SONG ONG HYDROPOWER PROJECT

Document Prepared by EKI Energy Services Limited

Project Title	Song Ong Hydropower Project
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Monitoring Period	01-March-2012 to 28-February-2018 (Inclusive of both days)
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The Song Ong Hydropower Project involves the construction of a hydropower plant with 3 units, which is located on Ong River in Quang Son commune, Ninh Son district in Ninh Thuan province of Vietnam. The project's installed capacity and estimated annual gross power generation are 8.1 MW and 40,500 MWh, respectively. The project's generates and to supply renewable electricity to the national grid under the Power Purchase Agreement (PPA) signed with the Electricity Corporation of Vietnam (EVN). The net electricity generated from this project (annual estimated volume is 39,994 MWh) which supplies to the national grid via a 22 kV line which connects the plant with the Ninh Son 110/22 kV transformer station.

The project activity involves the construction of a dam, an intake, tunnels, a penstock, a pressurized well, a powerhouse and a discharge channel in order to convert potential flowing energy from the stream into clean electrical energy.

The construction of Song Ong Hydropower plant was started in late of 2005 and finished in March 2009. On 05-March-2009, the test run was conducted and plant started supplying electricity to the national grid on 24-March-2009.

The project activity generates renewable power with negligible Greenhouse Gas (GHG) emissions, which displaces electricity otherwise supplied by fossil fuel fired power plants. The monthly reading protocol signed between the project owner and the EVN is the data source and serves as evidences for calculation of emission reduction. During the current monitoring period, a total of 127,120 tCO_2e have been avoided.

1.2 Sectoral Scope and Project Type

Sectoral scope	: 01.Energy industries (renewable - /non-renewable sources)
Project Type	: I. Renewable energy project
Project Category	: I.D. Grid connected renewable electricity generation – Version 16

1.3 Project Proponent

Organization name	Song Ong Hydropower Joint Stock Company
Contact person	Mr Nguyen Hai Quynh
Title	General Director of Song Ong Hydropower Joint Stock Company
Address	Quang Son commune, Ninh Son district, Ninh Thuan province, Viet Nam

Telephone	+84 683 851 556
Email	thuydienso@yahoo.com.vn

1.4 Other Entities Involved in the Project

Organization name	EKI Energy Services Limited
Role in the Project	Project Consultant
Contact person	Mr. Prakash Kumar Sahu
Title	Senior Manager
Address	Office No 201, Plot No 48, Scheme 78, Vijay Nagar Part- II, Indore 452010, India
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1.5 Project Start Date

The start date of Song Ong hydropower project is 24-March-2009. This was the first date Song Ong hydropower plant supplied electricity to Vietnam national grid.

1.6 Project Crediting Period

Start date of crediting period : 24-March-2009
End date of crediting period : 23-March-2019

Song Ong Hydropower Project was registered as Clean Development Mechanism (CDM) project on 04-February-2011 with the PDD version 2.5 dated 02 November 2010[1]. However, the start date of the first CDM crediting period is 01-March-2011.

1.7 Project Location

Song Ong Hydropower project is located on Ong River in Quang Son commune, Ninh Son district in Ninh Thuan province.

The geographic coordinate of the dam and water intake of the project as below:

Project	Song Ong hydropower project	
	Latitude	Longitude
Water intake	11° 45' 13''	108° 48' 19''
Power house	11° 44' 56''	108° 49' 20''

[1] https://cdm.unfccc.int/Projects/DB/RWTUV1289918487.21/view

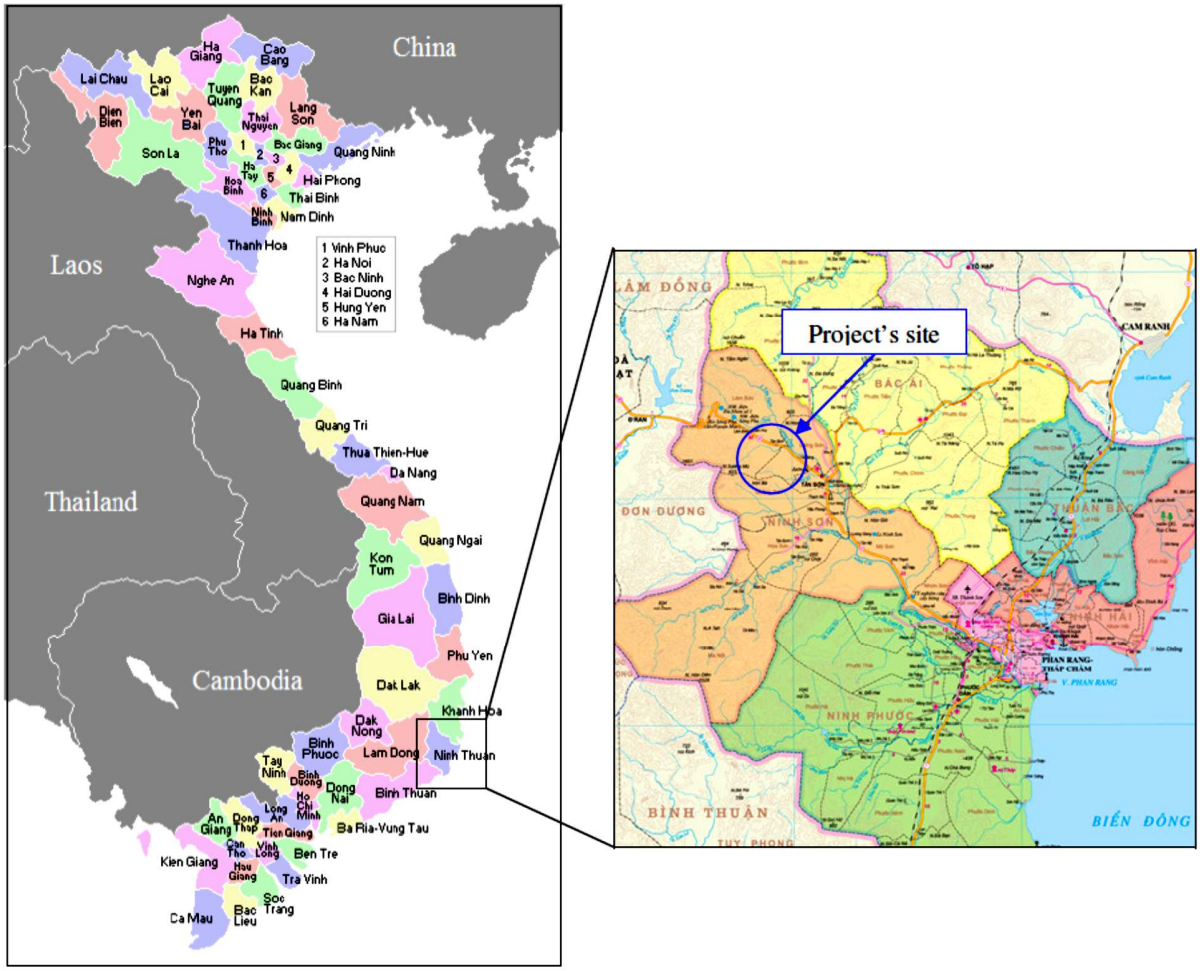

Figure 1. Project Site

1.8 Title and Reference of Methodology

The monitoring methodology AMS – I.D "Grid connected renewable electricity generation" – Version 16[2] was applied for the project.

Tools used with respect with methodology:

- Tool to calculate project or leakage CO2 emissions from fossil fuel combustion version 02[3]

[2] https://cdm.unfccc.int/UserManagement/FileStorage/SJI52M6QXGKFNOZABTHDYPU789EV3C

[3] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

1.9 Participation under other GHG Programs

The project was developed and registered under Clean Development Mechanism[4] project on 04-February-2011. The CDM crediting period of Song Ong Hydropower project is from 01-March-2011 to 28-February-2018 with the estimated reduction is 21,416 tonnes CO2 equivalent per year. The project participant has claimed 21,848 carbon credit for the duration 01-March-2011 to 29-February-2012. The current monitoring period start just after i.e. 01-March-2012. Declaration has been provided stating that PP will not claim carbon credits under both mechanisms for same monitoring period.

1.10 Other Forms of Credit

Song Ong Hydropower project did not participate in any Environmental Credit Scheme other than CDM. The declaration of not being a participant in any other Environmental Credit Schemes in the monitoring period is provided to the DOE.

1.11 Sustainable Development

The project contributes to the sustainable development on the local, regional and national scale as follows:

General contributions towards national sustainable development:

In recent years, Vietnam has suffered a critical electricity shortage as a consequence from rapidly increasing demand and insufficient supply, thereby imposing negative impacts on economic growth as well as on daily lives of people. This project activity contributes towards balancing the supply and demand gap. By exporting electricity directly to the grid, it would help to reduce electricity losses across the national grid and to lessen the risks of cascading national grid collapse due to overload.

The project activity would generate renewable power without any GHG emissions, which could displace part of the electricity otherwise supplied by fossil fuel fired power plants. Thus, GHG emission reductions can be achieved.

Reducing reliance on exhaustible fossil fuel based power sources and also reducing the import of fuels for the purpose of power generation. Modern and highly efficient turbines and generators are being used in the project and the power transmission would be at high voltage to ensure low losses. The project would accelerate the deployment of renewable energy technologies in Vietnam.

Contributions towards local sustainable development:

Economic well-being

[4] https://cdm.unfccc.int/Projects/DB/RWTUV1289918487.21/view

Once commissioning, this proposed project would increase the industrial share in the economic structure of Ninh Thuan province.

By supplying a stable electricity output, this project would facilitate the industrialization process of the province and leverage the performance of traditional trade villages as well as tourism industry and services inside the province. After commissioning, this project supplies electricity to speed up the commissioning of other infrastructure projects in the region.

Social well-being

This project would contribute directly to improve the low-quality infrastructure systems of the Quang Son commune, where minority ethnics groups are living. The project would construct a new road that then would be integrated into the traffic system of the commune. The new 22 kV line would reduce electricity losses and improve the electricity quality supplied in the region.

The communication system and clean water treatment serving for workers of the project during the both construction and operation phases would be shared with local people. Besides, new jobs are created during construction and operation phases. The project activity could result in the employment of the local people for the construction and operation later on.

This demonstrates that the project activity would contribute positively towards sustainable development and that it is consistent with the general encouragement of the investment in exploitation of renewable energy resources in Vietnam set by the Government. Therefore, it satisfies the sustainable development criteria set by the DNA of Vietnam.

2 SAFEGUARDS

2.1 No Net Harm

The Environment Impact Assessment study was conducted for the project activity and judicious efforts to cause minimal impacts on the surrounding environment and to maintain the natural balance.

2.2 Local Stakeholder Consultation

As a part of continual improvement process, feedback from the associated stakeholders is vital, therefore a dedicated Visitor register cum grievance register has been placed at the project site which is accessible to stakeholders to provide their feedback on the project. It is appropriate publicly accessible location at which local stakeholders can provide their feedback on the project. This location is also conducive to continuous and regular checks for stakeholder comments. For the global stakeholders, the suggestion and the grievance can be submitted to thuydienso@yahoo.com.vn

Stakeholder meetings were organized at the time of registration of project activity in order to identify the major challenges around the area, stakeholders were invited well in advance through printed invitation, calls, meeting and a notice is placed around the local common areas. Various

CSR activities around site are carried out. The stakeholder are also request to share their experiences and grievances on continuous basis. Registers is used to records the grievances and feedback.

During the current monitoring period, positive feedback are received regarding site operation. No any grievances received during the current monitoring period, therefore, no any mitigation measures are required. In case of grievances, the nature of probable resolution is discussed with the plant head office and implemented by the site incharge. The grievance copies have been submitted to DOE.

2.3 AFOLU-Specific Safeguards

Not applicable to this as this is not an AFOLU project activity.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project involves the construction of a hydro plant and installation of new hydro turbines and alternators in order to convert potential energy available in the river flow into electrical energy, which would be supplied to the national grid at the connection point through the transmission line. At the connection point, the power metering systems were installed. They are digital and bi-directional type to measure the export and import electricity of Song Ong Hydropower plant.

The metering systems include a main system and a back-up system, each system includes: current transformers (CTs), voltage transformers (VTs) and power meters which are met the IEC62053 or equivalent standard.

Current Transformers (CTs) are used for measurement of electric currents. When current in a circuit is too high to directly apply to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments (power meters).

Voltage Transformers (VTs) are used in power systems to step-down extra high voltage signals and provide low voltage signals either for measurement. Power meters are used to combine the current and voltage signal from CTs and VTs to measure the electrical power. The technical details is being mentioned:

Main parameters	Units	Values
1.Turbine		
• Manufacture		Chongqing Yunhe Industry (Group) Co., Ltd.
• Type		Francis, vertical axis

• Diameter of Runner	m	1.4
• Rated net head	m	27
• Number of turbine	set	03
• Turbine discharge	m^3/s	11.57
• Efficiency	%	86.91
• Capacity	MW	2.7
• Annual utilisation hours	hour	5.000
2.Generator		
• Manufacturer		Chongqing Yunhe Industry (Group) Co., Ltd.
• Number	set	03
• Type		SF2700-20/3250
• Rated voltage	kV	6.3
• Rated capacity	MW	2.7
• Efficiency	%	95.2
3.Transformer		
• Manufacturer		ABB Ltd.
• Number	set	03
• Type		3 phases, 2 windings
• Rated capacity	MVA	3.5
• Primary voltage	KV	6.3
• Secondary voltage	KV	24
4. Annual river flow	m3/s	5.81
5. Expected lifetime of the project	years	30
6. Plant load factor	%	57.08

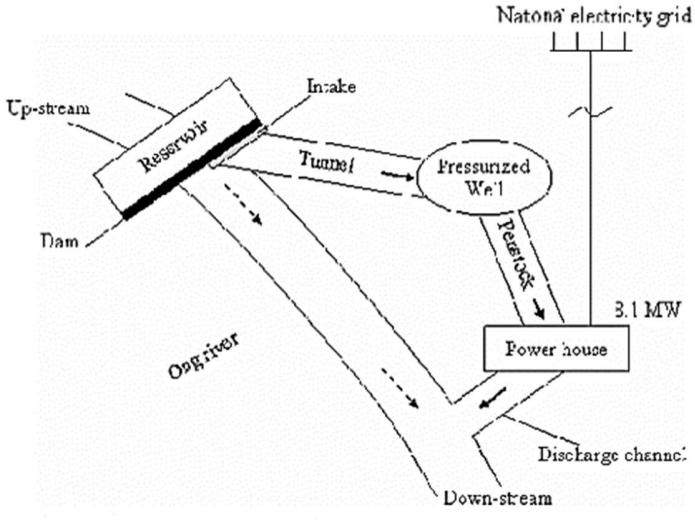

Figure 2. Song Ong Project Layout

The project is running successfully since commissioning, there were several breakdown which having slight impact electricity generation thereby reducing the GHG emission reductions. Also,

the breakdown having no impact on the design parameter and the project monitoring practices. The details of major breakdown has been mentioned in Appendix 1: Major Breakdown details

3.2 Deviations

3.2.1 Methodology Deviations

No methodology deviation is applied during the monitoring period.

3.2.2 Project Description Deviations

Deviation 1:

There was typographical in the VCS PD regarding Crediting period. 10 year crediting period have been chosen for this project activity which can be renewed twice. The nature of deviation is permanent.

3.3 Grouped Projects

The project is not a grouped project thus this is not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Cap_{BL}
Data unit	MW
Description	Installed capacity of hydropower plant before the implementation of the project activity.
Source of data	This is a newly constructed power plant. This value does not exist prior to the implementation of the project activity
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	The project activity constructs a new hydropower plant, so Cap_{BL} is considered by zero.
Purpose of Data	For calculating the power density (PD)
Comments	-

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. For new reservoirs, this value is zero.
Source of data	This is a newly constructed power plant. This value does not exist prior to the implementation of the project activity.
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	The project activity builds a new reservoir, so ABL is considered by zero.
Purpose of Data	For calculating the power density (PD)
Comments	-

Data / Parameter	Heat Rate
Data unit	Kcal/KWh
Description	Heat rate of each power plant or the energy conversion.
Source of data	Data supplied by EVN
Value applied	Value applied in grid emission factor calculation
Justification of choice of data or description of measurement methods and procedures applied	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public and this data source is recommended by DNA Vietnam
Purpose of Data	For calculating the power density (PD)
Comments	-

Data / Parameter	$EG_{m,y}$
Data unit	MWh
Description	Net electricity generated and delivered to the grid by power plant/unit m in year y
Source of data	Data supplied by EVN
Value applied	Value applied in grid emission factor calculation
Justification of choice of data or description of measurement methods and procedures applied	Dispatch data is not disclosed by the Government of Vietnam. EVN provides the most actually updated data relevant to the power generation in Vietnam that could be accessed by public and this data source is recommended by DNA Vietnam
Purpose of Data	For calculation of EF_{OM} or EF_{BM}

Comments	-

Data / Parameter	$EF_{CO2,i,y}$
Data unit	tCO_2/GJ
Description	CO2 emission factor of fossil fuel type i in year y
Source of data	Default value of the IPCC 2006 Guidelines
Value applied	Value applied in grid emission factor calculation
Justification of choice of data or description of measurement methods and procedures applied	With reference to Version 1.1 of "Tool to calculate the emission factor for an electricity system"
Purpose of Data	For calculation of EF_{OM} or EF_{BM}
Comments	-

Data / Parameter	$NCV_{i,y}$
Data unit	TJ/Gg
Description	Net calorific value (energy content) of diesel in year y
Source of data	IPCC Default Value
Value applied	43.3
Justification of choice of data or description of measurement methods and procedures applied	With reference to Version 02 of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 02, report annex 11, EB41
Purpose of Data	For calculation of $PE_{FFj\,y}$
Comments	-

Data / Parameter	$EF_{CO2,diesel,y}$
Data unit	$kgCO_2/TJ$
Description	CO2 emission factor of diesel in year y
Source of data	IPCC Default Value
Value applied	74800
Justification of choice of data or description of measurement methods and procedures applied	With reference to Version 02 of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 02, report annex 11, EB41

Purpose of Data	For calculation of $PE_{FFj\,y}$
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{y,\,export}$
Data unit	MWh
Description	Electricity supplied by the proposed hydropower plant to the national grid
Source of data	Direct measurement at the connection point
Description of measurement methods and procedures to be applied	Two-way power meters are installed at the grid-connected point to measure the amount of electricity supplied to the grid by the proposed project by the positive direction. The readings of electricity meter are hourly measured and monthly recorded. The recorded data would be confirmed by the joint balance sheet which would be signed by the representatives of EVN and the project owner. Electronic data would be archived within the crediting period and 2 years after the end of the crediting period.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value monitored	237,472.10
Monitoring equipment	

Technical Details	**Main Power meter CTC**	**Backup Power Meter CTP**
Serial number	8062733	8062734
Model	PB3KAAGHT-5	
Accuracy	0.5s	0.5s
Date of current Calibration	09-May-2013	09-May-2013
	17-January-2014	17-January-2014
	16-January -2015	16-January -2015
	03-November-2016	03-November-2016
	08-April-2017	08-April-2017
	14-August-2018	14-August-2018
Calibration Validity	14-August-2020	
Calibration Frequency	At least once every two years.	

QA/QC procedures to be applied	The uncertainty level of this data is low. The measurement/ monitoring equipment should be complied with national standard and technology. These equipment and systems should be calibrated and checked every 2 year.
Purpose of the data	Calculation of Baseline Emission
Calculation method	Net Energy Generation = Total energy export to the Grid – Total energy import from the grid
Comments	-

Data / Parameter	$EG_{y,\ import}$
Data unit	MWh
Description	Electricity supplied by the national grid to the proposed hydropower plant
Source of data	Direct measurement at the connection point
Description of measurement methods and procedures to be applied	Two-way power meters are installed at the grid-connected point to measure the amount of electricity supplied to the grid by the proposed project by the positive direction. The readings of electricity meter are hourly measured and monthly recorded. The recorded data would be confirmed by the joint balance sheet which would be signed by the representatives of EVN and the project owner. Electronic data would be archived within the crediting period and 2 years after the end of the crediting period.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value monitored	62.20
Monitoring equipment	

Technical Details	Main Power meter CTC	Backup Power Meter CTP
Serial number	8062733	8062734
Model	PB3KAAGHT-5	
Accuracy	0.5s	0.5s
Date of current Calibration	09-May-2013	09-May-2013
	17-January-2014	17-January-2014
	16-January -2015	16-January -2015
	03-November-2016	03-November-2016
	08-April-2017	08-April-2017
	14-August-2018	14-August-2018

	Calibration Validity	13-August-2020
	Calibration Frequency	At least once every two years.
QA/QC procedures to be applied	Both power meters have been calibrated at least once every 2 year by a qualified third party.	
Purpose of the data	Calculation of Baseline Emission	
Calculation method	-	
Comments	For calculation $EG_{BL,y} = EG_{y,\ export} - EG_{y,\ import}$	

Data / Parameter	$EG_{BL,y}$
Data unit	MWh
Description	Net electricity supplied to the national grid by the proposed hydropower plant
Source of data	Calculating from $EG_{y,import}$ and $EG_{y,export}$
Description of measurement methods and procedures to be applied	Calculating by subtracting $EG_{y,}$ import from EG_{y}, export. Double checking by the joint balance sheet issued by EVN and project owner to ensure the consistency. Data would be archived within the crediting period and 2 years after the end of the crediting period.
Frequency of monitoring/recording	Continuous monitoring, hourly measurement and at least monthly recording
Value monitored	237,409.90
Monitoring equipment	NA
QA/QC procedures to be applied	The uncertainty level of this data is low.
Purpose of the data	For CERs calculation ($EG_{BL,y,} = EG_{y,\ export} - EG_{y,\ import}$)
Calculation method	Net Energy Generation = Total energy export to the Grid – Total energy import from the grid
Comments	-

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	Project Site
Description of measurement methods and procedures to be applied	Measured from topographical surveys, maps, satellite pictures, etc
Frequency of monitoring/recording	yearly
Value monitored	17,448
Monitoring equipment	Measured by a third Party.
QA/QC procedures to be applied	The uncertainty level of this data is low.
Purpose of the data	For power density calculation.
Calculation method	NA
Comments	-

Data / Parameter	Cap_{PJ}
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	Manufacture's nameplate.
Frequency of monitoring/recording	yearly
Value monitored	8,100,000
Monitoring equipment	NA
QA/QC procedures to be applied	-
Purpose of the data	Use for calculating the power density
Calculation method	-

Comments	-

Data / Parameter	$FCi_{j\,y}$
Data unit	Mass or volume unit per year (e.g. ton/yr or m^3/yr)
Description	the quantity of fuel type I combusted in process j during the year y in the event of black out of the plant
Source of data	Onsite Measurements
Description of measurement methods and procedures to be applied	Continuously if backup system is used.
Frequency of monitoring/recording	Yearly
Value monitored	1,279.29 lit
Monitoring equipment	-
QA/QC procedures to be applied	The consistency of metered fuel consumption quantities should be crosschecked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of the data	Use for calculating $PE_{FF,y,i}$
Calculation method	Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift)
Comments	-

4.3 Monitoring Plan

Because the baseline emission factor of Vietnam National Grid ($EF_{grid,CM,y}$) is fixed ex-ante (detail in Section B.6), the main data to be monitored is $EG_{BL,y}$ would be calculated according to this formula below:

$EG_{BL,y,} = EG_{y,\,export} - EG_{y,\,import}$

The electricity generated from the project activity would be sold to the EVN for the complete project Life time under a long-term PPA with EVN. The electricity generated from the project activity before entering into the grid at the grid interconnection point would be measured by a digital kilowatt hour (kWh) meter. The metering system includes the main system and a back-up system. The back-up system would be used in case of failing of the main meter.

Data from the operating meters would be recorded hourly. Additionally, monthly manual readings would be taken from the operating meters. Monthly, EVN staff and staff of the operation division of the power plant would cross-check manual meter readings with the electronically recorded data and prepare and sign a joint balance sheet which indicates the amount of power fed into the grid within that month.

This joint balance sheet is also the basis of payment by the EVN to the project proponent. Hence, the monitoring plan is well integrated into the standard EVN procedures. When the electricity generation from the plant is cut off, a backup generator with installed capacity of 250KVA to generate electricity would be used internally within the plant. In such case, the CDM team would keep all relevant records for verification purposes.

Description of technical equipment

The metering system would be installed at the connecting point in 110kV Ninh Son Station. They are digital meters bi-directly with the accuracy of 0.5 S. The metering system includes the main system and a back-up system.

The meter type used is an electronic 3 phase and details on the technical equipment can be found in the hard copy document "Technical explanation for metering system" as developed by the project proponent and approved by EVN. The following figure mentions the position of installed meter equipment as the connected point.

Monitoring organization.

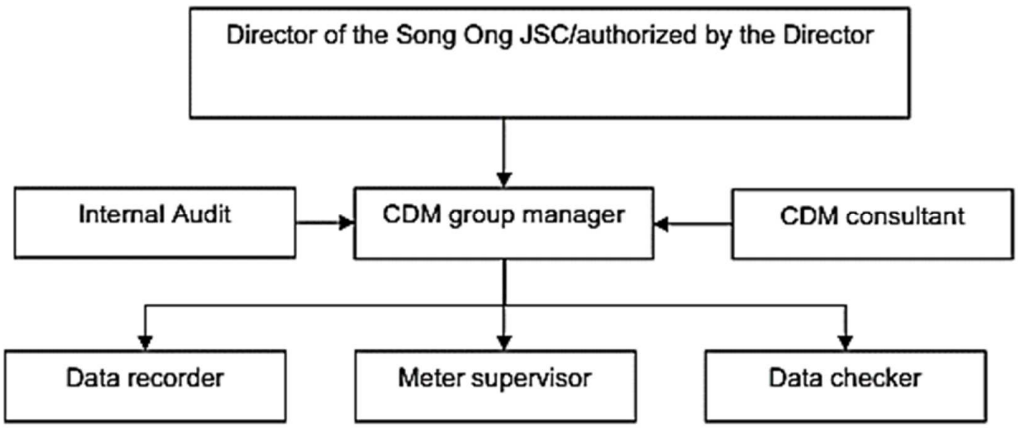

Figure 3. Structure of monitoring group

The responsibilities of each person involved are elaborated as follows:

Person	Responsibility
Director of the Song Ong JSC/authorised by the Director	Check and sign the monitoring report annually
CDM group manager	Managing the whole CDM business of Song Ong power plant, guiding and supervising data recorder after trained by CDM consultant.
CDM consultant	Providing CDM group manager training and technical support about CDM monitoring plan.
Internal auditor	Check the monitoring procedure at least once in a year.
Data recorder	Collecting and recording data every month.
Meter supervisor	Checking power meter periodically according to relevant regulation.
Data checker	Double checking the collected data measured by power meter.

Monitoring procedure

The steps of monitoring the electricity supplied to the grid and the electricity imported from grid and consumed by the proposed project are as follows:

1. Persons in charge of data record and meter supervisor from Song Ong power plant together with staff from EVN shall read and collect data from main power meters on the first day of every month, the result would be signed by both parties and kept respectively;
2. The data from the backup power meter would be hourly recorded by the person in charge of data record of Song Ong power plant. This recorded data would be cross checked with the data from main power meter. Data would be filled in the form provided by VNEEC.
3. Song Ong power plant provides electricity sales invoice to EVN, and keeps the copy of invoice;
4. Song Ong power plant provides the record of main, backup power meters and copy of invoices to the verifier of DOE

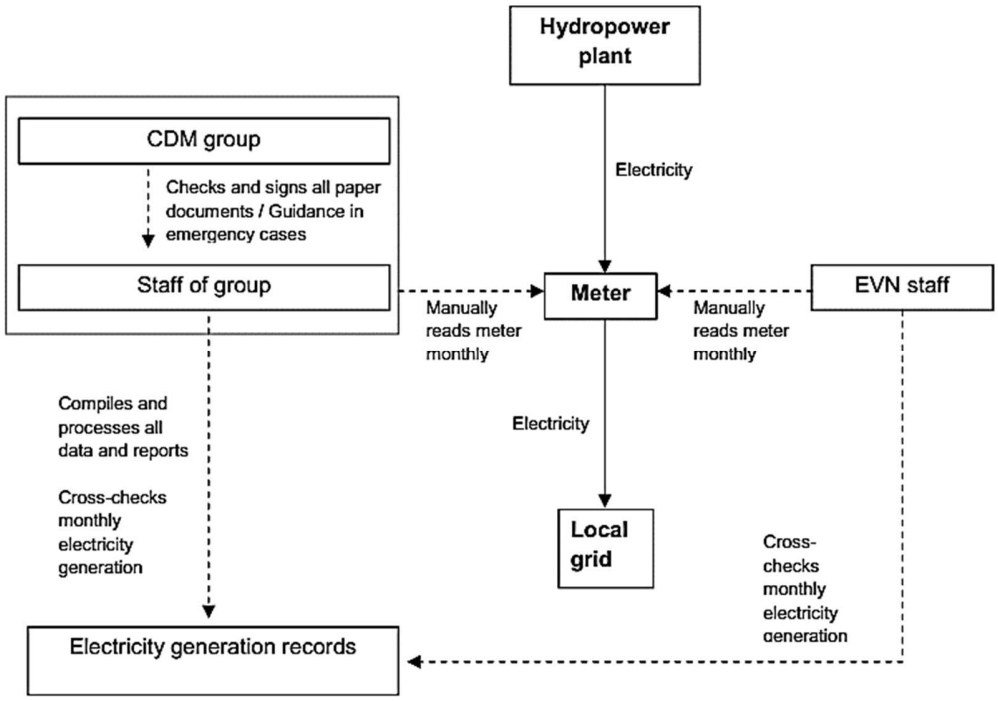

Figure 4. Monitoring Process

Calibration of metering equipment

Before on-site installation meters would be calibrated and verified by local STAMEQ pursuant to the Decision No 65/2002/QD-BKHCNMT. According to this Decision, calibration and verification for 3phase meters need to be conducted every second year. This means that calibration would be undertaken by local STAMEQ once in every two-year period during project operation. Local STAMEQ would after every calibration seal the meters so that no interference is possible.

Data recording and archiving procedures

The CDM group appointed by Song Ong power plant shall keep monitored data in electronic archives at the end of every month. Paper documents should be stored in electronic format and copied by CD. Electronic documents should be printed out and kept.

Song Ong power plant shall keep the copy of electricity sales/purchase invoices (the original electricity sales/purchase invoices shall be kept by Finance Department of Song Ong Hydro power JSC). In order to help verifiers obtain documents and information related to the emission reduction of the proposed project, Song Ong Hydropower JSC shall prepare an index of the data documents and monitoring report. All the data and information in the form of paper documents shall be archived by the CDM group, with at least one copy backup for each datum.

All the data shall be kept for 2 years after the crediting period.

Emergency procedures

In case of any unforeseen event that is not covered under this monitoring plan, staff of the operation division would immediately inform the chief of the operation division. The chief of the operation division is then responsible to ensure that the cause for the unforeseen event is detected, the event is remedied and for the period of time in which the unforeseen event has occurred uncertainty in data gathered is limited as much as possible. In doing so, the chief of division shall seek guidance from VNEEC.

Training

Before the start of the crediting period, VNEEC in close collaboration with the chief of the operation division of the power plant develop a training manual and training course for the staff of the operation division that would clearly lay out rules and procedures for all activities related to metering, data recording and processing, data archiving and preparation of monitoring reports.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

Baseline emissions include only CO_2 emissions from electricity generation by fossil fuel fired power plants that are displaced due to the project activity. It is calculated as follows:

$BE_y = EG_{BL,y} * EF_{grid,CM,y}$

Where:

BE_y	Baseline emissions in year y (tCO_2e/yr)
$EG_{BL,y}$	Quantity of net electricity generation supplied by the hydropower plant to the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$	Combined margin CO2 emission factor of the national electricity grid in year y (tCO2/MWh).

Therefore,

$BE_y = 237{,}409.90 * 0.5355$

$BE_y = 127{,}129\ tCO_2e$ (Rounddown for each vintage year)

5.2 Project Emissions

According to the AMS.ID, the project emission for the Hydropower project includes the two proponents of emission from backup power and a new reservoir. The following formula is applied:

$PE_y = PE_{FF,y} + PE_{HP,y}$

Where,

$PE_{FF,y}$ - backup power emissions

$PE_{HP,y}$ - the emissions from the reservoir

The emissions from the reservoir ($PE_{HP,y}$)

For hydropower project activity that results in new reservoirs and/or the increase of existing reservoirs, the power density (PD) of the project activity shall be calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

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.

If the PD is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,Y} = \frac{EF_{Res} * TEG_y}{1000}$$

Where:

$PE_{HP,y}$ Emission from reservoir expressed as tCO2e/year

EF_{Res} the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO2e /MWh.

TEG_y Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh).

If PD is greater than 10 W/m2, then:

$PE_{HP,y} = 0$

Emission from diesel backup generators ($PE_{FF,y}$)

The project would employ a diesel motor as backup power for emergency situation, such as both cut-off of electricity supply and the hydropower station. According to the "Tool to calculate project or leakageCO2 emissions from fossil fuel consumption", the annual CO2 emissions from diesel oil combustion are calculated as follows:

$$PE_{FF,j,y} = \sum_i FC_{i,j,y} * COEF_{i,y}$$

And

$$COEF_{i,y} = NCV_{i,y} * EF_{CO2,i,y}$$

Where:

$PE_{FF,j,y}$ The CO_2 emissions from fossil fuel combustion in process j during the year y

$FC_{i,j\,y}$ The quantity of fuel type I combusted in process j during the year y (mass or volume unit/year)

$COEF_{i,y}$ The CO_2 emission coefficient of fuel type I in year y (tCO_2/mass or volume unit)

$NCV_{i,y}$ The weighted average net calorific value of the fuel type I in year y

$EF_{CO2,i,y}$ The weighted average CO_2 emission factor of fuel type I in year y (tCO_2/GJ)

i The fuel types combusted in process j during the year y

According to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, the NCV of diesel oil is 43.3 TJ/Gg and the emission factor is 74,800 $kgCO_2$/TJ, and thus the $COEF_{i,y}$ = 0.0032 tCO_2/kg diesel.

Therefore,

$$PE_{FF,j,y} = \sum_i FC_{i,j,y} * COEF_{i,y}$$

$$PE_{FF,j,y} = 1{,}279.29 * \frac{1}{1165} * 1000 * 0.0032$$

$PE_{FF,j,y}$ = 9 tCO_2e (Roundup for each vintage year)

5.3 Leakage

Because the technology used in this project is neither transferred to nor transferred from another activity leakage is considered to be zero (L_y = 0).

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)
01-March-2012 to 31-December-2012	18,368	1	0	18,367
01-January-2013 to 31-December-2013	21,811	1	0	21,810
01-January-2014 to 31-December-2014	18,393	1	0	18,392

01-January-2015 to 31-December-2015	17,452	2	0	17,450
01-January-2016 to 31-December-2016	20,192	2	0	20,190
01-January-2017 to 31-December-2017	27,699	1	0	27,698
01-January-2018 to 28-February-2018	3,214	1	0	3,213
Total	**127,129**	**9**	**0**	**127,120**

The achieved GHG emission is 1.11% is lower than the estimated value. Thus, the lower GHG emission is acceptable.

APPENDIX 1: MAJOR BREAKDOWN DETAILS

Tripping Data

Sl. No.	Date	System	Time (hours)
1	31-March-2012	Malfunctioning of Stator Winding RTD	11:36
2	08-June-2014	Stator earth fault	10:36
3	29-August-2015	SPS-3 activated from Rampur end	09:20
4	29-August-2015	SPS-3 activated from Rampur end	12:20
5	09-July-2016	SPS-1 activated from Rampur end	08:12
6	26-March-2017	Flashover in SSB-B MSLB Feeder	07:30

Forced shutdown due to high shift

Sl. No.	Date	High Silt / Flushing	Time (hours)
1	27-July-2012	HS	04:08
2	07-August-2012	HS/flushing	66:56
3	08-August-2013	HS/flushing	165:09
4	10-August-2014	HS	54:29
5	11-August-2014	HS	27:30
6	13-August-2015	HS	14:53
7	18-August-2015	HS	36:42
8	23-August-2016	HS/flushing	68:27
9	08-August-2016	HS	16:47
10	08-September-2017	HS/flushing	10:11
11	25-August-2018	HS/flushing	15:19