65MW DAGUSHAN HYDROPOWER PROJECT IN CHINA

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

This project activity is located in Su'nan Yugu Autonomous County and about 102 km far from Zhangye City in Gansu Province, China. The project activity is a project which is constructed and operated by Gansu Zhangye Dagushan Hydropower Co. Ltd. It is a run-of-river hydropower project with a total installed capacity of 65MW (2×26 MW+1×13 MW). The designed operation life of the project is 30 years with an annual electricity generation of 195.15GWh to the Northwest Power Grid of China (NWPG).

The project started the construction on 16/11/2007, and 3 units 26 MW, 26 MW and 13 MW are commissioned on 22/07/2009, 24/07/2009, and 26/07/2009 respectively. The project consists of diversion weir, a tunnel, a penstock, high pressure pipelines, a power station and a transfer station. Three units are three phases' vertical axis hanging turbines. As a renewable energy project, Dagushan Hydropower Plant (abbreviation "DHP") produces positive environmental and economic benefits and contributes to the local sustainable development.

The implementation of the project achieves CO_2 emission reduction by replacing electricity generated by fossil fuel fired power plants. The project first crediting period is from 22/07/2009 to 21/07/2019, the credits in the monitoring period from 22/07/2009 to 08/05/2010 have been issued as VCUs ,and the credits in the monitoring periods from 09/05/2010 to 28/04/2012 have been issued as CERs (Refer to Section 1.10 for details).This monitoring period is from 29/04/2012 to 31/03/2018, and the emission reductions generated in this monitoring period is 1,338,564 tCO_2e.

1.2 Sectoral Scope and Project Type

Sectoral Scope 1: Energy industries (renewable - / nonrenewable sources);

Project type: Hydropower generation project;

The project is not a grouped project.

1.3 Project Proponent

Organization name	Gansu Zhangye Dagushan Hydropower Co., Ltd.
Contact person	Mengde Liu
Title	Project Manager
Address	Cross at Qingnian East Street of Zhangye City, Su'nan Yugu Autonomous County, Zhangye City, Gansu Province, China

Telephone	+86 021-23019950
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1.4 Other Entities Involved in the Project

Organization name	Climate Bridge (Shanghai) Ltd.
Role in the Project	Consultancy
Contact person	Zhiwen Gao
Title	General Manager
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1.5 Project Start Date

The project started on 22/07/2009 (The commissioning date of the 1st generator).

1.6 Project Crediting Period

The project crediting period is ten years, twice renewable for a total of 30 years. However, as the project is also registered as a CDM project with a seven year twice renewable project crediting period, it is not eligible for VCU issuance beyond the end of those 21 years (08/05/2031). The project first crediting period is from 22/07/2009 to 21/07/2019.

1.7 Project Location

This project activity is located in the middle of the upper steam of the Heihe River, within the territory of Su'nan Yugu Autonomous County of Gansu Province, approximately 102 km far from Zhangye City. The geographical coordinates of the project are east longitude of 100°01′29″ and north latitude of 38°37′21″, as shown in figure 1.

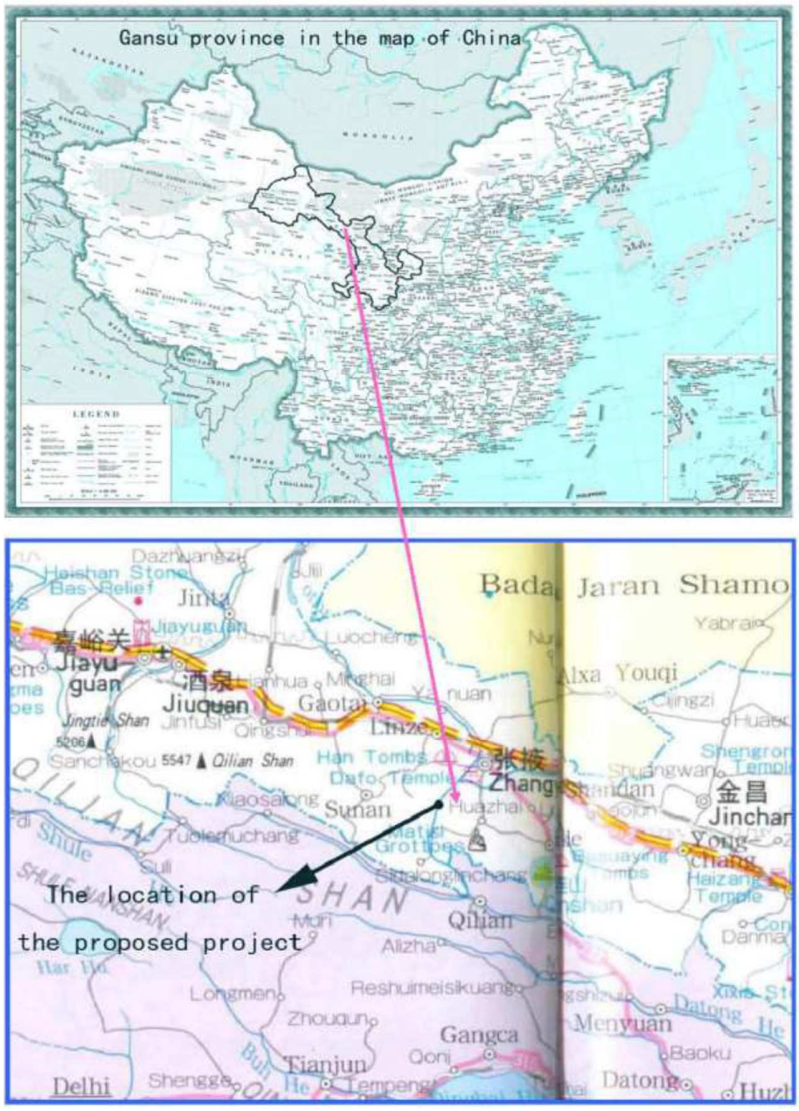


Fig.1. Location of Dagushan Hydropower Project.

1.8 Title and Reference of Methodology

Methodology:

Version 10 of the approved methodology ACM0002 “Consolidated methodology for grid-connected electricity generation from renewable source” and “Consolidated monitoring methodology for grid connected electricity generation from renewable source”;

Reference:

http://cdm.unfccc.int/UserManagement/FileStorage/NF9EDAOV5K382HW0JR14GS7XYQUMCP .

Tools:

- Version 05.2 of “Tool for the Demonstration and Assessment of Additionality”;

- Tool to calculate the emission factor for an electricity system version 02:

Reference:

http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf

1.9 Participation under other GHG Programs

The project was registered as a Clean Development Mechanism (CDM) project (reference number: 3045) in UNFCCC with the 21 (3*7) years crediting period started from 09/05/2010. Please refer to the following link for details:

https://cdm.unfccc.int/Projects/DB/RWTUV1256040897.46/view?cp=1

1.10 Other Forms of Credit

Start Date	End Date	GHG Emission Reduction (tCO_2e)	Credit	Program
22/07/2009	08/05/2010	172,015	VCU	VCS
09/05/2010	31/03/2011	196,425	CER	CDM
01/04/2011	28/04/2012	232,859	CER	CDM

The emission reductions generated during this monitoring period, from 29/04/2012 to 31/03/2018, will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions.

The emission reduction during this monitoring period will request for VCUs and will not be submitted for any emission reduction certificate or carbon offset. There is no CERs or any other environmental credits issued in this monitoring period.

1.11 Sustainable Development

The construction and operation of the project has brought prominent environmental and social benefit, and contribute to region sustainable development through following aspects:

- To act as a direct supplement to power grid capacity, and alleviate regional shortage of electricity in a sense;
- Compared with fossil fuel fired plants, the project does not release pollutants into the air, such as sulphur dioxide, nitrogen oxide and particulates, nor does it emit residuals that can give harmful impacts on soil, water etc.;
- Create new job opportunities for the local people during the project construction and operation.

2 SAFEGUARDS

2.1 No Net Harm

Construction and operation of this project does not result in any significant environmental impacts with following aspects being meticulously investigated:

1. **Ecosystem impact**

   This project has little impact on vegetation and biodiversity since there's very sparse vegetation on the riverside mountains located by the project. After project construction, the rehabilitation of vegetation are conducted on the project site, which improves the vegetation further. Furthermore, the plant species in the construction site are common species existing in extensive areas and move near areas during the construction period with little negative impact.

   The upstream view are altered as a result of the project. The diversion reroutes water away from the traditional route taken by the river. Although water is returned to the river after being diverted, the downstream water level is intermittently affected by the project. In order to protect the ecology system, the project developer ensures that minimum ecological waters flows will be maintained (4.43m^3/s), according to the EIA10, therefore the negative impacts are not considered to be significant.

2. **Wastewater**

   In order to protect the Heihe River from being polluted, the wastewater is not allowed to be discharged into the river directly. During the operation period, the waste water, mainly sanitary waste from the plant staffs, is treated by an integrated sewage disposal equipment of 10 cubic meters to meet the standard of GB8978-1996, and then is used for irrigation purpose in the project site.

3. **Solid waste**

   During the construction period, the solid waste includes the engineering waste residue and the domestic garbage. The engineering waste residue is disposed in dumping sites. And the domestic garbage is collected and carried to designed dumpsites regularly for disposal.

4. **Noise**

   Noise is mainly caused by the machines and vehicles during construction period. The construction personnel takes precautionary measures during the construction to avoid the negative impacts from noise. Furthermore, the construction site is located in deep gorge with seldom residents resulting in no quarrels of "disturbing of sweet dreams. Hence the noise impact of the project is insignificant.

5. **Impact on Qilianshan Natural Reserve**

   The project is located in the experimental zone of Qilianshan Natural Reserve (QNR). The natural reserve area is classified into core, buffer and experimental zones according to the nature characteristics. In the core and buffer zone any kind of exploitation is

prohibited, while in the experimental zone, production and living areas activities are allowed. The project area is not the habitat of wild animals, so through rationally designing and carrying out construction activities, the adverse impact on the wild animals will be very little.

6. **Reduce the pollution resulting from coal-fired consumption**

   When the project is put into operation, the electricity displacement reduces 77.7 kilo tons of coal consumption, 17.7 tons of CO emission, 3.69 kilo tons of SO_2 emission and 680 tons of NO_x emission, which not only mitigates the local shortage pressure of coal and water, and also improves the local environment quality.

2.2 Local Stakeholder Consultation

100 questionnaires were distributed in October 2006, and by the end of December 2006 to collect local stakeholders' opinions and concerns on the monitored hydropower project in Su'nan county and Zhangye city. All of the distributed questionnaires had been returned, and the return rate is 100%. Investigated issues include:

- Key environmental problems currently existing in the project construction area
- Main impacts on the local environment of the project activity
- Contribution of the project to local economic development
- Necessity of the project activity
- Major impacts of the project on local public living quality
- Recommendations on the construction of the project and environmental protection in the construction area

With factors, such as age, civilizations, and occupations, considered, the scope of investigated stakeholders is well-rounded, including herdsman, forestry authority staff, residents, students, teachers, technicians, environmentalists and governmental officials in Su'nan county and Zhangye city.

It is the general opinion that the Dagushan hydropower plant is a feasible project that depends on viewpoints from experts and officials. The major public concerns regarding this project are landscape destroy (36%) and noise pollution (28%); regarding the attitude towards the project, 98% support it and only one person object (the attitude of another person is indifferent). The objection reason is that they worry about the possible negative impact on the local eco-environment. Most of the stakeholders think that it should be scientific design, make effort to protect the eco-environment and make full use of the hydro energy resource.

For the 2% stakeholders who worried about the possible negative impact on the local eco-environment, the project owner has taken effort to make them understand the little impact on the eco-environment as the EIA conclusion. The project owner keeps regular

communication with the public regarding the construction and operation of this project. At the same time, according to the stakeholders' requirements, 2 stakeholders among them have been selected and assigned to be the volunteer supervisor of environment protection, who has been supervising the environment issue during the operation period.

2.3 AFOLU-Specific Safeguards

NA.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

This project is a run-of-river hydropower project, the total installed capacity is 65 MW served by two 26 MW generators and one 13 MW generator. The designed operation life of the project is 30 years. After commissioning, the project is operating in good conditions. In this monitoring period, the project was also running orderly without any overhauling and downtimes of equipment. No special events occurred during the monitoring period which may impact the applicability of the methodology.

The main construction of the project consists of a diversion weir, a tunnel, a penstock, high pressure pipelines, a power station and a transfer station. The voltage of the generated electricity is increased to 330 kV and the electricity is delivered to the NWPG. The powerhouse installed three sets of turbines and generators, and more details of the equipment can be referred to Table 1 below.

Table 1. Summary of key equipment in the project.

Equipment	Parameter	Unit	Amount
Turbine	Units(large/small)	-	3 (2*large/1*small)
	Model(large/small)	-	HL(257)-LJ-225 HL(257)-LJ-160
	Rated Head	m	73
	Rated Flow (large/small)	m^3/s	40/21
	Rated Rotation Speed (large/small)	r/min	300/428.6
	Rated Power (large/small)	MW	27.3/13.6

	Annual operation time	h	3,094
Generator	Model (large/small)	-	SF-J26-20/4800 SF-J13-14/3400
	Rated Power	MW	26/13
	Rated Voltage	kV	10.5
	Rated Rotation Speed	r/min	300/428.6
Manufacturer	Hangzhou Resource Power Equipment Co., Ltd.		

Changes of measuring meters during this monitoring period will be illustrated in Section 4.2.

3.2 Deviations

3.2.1 Methodology Deviations

There is no methodology deviation applied to this monitoring period.

3.2.2 Project Description Deviations

The project is registered under VCS Version 2007.1 and completed validation before 21/07/2019, thus it remains eligible to apply the crediting period requirements under VCS Version 3, the first crediting period of the project should be updated from 22/07/2009~08/05/2010 to 22/07/2009~21/07/2019 (3*10 years).

3.3 Grouped Projects

NA.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

The baseline grid emission factor EF_y is obtained directly from the official source Notification on Determining Baseline Emission Factor of China's Grid by China's DNA. Thus, the relevant basic parameters for calculation are not described in detail here. With consideration of the fact of the project, data and parameters that are available at validation are summarized in the following tables:

Data / Parameter	EF_y
Data unit	tCO_2e/MWh
Description	Baseline Emission Factor
Source of data	2008 Baseline Emission Factors for Regional Power Grids in China published by China DNA
Value applied	0.8712
Justification of choice of data or description of measurement methods and procedures applied	As per the requirements in "Tool to calculate the emission factor for an electricity system version 02"
Purpose of Data	Calculation of baseline emissions
Comments	NA

Data / Parameter	Cap_{BL}
Data unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project Site
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	NA
Purpose of Data	Calculation of project emissions
Comments	NA

Data / Parameter	A_{BL}
Data unit	m^2

Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data	Project Site
Value applied	Zero
Justification of choice of data or description of measurement methods and procedures applied	NA
Purpose of Data	NA
Comments	NA

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y.
Source of data	Project site
Description of measurement methods and procedures to be applied	• The measurement is conducted hourly and archived monthly. • The meter equipment meets the GB/T 17883 and DL/T 614 standard and is deployed under DL/T 448 rules. • Power Measurement Center of Gansu Province Electric Power Company, recognized by the National Metrology Administration and both parties, are responsible for the examination, test, malfunction investigation, and seal. • The calibration is carried out quarterly for main meters and yearly for backup meters. • The accuracy of the electric meters is 0.2s.
Frequency of monitoring/recording	The automatic monitoring system which monitors all the meters related will collect the data every 15 minutes and at 24:00 o'clock of the day at the end of each month. Gansu Power Grid will then collect the readings on M1, M2, M5, M7 and M9.

Value monitored	1,536,460.700
Monitoring equipment	M1, M2, M3, M4, M5, M6, M7, M8, M9, M10 (details will be illustrated in Section 4.3)
QA/QC procedures to be applied	The meters are calibrated according to the relevant national standard and regulations; net electricity generation delivered to the grid are recorded by both the project owner and the grid company. The collected data are cross checked by sales invoices, and the lower values are used for the calculation of emission reduction to ensure the conservative quality.
Purpose of the data	Calculation of baseline emissions
Calculation method	The original data are collected and calculated by the Grid Company. This value ($EG_{facility,y}$) is calculated by summing all the electricity generation from each month during the monitoring period. Monthly electricity generation is calculated from the following equation: $EG_{facility,y} = (EG_{M1} + EG_{M2}) \times \frac{(EG_{M7}+EG_{M9})}{(EG_{M5}+EG_{M7}+EG_{M9})}$
Comments	NA

Data / Parameter	Cap_{PJ}
Data unit	W
Description	Installed capacity of the hydropower plant after the implementation of the project activity.
Source of data	Project Site
Description of measurement methods and procedures to be applied	Determined installed capacity based on recognized standards.
Frequency of monitoring/recording	Yearly
Value monitored	65×10^6
Monitoring equipment	NA

QA/QC procedures to be applied	NA
Purpose of the data	Calculation of project emissions
Calculation method	Monitoring data from the nameplate of hydroelectric generating set.
Comments	NA

Data / Parameter	A_{PJ}
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	Calculated based on the design schematics and area maps.
Description of measurement methods and procedures to be applied	Measured
Frequency of monitoring/recording	Yearly
Value monitored	138,047 (2012~2018)
Monitoring equipment	NA
QA/QC procedures to be applied	Project direct emission is excluded because the project's power density is 471W/m^2 which is much higher than 10 W/m^2. Further QA/QC procedures are therefore not considered necessary.
Purpose of the data	Calculation of project emissions
Calculation method	NA
Comments	The measurement will be carried out by the third authorized party.

The generation during the meter changing period has been confirmed based on the record provided by the equipment for voltage missing record and voltage missing timing and on the basis of fully negotiation.

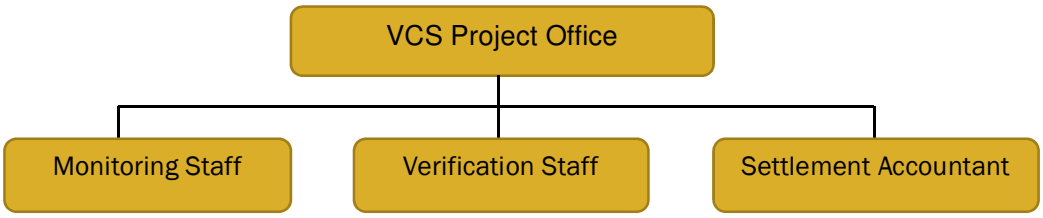
4.3 Monitoring Plan

1. Monitoring of reservoir surface area:

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

2. Monitoring Management Structure:

Thee management structure for monitoring of emission reductions are displayed as following chart:



The DHP entity will set up a VCS team/committee comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. The VCS team also comprises of a special group of operators who are assigned the responsibility of monitoring different parameters and record. On a weekly basis, the monitoring reports are checked and discussed by the senior VCS team members/managers. In case of any irregularity observed by any of the VCS team member, it is informed to the concerned person for necessary actions.

The responsibility of general manager is to supervise the whole process of monitoring activity; monitoring staffs are from Generation & Operation Department and VCS project office. Their responsibility is to collect the data from Grid Company and to prepare the monitoring report each year; verification staffs are from Operation and Management Department and Finance & Management Department. For the staff of Operation and Management Department, their responsibility is to compare and cross check the data, and for the Staff of Finance and management Department, their responsibility is to deal with the issuance of invoice and settlement of payment.

3. Main Interface:

The electricity generation is measured by the grid company and the project owner. An agreement has been signed between the project owner and the grid company that defines the metering arrangements and the required quality control procedures to ensure accuracy.

The power generated by the proposed project is transmitted to Heihe Substation (330kV) together with the electricity of Erlongshan Hydropower Plant (EHP), a CDM project which is located in the upper reaches of the proposed project, then to Gansu Power Grid and finally to North West Power Grid (NWPG).

The collected data are delivered to Gansu Provincial Power Trading Centre (hereunder abbreviated as GPPTC) and local grid company by the same system. GPPTC then issues a monthly power settlement notice to inform the monthly generation amount for settlement. Afterwards, project owners will dispatch corresponding receipts.

There are 10 meters, including both main and backup meters, installed to measure the electricity delivered from different sources:

M1 and M2 (0.2S, bi-directional): Owned by the grid company. M1 and M2 were installed at the Heihe Substation (330kV) of the Grid Company. Both of them measures the net electricity generation supplied to the grid by the DHP and EHP.

M3 and M4 (0.2S, bi-directional): Owned by the project owner. M3 and M4 are located at the exit of booster station of DHP, as the backup meter of M1 and M2.

According to Power Purchasing Agreement (PPA), once M1 and M2 have a breakdown, the electricity will be measured accordingly by M3 and M4. The caused line loss will be negotiated by project owner and the grid company.

M5 and M6 (0.2S, single-directional): M5 is owned by the grid company, which are located at the inlet of booster station of DHP on the transmission line from EHP to DHP. M6 is owned by the project owner, which is located in the booster station of EHP. The reading on M5 is employed to record the net electricity generation supplied by EHP. M6 is the backup meter for M5.

M7 and M9 (0.2S, bi-directional): Owned by the grid company, which are located at the powerhouse of DHP. M7 and M9 measure the electricity exported from No.1 and No.2 main transformer respectively of DHP.

M8 and M10 (0.2S, bi-directional): Owned by the grid company, which are located at the powerhouse of DHP. Both of them are used as the backup meters of M7 and M9 correspondingly.

Figure 2. shows the grid connection of DHP:

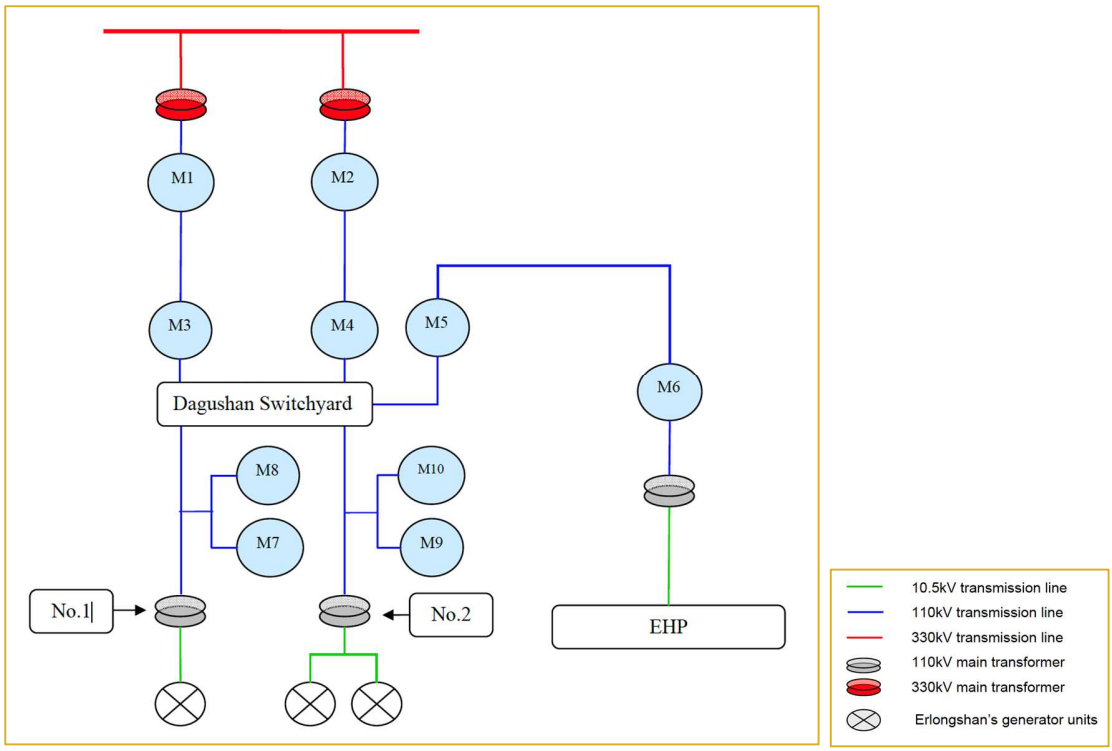


Figure 2. Monitoring system of the project.

Monitoring Procedure:

M1, M2, M5, M7, M9 Monitoring: At the end of each month, the data on M1, M2, M5, M7 and M9 will be collected by provincial power grid company. Based on that, the sales invoice will be issued.

M3, M4, M6, M8, M10 Monitoring: The Generation & Operation Department will manually record the electricity quantity data daily. Every day the computer monitoring system will prepare a data recording table. At the end of each month, the monthly recorded data of electricity will be sent to the Operation& management Department by the staff of generation and operation department. The data will be rechecked and kept by Operation& management Department.

4. Calibration:

Inspection and calibration on meters are carried out according to national standard. The routine check and calibration activities for electricity monitoring apparatus are being done by the national authorized duly accepted power metering authority which is Power Measurement Center of Gansu Province Electric Power Company. The meters installed at the Heihe substation and the power plant is checked, sealed by the authority calibration entity. The detailed information is as follow:

	Year	Serial Number	Accuracy	Type	Calibration Date
M1	29/04/2012~	36061122	0.2s	SL7000	

	31/03/2018				22/02/2012; 21/05/2012; 18/08/2012; 16/11/2012; 15/02/2013; 14/05/2013; 13/08/2013; 12/11/2013; 11/02/2014; 10/05/2014; 09/08/2014; 08/11/2014; 07/02/2015; 06/05/2015; 05/08/2015; 04/11/2015; 03/02/2016; 02/05/2016; 01/08/2016; 31/10/2016; 30/01/2017; 29/04/2017; 28/07/2017; 27/10/2017; 26/01/2018;
M2	29/04/2012~ 31/03/2018	36085837	0.2s	SL7000	22/02/2012; 21/05/2012; 18/08/2012; 16/11/2012; 15/02/2013; 14/05/2013; 13/08/2013; 12/11/2013; 11/02/2014; 10/05/2014; 09/08/2014; 08/11/2014; 07/02/2015; 06/05/2015; 05/08/2015; 04/11/2015; 03/02/2016; 02/05/2016; 01/08/2016; 31/10/2016; 30/01/2017; 29/04/2017; 28/07/2017; 27/10/2017; 26/01/2018;
M3	29/04/2012~ 31/03/2018	20080850060011	0.2s	DTSD341	16/06/2011; 21/05/2012; 18/05/2013; 17/05/2014; 16/05/2015; 15/05/2016; 14/05/2017;
M4	29/04/2012~ 31/03/2018	20080850060012	0.2s	DTSD341	16/06/2011; 21/05/2012; 18/05/2013; 17/05/2014; 16/05/2015; 15/05/2016; 14/05/2017;

M5	29/04/2012~ 15/12/2016	53033805	0.2s	SL7000	10/03/2012; 21/05/2012; 17/08/2012; 16/11/2012; 15/02/2013; 14/05/2013; 13/08/2013; 12/11/2013; 11/02/2014; 10/05/2014; 09/08/2014; 08/11/2014; 07/02/2015; 06/05/2015; 05/08/2015; 04/11/2015; 03/02/2016; 02/05/2016; 01/08/2016; 31/10/2016;
	16/12/2016~ 31/03/2018	215294945	0.2s	MK6E	09/11/2016; 30/01/2017; 29/04/2017; 28/07/2017; 27/10/2017; 26/01/2018;
M6	29/04/2012~ 31/03/2018	06022100934603	0.2s	DTSD50	13/06/2011; 21/05/2012; 18/05/2013; 17/05/2014; 16/05/2015; 15/05/2016; 14/05/2017;
M7	29/04/2012~ 15/12/2016	53033804	0.2s	SL7000	10/03/2012; 21/05/2012; 17/08/2012; 16/11/2012; 15/02/2013; 14/05/2013; 13/08/2013; 12/11/2013; 11/02/2014; 10/05/2014; 09/08/2014; 08/11/2014; 07/02/2015; 06/05/2015; 05/08/2015; 04/11/2015; 03/02/2016; 02/05/2016; 01/08/2016; 31/10/2016;
	16/12/2016~ 31/03/2018	215294941	0.2s	MK6E	09/11/2016;

					30/01/2017; 29/04/2017; 28/07/2017; 27/10/2017; 26/01/2018;
M8	29/04/2012~ 15/12/2016	53033803	0.2s	SL7000	13/06/2011; 21/05/2012; 18/05/2013; 17/05/2014; 16/05/2015; 15/05/2016;
	16/12/2016~ 31/03/2018	215294942	0.2s	MK6E	09/11/2016; 27/10/2017;
M9	29/04/2012~ 15/12/2016	53033801	0.2s	SL7000	10/03/2012; 21/05/2012; 17/08/2012; 16/11/2012; 15/02/2013; 14/05/2013; 13/08/2013; 12/11/2013; 11/02/2014; 10/05/2014; 09/08/2014; 08/11/2014; 07/02/2015; 06/05/2015; 05/08/2015; 04/11/2015; 03/02/2016; 02/05/2016; 01/08/2016; 31/10/2016;
	16/12/2016~ 31/03/2018	215294943	0.2s	MK6E	09/11/2016; 30/01/2017; 29/04/2017; 28/07/2017; 27/10/2017; 26/01/2018;
M10	29/04/2012~ 15/12/2016	53033802	0.2s	SL7000	13/06/2011; 21/05/2012; 18/05/2013; 17/05/2014; 16/05/2015; 15/05/2016;
	16/12/2016~ 31/03/2018	215294944	0.2s	MK6E	09/11/2016; 27/10/2017;

Because of malfunction, the State Grid Measurement Center of Electric Power Research Institute of Gansu Province replaced new meters for several meters on December 16th, 2016. Details are as follow:

Meters	Replacing Time (start)	Replacing Time (end)

M5	16/12/2016 13:38	16/12/2016 14:00
M7	16/12/2016 12:30	16/12/2016 13:25
M8	16/12/2016 12:30	16/12/2016 13:25
M9	16/12/2016 10:50	16/12/2016 12:20
M10	16/12/2016 10:50	16/12/2016 12:20

5. Emergency Procedures:

Under normal circumstances, the settlement of electricity is measured from the main meter. However, either DHP or the grid company, who finds abnormality on main meters or finds troubles impacting the metering of generation amount, should inform immediately the other party and metering apparatus inspection organization accepted by both parties to examine problems together in order to resume normal condition as soon as possible. The process of dealing with the problem is as following:

Representatives from the Gansu Power Grid Company, Zhangye branch of Gansu Power Grid and DHP will negotiate and deal with the problem together. They will check the malfunctional meters and conduct the maintenance work. Meanwhile, electricity data will be collected, checked, and calculated from the corresponding backup meters. If both the main and backup meters are abnormal, data will be determined by the alternate measuring point from the main meter from the other party. If the main meter from the other party is abnormal, data will be determined by the corresponding backup meter from the other party. Data will then be confirmed by the three parties. Finally, the undercounting amount of electricity generation during the maintenance period will be added to the electricity data of this month.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The emission reduction by the project is calculated according to approved consolidated methodology ACM0002 (Version 10). The equation is showed below:

$$\mathbf{ER_y = BE_y - PE_y}$$

Where:

ER_y is the emission reductions in year y (tCO_2e/yr)

BE_y is baseline emissions in year y (tCO_2e/yr)

PE_y is project emissions in year y (tCO_2e/yr)

To calculate BE_y:

$$\mathbf{BE_y = EG_{PJ,y} \times EF_{grid,CM,y}}$$

Where:

BE_y = Baseline emission in year y (tCO_2e/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid in year y (MWh/yr).

$$\mathbf{EG_{PJ,y} = EG_{facility,y}}$$

Where, $EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant to the grid in year y (MWh/yr).

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (version 02).

The emission factor $EF_{grid,CM,y}$, with the value of 0.8712 tCO_2e/MWh, is calculated ex-ante and is fixed during this monitoring period. The details[1] of the electricity generation calculated after the deduction of electricity imported from electricity exported in this monitoring period (29/04/2012 ~ 31/03/2018) is shown in Table 2~8.

Table 2. The summarization of electricity generation of DHP from 29/04/2012 ~ 31/12/2012.

2012			
Period	$EG_{facility,y}$(MWh)	Electricity Data in Sales Receipt (MWh)	$EG_{facility,y}$(MWh) = min(A,B)
	A	B	
29/04 ~ 31/05	25,236.399	25,234.455	25,234.455
01/06 ~ 30/06	30,495.271	30,495.271	30,495.271
01/07 ~ 31/07	43,719.800	43,721.291	43,719.800
01/08 ~ 31/08	46,913.313	46,913.313	46,913.313
01/09 ~ 30/09	40,317.377	40,317.377	40,317.377
01/10 ~ 31/10	24,339.624	24,339.624	24,339.624

[1] For more detailed calculation process, please refer to the Emission Reduction (ER) calculation sheet.

01/11 ~ 30/11	15,534.054	15,000.545	15,000.545
01/12 ~ 31/12	9,914.338	9,914.338	9,914.338
Total	**236,470.176**	**235,936.214**	**235,934.723**

Table 3. The summarization of electricity generation of DHP from 01/01/2013 ~ 31/12/2013.

2013			
Period	**$EG_{facility,y}$(MWh)**	**Electricity Data in Sales Receipt (MWh)**	**$EG_{facility,y}$(MWh) = min(A,B)**
	A	**B**	
01/01 ~ 31/01	5,716.124	5,716.124	5,716.124
01/02 ~ 28/02	7,695.533	7,456.296	7,456.296
01/03 ~ 31/03	7,640.360	7,640.360	7,640.360
01/04 ~ 30/04	12,498.675	12,498.675	12,498.675
01/05 ~ 31/05	16,143.866	16,143.866	16,143.866
01/06 ~ 30/06	36,443.248	36,425.769	36,425.769
01/07 ~ 31/07	46,652.358	46,619.837	46,619.837
01/08 ~ 31/08	41,064.776	41,050.904	41,050.904
01/09 ~ 30/09	41,833.764	41,833.764	41,833.764
01/10 ~ 31/10	26,769.345	26,769.345	26,769.345
01/11 ~ 30/11	10,716.965	10,378.374	10,378.374
01/12 ~ 31/12	11,358.210	11,318.813	11,318.813
Total	**264,533.224**	**263,852.127**	**263,852.127**

Table 4. The summarization of electricity generation of DHP from 01/01/2014 ~ 31/12/2014.

2014			
Period	**$EG_{facility,y}$(MWh)**	**Electricity Data in Sales Receipt (MWh)**	**$EG_{facility,y}$(MWh) = min(A,B)**
	A	**B**	

01/01 ~ 31/01	5,569.417	5,569.417	5,569.417
01/02 ~ 28/02	7,585.093	7,585.093	7,585.093
01/03 ~ 31/03	10,425.588	10,425.588	10,425.588
01/04 ~ 30/04	15,394.519	15,354.395	15,354.395
01/05 ~ 31/05	18,718.002	18,667.295	18,667.295
01/06 ~ 30/06	31,008.521	31,008.521	31,008.521
01/07 ~ 31/07	35,990.776	35,794.491	35,794.491
01/08 ~ 31/08	39,720.342	39,720.342	39,720.342
01/09 ~ 30/09	37,153.443	36,945.567	36,945.567
01/10 ~ 31/10	35,808.177	35,808.177	35,808.177
01/11 ~ 30/11	10,516.335	10,516.335	10,516.335
01/12 ~ 31/12	9,929.600	9,256.943	9,256.943
Total	**257,819.813**	**256,652.164**	**256,652.164**

Table 5. The summarization of electricity generation of DHP from 01/01/2015 ~ 31/12/2015.

2015			
Period	**$EG_{facility,y}$(MWh)**	**Electricity Data in Sales Receipt (MWh)**	**$EG_{facility,y}$(MWh) = min(A,B)**
	A	**B**	
01/01 ~ 31/01	9,294.909	9,294.909	9,294.909
01/02 ~ 28/02	8,164.010	8,164.010	8,164.010
01/03 ~ 31/03	11,319.800	11,052.519	11,052.519
01/04 ~ 30/04	13,961.839	13,891.884	13,891.884
01/05 ~ 31/05	19,106.743	19,106.743	19,106.743
01/06 ~ 30/06	29,917.530	29,827.114	29,827.114
01/07 ~ 31/07	35,641.738	35,588.028	35,588.028
01/08 ~ 31/08	40,335.072	40,237.022	40,237.022
01/09 ~ 30/09	36,559.667	36,559.667	36,559.667

01/10 ~ 31/10	23,833.531	23,363.998	23,363.998
01/11 ~ 30/11	11,651.894	11,476.287	11,476.287
01/12 ~ 31/12	9,161.380	8,799.438	8,799.438
Total	**248,948.113**	**247,361.619**	**247,361.619**

Table 6. The summarization of electricity generation of DHP from 01/01/2016 ~ 31/12/2016.

2016			
Period	**$EG_{facility,y}$(MWh)**	**Electricity Data in Sales Receipt (MWh)**	**$EG_{facility,y}$(MWh) = min(A,B)**
	A	**B**	
01/01 ~ 31/01	6,503.563	6,503.563	6,503.563
01/02 ~ 28/02	7,205.303	7,205.303	7,205.303
01/03 ~ 31/03	10,490.043	9,640.659	9,640.659
01/04 ~ 30/04	14,105.571	14,105.571	14,105.571
01/05 ~ 31/05	17,518.996	17,442.413	17,442.413
01/06 ~ 30/06	28,939.365	28,939.365	28,939.365
01/07 ~ 31/07	36,848.845	36,848.845	36,848.845
01/08 ~ 31/08	40,793.654	40,793.654	40,793.654
01/09 ~ 30/09	40,223.618	39,890.064	39,890.064
01/10 ~ 31/10	24,419.622	24,419.622	24,419.622
01/11 ~ 30/11	13,765.893	13,765.893	13,765.893
01/12 ~ 31/12	11,386.925	8,496.987	8,496.987
Total	**252,201.398**	**248,051.939**	**248,051.939**

Table 7. The summarization of electricity generation of DHP from 01/01/2017 ~ 31/12/2017.

2017			
Period	**$EG_{facility,y}$(MWh))**	**Electricity Data in Sales Receipt (MWh)**	**$EG_{facility,y}$(MWh) = min(A,B)**

	A	B	
01/01 ~ 31/01	7,400.989	7,400.989	7,400.989
01/02 ~ 28/02	6,724.962	6,724.962	6,724.962
01/03 ~ 31/03	8,644.947	8,644.947	8,644.947
01/04 ~ 30/04	15,268.700	15,268.700	15,268.700
01/05 ~ 31/05	27,856.624	27,005.893	27,005.893
01/06 ~ 30/06	27,639.454	27,639.454	27,639.454
01/07 ~ 31/07	36,143.726	36,143.726	36,143.726
01/08 ~ 31/08	38,977.247	38,977.247	38,977.247
01/09 ~ 30/09	39,649.074	39,649.074	39,649.074
01/10 ~ 31/10	26,211.848	26,211.848	26,211.848
01/11 ~ 30/11	15,241.700	15,241.700	15,241.700
01/12 ~ 31/12	9,894.734	9,894.734	9,894.734
Total	**259,654.005**	**258,803.274**	**258,803.274**

Table 8. The summarization of electricity generation of DHP from 01/01/2018 ~ 31/12/2018.

2018			
Period	**$EG_{facility,y}$(MWh)**	**Electricity Data in Sales Receipt (MWh)**	**$EG_{facility,y}$(MWh) = min(A,B)**
	A	**B**	
01/01 ~ 31/01	7,794.590	7,794.590	7,794.590
01/02 ~ 28/02	6,640.218	6,640.218	6,640.218
01/03 ~ 31/03	11,370.046	11,370.046	11,370.046
Total	**25,804.854**	**25,804.854**	**25,804.854**

Table 9. The summarization of electricity generation of DHP during the whole monitoring period (29/04/2012 ~ 31/03/2018).

Year	$EG_{facility,y}$(MWh)

29/04/2012 ~ 31/12/2012	235,934.723
2013	263,852.127
2014	256,652.164
2015	247,361.619
2016	248,051.939
2017	258,803.274
01/01/2018 ~ 31/03/2018	25,804.854
Total	**1,536,460.700**

Then, by multiplying total electricity generation with the emission factor $EF_{grid,CM,y}$, the baseline emission will be gained:

$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$ = 1,536,460.700 MWh × 0.8712 tCO_2e/MWh = 1,338,564 tCO_2e

Thus, the baseline emission during this monitoring period is **1,338,564 tCO_2e**.

5.2 Project Emissions

The power intensity of this project is 471 W/m^2, much greater than 10 W/m^2, since this project is a run-of river hydropower clean energy project, so there is no GHG emission from the project activity. Therefore, PE_y = 0 tCO_2e. The power density of the project activity is calculated as follows:

$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$ = (65×10^6-0) / (138,047-0) = 471 (W/m^2)

Where:
PD = Power density of the project activity, in W/m^2.
Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W).
Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.
A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

5.3 Leakage

According to methodology ACM0002 (ver.10), No leakage emissions should be considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use. These emissions sources are neglected.

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
29/04/2012 ~ 31/12/2012	205,546	0	0	205,546
2013	229,867	0	0	229,867
2014	223,595	0	0	223,595
2015	215,501	0	0	215,501
2016	216,102	0	0	216,102
2017	225,469	0	0	225,469
01/01/2018 ~ 31/03/2018	22,481	0	0	22,481
Total	**1,338,564**	**0**	**0**	**1,338,564**

According to the registered PDD, the estimated value of emission reduction during this monitoring period is 170,015 tCO_2e per year. The total estimated value of the emission reduction is calculated as:

$$\textbf{Total Estimated } ER_y = \frac{\textbf{170,015 tCO2e} \times \textbf{number of monitored days}}{\textbf{365}}$$

There are 2,163 days during the monitoring period. Thus, the total estimated emission reduction is 1,007,514 tCO_2e during the monitoring period. Table 10 shows the comparison between estimated and actual emission reduction. The difference percentage is calculated as:

$$\textbf{Difference Percentage} = \frac{\textbf{Actual} - \textbf{Estimated}}{\textbf{Estimated}}$$

Table 10. The comparison of emission reductions between the estimated and actual value.

Estimated ER_y during Monitoring Period (tCO_2e)	Actual ER_y during Monitoring Period (tCO_2e)	Difference Percentage (%)
1,007,514	1,338,564	32.86

In the monitoring period from 29/04/2012 to 31/03/2018, the estimated emission reduction is 1,007,514 tCO_2e while the actual emission reduction is 1,338,564 tCO_2e. Thus, the actual emission reduction is 32.86% higher than the estimated emission reduction, which is caused by the increased water flow to the Heihe River. Moreover, DHP has high quality of management, which eliminates most of the uncontrollable factors and guarantees its operation. The above factors could explain the increase of electricity generation from DHP.

According to the registered PDD, the maximum exceeding percentage of power generation is 37.5% to ensure Financial Internal Return Rate (FIRR) below the benchmark (8%). Thus, with 32.86% higher, the FIRR of this project during this monitoring period is still lower than the benchmark, which retain the additionality of this project.