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Standard**

# MADUSHAN HYDROPOWER PROJECT ON HONGHE RIVER IN YUNNAN PROVINCE, CHINA

Document Prepared by Goldchina Consultancy International Co., Ltd.

|                          |                                                                                                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Title</b>     | Madushan Hydropower Project on Honghe River in Yunnan Province, China                                                                                                                                           |
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| <b>Project ID</b>        | 883                                                                                                                                                                                                             |
| <b>Monitoring Period</b> | 01/08/2012 to 31/12/2017                                                                                                                                                                                        |
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# 1 PROJECT DETAILS

## 1.1 Summary Description of the Implementation Status of the Project

Madushan Hydropower Project on Honghe River in Yunnan Province, China (hereafter referred to as “the project”) is a newly-built hydropower project. The total installed capacity of the project is 288MW, consisting of three sets of 96 MW hydro turbine and generator units. The electricity generated by the project is supplied to South China Power Grid (SCPG). According to the registered PDD, the estimated annual net grid-connected electricity is 1,164,249MWh for the first three operational years and 1,217,569MWh for the remaining years. The emission reductions are achieved by displacing part of the electricity of SCPG, which is dominated by coal-fired power plants. The estimated annual emission reductions for the first three operational years are 917,369tCO<sub>2</sub>e, and 959,382 tCO<sub>2</sub>e for the remaining years in the registered PDD.

Relevant dates for the project are as follows:

The construction of the project started on 25/01/2009. The first set of water turbine and generator unit was commissioned on 28/02/2011<sup>1</sup>, the second on 29/06/2011, and the third on 27/07/2011.

The project was registered as a VCS project (VCS883). The first 10 year renewable crediting period started on 28/02/2011 and expired on 27/02/2021.

During the monitoring period (01/08/2012 to 31/12/2017), the emission reduction achieved by the project in this monitoring period are 5,610,592tCO<sub>2</sub>e. The emission reductions in the monitoring period will be verified and issued under VCS rules.

## 1.2 Sectoral Scope and Project Type

This category would fall within sectoral scope 1: energy industries (renewable/non-renewable).

Project type: Renewable energy projects.

The project is not a grouped project.

## 1.3 Project Proponent

|                   |                                                            |
|-------------------|------------------------------------------------------------|
| Organization name | Honghe Guangyuan Madushan HydroPower Development Co., Ltd. |
|-------------------|------------------------------------------------------------|

<sup>1</sup> The first generator was tested on 28/02/2011 and put into formal operation on 04/03/2011. Some electricity was generated since 28/02/2011. So, 28/02/2011 was selected as the start date to include the electricity generated in the testing operation period(28/02/2011-04/03/2011) in 1<sup>st</sup> VCS monitoring period. The crediting period start date of CDM project is 07/06/2011, 28/02/2011 or 04/03/2011 have no impact on CER monitoring,

|                       |                                                                |
|-----------------------|----------------------------------------------------------------|
| <b>Contact person</b> | Zhang Jing                                                     |
| <b>Title</b>          | Director of Investment                                         |
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| <b>Telephone</b>      | +86-873-3743179                                                |
| <b>Email</b>          | hhgyhydropower@sina.com                                        |

#### 1.4 Other Entities Involved in the Project

|                            |                                                                                                                 |
|----------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Organization name</b>   | Goldchina Consultancy International Co., Ltd.                                                                   |
| <b>Role in the Project</b> | Consultancy                                                                                                     |
| <b>Contact person</b>      | Dr. Zheng Zhaoning                                                                                              |
| <b>Title</b>               | Technical director                                                                                              |
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#### 1.5 Project Start Date

The operation starting date for the project was 28/02/2011.

#### 1.6 Project Crediting Period

The project was registered as CDM project (CDM ref no.:4476). 3\*7 years renewable crediting period is adopted by the project activity.

The VCS project crediting period will be ended once the third CDM project crediting period expired. The first 10 years renewable crediting period started on 28/02/2011 and expired on 27/02/2021.

#### 1.7 Project Location

The proposed project is located on Honghe River in Honghe Hani and Yi Autonomous State, Yunnan Province. It is about 75km away from Gejiu City, about 59km away from Yuanyang County, and about 86km away from Mengzi County. The geographical coordinates of the dam are

103°16'58.5"E , 23°02'43.9"N, and the geographical coordinates of the power house are 103°17'15" E, 23°02'39" N. The detailed project location is shown in Figure 1.1.

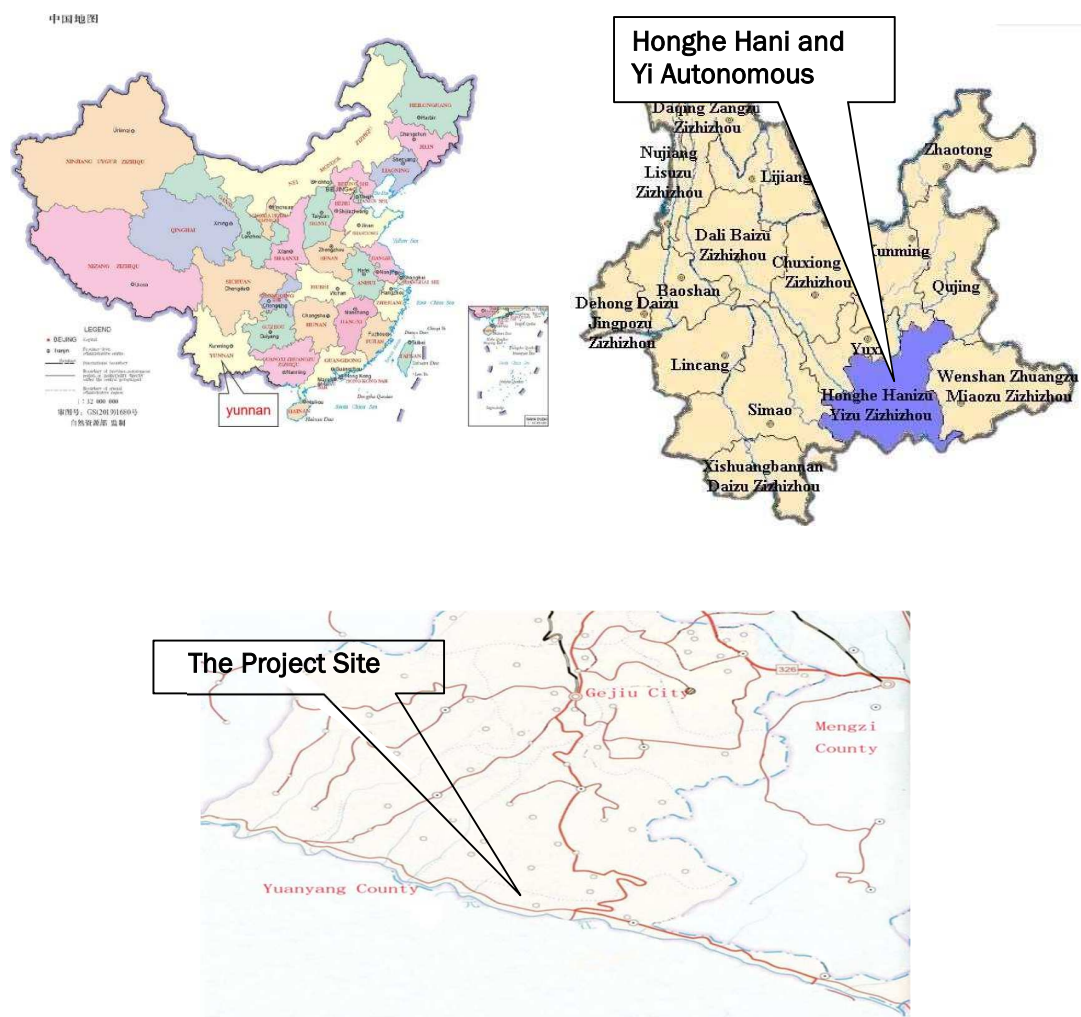


Figure 1.1. Geographical location of the proposed project

## 1.8 Title and Reference of Methodology

ACM0002 ver.11 - Consolidated methodology for grid-connected electricity generation from renewable sources

Version 02 of the tool to calculate the emission factor for an electricity system

Version 05.2 of the tool for the demonstration and assessment of additionality

## 1.9 Participation under other GHG Programs

The project has been registered as a CDM project with registration number 4476 and VCS project (project ID: 883). CERs were claimed for 07/06/2011 to 30/11/2011 and 01/12/2011 to 31/07/2011<sup>2</sup>.

## 1.10 Other Forms of Credit

The project has not created any other form of environmental credit during this monitoring period, which will be verified by VVB. *The project was registered as CDM project (CDM no.:4476) with the start date of the first crediting period, 07/06/2011. As per CCER rule, those emission reductions in the CDM crediting periods are Ineligible to participate the China's ETS. And the emission reductions before CDM registration were claimed as VCUs. The project owner is a hydropower company in Yunnan Province, which will not be included the Emission Trading Programs and Other Binding Limits in China.*

## 1.11 Sustainable Development Contributions

The project contributes to the sustainable development to both local, global and the host country in a number of ways:

- (1) The construction and operation of the proposed project will mitigate shortage of electricity supply in local area, increase electricity quality in the power grid, ensure industrial and agricultural production, and satisfy local people with sufficient electricity in daily life;
- (2) The construction and operation of the proposed project will create more job opportunities for local people. Rural labors could be arranged for on-site construction during the construction period, and 55 long-term job opportunities could be offered during the operation period.
- (3) By displace coal fired electricity in SCPG, the project reduced more than 5 million CO<sub>2</sub> emission in the monitoring period.

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<sup>2</sup> <https://cdm.unfccc.int/Projects/DB/ERM-CVS1297254096.28/view>

Table 1: Sustainable Development Contributions

| Row number | SDG Target | SDG Indicator                                                                                                        | Net Impact on SDG Indicator        | Current Project Contributions                                                              | Contributions Over Project Lifetime                                                                                                                                                                                                                                                                                                                                                                                         |
|------------|------------|----------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1)         | 7.0        | Ensure access to affordable, reliable, sustainable and modern energy for all                                         | Implemented activities to increase | Provide 7,120,495.25 MWh clean electricity in this monitoring period                       | With 288 MW installed capacity and annual 1,217,569 MWh clean electricity supply, the project ensure access to affordable, reliable, sustainable and modern energy for all. Especially supply enough clean electricity for industry development in Honghe Hani & Yi Autonomous State. To displace part of the electricity from coal-fired power plants, and thus will avoid environmental pollution caused by coal burning. |
| 2)         | 8.0        | Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all | Implemented activities to increase | No further changes this monitoring period                                                  | create new job opportunities for the local people: thousands temporary job opportunities were available during the construction period and 55 permanent jobs during the operation time.                                                                                                                                                                                                                                     |
| 3)         | 13.0       | Tonnes of greenhouse gas emissions avoided or removed                                                                | Implemented activities to increase | By displacing fuel fired electricity, reduce 5,610,592 tonnes of CO <sub>2</sub> emission. | Reduce 959,382 tCO <sub>2</sub> e annually over the project lifetime.                                                                                                                                                                                                                                                                                                                                                       |

## 2 SAFEGUARDS

### 2.1 No Net Harm

There is no net harm.

The Environment Impact Assessment (EIA) report for the proposed project was made by Pearl River Water Resource Conservation Science Institute. The EIA report for the proposed project was approved by State Environmental Protection Administration on 27/09/2007. According to the EIA report, the environmental impacts likely to be caused by the proposed project, protective actions adopted by the project owner and effect analysis are analyzed as follows:

#### ***Construction Period***

##### **Wastewater**

The wastewater produced by the proposed project will be industrial, workers' and power station's wastewater. Production wastewater treatment facilities will be built to gather the wastewater, after the treatments of sand setting, precipitation, adding neutralizer etc., then the production wastewater will be discharged. Domestic wastewater will also be dealt before being discharged.

Both production wastewater and domestic wastewater will meet the Level-two standard of Integrated Wastewater Discharge Standard (GB8978-1996).

##### **Waste Air**

Waste air during the construction period will be mainly from blasts, crushed sand processing, dust and the pollutant discharged by construction equipment etc. Wet techniques and protect measures will be adopted; dust collecting equipment is installed.

These measures will ensure that the discharge of air pollutants will meet the standard of the Integrated Emission Standard of Air Pollutants (GB16297-1996).

##### **Noise**

Noise during the construction period will be mainly from blasts, drilling, crushed sand processing, mixing of concrete and traffic. Low-noise processing equipments will be used. Meanwhile the construction time will be strictly controlled. If the condition allows, greenbelt will be built to decrease the effect of noise. These measures will ensure that the construction site will meet the Standard of Noise at Boundary of Industrial Enterprises (GB 12523-90).

##### **Waste Residue**

Waste residue consists of engineering refuse and domestic waste produced by constructors. The construction waste and domestic waste will be piled up in corresponding abandoned dredge site respectively. All the abandoned dredge sites will be reinforced, and slag dam will be built along rivers and roads. Domestic waste will be put together, and delivered to landfill sites to be dealt at set intervals.

### Ecological impacts

There is little impact to terricolous plant. The large lizard and tortoise will be affected by the construction of the proposed project. It must take measures to protect them. Five species of fish will be affected by the construction of the proposed project, as there is no influence to fishes in other branch of river, so the influences to fishes in Honghe river will be very small either. There are two terminalia myriocarpa trees (a Class II nationally protected species) in the Project affected area, they will be relocated. They won't be affected by the construction of the proposed project. The Mayutian village relocation is near the protection area, it will be taken measures to protect.

### Operation Period

●The production wastewater is mainly little oil pollution during the operation phase, there is base sumps and corresponding treatment equipments, there are also integrative domestic wastewater treatment. These measures will ensure that the operation of station will not contaminate the water of the reservoir.

●The project owner will shoulder the obligation of the effects of construction and operation on the fishes, the construction of remedial measures and the corresponding cost.

●The operation and management of this project will be optimized, which will ensure that the minimum flow is no less than 30.2m<sup>3</sup>/second, and satisfy the demand of water environment of lower and aquatic biological environment.

●Adopting water and soil conservation engineering and vegetation measures to control soil loss, the main places are slag dumps, material yards, temporary area for construction, roads for construction, affected zones and the occupied areas of key building.

Because of reservoir inundation and project permanent land occupation, there are people need to resettle. Resettlement can't occupy ecological protection wetland. The prevention of water and soil loss, meanwhile the measures of water environment protection, waste disposal etc. in the resettlement area should be reinforced. Environmental protection measures should be implemented during relocation and reconstruction.

## 2.2 Local Stakeholder Consultation

In order to know the attitudes and views of the public on the project' s construction, Pearl River Water Resource Conservation Science Institute, made a sampling survey when compiling EIA Report. A total of 125 questionnaires had been handed out and 100 questionnaires were returned, so the return rate was 80%. The information of stakeholders is as follows:

| Age situation of the stakeholders |       |       |       |       |
|-----------------------------------|-------|-------|-------|-------|
| Age                               | 19~29 | 30~40 | 41~45 | 46~66 |
| Number(people)                    | 28    | 34    | 21    | 17    |

|                                          |                |        |                            |            |                    |         |                    |  |
|------------------------------------------|----------------|--------|----------------------------|------------|--------------------|---------|--------------------|--|
| Proportion(%)                            | 28             |        | 34                         |            | 21                 |         | 17                 |  |
| Occupation situation of the stakeholders |                |        |                            |            |                    |         |                    |  |
| Occupation                               | Cadre          | Worker | teacher                    | technician | Farmer             | Student | others             |  |
| Number(people)                           | 20             | 15     | 5                          | 28         | 15                 | 5       | 12                 |  |
| Proportion(%)                            | 20             | 15     | 5                          | 28         | 15                 | 5       | 12                 |  |
| Education situation of the stakeholders  |                |        |                            |            |                    |         |                    |  |
| Education                                | Junior college |        | Technical secondary school |            | Senior high school |         | Junior high school |  |
| Number(people)                           | 30             |        | 25                         |            | 20                 |         | 25                 |  |
| Proportion(%)                            | 30             |        | 25                         |            | 20                 |         | 25                 |  |

The contents of investigation are as follows:

- Do you know the proposed project?
- What's your attitude toward the construction of the project?
- What are the impacts of the proposed project after its construction?
- What are the effects of this hydropower station on local environment?
- Will the reservoir worsen the water pollution?
- What are the effects of this hydropower station on landscape? If there are effects on landscape, what are the effects?
- If you need to resettle, do you agree with the resettlement?
- Where do you think the immigrants to move?
- What are the influence to the immigrants?
- If there are immigrants move to your living place, do you accept?

The analysis of 100 questionnaires is as follows:

| Item                                                            | Survey result                          | Proportion |
|-----------------------------------------------------------------|----------------------------------------|------------|
| 1. Do you know the proposed project?                            | Know and somehow know                  | 85%        |
|                                                                 | Don't know                             | 15%        |
| 2. What's your attitude toward the construction of the project? | Agree                                  | 88%        |
|                                                                 | Indifferent                            | 12%        |
|                                                                 | Oppose                                 | 0          |
|                                                                 | Great affects to the local development | 65%        |

|                                                                          |                                                                 |      |
|--------------------------------------------------------------------------|-----------------------------------------------------------------|------|
| 3. What are the impacts of the proposed project after its construction?  | Accelerate the economic development                             | 70%  |
|                                                                          | Improve environment in downstream area and country water supply | 63%  |
|                                                                          | Improve water environment in downstream area                    | 65%  |
|                                                                          | Improve the local peoples' life                                 | 56%  |
|                                                                          | Improve traffic situation in                                    | 30%  |
| 4. What are the effects of this hydropower station on local environment? | Is benefit to improve the environment                           | 75%  |
|                                                                          | Some influence, must take measurement to control                | 15%  |
|                                                                          | No influence                                                    | 10%  |
| 5. Will the reservoir worsen the water pollution?                        | No pollution                                                    | 84%  |
|                                                                          | Little pollution                                                | 16%  |
| 6. What are the effects of this hydropower station on landscape?         | No influence                                                    | 100% |
|                                                                          | Little influence                                                | 0    |
| 7. If you need to resettle, do you agree the resettlement?               | Would like to immigrate                                         | 92%  |
|                                                                          | Obeys the arrangement                                           | 8%   |
| 8. Where do you think the immigrants to move?                            | Would like to backwards                                         | 60%  |
|                                                                          | Would like to move to other place                               | 8%   |
|                                                                          | Obeys the arrangement                                           | 24%  |
|                                                                          | Don't know                                                      | 8%   |
| 9. What are the influences to the immigrants?                            | Increase the incomes                                            | 58%  |
|                                                                          | No changes of the incomes                                       | 21%  |
|                                                                          | Don't know                                                      | 21%  |
|                                                                          | Accept                                                          | 50%  |

|                                                                       |                      |     |
|-----------------------------------------------------------------------|----------------------|-----|
| 10. If there are immigrants move to your living place, do you accept? | Indifferent          | 20% |
|                                                                       | Obey the arrangement | 30% |

The investigation shows that the majority of common people have the supportive attitude towards the construction of this project, only few people think there are a few questions, which focus on the ecology and environment after the implementation of this project, immigration and compensation. As for the above 3 questions, the project owner will solve them by the following ways:

- As for the ecology and environmental protection, a big investment will be used during the construction phase, which will ensure that the environment and water protection, it will minimize the damage to ecological environment.

- The resettlement areas consist of Yuanyang County, Gejiu City, Mengzi County and Jinping County, which will ensure the resettlement of immigrants.

- The compensation for the land and crops is constituted according to the relevant policies of the State and Yunnan Province. Based on the local price level, that will satisfy the need of immigration and reproduction.

In conclusion, the problems of this project brought forward by the public can be solved effectively, and there would be no negative effects.

During project implementation phase, there is a public comments collection and feedback book for the project. The local stakeholders can leave their opinions, comments and concerns on the project and contact information in the public comments collection and feedback book at any time. The project owner will contact the local stakeholder to give feedback within two weeks. So far, no comment about potential negative impacts during project implementation have been received by the project owner.

## 2.3 AFOLU-Specific Safeguards

The project is not AFOLU projects.

# 3 IMPLEMENTATION STATUS

### 3.1 Implementation Status of the Project Activity

The project involves the installation of three sets of 96MW water turbine and generator units. The main structures include the dam, reservoir, water diversion structures, powerhouse, and switch station. The main parameters of the installed equipments are as follows:

Table 2 The main parameters of the installed equipments

|               |                   |                              |
|---------------|-------------------|------------------------------|
| Water turbine | Model:            | HL210a-LJ-430                |
|               | Number:           | 3                            |
|               | Rated capacity:   | 96 MW                        |
|               | Rated water head: | 67.0m                        |
|               | Rated flow:       | 168.67m <sup>3</sup> /s      |
|               | Rated speed:      | 142.9 r/min                  |
|               | Operation year    | 50 years in ideal condition  |
| Generator     | Model:            | SF96-42/10000                |
|               | Number:           | 3                            |
|               | Capacity per set: | 96MW                         |
|               | Power factor:     | 0.85                         |
|               | Rated speed:      | 142.9 r/min                  |
|               | Rated voltage:    | 13.8kV                       |
|               | Operation year    | 50 years in ideal condition  |
| Transformer   | Model:            | SFP10-120000/230             |
|               | Number:           | 3                            |
|               | Rated capacity    | 120000kVA                    |
|               | Rated frequency:  | 50HZ                         |
|               | Operation year    | >30 years in ideal condition |

The construction of the project started on 25/01/2009. The first set of water turbine and generator unit was commissioned on 28/02/2011, the second on 29/06/2011, and the third on 27/07/2011. All facilities and equipments have been installed as described in the registered PDD.

Over this monitoring period, the water turbine and generator units and the monitoring meters operated normally, no malfunction or replacement of the equipments took place. Not any special events such as any plant breakdowns during the monitoring period. Not any project design change. Moreover, no events or situations have occurred during this monitoring period that could have impacted the applicability of the applied methodology.

Over this monitoring period, not any other changes such as project proponent change. The consultant was change to Goldchina Consultancy International Co., Ltd. And the project was moved to the Verra account of Goldchina Consultancy International Co., Ltd. Which have no any impact on on emission reductions.

## 3.2 Deviations

### 2.1.1 Methodology Deviations

There is no deviation applied to this monitoring period.

### 2.1.2 Project Description Deviations

The project was registered under VCS standard 3, according to VCS standard 3, the crediting period of the project activity is 10 year and could be renewed twice, as the project started operation which is also the start date of the project was 28/02/2011, therefore the first crediting period for project under VCS should from 28/02/2011 to 27/02/2021.

## 3.3 Grouped Projects

The project is not a grouped project.

# 4 DATA AND PARAMETERS

## 4.1 Data and Parameters Available at Validation

|                                                   |                                                                                                |
|---------------------------------------------------|------------------------------------------------------------------------------------------------|
| Data / Parameter                                  | EF <sub>grid,CM,y</sub>                                                                        |
| Data unit                                         | tCO <sub>2</sub> e/MWh                                                                         |
| Description                                       | CM emission factor of South China Power Grid                                                   |
| Source of data                                    | The registered PDD                                                                             |
| Value applied                                     | 0.78795                                                                                        |
| Justification of choice of data or description of | The data is ex ante determined in the registered PDD and fixed for the first crediting period. |

|                                            |                                   |
|--------------------------------------------|-----------------------------------|
| measurement methods and procedures applied |                                   |
| Purpose of Data                            | Calculation of baseline emissions |
| Comments                                   | -                                 |

|                                                                                              |                                                                                                |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | Cap <sub>BL</sub>                                                                              |
| Data unit                                                                                    | W                                                                                              |
| Description                                                                                  | Installed capacity of the hydro power plant before the implementation of the project activity. |
| Source of data                                                                               | Project site                                                                                   |
| Value applied                                                                                | 0                                                                                              |
| Justification of choice of data or description of measurement methods and procedures applied | For new hydropower plant, this value is 0                                                      |
| Purpose of Data                                                                              | Calculation of project emissions                                                               |
| Comments                                                                                     | -                                                                                              |

|                                                                                              |                                                                                                                                                              |
|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | A <sub>BL</sub>                                                                                                                                              |
| Data unit                                                                                    | m <sup>2</sup>                                                                                                                                               |
| 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 <sup>2</sup> ). |
| Source of data                                                                               | Project site                                                                                                                                                 |
| Value applied                                                                                | 0                                                                                                                                                            |
| Justification of choice of data or description of measurement methods and procedures applied | For new hydropower plant, this value is 0                                                                                                                    |
| Purpose of Data                                                                              | Calculation of project emissions                                                                                                                             |
| Comments                                                                                     | -                                                                                                                                                            |

Only those data or parameters are determined or available at validation and remain fixed throughout the project crediting period need to be fill the table. Among those data or parameters only EF<sub>grid,CM,y</sub> , Cap<sub>BL</sub> , A<sub>BL</sub> are determined or available at validation and remain fixed throughout the project crediting period. Furthermore, only EFCM<sub>y</sub>, Cap<sub>BL</sub> , A<sub>BL</sub> was used for ER calculation.

## 4.2 Data and Parameters Monitored

|                                                                 |                                                                                |                                                                                                                                                                                                                                                                                                          |                                                                 |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Data / Parameter                                                | EG <sub>facility to SCPG, y</sub>                                              |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Data unit                                                       | MWh                                                                            |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Description                                                     | Quantity of electricity supplied by the proposed project to the grid in year y |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Source of data                                                  | Meter records                                                                  |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Description of measurement methods and procedures to be applied | Measured                                                                       |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Frequency of monitoring/recording                               | Continuous measurement and at least monthly recorded                           |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Value monitored                                                 | 7129478.40                                                                     |                                                                                                                                                                                                                                                                                                          |                                                                 |
| Monitoring equipment                                            | Meter                                                                          | M1 (Main meter)                                                                                                                                                                                                                                                                                          | M2 (Backup meter)                                               |
|                                                                 | SN                                                                             | 210299938<br><br>213139169 (replace 210299938 since 20/03/2017)                                                                                                                                                                                                                                          | 210299936<br><br>213139150 (replace 210299936 since 20/03/2017) |
|                                                                 | Location                                                                       | Manhao Switching Station                                                                                                                                                                                                                                                                                 |                                                                 |
|                                                                 | Type                                                                           | MK6E, 3×57.7V, 3×1(6)A                                                                                                                                                                                                                                                                                   |                                                                 |
|                                                                 | Accuracy class                                                                 | 0.2S                                                                                                                                                                                                                                                                                                     |                                                                 |
|                                                                 | Calibration date                                                               | 30/05/2012 (for meter 210299938 and 210299936)<br>29/05/2013 (for meter 210299938 and 210299936)<br>28/05/2014 (for meter 210299938 and 210299936)<br>26/05/2015 (for meter 210299938 and 210299936)<br>25/05/2016 (for meter 210299938 and 210299936)<br>17/03/2017 (for meter 213139169 and 213139150) |                                                                 |
|                                                                 |                                                                                |                                                                                                                                                                                                                                                                                                          |                                                                 |
|                                                                 |                                                                                |                                                                                                                                                                                                                                                                                                          |                                                                 |

|                                |                                                                            |                                                                                                       |
|--------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
|                                | Validity period                                                            | 30/05/2012-29/05/2013 (for meter 210299938 and 210299936)                                             |
|                                |                                                                            | 29/05/2013-28/05/2014 (for meter 210299938 and 210299936)                                             |
|                                |                                                                            | 28/05/2014-27/05/2015 (for meter 210299938 and 210299936)                                             |
|                                |                                                                            | 26/05/2015-25/05/2016 (for meter 210299938 and 210299936)                                             |
|                                |                                                                            | 25/03/2016-24/05/2017 (for meter 210299938 and 210299936)                                             |
|                                |                                                                            | 17/03/2017-16/03/2018 (for meter 213139169 and 213139150)                                             |
|                                | Calibration frequency                                                      | At least once a year                                                                                  |
|                                | Calibration entity                                                         | Electric Power Research Institute of Yunnan Electric Power Test & Research Institute (Group) Co., Ltd |
| QA/QC procedures to be applied | Measurement results should be cross-checked by electricity sales receipts. |                                                                                                       |
| Purpose of the data            | Calculation of baseline emissions                                          |                                                                                                       |
| Calculation method             | -                                                                          |                                                                                                       |
| Comments                       | -                                                                          |                                                                                                       |

|                                                                 |                                                          |
|-----------------------------------------------------------------|----------------------------------------------------------|
| Data / Parameter                                                | EG SCPG to facility, y                                   |
| Data unit                                                       | MWh                                                      |
| Description                                                     | Quantity of electricity imported from the grid in year y |
| Source of data                                                  | Meter records                                            |
| Description of measurement methods and procedures to be applied | Measured                                                 |
| Frequency of monitoring/recording                               | Continuous measurement and at least monthly recorded     |
| Value monitored                                                 | 8983.15                                                  |

| Monitoring equipment | Meter            | M1 (Main meter)                                                                                                                                                                                                                                                                                                                                                            | M2 (Backup meter)                                                        |
|----------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
|                      | SN               | 210299938<br><br>213139169 (replace<br>210299938 since<br>20/03/2017)                                                                                                                                                                                                                                                                                                      | 210299936<br><br>213139150<br>(replace<br>210299936 since<br>20/03/2017) |
|                      | Location         | Manhao Switching Station                                                                                                                                                                                                                                                                                                                                                   |                                                                          |
|                      | Type             | MK6E, 3×57.7V, 3×1(6)A                                                                                                                                                                                                                                                                                                                                                     |                                                                          |
|                      | Accuracy class   | 0.2S                                                                                                                                                                                                                                                                                                                                                                       |                                                                          |
|                      | Calibration date | 30/05/2012 (for meter 210299938 and 210299936)<br>29/05/2013 (for meter 210299938 and 210299936)<br>28/05/2014 (for meter 210299938 and 210299936)<br>26/05/2015 (for meter 210299938 and 210299936)<br>25/05/2016 (for meter 210299938 and 210299936)<br>17/03/2017 (for meter 213139169 and 213139150)                                                                   |                                                                          |
|                      | Validity period  | 30/05/2012-29/05/2013 (for meter 210299938 and 210299936)<br>29/05/2013-28/05/2014 (for meter 210299938 and 210299936)<br>28/05/2014-27/05/2015 (for meter 210299938 and 210299936)<br>26/05/2015-25/05/2016 (for meter 210299938 and 210299936)<br>25/03/2016-24/05/2017 (for meter 210299938 and 210299936)<br>17/03/2017-16/03/2018 (for meter 213139169 and 213139150) |                                                                          |
|                      |                  |                                                                                                                                                                                                                                                                                                                                                                            |                                                                          |

|                                |                                                                            |                                                                                                       |
|--------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
|                                | Calibration frequency                                                      | At least once a year                                                                                  |
|                                | Calibration entity                                                         | Electric Power Research Institute of Yunnan Electric Power Test & Research Institute (Group) Co., Ltd |
| QA/QC procedures to be applied | Measurement results should be cross-checked by electricity sales receipts. |                                                                                                       |
| Purpose of the data            | Calculation of baseline emissions                                          |                                                                                                       |
| Calculation method             | -                                                                          |                                                                                                       |
| Comments                       | -                                                                          |                                                                                                       |

|                                                                 |                                                                                                   |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | EG <sub>facility, y</sub>                                                                         |
| Data unit                                                       | MWh                                                                                               |
| Description                                                     | Quantity of net electricity generation supplied by the project plant/unit to the grid in year y   |
| Source of data                                                  | Meter records                                                                                     |
| Description of measurement methods and procedures to be applied | Calculated                                                                                        |
| Frequency of monitoring/recording                               | -                                                                                                 |
| Value monitored                                                 | 7,120,495.25                                                                                      |
| Monitoring equipment                                            | Refer to EG <sub>facility to SCPG, y</sub> and EG <sub>SCPG to facility, y</sub> for details.     |
| QA/QC procedures to be applied                                  | Refer to EG <sub>facility to SCPG, y</sub> and EG <sub>SCPG to facility, y</sub> for details.     |
| Purpose of the data                                             | Calculation of baseline emissions                                                                 |
| Calculation method                                              | EG <sub>facility, y</sub> = EG <sub>facility to SCPG, y</sub> - EG <sub>SCPG to facility, y</sub> |
| Comments                                                        | -                                                                                                 |

|                  |                   |
|------------------|-------------------|
| Data / Parameter | Cap <sub>PI</sub> |
| Data unit        | W                 |

|                                                                 |                                                                                               |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Description                                                     | Installed capacity of the hydro power plant after the implementation of the project activity. |
| Source of data                                                  | Project site                                                                                  |
| Description of measurement methods and procedures to be applied | Read directly from the nameplates of three generators of the project.                         |
| Frequency of monitoring/recording                               | Measured once at the start of the operation of the project.                                   |
| Value monitored                                                 | 288,000,000                                                                                   |
| Monitoring equipment                                            | -                                                                                             |
| QA/QC procedures to be applied                                  | Cross check against the project documentation.                                                |
| Purpose of the data                                             | Calculation of project emissions                                                              |
| Calculation method                                              | -                                                                                             |
| Comments                                                        | -                                                                                             |

|                                                                 |                                                                                                                                                                         |                |                  |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------|
| Data / Parameter                                                | A <sub>PJ</sub>                                                                                                                                                         |                |                  |
| Data unit                                                       | m <sup>2</sup>                                                                                                                                                          |                |                  |
| 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                                                  | Project site                                                                                                                                                            |                |                  |
| Description of measurement methods and procedures to be applied | A <sub>PJ</sub> has been measured through an engineering survey by Pearl River Water Resources Scientific Research Institute of Pearl River Water Resources Commission. |                |                  |
| Frequency of monitoring/recording                               | Yearly measured                                                                                                                                                         |                |                  |
| Value monitored                                                 | Year                                                                                                                                                                    | Measured value | Measurement date |
|                                                                 | 2012                                                                                                                                                                    | 19,180,000     | 28/05/2012       |
|                                                                 | 2013                                                                                                                                                                    | 19,180,000     | 10/08/2013       |
|                                                                 | 2014                                                                                                                                                                    | 19,190,000     | 10/09/2014       |
|                                                                 | 2015                                                                                                                                                                    | 19,180,000     | 10/09/2015       |

|                                |                                                                                                                                                                                                                                                                                |      |            |            |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------|------------|
|                                |                                                                                                                                                                                                                                                                                | 2016 | 19,180,000 | 10/09/2016 |
|                                |                                                                                                                                                                                                                                                                                | 2017 | 19,180,000 | 10/09/2017 |
| Monitoring equipment           | -                                                                                                                                                                                                                                                                              |      |            |            |
| QA/QC procedures to be applied | The measured frequency is once a year. Pearl River Water Resources Scientific Research Institute of Pearl River Water Resources Commission is a qualified design institute with Class B of Certificate Surveying and Mapping Qualification (Certificate No.Yicezizi 44101043). |      |            |            |
| Purpose of the data            | Calculation of project emissions                                                                                                                                                                                                                                               |      |            |            |
| Calculation method             | -                                                                                                                                                                                                                                                                              |      |            |            |
| Comments                       | -                                                                                                                                                                                                                                                                              |      |            |            |

## 4.3 Monitoring Plan

### 1. Monitoring system

The electricity exported to the grid ( $EG_{\text{facility to SCPG, y}}$ ) and imported from the grid ( $EG_{\text{SCPG to facility, y}}$ ) by the project is monitored through two bidirectional electric energy meters (M1 and M2) installed in Manhao Switching Station. M1 is the main meter; M2 is the backup meter in case of emergency use. Figure 1 is the monitoring system diagram of the project.

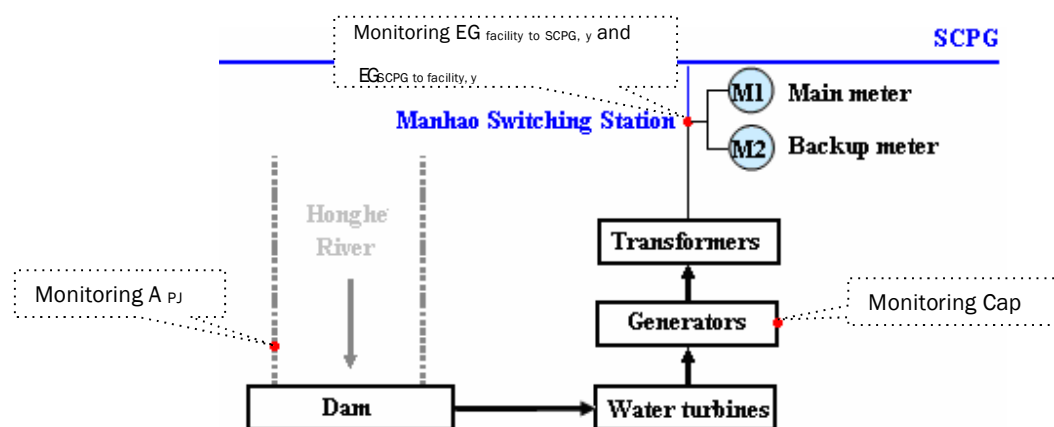


Figure 1 Monitoring system diagram

### 2.Data collection procedures

$EG_{\text{facility to SCPG, y}}$  and  $EG_{\text{SCPG to facility, y}}$  is continuously measured and automatically accumulated by the electric energy meters. The designated personnel from the grid company and the project owner record the meter readings at 24:00 on the last day of each month in Monthly Readings Records (MRRs). Then the grid company issues Electricity Transaction Notes (ETNs) to the project

owner . MRRs serve as the basis for ERs calculation; ETNs serves as the electricity sales receipts for cross-check.

EG<sub>facility, y</sub> is net electricity generation supplied by the project to the grid. It is calculated as EG<sub>facility to SCPG, y</sub> minus EG<sub>SCPG to facility, y</sub>.

Cap<sub>PJ</sub> is monitored yearly by the CDM management team. No replacement of hydro turbines and generators has taken place during this monitoring period. Cap<sub>PJ</sub> of the project could be verified by the nameplates of water turbine and generator units.

A<sub>PJ</sub> is measured yearly by Pearl River Water Resources Scientific Research Institute of Pearl River Water Resources Commission, which is a qualified institute. The measurement result of A<sub>PJ</sub> in Year, A<sub>PJ</sub> of the full reservoir has not been change and has been provided by Pearl River Water Resources Scientific Research Institute of Pearl River Water Resources Commission.

### 3. The Organizational structure and responsibilities

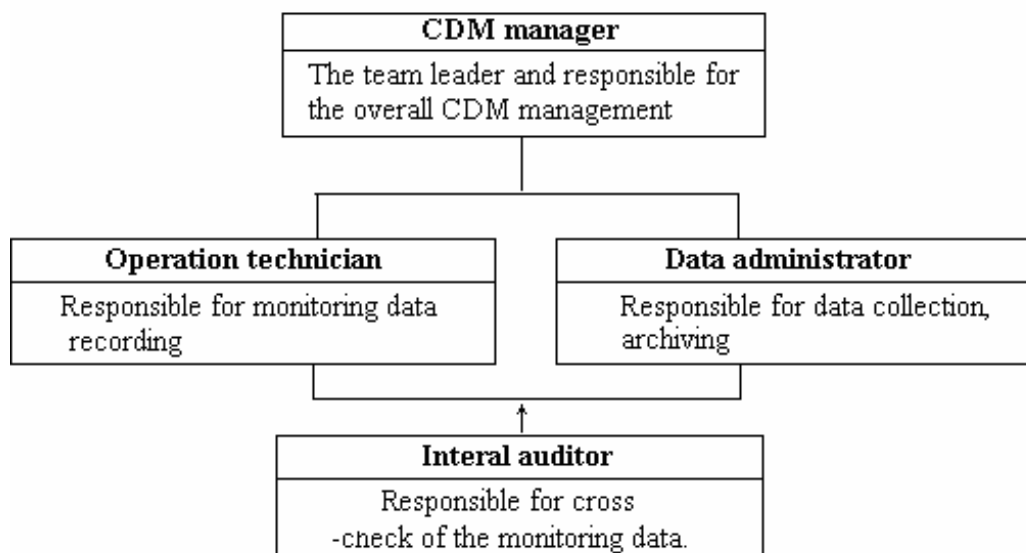


Figure 2 Organizational structure and responsibility

### 4. Emergency procedures

In normal condition, meter records from the main meter are used for ER calculation. If the malfunction happened to the main meter, the meter records from the backup meter will be used for ER calculation, and the electricity sales receipts will be kept for cross check. Problem occurred in monitoring and measurement process will be recorded and reported to project manager.

During this monitoring period, the meters operated normally, and no emergency occurred.

### 5. Internal audit

All the monitoring data are forwarded to the internal auditor monthly for the cross-check. The  $EG_{\text{facility to SCPG}, y}$  and  $EG_{\text{SCPG to facility}, y}$  from meter records will be cross-checked against the electricity sales receipts issued by the grid company.

## 6. Training

The team members of the monitoring team was trained by the CDM consulting company before the operation of the project. Relevant training material was provided to VVB

## 7. Data management

All of the data records relevant to monitoring such as Power Purchase Agreement, DL/T448-2000 and DL/T448-2016, technical parameters of the energy meters, monthly meter records, electricity transaction receipts, calibration records, training records and so on will be archived electronically and kept at least for 2 years after the end of the last crediting period. Thereinto, monthly meter records, electricity transaction receipts will be preserved monthly and kept at least for 2 years after the end of the last crediting period or the last issuance of VCUs, whichever occurs later; the Power Purchase Agreement, calibration records will be preserved yearly and kept at least for 2 years after the end of the last crediting period or the last issuance of CERs, whichever occurs later; DL/T448-2000 and DL/T448-2016, technical parameters of the energy meters and training records will be preserved and kept at least for 2 years after the end of the last crediting period or the last issuance of VCUs, whichever occurs later.

# 5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

## 5.1 Baseline Emissions

According to the registered PDD, the baseline emissions (BE<sub>y</sub>) is calculated as follows:

$$BE_y = EG_{PJ, y} \times EF_{\text{grid, CM}, y} = EG_{\text{facility}, y} \times EF_{\text{grid, CM}, y} = (EG_{\text{facility to SCPG}, y} - EG_{\text{SCPG to facility}, y}) \times EF_{\text{grid, CM}, y}$$

Where:

$EG_{PJ, y}$  = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y.

The detailed calculation procedure is described below:

Table 3  $EG_{\text{facility to SCPG}, y}$  and  $EG_{\text{SCPG to facility}, y}$  in the monitoring period

| Period | $EG_{\text{facility to SCPG}, y}$ |                |                | $EG_{\text{SCPG to facility}, y}$ |                |                |
|--------|-----------------------------------|----------------|----------------|-----------------------------------|----------------|----------------|
|        | MRRs                              | Sales receipts | ER calculation | MRRs                              | Sales receipts | ER calculation |
|        | MWh                               | MWh            | MWh            | MWh                               | MWh            | MWh            |

|                       | A          | B          | C=MIN(A,B) | D       | E       | F=MAX(D,E) |
|-----------------------|------------|------------|------------|---------|---------|------------|
| 01/08/2012-31/12/2012 | 641465.00  | 641465.00  | 641465.00  | 770.00  | 770.00  | 770.00     |
| 01/01/2013-31/12/2013 | 1032570.00 | 1032570.00 | 1032570.00 | 2365.00 | 2365.00 | 2365.00    |
| 01/01/2014-31/12/2014 | 1097965.00 | 1097965.00 | 1097965.00 | 2420.00 | 2420.00 | 2420.00    |
| 01/01/2015-31/12/2015 | 1246410.00 | 1246410.00 | 1246410.00 | 1705.00 | 1705.00 | 1705.00    |
| 01/01/2016-31/12/2016 | 1448480.00 | 1448480.00 | 1448480.00 | 1210.00 | 1155.00 | 1155.00    |
| 01/01/2017-31/12/2017 | 1662588.40 | 1662588.40 | 1662588.40 | 513.15  | 513.15  | 513.15     |
| Total                 | 7129478.40 | 7129478.40 | 7129478.40 | 8983.15 | 8983.15 | 8983.15    |

Table 4 Baseline emission in the monitoring period

| Period                | EG <sub>facility to SCPG, y</sub><br>(MWh) | EG <sub>SCPG to facility, y</sub><br>(MWh) | EG <sub>facility, y</sub><br>(MWh) | EF <sub>grid, CM, y</sub><br>(tCO <sub>2</sub> e/MWh) | BE <sub>y</sub> (tCO <sub>2</sub> e) |
|-----------------------|--------------------------------------------|--------------------------------------------|------------------------------------|-------------------------------------------------------|--------------------------------------|
| 01/08/2012-31/12/2012 | 641465.00                                  | 770.00                                     | 640695.00                          | 0.78795                                               | 504835                               |
| 01/01/2013-31/12/2013 | 1032570.00                                 | 2365.00                                    | 1030205.00                         | 0.78795                                               | 811750                               |
| 01/01/2014-31/12/2014 | 1097965.00                                 | 2420.00                                    | 1095545.00                         | 0.78795                                               | 863234                               |
| 01/01/2015-31/12/2015 | 1246410.00                                 | 1705.00                                    | 1244705.00                         | 0.78795                                               | 980765                               |
| 01/01/2016-31/12/2016 | 1448480.00                                 | 1210.00                                    | 1447270.00                         | 0.78795                                               | 1140376                              |
| 01/01/2017-31/12/2017 | 1662588.40                                 | 513.15                                     | 1662075.25                         | 0.78795                                               | 1309632                              |
| Total                 | 7,129,478.40                               | 8,983.15                                   | 7,120,495.25                       |                                                       | 5,610,592                            |

## 5.2 Project Emissions

The project is a newly-built hydropower project, the value of  $Cap_{BL}$  and the  $A_{BL}$  are zero. As per the nameplates of water turbine and generator units, the value of  $Cap_{PJ}$  is 288MW. According to the measurement results issued by Pearl River Water Resources Scientific Research Institute of Pearl River Water Resources Commission each year, the actual measured value of  $A_{PJ}$  is 19,180,000-19,190,000  $m^2$ , thus the power density of the project is calculated to be 15W/ $m^2$ , which is greater than 10W/ $m^2$ , so the project emission ( $PE_y$ ) is 0.

Table 5 Annual power density calculation

| Year | $Cap_{PJ}(W)$ | $A_{PJ}(m^2)$ | Power density(W/ $m^2$ ) |
|------|---------------|---------------|--------------------------|
| 2012 | 288000000     | 19180000      | 15.02                    |
| 2013 | 288000000     | 19180000      | 15.02                    |
| 2014 | 288000000     | 19190000      | 15.01                    |
| 2015 | 288000000     | 19180000      | 15.02                    |
| 2016 | 288000000     | 19180000      | 15.02                    |
| 2017 | 288000000     | 19180000      | 15.02                    |

## 5.3 Leakage

As per the methodology ACM0002 ver. 11, no leakage emissions need to be considered.

## 5.4 Net GHG Emission Reductions and Removals

| Year      | Baseline emissions or removals (tCO <sub>2</sub> e) | Project emissions or removals (tCO <sub>2</sub> e) | Leakage emissions (tCO <sub>2</sub> e) | Net GHG emission reductions or removals (tCO <sub>2</sub> e) |
|-----------|-----------------------------------------------------|----------------------------------------------------|----------------------------------------|--------------------------------------------------------------|
| Year 2012 | 504,835                                             | 0                                                  | 0                                      | 504,835                                                      |
| Year 2013 | 811,750                                             | 0                                                  | 0                                      | 811,750                                                      |
| Year 2014 | 863,234                                             | 0                                                  | 0                                      | 863,234                                                      |
| Year 2015 | 980,765                                             | 0                                                  | 0                                      | 980,765                                                      |
| Year 2016 | 1,140,376                                           | 0                                                  | 0                                      | 1,140,376                                                    |
| Year 2017 | 1,309,632                                           | 0                                                  | 0                                      | 1,309,632                                                    |

|       |           |   |   |           |
|-------|-----------|---|---|-----------|
| Total | 5,610,592 | 0 | 0 | 5,610,592 |
|-------|-----------|---|---|-----------|

During this monitoring period from 01/08/2012 to 31/12/2017 (total 1979 days). The actual emission reductions are 5,610,592tCO<sub>2</sub>e. According to the registered PDD, the estimated emission reductions for this monitoring period should be 5,096,374tCO<sub>2</sub>e. In comparison, the actual emission reductions are 10.09% higher than the estimated emission reductions in the registered PDD. For hydropower project, the 10.09% increase of emission reductions means 10.09% increase of quantity of net electricity generation supplied by the project to the grid. As per the registered PDD, only when the annual grid-in electricity is increased by 16.20%, the IRR would reach 8%, the critical point of additionality, so the 10.09% increase of emission reduction will not affect the additionality. The project was put into operation since 28/02/2011, by comparison of the actual emission reduction with the estimated emission reduction, the emission reduction increase during 28/02/2011 to 31/12/2017 is very small, only 0.32%.

Table comparison of the actual emission reduction with the estimated emission reduction

| Monitoring period             | Actual ER(tCO <sub>2</sub> e) | Estimated ER(tCO <sub>2</sub> e) | +/-           |
|-------------------------------|-------------------------------|----------------------------------|---------------|
| 28/02/2011-06/06/2011         | 42,216                        | 81,792                           | -48.39%       |
| 07/06/2011 -30/11/2011        | 334,035                       | 439,666                          | -24.03%       |
| 01/12/2011-31/07/2012         | 264,480                       | 613,255                          | -56.87%       |
| 01/08/2012- 31/12/2017        | 5,610,724                     | 5,096,374                        | +10.09%       |
| <b>28/02/2011- 31/12/2017</b> | <b>6,251,323</b>              | <b>6,231,087</b>                 | <b>+0.32%</b> |