACM0002 baseline methodology.

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

The power density of the project is 32.3W/m^2 (15.87W/m^2 for Zhamushui hydropower plant and 75 W/m^2 for Hongwawu hydropower plant). According to the "Thresholds and criteria for the legibility of hydroelectric power plants with reservoirs as CDM project activities" (http://cdm.unfccc.int/EB/023/eb23_repan5.pdf), the project emissions from the reservoir may be neglected.

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 type	Data variable	Data unit	Measured (m), calculated (c) , estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data kept?	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.)

Not applicable, since no greenhouse gas will be emitted by the project.

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 type	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
1.EG_y	Electricity quantity	Electricity supplied to the grid by the project	MWh	*m*	hourly measure-ment and monthly recording	100%	electronic	During the crediting period and two years after	EG_y is determined by electricity exported to the grid by the project, electricity imported from the grid via main line and electricity imported from the grid via backup lines, please refer to Annex 4 of this monitoring plan.

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

Step 1: Calculate the Operating Margin emission factor (*$EF_{OM,y}$*)

The Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (4)$$

Where $F_{i,j,y}$ is the amount of fuel i consumed (ton for solid and liquid fuel, m^3 for gas fuel) by relevant power sources j in years y,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.
$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel i (tCO_2/t for solid and liquid fuel, tCO_2/m^3 for gas fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in years y, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j. In the China Electric Power Year Book and other data resources, only generation data is available. The generation from source j can be translated into electricity delivered to the grid by source j by the following formulation:

$$GEN_{j,y} = G_{j,y} \times (1-e_{j,y}), \quad , \quad (5)$$

Where $G_{j,y}$ is the amount of generation (in MWh) by source j in year y; $e_{j,y}$ is the rate of plant self consumption of source j in year y.

The CO_2 emission coefficient of fuel type i $COEF_i$ is obtained as

$$COEF_i = NCV_i \times EF_{CO_2,i} \times OXID_i \quad (6)$$

Where:
NCV_i is the net calorific value per ton or m^3 of a fuel i (GJ/tce).
$OXID_i$ is the oxidation factor of the fuel i.
$EF_{CO2,i}$ is the CO_2 emission factor per GJ of fuel type i (tCO_2/GJ).

The Simple OM emission factor is calculated as a 3-year average (2002-2004), based on the most recent statistics

Step 2. Calculate the Build Margin emission factor (*$EF_{BM,y}$*)

According to ACM0002, the BM is calculated as the generation-weighted average emission factor of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m,y}}{\sum_{m} GEN_{m,y}} \quad (4)$$

Where

$F_{i,m,y}$ is the amount of fuel *i* (tce) consumed by plant *m* in year *y*.

$COEF_{i,m,y}$ is the CO_2 emission coefficient (tCO_2/tce) of fuel *i*, taking into account the carbon content of the fuels used by plant *m* and the percent oxidation of the fuel in year *y*.

$GEN_{m,y}$ is the electricity (MWh) delivered to the grid by plant *m*, equals to generation minus plant self consumption

$$GEN_{m,y} = G_{m,y} \times (1-e_m), \quad (5)$$

Where,
$G_{m,y}$ is the electricity generation by plant *m* in year *y*; e_m is the rate of plant self consumption.
Because data is not available to identify and quantify the individual power plants comprising the most recently built 20% capacity, this PDD uses an approximation calculation modeled after the Executive Board's approved deviation for Methodologies AM0005 and AMS-I.D dated 7 October 2005. This approach has been used by several recently registered China energy project PDDs. In this PDD BM is calculated as follows:

$$EF_{BM,y} = \frac{CAP_{Thermal,new}}{CAP_{new}} \times EF_{Thermal,adv} \quad (6)$$

$EF_{Thermal,adv}$ is the estimated emission factor of fuel-fired thermal plants using Best Practice Commercial Technology. Compared with the *BM* calculation specified in ACM0002, this method is more conservative as it assumes all recently built plants have the fuel efficiency as that of best practice commercial technology. Another expression in formula (6) is the percentage share of thermal plant capacity within all recently built generation capacity.
$CAP_{Thermal,new}$ is the newly installed generation capacity of recently built fuel-fired thermal plants, while CAP_{new} is the installed generation capacity of all recently built power plants. The proper year should be selected so that it is the closest time when the last 20% of generation capacity was installed.

Step 3. Calculate the baseline emission factor EF_y.
The baseline emission factor is the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = \omega_{OM} \times EF_{OM,y} + \omega_{BM} \times EF_{BM,y}, \quad (7)$$

Where the weight w_{OM} and w_{BM} by default, are 50%.
Based on the emission factors in the first 2 steps, the baseline emission factor is $EF_y = EF_{OM,y}/2 + EF_{BM,y}/2$.

Step 4. Calculte the baseline emission (BE_y).
The baseline emissions (BE_y) are the product of the baseline emissions factor (EF_y) calculated in Step 3, times the electricity supplied by the project activity to the grid: $BE_y=EG_y \times EF_y$。

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

Not applicable, since the Option 2 is not applicable to the monitoring of the project.

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 type	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
2.	Area	Surface area at full reservoir level	m^2	*m*	At start of the project	100%	electronic	The data will be kept during the crediting period.	This variable will be Measured through reservoir map.

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

The power density is calculated as follows:

$$Powerdensity = \frac{CAP_{PJ}}{Area} \qquad (8),$$

where,
CAP_{PJ} is the capacity (W) of the project, which is equal to 28,000,000 in this PDD.
Area is the surface area of the newly constructed reservoir at full reservoir level which will be monitored at the begin of the project using map of the reservoir.

If *Powerdensity* is greater than $10W/m^{2,}$ then the project emission $PE_y=0$.

If *Powerdensity* is greater than 4W/m², but less than or equal to 10W/m² , the project emission can be calculated as follows:

$$PE_y = \frac{EF_{Res} \times EG_y}{1000} \qquad (9)$$

where,
EF_{Res} is the default emission factor for emission from reservoir, the default value is 90kg CO^2e/MWh.
EG_y is the electricity delivered by the project to the grid in year y (in MWh).

In this PDD, according to ACM0002 and data from project preliminary design report, the power density is greater than 10W/m², then the project emission of the project (PE_y) is estimated as 0.

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

Not applicable

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

In this PDD, according to ACM0002 and data from project preliminary design report, the power density is greater than 10W/m², then the leakage of the proposed project (L_y) is estimated as 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 emission reductions of the project (ER_y):

$$ER_y = BE_y - PE_y - L_y \qquad (10)$$

Since PE_y and L_y are both zero for the project,

$ER_y = BE_y$ (11)

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*	The data is monitored through the electricity meters, and the electricity exported to the grid by the project and imported from the grid via main line will be rechecked by comparing with the electricity sales receipt from power corporation. As the electricity imported from the grid via the backup are monitored by the local grid company which is unlikely to under estimate the value, thus, QA/QC procedure is not necessary.
D.2.1.3-2	*Low*	The data is calculated through reservoir map, the QA/QC procedure is not necessary because the official or professional map will be used for such calculation.

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

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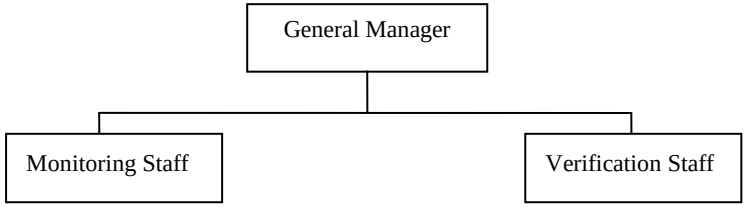
This monitoring plan will be implemented by professional staff authorized by the project sponsor. The management structure is illustrated as follows:



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

The monitoring methodology of the project was completed on 26 March 2006 by:

Carbon Finance Unit
The World Bank
1818 H. Street, NW

Dr Fei TENG, Global Climate Change Institute,
Tsinghua University.
Address: Room C402, Energy Science Building,

Washington, DC 20433
USA

Tsinghua University, 100084, Beijing, China.
Telephone: +8610-62784805
Email: tengfei@tsinghua.edu.cn

Global Climate Change Institute, Tsinghua University is not the project participants listed in Annex 1.

Annex 4

MONITORING PLAN

This monitoring plan includes the management and implementation structures of monitoring activity, parameter to be monitored and quality control process.

Management and implementation structure for monitoring plan

This monitoring plan will be implemented by professional staff authorized by the project sponsor.

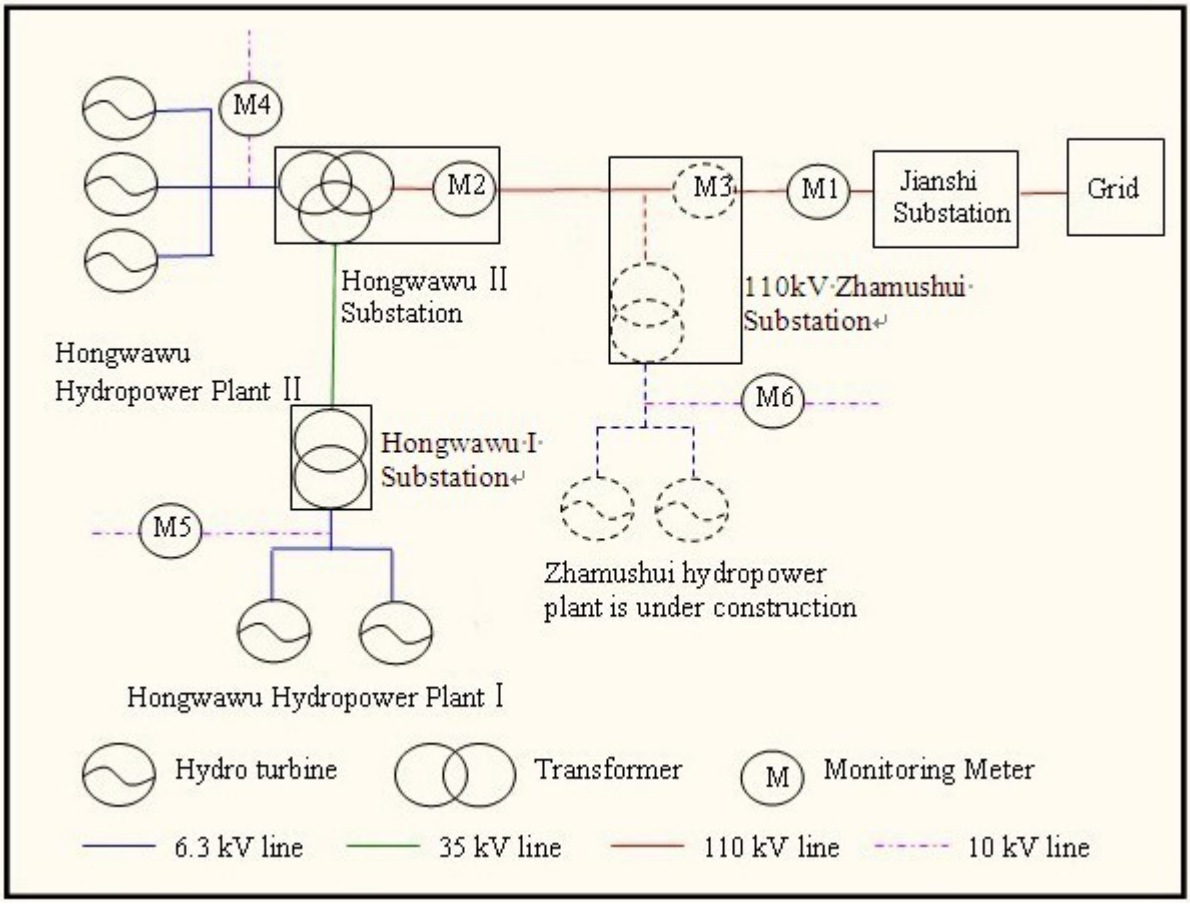
Parameter to be monitored

Please refer to section D of this MP.

Quality Control

The GHP includes three hydropower plants: Hongwawu I hydropower plant, Hongwawu II hydropower plant and Zhamushui hydropower plant. Hongwawu I hydropower plant includes a 8MW powerhouse, a 35kV substation(Hongwawu I Substation) and 35kV transmission line to Hongwawu II Substation; Hongwawu II hydropower plant includes a 10MW powerhouse, a 110kV substation(Hongwawu II Substation) and 110kV transmission line to 110kV Zhamushui Substation; Zhamushui hydropower plant includes a 10MW powerhouse, a 110 kV Zhamushui Substation and 110 kV transmission line to existing Jianshi Substation (Huangtuping Substation in registered PDD).

A line diagram of the monitoring system for the project is presented as follows:



Firstly, the project company and Jianshi Electric Power Company have identified jointly the exact points at which the amount of electricity exported to and imported from the grid will be measured. A meter M1 installed at Jianshi Substation is used to monitor electricity exported to the grid and imported from the grid via main line; The accuracy of the meter (M1) is 0.2s and will be calibrated annually by qualified staff in Jianshi Electric Power Company. A meter M2 is installed at Hongwawu Ⅱ Substation in the project site to measure the electricity export and import of Hongwawu I and II stations; after Zhamushui hydropower plant operating, meter M3 will be installed to measure the electricity export and import of the project. The meter readings of M2 and M3 will not be used in emission reduction calculation, but only as internal reference for proect company, the accuracy and calibration of Meter M2 and M3 is to be in compliance with relative national standard DL/T448-2000.

Secondly, the amount of electricity exported to the grid by the project and imported from the grid via the main line will be recorded every month jointly by designated staff of the project company and Jianshi Electric Power Company. After that, Jianshi Electric Power Company will pay to the project company certain period and the project company will give corresponding receipt for the electricity exported. The project company will pay the grid company for the electricity imported and the grid company will provide corresponding receipt.

Thirdly, the installation and calibration of related kilowatt-hour meters will be in compliance with the regulations of State Electricity Regulatory Commission and relevant articles in the power purchase agreement.
10 kV backup line at each plant (Hongwawu I hydropower plant, Hongwawu II hydropower plant and Zhamushui hydropower plant) will be used to supply electricity to the plant in emergent case when the main power line fails to supply power. Meter M4, M5 and M6 are installed to measure the electricity imported from the grid via these lines. These meters are owned, maintained, read and monthly recorded by grid company. Only grid company has access to these meters. Sales receipts of electricity imported from the grid via backup lines will be issued to the project company by grid company accordingly in an approach which is agreed by both parties. Accuracy and calibration of meter M4, M5 and M6 are in compliance with relative national standards DL/T448-2000. Calibration reports of these meters will be provided to DOE by grid company for verification.

Electricity supplied to the grid by the project (EG_y) will be calculated as electricity exported to the grid by the project minus electricity imported from the grid via main line and electricity imported from the grid via backup lines. Meter readings of electricity exported to the grid by the project and electricity imported from the grid via main line will be cross checked by their own corresponding sales receipts to ensure the conservativeness of emission calculation. Values from the sales receipts of electricity imported from the grid via backup lines will be used for emission calculation as only grid company is accessible to the meters and grid company is not likely to underestimate the electricity sold to project company.

Meter replacement: The original Meter M1 was replaced by a new meter M1 on 31/03/2010 due to the accuracy issue. The accuracy of original M1 before 31/03/2010 was 0.5S, while the registered monitoring plan states the accuracy of meter at the monitoring point will be 0.2S, so a new meter with accuracy of 0.2S was installed to replace original one. For conservativeness, the maximum permissible uncertainty of 0.5% is used to adjust the electricity exported to the grid and imported from the grid via the main line during the period from the starting date of crediting period to 31/03/2010, which means 0.5% of electricity exported to the grid will be deducted and 0.5% of electricity imported by the project will be added are to be applied in the calculation of EG_y during this period.

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

Note: This monitoring plan is to be applied since the start of crediting period.