



**Monitoring report form for CDM programme of activities**  
(Version 02.0)

*Complete this form in accordance with the instructions attached at the end of this form.*

**MONITORING REPORT**

<b>Title of the PoA</b>	Viet Nam Renewable Energy Development Program (REDP)																																			
<b>UNFCCC reference number of the PoA</b>	6810																																			
<b>Version numbers of the PoA-DD applicable to this monitoring report</b>	Version 09 dated 02/07/2015																																			
<b>Version number of this monitoring report</b>	01																																			
<b>Completion date of this monitoring report</b>	23/04/2018																																			
<b>Monitoring period number</b>	05																																			
<b>Duration of this monitoring period</b>	<table border="1"> <thead> <tr> <th>PoA / CPA</th><th>MP number</th><th>MP (first and last included)</th></tr> </thead> <tbody> <tr> <td><b>PoA 6810</b></td><td>5<sup>th</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA1_ Sung Vui Hydropower Project</td><td>5<sup>th</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA2_ Nam Tha 4 Hydropower Project</td><td>4<sup>th</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA3_ Pa Chien Hydropower</td><td>4<sup>th</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA4_ Song Rieng Hydropower Project</td><td>4<sup>th</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA5_ Hoa Phu Hydropower Project</td><td>4<sup>th</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA6_ Ban Ang Hydropower Project</td><td>1<sup>st</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CP7_ Bao Lam 1 Hydropower Project</td><td>1<sup>st</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA8_ Trung Thu Hydropower Project</td><td>2<sup>nd</sup></td><td>01/01/2017 - 31/12/2017</td></tr> <tr> <td>CPA9_ Bai Thuong Hydropower Project</td><td>2<sup>nd</sup></td><td>01/01/2017 - 31/12/2017</td></tr> </tbody> </table>	PoA / CPA	MP number	MP (first and last included)	<b>PoA 6810</b>	5 <sup>th</sup>	01/01/2017 - 31/12/2017	CPA1_ Sung Vui Hydropower Project	5 <sup>th</sup>	01/01/2017 - 31/12/2017	CPA2_ Nam Tha 4 Hydropower Project	4 <sup>th</sup>	01/01/2017 - 31/12/2017	CPA3_ Pa Chien Hydropower	4 <sup>th</sup>	01/01/2017 - 31/12/2017	CPA4_ Song Rieng Hydropower Project	4 <sup>th</sup>	01/01/2017 - 31/12/2017	CPA5_ Hoa Phu Hydropower Project	4 <sup>th</sup>	01/01/2017 - 31/12/2017	CPA6_ Ban Ang Hydropower Project	1 <sup>st</sup>	01/01/2017 - 31/12/2017	CP7_ Bao Lam 1 Hydropower Project	1 <sup>st</sup>	01/01/2017 - 31/12/2017	CPA8_ Trung Thu Hydropower Project	2 <sup>nd</sup>	01/01/2017 - 31/12/2017	CPA9_ Bai Thuong Hydropower Project	2 <sup>nd</sup>	01/01/2017 - 31/12/2017		
PoA / CPA	MP number	MP (first and last included)																																		
<b>PoA 6810</b>	5 <sup>th</sup>	01/01/2017 - 31/12/2017																																		
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CP7_ Bao Lam 1 Hydropower Project	1 <sup>st</sup>	01/01/2017 - 31/12/2017																																		
CPA8_ Trung Thu Hydropower Project	2 <sup>nd</sup>	01/01/2017 - 31/12/2017																																		
CPA9_ Bai Thuong Hydropower Project	2 <sup>nd</sup>	01/01/2017 - 31/12/2017																																		
<b>Monitoring report number for this monitoring period</b>	01 (Single monitoring report for 09 CPAs in PoA covered during this monitoring period)																																			
<b>Coordinating/managing entity</b>	Vietnam Ministry of Industry and Trade (MOIT)																																			
<b>Host Parties</b>	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)																																		

	Socialist Republic of Viet Nam	Yes
<b>Sectoral scopes</b>	1: Energy industries (renewable - / non-renewable sources)	
<b>Applied methodologies and standardized baselines</b>	ACM0002 (Version 13.0.0) "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"	
<b>Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period</b>	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	<b>0tCO<sub>2</sub>e</b>	CPA1_ Sung Vui Hydropower Project 42,693 tCO <sub>2</sub> e
		CPA2_ Nam Tha 4 Hydropower Project 31,211 tCO <sub>2</sub> e
		CPA3_ Pa Chien Hydropower Project 43,519 tCO <sub>2</sub> e
		CPA4_ Song Rieng Hydropower Project 9,211 tCO <sub>2</sub> e
		CPA5_ Hoa Phu Hydropower Project 91,352 tCO <sub>2</sub> e
		CPA6_ Ban Ang Hydropower Project 34,137 tCO <sub>2</sub> e
		CPA7_ Bao Lam 1 Hydropower Project 51,808 tCO <sub>2</sub> e
		CPA8_ Trung Thu Hydropower Project 61,589 tCO <sub>2</sub> e
		CPA9_ Bai Thuong Hydropower Project 9,632 tCO <sub>2</sub> e
		<b>Total of 09 CPAs 375,162 tCO<sub>2</sub>e</b>
<b>Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report</b>	CPA1_ Sung Vui Hydropower Project	30,115 tCO <sub>2</sub> e
	CPA2_ Nam Tha 4 Hydropower Project	26,932 tCO <sub>2</sub> e
	CPA3_ Pa Chien Hydropower Project	48,120 tCO <sub>2</sub> e
	CPA4_ Song Rieng Hydropower Project	8,204 tCO <sub>2</sub> e
	CPA5_ Hoa Phu Hydropower Project	77,050 tCO <sub>2</sub> e
	CPA6_ Ban Ang Hydropower	37,059 tCO <sub>2</sub> e

	Project	
	CPA7_Bao Lam 1 Hydropower Project	62,270 tCO <sub>2</sub> e
	CPA8_Trung Thu Hydropower Project	66,994 tCO <sub>2</sub> e
	CPA9_Bai Thuong Hydropower Project	13,306 tCO <sub>2</sub> e
	<b>Total of 09 CPAs</b>	<b>370,050 tCO<sub>2</sub>e</b>

## PART I Monitoring of programme of activities (PoA)

### SECTION A. Description of PoA

#### A.1. General description of PoA

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The Government of Viet Nam (GoV) recognized the potential for renewable energy to contribute to the sustainable development of the electricity sector while also helping to close the crucial supply-demand gap, particularly in the rural areas. It had made a good start with the Renewable Energy Action Plan (REAP)<sup>1</sup> adopted in 2001 and through the World Bank's System Efficiency Improvement, Equitization and Renewables Project (SEIER, Cr.3680-VN<sup>2</sup>, approved in 2003), which supported the development of policy and regulatory framework. By developing this Programme of Activities (PoA) along with carbon finance support, the developers (mostly private companies with limited financial capacity) were able to exploit renewable energy resources (mainly small hydro power sites) to sell electricity to the national grid under the framework of the Government of Viet Nam's Electricity Law passed in November 2004.

The main objective of this PoA is to generate power from clean renewable hydropower in Viet Nam and to contribute to the sustainability of power generation of the Viet Nam National Power Grid and reduce the GHG emissions from fossil fuels used for power generation. Viet Nam Ministry of Industry and Trade (MOIT) is the coordinating/managing entity (CME) of the PoA. The PoA is managed by the Project Management Board for Rural Energy and Renewable Energy (PMB-RERE) under MOIT. The component programme activities (CPAs) covered under this report is a part of the PoA supporting the Renewable Energy Development Program (REDP) in Viet Nam.

This is the 5<sup>th</sup> monitoring report of the PoA from 01/01/2017 to 31/12/2017 (first and last days included) for a total 365 days of plant operation for Sung Vui, Nam Tha 4, Pa Chien, Hoa Phu, Song Rieng, Trung Thu, Bai Thuong, Bang Ang and Bao Lam 1 HPP. The cumulative net electricity export of the 09 CPAs to grid during the monitoring period is 662,659 MWh. Certified Emission Reductions (CERs) generated by 09 CPAs during this monitoring period is 375,162 tCO<sub>2</sub>e.

#### A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
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<sup>1</sup><http://go.worldbank.org/1VRS59LIH0>

<sup>2</sup><http://go.worldbank.org/PFINZBHNY>

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Single generic CPA as per Appendix 1 - VN REDP PoA-DD (Part II, VVS track) of PoA "Vietnam Renewable Energy Development Program (REDP)"  CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY  <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	09	1: Energy industries (renewable-/ non-renewable sources)	ACM0002 Version 13.0.0 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

## A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Crediting period type and duration	Covered in this monitoring report? (yes/no)
CPA1_Sung Vui Hydropower Project 6810-0001	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 01/01/2013 to 31/12/2019 include both days	Yes
CPA2_Nam Tha 4 Hydropower Project 6810-0003	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 26/11/2014 to 25/11/2021 include both days	Yes
CPA3_Pa Chien Hydropower Project 6810-0002	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 10/06/2014 to 09/06/2021 include both days	Yes
CPA4_Song Rieng Hydropower Project 6810-0004	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY	Version 09	Renewable 26/11/2014 to 25/11/2021 include both	Yes

	<a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>		days	
CPA5_Hoa Phu Hydropower Project 6810-0005	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 26/11/2014 to 25/11/2021 include both days	Yes
CPA6_Ban Ang Hydropower Project 6810-0008	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 01/11/2016 to 30/10/2023 include both days	Yes
CPA7_Bao Lam 1 Hydropower Project 6810-0007	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 30/11/2016 to 29/11/2023 include both days	Yes
CPA8_Trung Thu Hydropower Project 6810-0006	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 30/09/2016 <sup>3</sup> to 29/09/2023 include both days	Yes
CPA9_Bai Thuong Hydropower Project 6810-0009	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 15/11/2016 <sup>4</sup> to 14/11/2023 include both days	Yes

<sup>3</sup> Inclusion date 31/07/2015; operation start date 19/11/2016, which is the date of the minute of 72 hours test run completed for the first generating unit on 19/11/2016; starting date of crediting period 30/09/2016

<sup>4</sup> Inclusion date 11/09/2015; operation start date 12/11/2016, which is the date of the minute of 72 hours test run completed for the generating units on 12/11/2016; starting date of crediting period 15/11/2016

	<a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">age/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>			
CPA10_Than Giap Hydropower Project 6810-0010	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 01/01/2018 to 30/12/2023 include both days	No
CPA11_Muong Khuong Hydropower Project 6810-0011	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 01/08/2018 to 30/07/2024 include both days	No
CPA12_Muong Hung Hydropower Project 6810-0012	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 01/10/2018 to 30/09/2024 include both days	No
CPA13_Xuan Minh Hydropower Project 6810-0013	CPAXX: [Name of the Hydro Project] Hydropower Project Version: XX Date:DD/MM/YYYY <a href="https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1">https://cdm.unfccc.int/UserManagement/FileStorage/SNX7TV5G8M6UQ20RP9LAEKJ43BCDH1</a>	Version 09	Renewable 01/05/2018 to 30/04/2024 include both days	No

**A.2. Coordinating/managing entity**

&gt;&gt;

Mr. Phuong Hoang Kim

Director General, Electricity and Renewable Energy Authority

Ministry of Industry and Trade (MOIT) (MOIT is also a project participant)

Tel: 84 24 6278 6184

Email: [kimph@moit.gov.vn](mailto:kimph@moit.gov.vn)**SECTION B. Implementation of PoA****B.1. Description of implemented PoA**

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**Operation and management plan:**

The CME(MOIT) will maintain an electronic data base with the following information per CPA subscribing to the PoA:

- Name of the CPA
- Implementing entity of the CPA
- Installed capacity of the CPA
- Location of the CPA (GPS coordinates of the power house)
- Data related to CPA monitoring and verification

This information shall also be utilized by the validating DOE to determine that a CPA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity. In order to avoid double accounting and to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA, the implementing entity of a CPA shall enter into a contractual arrangement with MOIT including respective provisions that:

- The CPA has not been and will not be registered as a single CDM project activity or as a CPA under another PoA.
- The implementing entity is aware that the CPA will be subscribed to the present PoA.
- The implementing entity cedes its rights to claim and own emission reductions under the Clean Development Mechanism of the UNFCCC or any voluntary scheme to the coordinating of the present PoA

### **Monitoring Plan:**

Monitoring will be carried out for each CPA. All parameters included in section B.7.1 of Section II of PoA DD will be monitored by the implementing entity of the CPA according to the procedures established in B.7.2 of Section II of PoA DD, and will be submitted to the coordinating entity in the form of annual Monitoring report of the respective CPA.

At the PoA level, the coordinating entity will collect and store the monitoring data of all CPAs in an electronic database for the verification purpose. Primary data will be stored by the implementing entities. The data shall be verified per CPA and the verification status of each CPA will be recorded by the coordinating entity in the database.

## **B.2. Post-registration changes to PoA**

### **B.2.1. Corrections**

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During first verification (for Sung Vui CPA) of this PoA “Vietnam Renewable Energy Development Program (REDP)”, the PoA DD was revised. The changes in PoA DD version 08 dated 19/09/2014<sup>5</sup> was accepted by UNFCCC without prior approval. The calibration frequency of electricity meters is revised as 2 years as per national practise in Vietnam. However, the calibration requirement for each CPA depends on the PPA signed with EVN.

During second verification, the PoA DD was again revised (becoming version 09 dated 02/07/2015 and approved on 15/07/2016) during PRC without prior approval for CPA DDs Nam Tha 4 and Song Rieng<sup>6</sup>.

### **B.2.2. Inclusion of monitoring plan**

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<sup>5</sup>[https://cdm.unfccc.int/PoAIssuance/iss\\_db/poaiss761634785/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poaiss761634785/view)

<sup>6</sup>[https://cdm.unfccc.int/PoAIssuance/iss\\_db/poaiss701157336/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poaiss701157336/view)

Not applicable

**B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools**

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Not applicable

**B.2.4. Changes to programme design**

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Not applicable

## **PART II Monitoring of CPAs**

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### **SECTION C. Implementation of CPAs**

#### **C.1. Description of implemented CPAs**

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As of end of this monitoring period, 13 CPAs have been included in this PoA. This monitoring report is prepared for 09 CPAs which generated electricity in late 2016 and 2017. Other 04 CPAs namely Than Giap, Muong Khuong, Muong Hung and Xuan Minh are expected to start generation in 2018 and therefore are not covered in this monitoring period. The details of CPAs considered in this report are provided in Table 1.

**Table 1: CPAs of PoA covered in this monitoring period**

<b>CPA name<sup>7</sup></b>	<b>Registered/ Included<sup>8</sup></b>	<b>Capacity (MW)</b>	<b>Project implementer</b>
CPA1_ Sung Vui Hydropower Project (Sung Vui)	19/12/2012 <sup>9</sup>	18	Nam Tien Construction Investment and Commercial Joint Stock Company
CPA2_ Nam Tha 4 Hydropower Project (Nam Tha 4)	26/11/2014	11.5	Phuc Khanh Investment Construction and Energy Development JSC
CPA3_ Pa Chien Hydropower Project (Pa Chien)	10/06/2014	22	Pa Chien Hydropower JSC
CPA4_ Song Rieng Hydropower	26/11/2014	2.95 <sup>10</sup>	HP Joint Stock Company

<sup>7</sup>For simplicity, in this monitoring report these CPAs are shortly referred to as Sung Vui, Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Bang Ang, Bao Lam 1, Trung Thu and Bai Thuong respectively.

<sup>8</sup>[http://cdm.unfccc.int/ProgrammeOfActivities/poa\\_db/06901LAWYS37INVEB5RZHMUCU4KJFPD/view](http://cdm.unfccc.int/ProgrammeOfActivities/poa_db/06901LAWYS37INVEB5RZHMUCU4KJFPD/view)

<sup>9</sup>PRC done without prior approval for this CPA during monitoring period from 01/01/2013 to 31/12/2013. Changes are corrected and accepted in the revised CPA-DD version 08, dated 08/09/2014. ([https://cdm.unfccc.int/PoAIssuance/iss\\_db/poais761634785/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poais761634785/view))

<sup>10</sup>Total capacity of plant as per CPA DD is 3.75 MW of which 2.95 MW is installed in phase 1. Phase 2 capacity of 0.8 MW has not been installed at this stage yet. Therefore, in this monitoring period, the CME opted to apply a design change to the CPA, resulting in an updated installed capacity of 2.95 MW.



CPA name <sup>7</sup>	Registered/ Included <sup>8</sup>	Capacity (MW)	Project implementer
Project (Song Rieng)			
CPA5_ Hoa Phu Hydropower Project (Hoa Phu)	26/11/2014	29	Tam Long Power Joint Stock Company
CPA6_ Ban Ang Hydropower Project (Ban Ang)	31/07/2015	17	Nam Mo & Nam Non Hydropower Joint Stock Company
CPA7_ Bao Lam 1 Hydropower Project (Bao Lam 1)	31/07/2015	30	Power Construction Joint Stock Company No.1 (PCC1)
CPA8_ Trung Thu Hydropower Project (Trung Thu)	31/07/2015	30	Trung Thu Hydropower Joint Stock Company
CPA9_ Bai Thuong Hydropower Project (Bai Thuong)	11/09/2015	06	Bai Thuong Hydro Power Joint Stock Company

This report is prepared as a single monitoring report for nine CPAs (Sung Vui, Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Ban Ang, Bao Lam 1, Trung Thu and Bai Thuong, ) for the 5<sup>th</sup> monitoring period under the registered PoA. Major milestones in the project implementation of these CPAs are shown in **Table 2** below:

**Table 2. Timeline of the CPA implementation**

CPA	Construction start date	CPA inclusion date	Start date of first crediting period	Commissioning date	Operation days during this monitoring period
Sung Vui	10/01/2010	19/12/2012	01/01/2013	28/03/2013	365
Nam Tha 4	04/10/2010	26/11/2014	26/11/2014	18/12/2013 <sup>11</sup>	365
Pa Chien	12/10/2010	10/06/2014	10/06/2014	27/06/2013 <sup>12</sup>	365
Song Rieng	25/01/2010	26/11/2014	26/11/2014	10/01/2012 <sup>13</sup>	365
Hoa Phu	28/09/2010	26/11/2014	26/11/2014	15/09/2014 <sup>14</sup>	365

<sup>11</sup> Based on the date of minute of meter readings confirmation after 72 hour test run, dated 18/12/2013

<sup>12</sup> Letter confirming the commercial operation date after 72 hour test run, dated 27/01/2015 from the grid company

<sup>13</sup> Letter confirming the commercial operation start date, dated 23/02/2012 from Central Power Corporation

<sup>14</sup> Minute of meter readings confirmation after 72 hour test run, dated 15/09/2014 (72 hours back is on 12/09/2014, which is the commercial start date)

CPA	Construction start date	CPA inclusion date	Start date of first crediting period	Commissioning date	Operation days during this monitoring period
Ban Ang	04/2015 <sup>15</sup>	31/07/2015	01/11/2016	16/01/2017 <sup>16</sup>	365
Bao Lam 1	13/07/2014 <sup>17</sup>	31/07/2015	30/11/2016	16/12/2016 <sup>18</sup>	365
Trung Thu	01/02/2014 <sup>19</sup>	31/07/2015	30/09/2016	19/11/2016 <sup>20</sup>	365
Bai Thuong	21/11/2014 <sup>21</sup>	11/09/2015	15/11/2016	12/11/2016 <sup>22</sup>	365

Installed technology and equipment:

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<sup>15</sup> Letter approving construction start in April 2015 by Nghe An provincial people's committee dated 26/02/2015

<sup>16</sup> Based on the date of minute of meter readings confirmation after 72 hour test run, dated 16/01/2017. The start date of crediting period was estimated based on the construction schedule. However, the actual construction was slower than estimation.

<sup>17</sup> Refer to the article on Web Portal of Cao Bang province, which shows construction start date of 13/11/2014

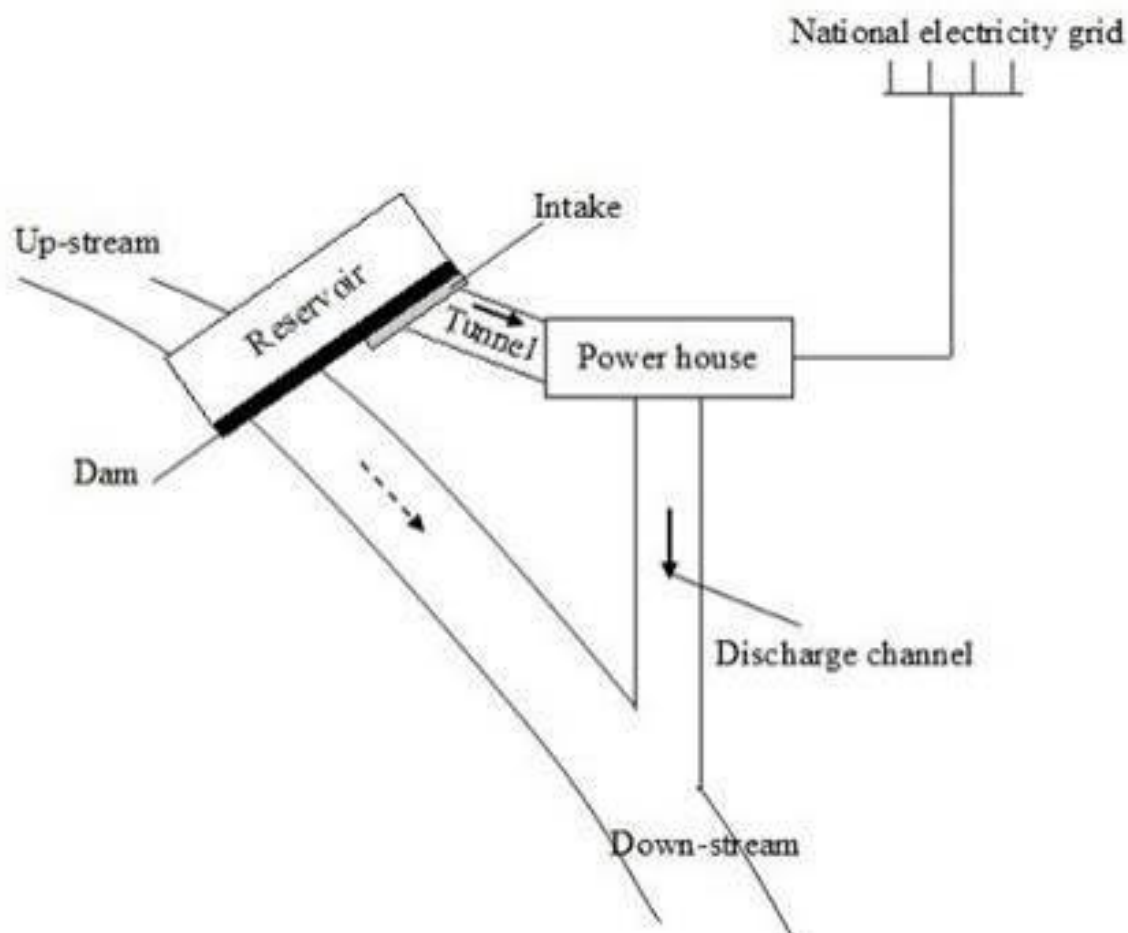
<sup>18</sup> Based on the date of minute of meter readings confirmation after 72 hour test run, dated 16/12/2016. The start date of crediting period was estimated based on the construction schedule. However, the actual construction was slower than estimation.

<sup>19</sup> According to the actual implementation schedule

<sup>20</sup> Minute of meter readings confirmation after 72 hour test run, dated 19/11/2016

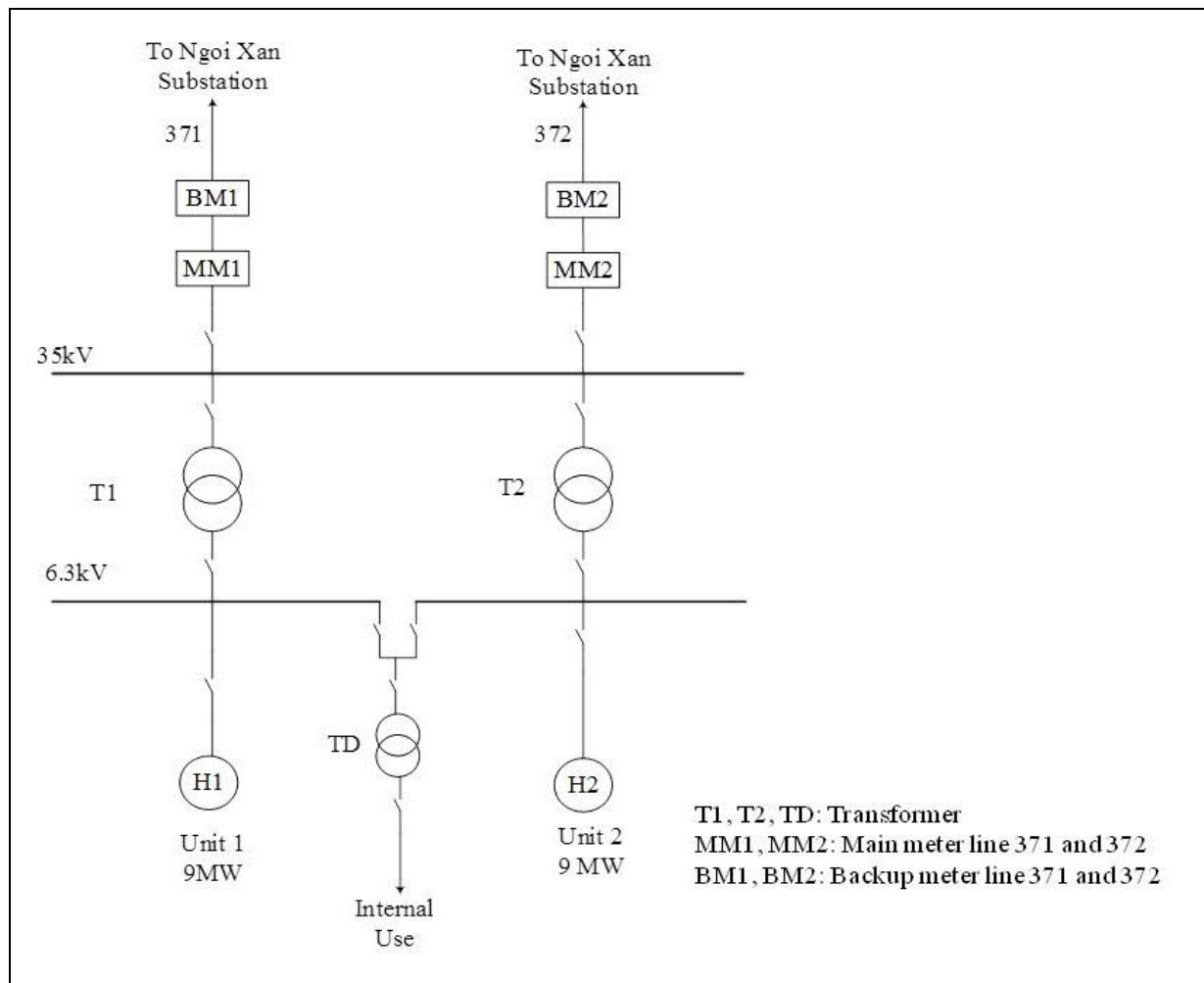
<sup>21</sup> Approval for construction start by the CPA implementer dated 15/11/2014

<sup>22</sup> Letter confirming the commercial operation start date, 24/02/2017, from the Northern Power Corporation.



**Figure 1. Schematic layout of the hydropower plants**

**Sung Vui:** This CPA has installed two turbo-generator units (Pelton type) with an installed capacity of 9MW each for a total installed capacity of 18MW. The project uses water from Phin Ho stream to generate and export electricity to the national power grid. Main construction works of the project include a gravity dam, a water diversion system, a powerhouse and a switching station. The power generated (at 6.3kV) by the generating units is stepped up at the power plant site itself to 35kV and is connected to the nearby 35kV power lines, before being transmitted to Ngoi Xan 110kV substation and then to the National Power Grid. Refer to **Figure 12**



**Figure 12** for the grid connection diagram for this plant.

The technical specifications of main equipment are listed in Table 3 below:

**Table 3. Main equipment installed at Sung Vui**

Equipment	Main Technical Data	Value (per unit)
<b>Turbine</b>	Unit	2
	Runner diameter	1,350 mm
	Type	Pelton turbine
	Capacity	9.330 MW
	Rated Speed	600 rpm
	Rated efficiency	86%
<b>Generator</b>	Unit	2
	Rated capacity in kVA	11,250 kVA

Equipment	Main Technical Data	Value (per unit)
	Rated capacity in MW	9 MW <sup>23</sup>
	Rated Speed	600 rpm
	Efficiency	96.5%
	Rated voltage	6.3 kV
	Power factor (Cosφ)	0.8

**Nam Tha 4:** The CPA is a hydropower plant having two generating units, each with capacity of 5.750MW for a total installed capacity of 11.5MW. The project uses water from Nam Tha stream to generate and export electricity to the national power grid. Main construction works of the project include a gravity dam, water intake, diversion canal, pressure tank, pressure pipe, a powerhouse and a switching station.

The power generated by the generators at Nam Tha 4 powerhouse is stepped up by two transformers to 110kV at the onsite substation before it is connected to Nam Tha 110kV substation. Power measurement for billing purpose is undertaken at this substation and supplied to the power grid via the 110kV outgoing bus-bar 171. One main meter (main meter 171-1) and two back-up meters (back-up meter 171-2 and back-up meter 171-3) are installed at Nam Tha 110kV substation to measure the power exported to and imported from the national grid. Refer to Figure 13 for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 4 below.

**Table 4. Main equipment installed at Nam Tha 4**

Equipment	Main Technical Data	Value (per unit)
<b>Turbine</b>	Unit	2
	Runner diameter	1,000 mm
	Type	Francis turbine, horizontal axis
	Capacity	5.958 MW
	Rated Speed	750 rpm
	Rated efficiency	92%
<b>Generator</b>	Unit	2
	Rated capacity in MW	5.75 MW
	Rated Speed	750 rpm
	Efficiency	97.24%

<sup>23</sup>Generator capacity = 11,250 kVA x 0.8 PF = 9,000 MW

Equipment	Main Technical Data	Value (per unit)
	Rated voltage	6.3 kV
	Power factor (Cosφ)	0.8

**Pa Chien:** The CPA is a hydropower plant having two generating units, each with capacity of 11 MW for a total installed capacity of 22 MW. The project uses water from Chien stream to generate and export electricity to the national power grid. Main construction works of the project include a gravity dam, water intake, concrete diversion canal, pressure tank, pressure pipe, a powerhouse and a switching station.

The power generated by the generators at Pa Chien powerhouse is stepped up from 6.3kV to 110kV by two onsite transformers before it is connected to the national power grid. Power measurement for billing purpose is undertaken at the onsite 110kV at bus-bar 131 and bus-bar 132, and supplied power directly to the power grid. Two main and two back-up meters are installed at the onsite 110kV substation to measure the power exported to and imported from the national grid. In addition, other two back-up meters are installed at bus-bar 171 and 172 for cross checking the power measurements by the grid company. Refer to **Figure 14** for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 5 below.

**Table 5. Main equipment installed at Pa Chien**

Equipment	Main Technical Data	Value (per unit)
<b>Turbine</b>	Unit	2
	Runner diameter	1,850 mm
	Type	Francis, vertical axis turbine
	Capacity	11.540MW
	Rated Speed	300 rpm
	Rated efficiency	92.5%
<b>Generator</b>	Unit	2
	Rated capacity	11 MW
	Rated Speed	300 rpm
	Efficiency	95.3%
	Rated voltage	6.3 kV
	Power factor (Cosφ)	0.8

**Song Rieng:** The CPA is a hydropower plant having two generating units, each with capacity of 1.475 MW for a total installed capacity of 2.95 MW. Phase 2 capacity of 0.8MW has not been installed at this stage yet. The project uses water from Rieng stream to generate and export electricity to the national power grid. Main construction works of the project include a gravity dam,

free spillway section, spillway with sand discharge gate, water intake, diversion canal, pipe section, pressure tunnel, pressure pipe, three feed-in pipes, a powerhouse and a switching station.

The power generated by generators at Song Rieng powerhouse is stepped up from 6.3kV to 22kV by onsite transformers before it is connected to Pole 232, Bus-bar 472 at Tra Bong substation. Power measurement for billing purpose is undertake at Tra Bong substation and supplied power directly to the power grid. One main and one back-up meter are installed at Tra Bong substation to measure the power exported to and imported from the national grid. Refer to **Figure 15** for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 6 below.

**Table 6. Main equipment installed at Song Rieng**

Equipment	Main Technical Data	Value (per unit)
<b>Turbine</b>	Unit	2 (phase 1)
	Runner diameter	600 mm
	Type	Francis, horizontal axis
	Capacity	1.553 MW
	Rated Speed	750 rpm
	Rated efficiency	86.7% (at rated water head)
<b>Generator</b>	Unit	2 (phase 1)
	Rated capacity in MW	Phase 1 – 1.475 MW x 2
	Rated Speed	750 rpm
	Efficiency	97% at $\text{Cos}\Phi = 0.8$
	Rated voltage	6.3 kV
	Power factor ( $\text{Cos}\phi$ )	0.80

**Hoa Phu:** The CPA is a hydropower plant which installs two generating units, each with capacity of 14.5 MW for a total installed capacity of 29 MW. The project uses water from Srepok River to generate and export electricity to the national power grid. Main construction works of the project include a gravity dam, spillway, free spillway, spillway with valve gate, a water diversion system, a powerhouse and a switching station.

The power generated by the generators at Hoa Phu powerhouse is stepped up to 110kV at the onsite substation before it is connected to Cu Jut 110kV substation over a line distance of approximately 7km. Power measurement for billing purpose is undertaken at Cu Jut 110kV substation and supplied to the power grid via the 110kV outgoing bus-bar 173. One main and one back-up meter (check meter system 1) are installed at Cu Jut 110kV substation to measure the power exported to and imported from the national grid. A second back-up meter (check meter system 2) is installed at Hoa Phu onsite substation for purpose of power cross-checking and internal records only. On 27/08/2016, meter serial 14159513 was replaced with meter serial 16083436 at 110kV Cu Jut substation. The new meter has been calibrated on 24/08/2016 and

functioning properly since then. Refer Figure 16 for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 7 below.

**Table 7. Main equipment installed at Hoa Phu**

Equipment	Main Technical Data	Value (per unit)
<b>Turbine</b>	Unit	2
	Runner diameter	5,500 mm
	Type	Bulb turbine
	Capacity	15.030 MW
	Rated Speed	240 rpm
	Rated efficiency	93.2%
<b>Generator</b>	Unit	2
	Rated capacity in MW	14.5 MW
	Rated Speed	240 rpm
	Efficiency	96.5% at $\cos\Phi = 0.85$
	Rated voltage	10.5 kV
	Power factor ( $\cos\phi$ )	0.85

**Ban Ang:** The CPA is a hydropower plant which installs two generating units, each with capacity of 8.5 MW for a total installed capacity of 17 MW. The project design consists of a gravity dam, water intake, feed-in pipes, a powerhouse, a tailrace canal, a sand discharge valve gate, and a switching station. The dam and the powerhouse are built sitting in the river bed. The dam is 122 m long and 90.50m high above sea level. The water from the reservoir runs directly into the generating units through the feed-in pipes via the water intake.

The power generated by the generators at Ban Ang powerhouse is stepped up by two transformers located at Ban Ang power plant via the two out-going lines, namely line 331 and line 332. The electricity is then is fed to the national power grid through two bus-bars C31 and C31 before it enters the grid via the Line 371 and Line 371 to Hoa Binh substation and to Ky Son respectively.

Power measurement for billing purpose is undertaken at Line 331 and Line 332, with two main and two back-up meters installed at Ban Ang substation. Refer **Figure 19** for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 8Table 11 below.



Table 8. Main equipment installed at Ban Ang

Main Technical Data		Value (per unit)
Turbine	Unit	02
	Type	Kaplan
	Rated speed	150 rpm
	Rated capacity at maximum water head	8,817 kW
	Runner diameter	3.35 mm
	Maximum efficiency at 100% load	95.1 %
Generator	Unit	02
	Type	Kaplan - three phases
	Rated speed	150 rpm
	Frequency	50 Hz
	Rated capacity	8,500 kW
	Rated voltage	6.3 kV
	Maximum power factor (cosφ)	0.9
	Maximum efficiency at rated capacity	96.4 %

**Bao Lam 1:** The CPA is a hydropower plant which installs two generating units, each with capacity of 15 MW, resulting in a total installed capacity of 30 MW. The project utilizes water from Gam river to generate and export electricity to the national power grid. The project design consists of a gravity dam, spillway, intake canal, water intake, a powerhouse, a tailrace canal, and an 110kV substation. All the project items are built sitting in the river bed except for the substation. The whole dam is 199.3 m long with the maximum dam height of 24.5m. The water from the reservoir runs directly into the generating units through the feed-in pipes in the water intake to generate electricity.

In the current monitoring period, the plant employed two metering arrangements. From the start of commercial operation to mid-November 2017, the power generated by Bao Lam 1 is exported to the national grid via the 110kV outgoing busbar 173 located at 220 kV Bao Lam substation. A single-line cable is utilized to transmit the power from Bao Lam 1 HPP to this substation for metering. The electricity is measured at 110 kV voltage level. The metering system includes 01 main and 01 back-up meters installed at 220 kV Bao Lam substation. Additionally another 02 back-up meters are installed on busbars 131 and 132, at the higher-voltage side of the 02 transformers installed at Bao Lam 1 HPP site.<sup>24</sup>

As of mid-November 2017, the grid utility company approved the measurement of electricity to be done at Bao Lam 1 HPP site. This was done by converting the 02 existing back-up meters on busbars 131 and 132 into 02 main meters and installing additionally another 02 new meters as back-up meters, resulting in 02 main and 02 back-up meters in total installed at Bao Lam 1 HPP onsite substation. The electricity is measured at higher-voltage side of the 02 transformers, at 110 kV voltage level. The electricity is eventually fed into the national power grid via the same 110 kV single-line cable at 220 kV Bao Lam substation.<sup>25</sup>

Refer **Figure 18** for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 11 below.

<sup>24</sup> Letter approving grid connection arrangement by the grid utility company dated 17/08/2015

<sup>25</sup> Letter approving revised grid connection arrangement by the grid utility company dated 19/07/2017

Table 9. Main equipment installed at Bao Lam 1

Main Technical Data		Value (per unit)
Turbine	Unit	02
	Type	Kapsun
	Rated speed	100 rpm
	Rated capacity	15,464 kW
	Runner diameter	3,000 mm
	Maximum water head	4.75 m
	Maximum efficiency at 100% load	95.1 %
Generator	Unit	02
	Type	Kapsun - three phases
	Rated speed	100 rpm
	Frequency	50 Hz
	Rated capacity	16.67 MVA (or almost 15,000 kW at 0.9 power factor) <sup>26</sup>
	Rated voltage	10.5 kV
	Maximum power factor (cosφ)	0.9
	Maximum efficiency at rated capacity	97 %

**Trung Thu:** The CPA involves the construction and operation of a new hydropower plant facility with the maximum water head of 29.7 m. The project design consists of gravity and spillway dam, water intake, pressure pipe, powerhouse, sand discharge valve gate and substation. All the project items are built sitting in the river bed except for the substation. The water intake and powerhouse are located on left side of the dam, looking from upstream to downstream region. The water from the reservoir runs through pressure pipe into generating units to generate electricity. The project will install two turbine/generator units, each with an installed capacity of 15 MW resulting in a total installed capacity of 30 MW.

The power generated by Trung Thu hydropower plant is stepped up from 10.5 kV to 110 kV and measured by 04 power meters at the 110 kV substation for connection to the national power grid. The grid connection point is located approximately 3.3 km away from this metering substation. Power measurement for billing purpose is undertaken at the 110 kV substation via Line 131 and Line 132. Line 132 was only used to measure power from Trung Thu HPP as of January 2017 and therefore, the power measured by this line is not covered in the current monitoring period. Two main and two back-up power meters are installed at the 110 kV substation to measure electricity export and import by Trung Thu HPP. Refer **Figure 17** for the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 10 below.

<sup>26</sup> The final output is the generator's output. The final generator capacity is determined as follow: generator capacity = 16.67 MVA \* 0.9 = 15,000 kW.

Table 10. Main equipment installed at Trung Thu

Main Technical Data		Value (per unit)
Turbine	Unit	02
	Type	Kaplan, vertical axis
	Rated speed	100 rpm
	Rated capacity	15,464 kW <sup>27</sup>
	Runner diameter	3.2 m
	Maximum water head	29.7 m
	Maximum efficiency	93.75 %
Generator	Unit	02
	Type	Three phases, vertical axis
	Rated speed	200 rpm
	Frequency	50 Hz
	Rated capacity <sup>28</sup>	15,000 kW
	Rated voltage	10.5 kV
	Power factor (cosφ)	0.85
	Maximum efficiency	97 %

**Bai Thuong:** The CPA is a hydropower plant which installs two generating units, each with capacity of 03 MW for a total installed capacity of 06 MW. The project uses water from the existing Bai Thuong irrigation reservoir to generate and export electricity to the national power grid. Main construction works of the project include water canal, water intake, powerhouse, tailrace, and outdoor substation.

The power generated by the generators at Bai Thuong powerhouse is stepped up to 35kV at Bai Thuong plant substation before it is connected via Pole No. 39 to Muc Son 110kV substation for further distribution to then national power grid. Power measurement for billing purpose is undertaken at busbar 371 installed at Bai Thuong plant 35 kV substation and supplied to the power grid via outgoing bus-bar 374. One main and one back-up meter are installed at Bai Thuong 35kV substation to measure the power exported to and imported from the national grid. Refer **Figure 20** or the grid connection diagram for this plant. The technical specifications of main equipment are listed in Table 11 below.

<sup>27</sup>The final output of a hydropower plant shall be the final output of the generators, not the turbines.

<sup>28</sup>During Investment Project phase in 2009, the installed capacity was 29.6MW. By optimizing project parameters in Basic Design phase, the project will install 30MW while keeping the same design as in 2009. Refer to Basic Design, Main Report, page 2

**Table 11. Main equipment installed at Bai Thuong**

Main Technical Data		Value (per unit)
<b>Turbine</b>	Unit	02
	Type	Bulb turbine <sup>29</sup>
	Rated speed	136.4 rpm
	Rated capacity at maximum water head	3,125 kW
	Runner diameter	3,000 mm
	Maximum water head	6.65 m
	Maximum efficiency at 100% load	94.7 %
<b>Generator</b>	Unit	02
	Type	Three phases, horizontal axis
	Rated speed	136.4 rpm
	Frequency	50 Hz
	Rated capacity	3,333 MVA <sup>30</sup>
	Rated voltage	6.3 kV
	Maximum power factor (cosφ)	0.9
	Maximum efficiency at rated capacity	96 %

In the current monitoring period, the respective CPAs experienced the following changes and/or incidents as compared with previous monitoring period:

**Table 12. Changes and/or incidents in current monitoring period**

No.	CPA	Description of changes and/or incidents
1	Nam Tha 4	The frequency of calibrating power meters has changed from every 1 year to every 2 years. This change was requested by the local grid utility company
2	Hoa Phu	The main power meter 16083436 installed at 110 kV Cu Jut substation has been replaced with meter 14159513 as of 14/08/2017 due to meter failure
3	Bai Thuong	Both main and back-up power meters 16076476 and 16076475 have been replaced with new meters 17051431 and 17051432 as of 01/11/2017, in the aftermath of a serious flood that hit the meter cubicle

Due to the above said changes and/or incidents, Bai Thuong CPA stopped generation for about one month, which was November 2017 and therefore supplied no electricity to the national power grid during this period.

For all other CPAs, some very short downtime periods existed as a result of plant periodical maintenance, water inavailability, local grid utility company's dispatching commands or because the operators of the CPAs voluntarily stopped generation in order to save water for power generation during peak hours for higher selling tariff purpose.

In general, all the CPAs have been implemented and operated in accordance with the registered CPA-DDs and monitoring plan and have no impact on the applicability of the methodology. Except for the case of Song Rieng, where the CME has opted to apply a design change with regards to

<sup>29</sup>Refer to FSR, General Description, page 20

<sup>30</sup>The output of each generator shall be calculated as:  $3,333 \text{ MVA} \times 0.90 = 2.9997 \text{ MW}$  (almost 3 MW). Furthermore, the final output of a hydropower plant will be the final output of the generators.

the project's number of generating units and installed capacity. Please refer to Section C.3 of this monitoring report for further details.

The net emission reduction achieved in each of the CPA during this monitoring period is provided below:

- Sung Vui: 42,693 tCO<sub>2</sub>e
- Nam Tha 4: 31,221 tCO<sub>2</sub>e
- Pa Chien: 43,519 tCO<sub>2</sub>e
- Song Rieng: 9,211 tCO<sub>2</sub>e
- Hoa Phu: 91,352 tCO<sub>2</sub>e
- Ban Ang: 34,137 tCO<sub>2</sub>e
- Bao Lam 1: 52,404 tCO<sub>2</sub>e
- Trung Thu: 61,589 tCO<sub>2</sub>e
- Bai Thuong: 9,632 tCO<sub>2</sub>e

It is also confirmed here that there electricity export readings for each month are metered and meter values are supported by monthly invoices of respective CPAs. Hence, the double counting of power generation and emission reduction is avoided.

## C.2. Location of CPAs

>>

CPA	Host party	Region / State / Province, etc.	City/Town/Commune, etc.	Geographical reference of project location
Sung Vui	Viet Nam	Lao Cai province	Phin Ngan and Ban Khoang communes, Bat Xat district	Powerhouse: Latitude (°N): 22.456 Longitude (°E): 103.855 Dam: Latitude (°N): 22.434 Longitude (°E): 103.820
Pa Chien		Son La province	Chieng San commune, Muong La district	Powerhouse: Latitude (°N): 21.476 Longitude (°E): 104.072
Nam Tha 4		Lao Cai province	Nam Tha commune, Van Ban district	Powerhouse: Latitude (°N): 21.885 Longitude (°E): 104.341 Dam: Latitude (°N): 21.887 Longitude (°E): 104.331
Song Rieng		Quang Ngai province	Tra Phong commune, Tay Tra district	Powerhouse: Latitude (°N): 15.157 Longitude (°E): 108.379 Dam: Latitude (°N): 15.170 Longitude (°E): 108.370
Hoa Phu		Dak Lak and Dak Nong provinces	Hoa Phu commune, Buon Ma Thuot city (Dak Lak province), Tam Thang commune, Cu Jut	Powerhouse & dam: Latitude (°N): 12.560 to 12.652 °N Longitude (°E): 107.908 to 107.911 °E

CPA	Host party	Region / State / Province, etc.	City/Town/Commune, etc.	Geographical reference of project location
			district (Dak Nong province)	
Trung Thu		Dien Bien province	Pa Ham commune, Muong Cha district and Trung Thu commune, Tua Chua district	Powerhouse & dam: Latitude (°N): 21.938178 Longitude (°E): 103.255517
Ban Ang		Nghe An province	Xa Luong commune, Tuong Duong district	Powerhouse & dam: Latitude (°N): 19.255833 Longitude (°E): 104.400278
Bao Lam 1		Cao Bang province	Ly Bon commune, Bao Lam district	Powerhouse & dam: Latitude (°N): 22.941667 Longitude (°E): 105.548889
Bai Thuong		Thanh Hoa province	Xuan Duong commune, Thuong Xuan district	Powerhouse & dam: Latitude (°N): 19.895278 Longitude (°E): 105.3775

The location maps of respective CPAs are shown in Figure 2 through Figure 10.

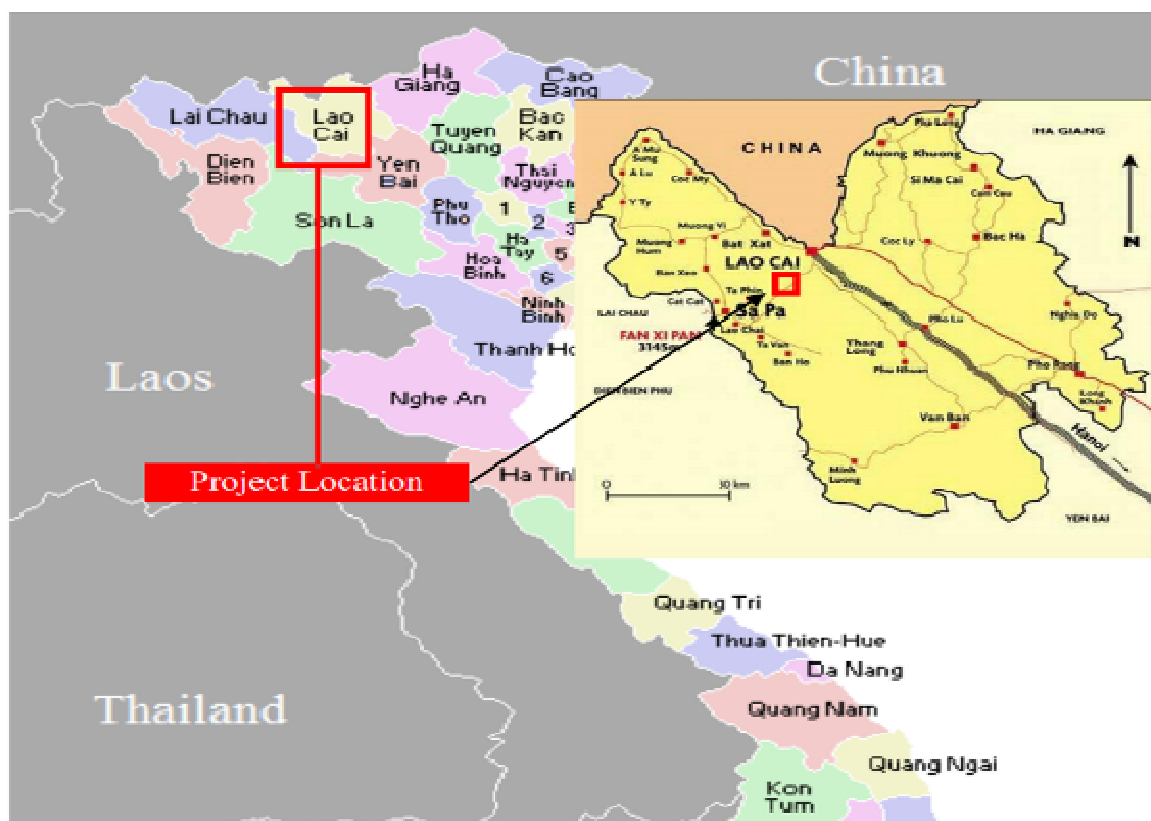
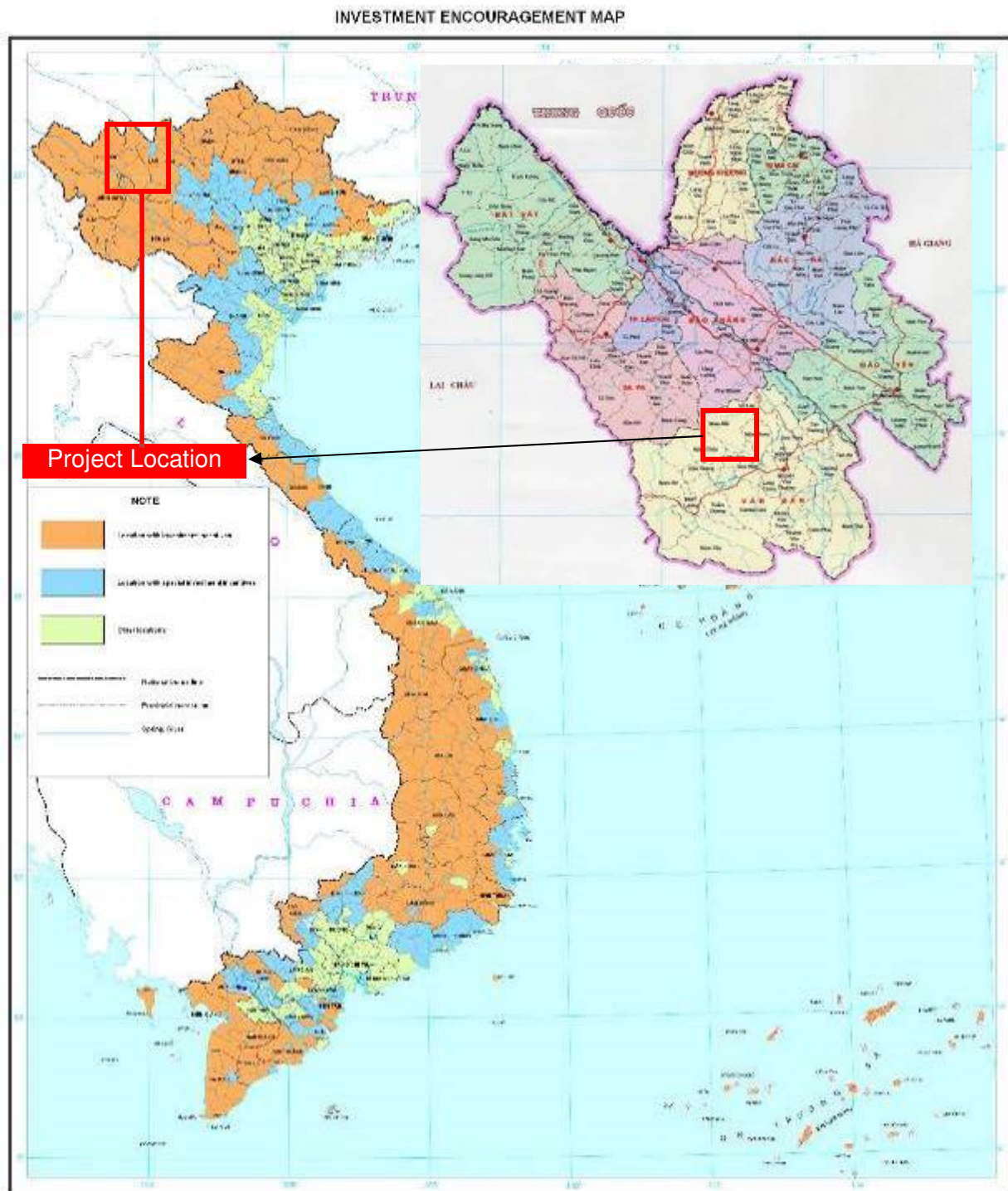
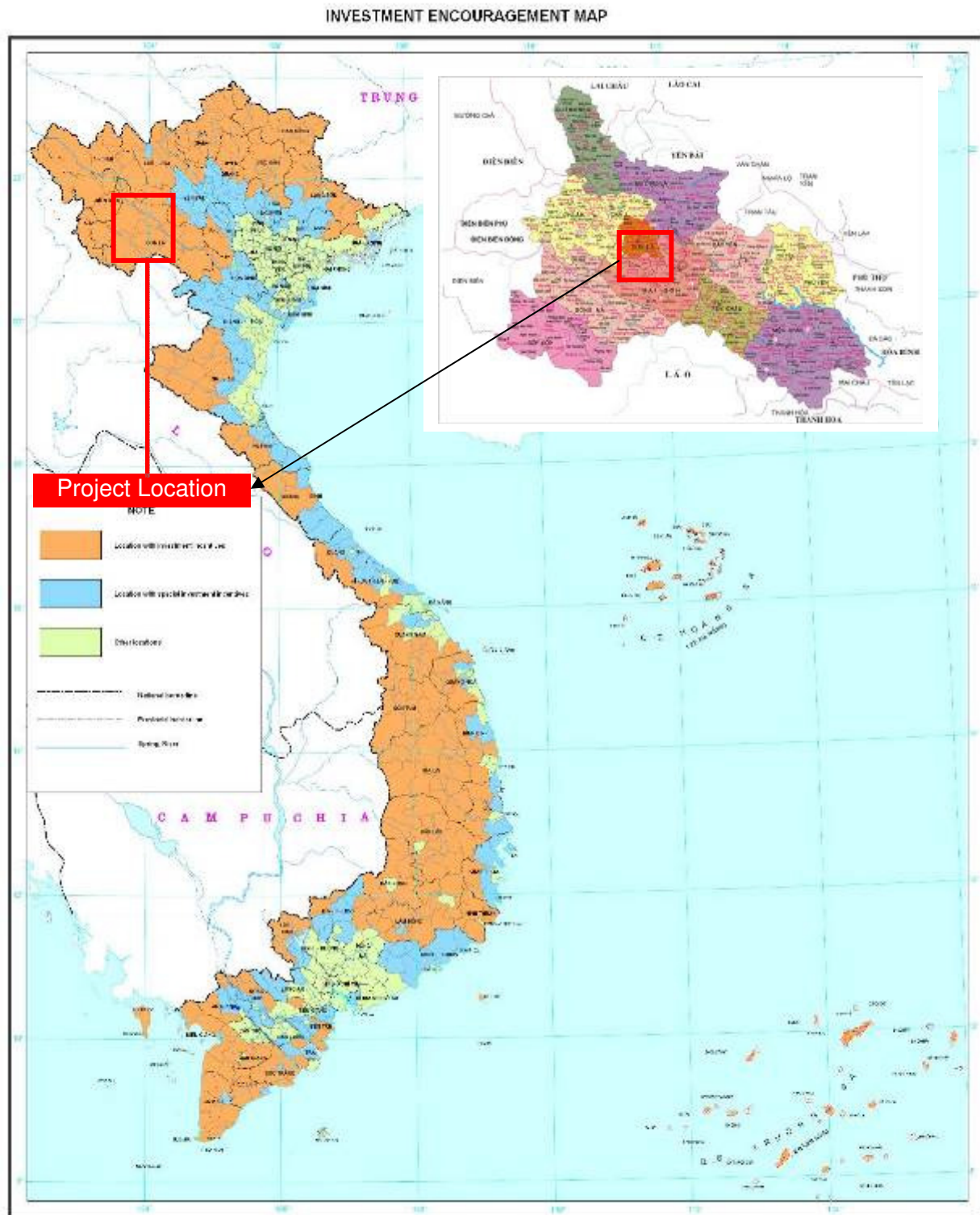


Figure 2. Location of Sung Vui hydropower project



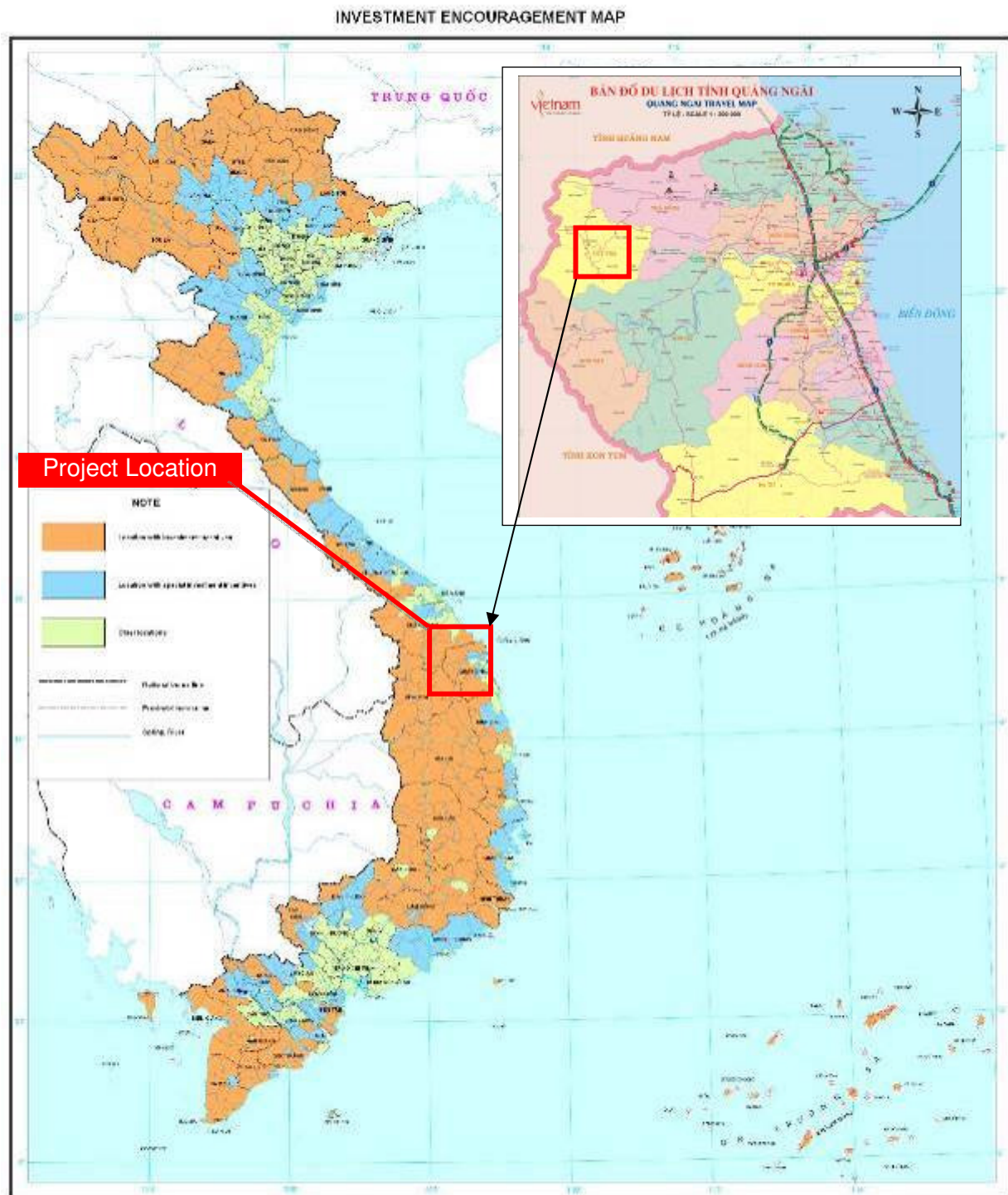
**Figure 3. Location of the Nam Tha 4 hydropower project**



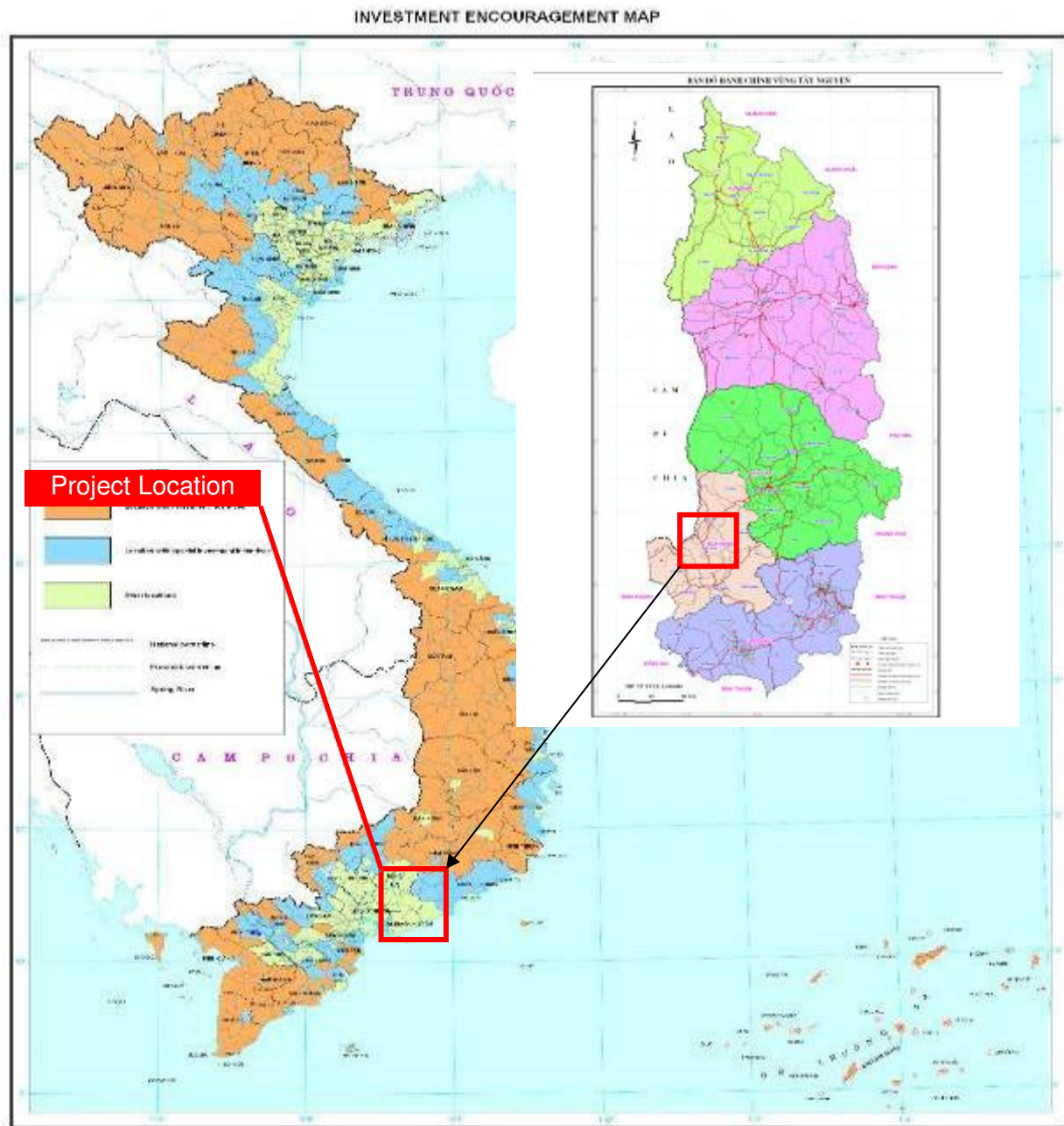


**Figure 4. Location of the Pa Chien hydropower project**





**Figure 5. Location of the Song Rieng hydropower project**



**Figure 6. Location of the Hoa Phu hydropower project**

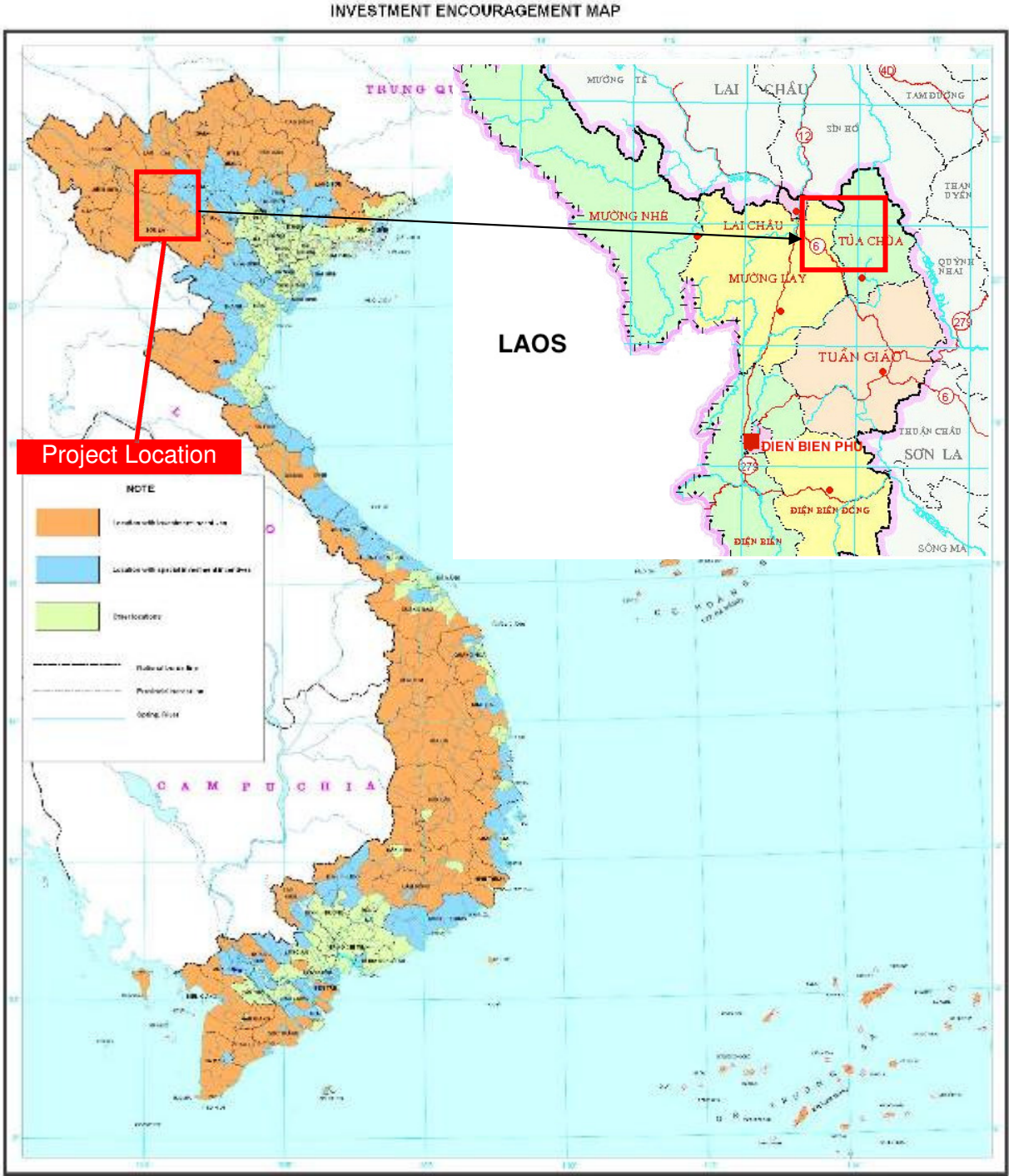


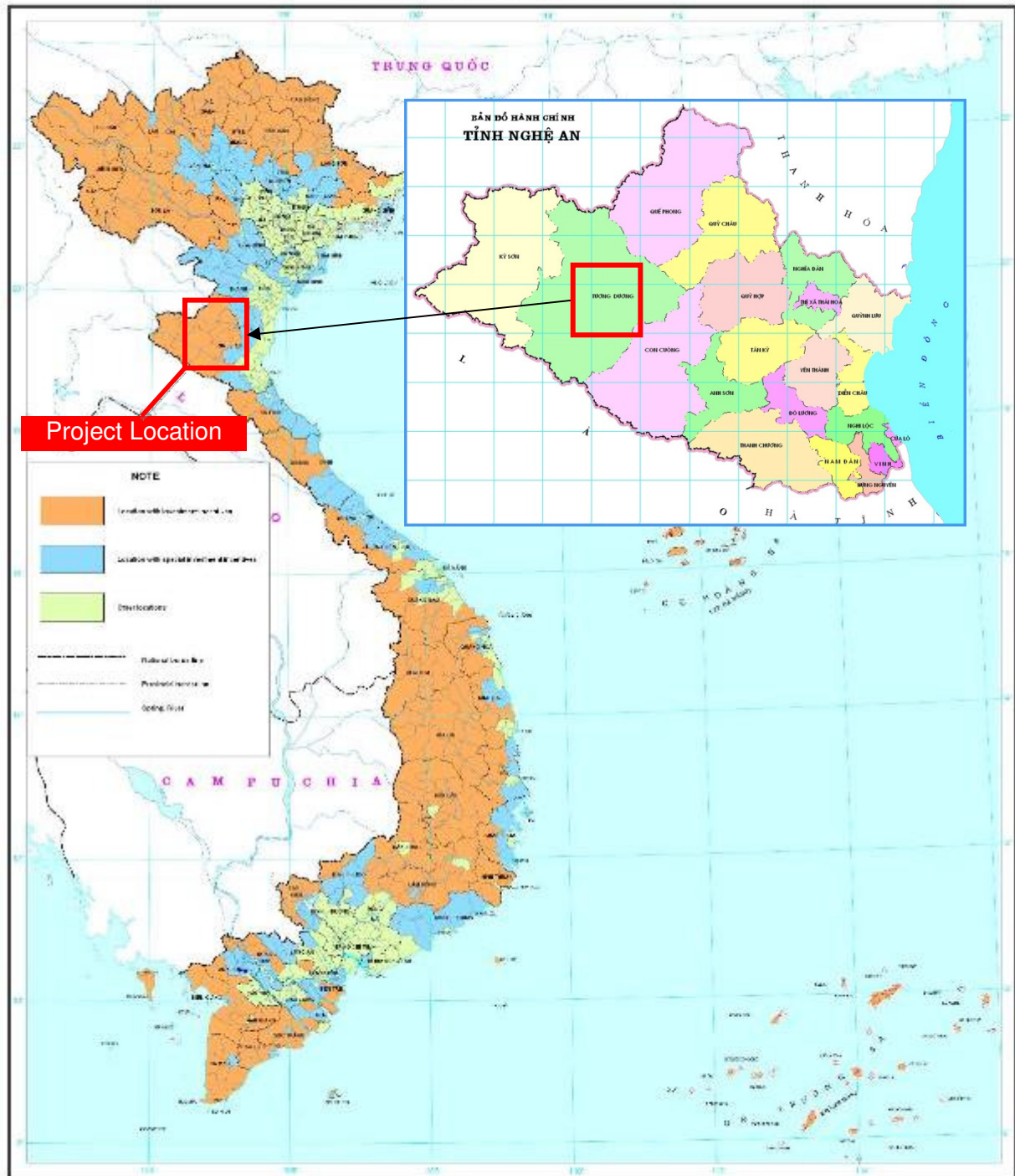
Figure 7. Location of the Trung Thu hydropower project



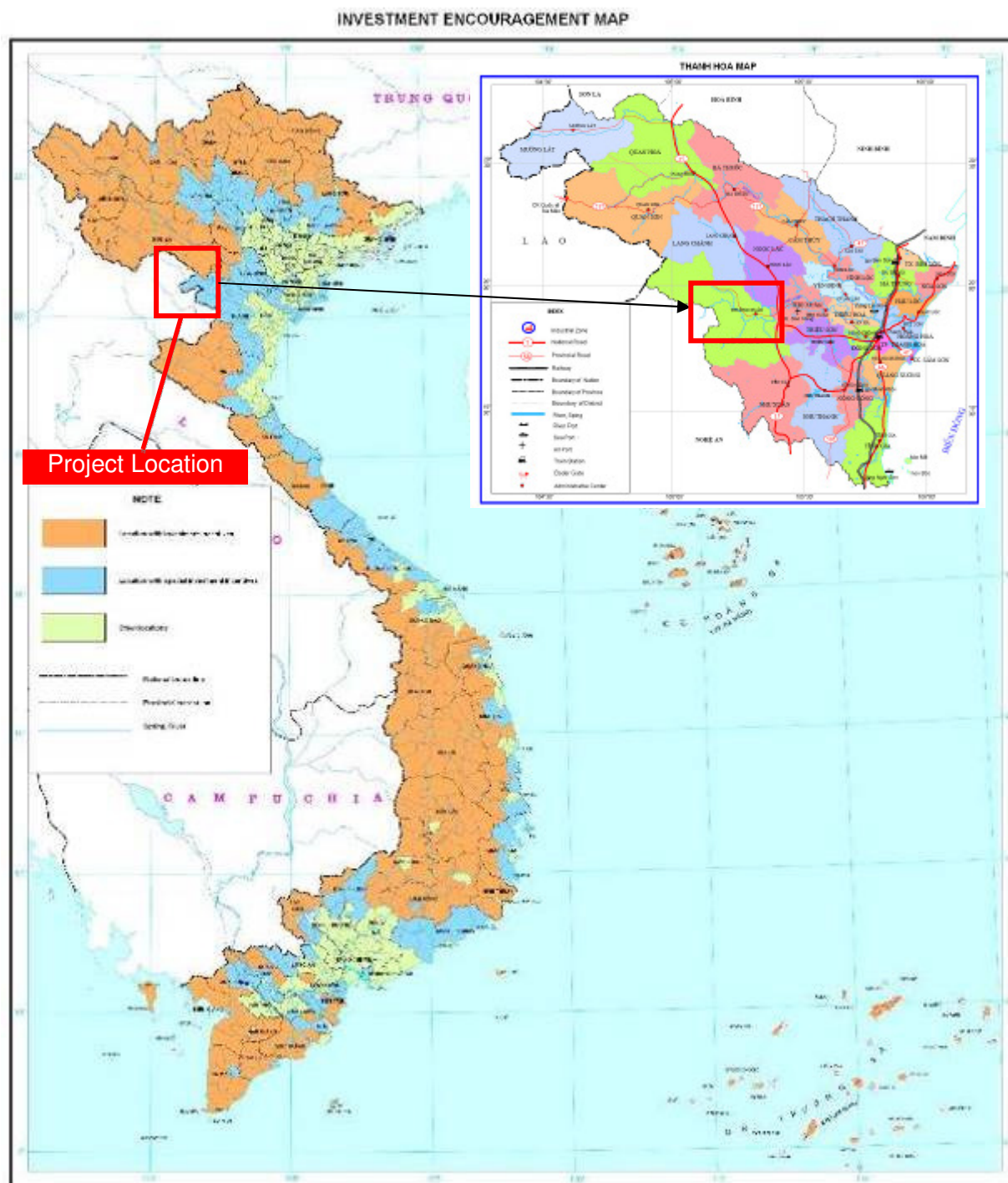


**Figure 8. Location of the Bao Lam 1 hydropower project**

## INVESTMENT ENCOURAGEMENT MAP



**Figure 9. Location of the Ban Ang hydropower project**



**Figure 10. Location of the Bai Thuong hydropower project**

### C.3. Post-registration changes to CPAs

### C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies or standardized baselines

>>  
Not applicable



### C.3.2. Corrections

>>

The following corrections were carried out in specific cases CPA DDs.

#### Sung Vui:

During the first monitoring period of the PoA, a PRC without prior approval was carried out. All the changes were shown in the revised CPA-DD version 08, dated 08/09/2014. An updated document of the CPA was accepted published by the verifying DOE on the UNFCCC CDM website<sup>31</sup>. The DOE assessment opinion was dated 20/09/2014. The following were the main changes in Sung Vui CPA-DD:

- The water level measurement at the reservoir was mentioned as an electronic reading is in the registered CPA DD. It was revised as manual reading as practised at the site.
- The capacity of turbine installed was revised to the actual value of 9.33 MW from 9 MW mentioned in registered CPA DD.
- The calibration frequency of electricity meters was revised as 2 years as per national practise against 1 year mentioned in registered CPA DD.

In the 4<sup>th</sup> monitoring period, another PRC without approval, involving the following corrections, has been made to the CPA-DD of Sung Vui. The CPA-DD has been updated to version 09, dated 13/07/2017 and submitted together with the request for issuance of the 4<sup>th</sup> monitoring period:

- The name of CPA implementer has changed to “Leader Nam Tien Hydropower Joint Stock Company”
- The legal representative of CPA implementer company has changed to “Cao Thi Thu Hien” and then “Tan Chin Jeen”

#### Song Rieng

During the second verification process, it was identified that the project information mentioned in registered CPA DD are incorrect. The following corrections are made:

- The power factor of turbine generator is revised to 0.8 (instead of 0.85) as per actual name plate details
- The substation to which the power plant exports power is corrected as 22 kV (instead of 35 kV) as per actual implementation. The grid connection diagram was also updated accordingly.

As per paragraph 1 (foot note 1) of “Appendix 1. Changes that do not require prior approval by the board” of CDM Project Standard, version 07, EB 79, this is a correction in the project information. Hence, this change does not require prior approval.

The Song Rieng CPA DD is revised to incorporate these changes. The revised CPA DD version 05 dated 09/05/2016 was approved during the verification process<sup>32</sup>. The DOE assessment opinion was dated 04-08-2015.

#### Nam Tha 4

In section D.7.1 Data and parameters to be monitored, for parameter  $EG_{\text{facility},y}$ , earlier it was mentioned that 03 bi-directional meters will be used. But in actual, there are 05 bidirectional power meters:

- 01 main meter and 01 back-up meter at Nam Tha 4 plant and
- 01 main meter and 02 back-up meters at 110kV Nam Tha substation

<sup>31</sup>[https://cdm.unfccc.int/PoAIssuance/iss\\_db/poaiss761634785/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poaiss761634785/view)

<sup>32</sup>[https://cdm.unfccc.int/PoAIssuance/iss\\_db/poaiss701157336/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poaiss701157336/view)

As per paragraph 1 (foot note 1) of “Appendix 1. Changes that do not require prior approval by the board” of CDM Project Standard, version 07, EB 79, this is a correction in the project information. Hence this change does not require prior approval.

The Nam Tha 4 CPA DD is revised to incorporate the change. The revised CPA DD version 05 dated 09/05/2016 was approved during the verification process<sup>33</sup>. The DOE assessment opinion was dated 04-08-2015.

### **C.3.3. Changes to the start date of the crediting period**

>>

Not applicable

### **C.3.4. Inclusion of monitoring plan**

>>

Not applicable

### **C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools**

>>

Not applicable

### **C.3.6. Changes to project design**

>>

#### **Addressing of FAR 03 in previous verification report**

#### **Song Rieng:**

The plant was initially scheduled to install 03 generating units, resulting in 3.75MW. However, as of this monitoring period, the plant has not installed the third generating unit yet. On 20/02/2017 the Board of Management of Song Rieng HPP met and discussed about the possibility of installing the third generating unit. The reason for not installing the third unit is because the local grid demand for power from Song Rieng HPP is minimum and the local grid company has not yet approved the plant's third unit installation. The Board agreed to maintain the current number of generating units (02) and installed capacity (2.9MW), and wait until the local grid demand for power increases and the local grid company allows the third unit installation.

Therefore, in this monitoring period, the CME has opted to apply a design change to update the information about the number of generating unit and finally installed capacity of Song Rieng in the registered CPA-DD.

The CPA additionality has been re-tested, using the inputs and assumptions available at the time of the board's investment decision on 09/12/2009. The financial and technical inputs are sourced from the FSR dated 2008 and only those related to the project phase 1 implementation are considered in such additionality test. With such financial and technical inputs and assumptions, the test shows that Song Rieng CPA is still additional.

Please refer to the revised CPA-DD, financial and emission reductions sheets for submitted together with this monitoring report further details.

<sup>33</sup>[https://cdm.unfccc.int/PoAIssuance/iss\\_db/poais701157336/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poais701157336/view)



## SECTION D. Description of monitoring system of CPAs

&gt;&gt;

The monitoring of the power plants were carried out in consistency with the methodology ACM0002 (version 13.0.0). Description of the monitoring plan implemented is presented as follows.

The power generated by the generating units is stepped up at the power plant site connected to the nearby power lines, before being transmitted to National Power Grid. The indicative monitoring diagram of the project of monitoring parameters is given in Figure 11. The grid connections are provided in **Figure 12 to Figure 20**.

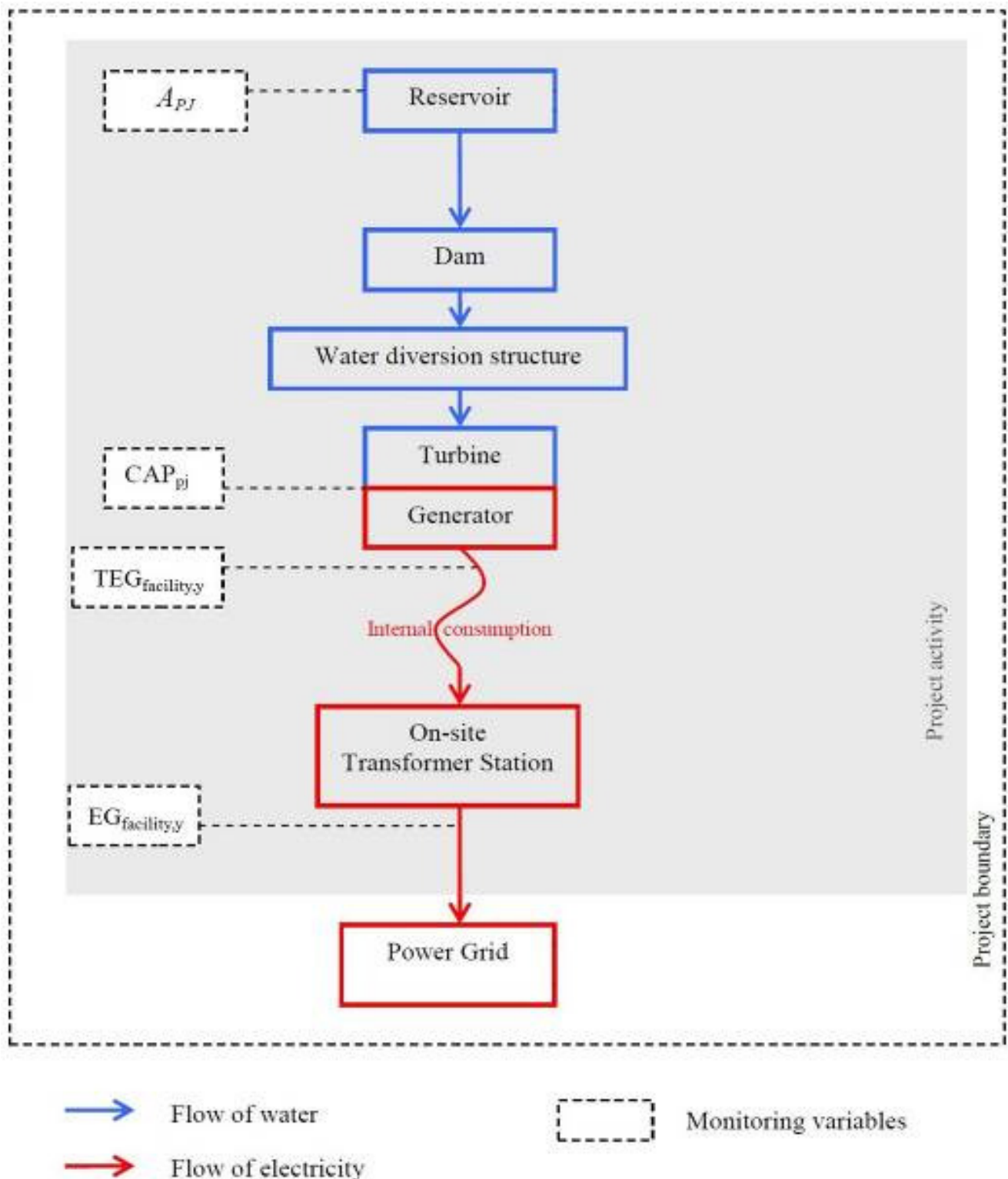


Figure 11. Flow diagram of CPA activity and monitoring parameters

Table 13: Technical detail of the power meters installed at Sung Vui plant

Parameter	371 Main meter	372 Main meter	371 Backup meter	372 Backup meter
Model	Elster	Elster	Elster	Elster
Type	A1700	A1700	A1700	A1700
Accuracy	0.5s	0.5s	0.5s	0.5s
Serial number	08116757	08116885	08116862	08116853
First calibration date	16/03/2013	06/07/2012	18/12/2013	18/12/2013
Second calibration date	18/03/2014	18/03/2014	11/03/2016	11/03/2016
Third calibration date	31/03/2015	31/03/2015	-	-
Fourth calibration date	22/03/2017	22/03/2017	-	-
Next calibration date	22/03/2019	22/03/2019	11/03/2018	11/03/2018
Calibration frequency	2 years	2 years	2 years	2 years

According to the registered CPA-DD, the main meters have accuracy class of 0.2s; however, actual installed main meters have accuracy class of 0.5s. For conservativeness reason, the accuracy difference of 0.003 has been applied in determining the power export and import throughout this monitoring period. Details are presented in Section G.2 and H.1 of this monitoring report.

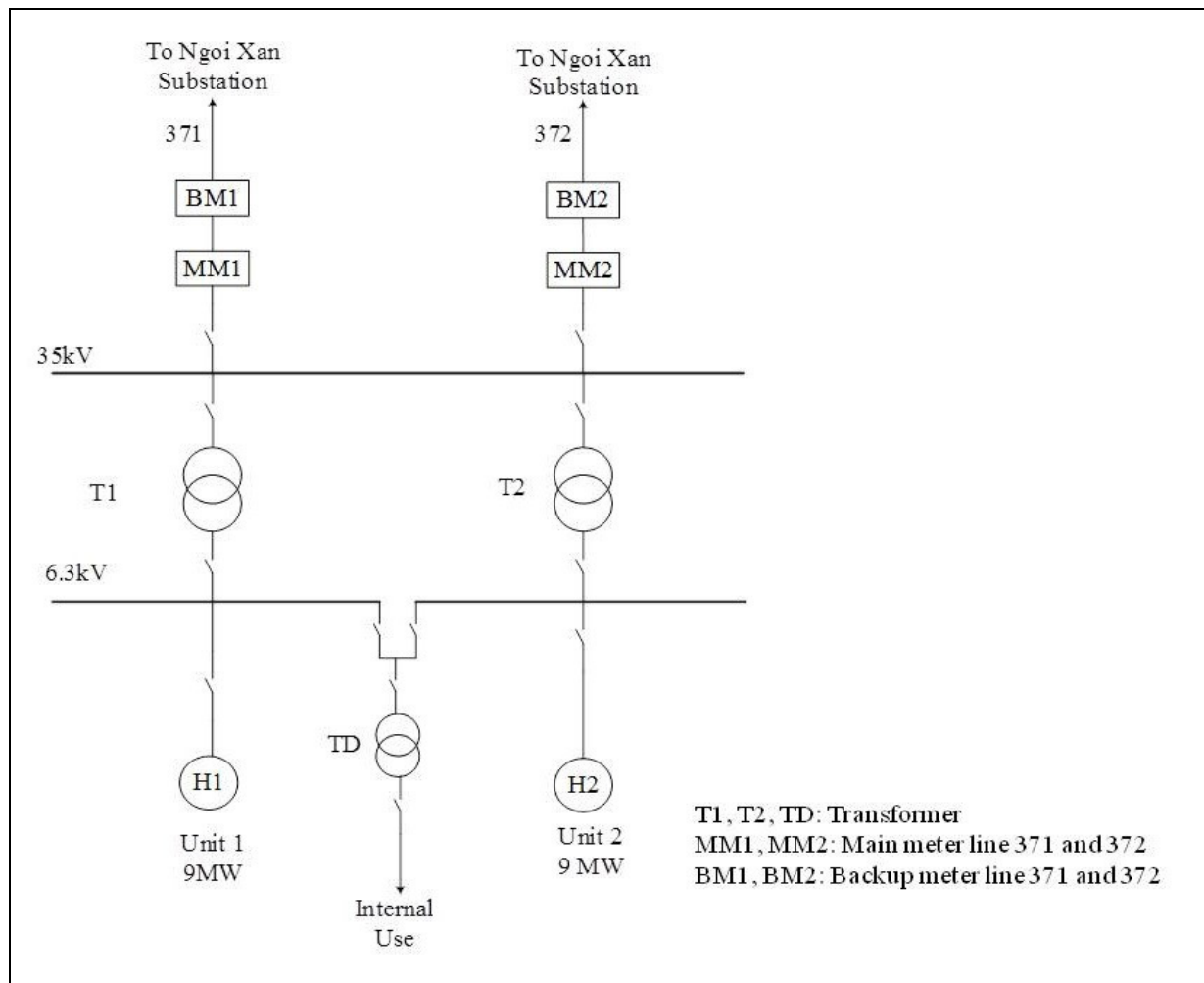


Figure 12. Diagram of grid connection of Sung Vui

Table 14: Technical details of power meters installed at Nam Tha 4 plant

Parameter	Main meter (at Nam Tha 4 HPP)	Backup meter (at Nam Tha 4 HPP)	171-1 Main meter (at 110kV substation)	171-2 Backup meter#1 (at 110kV substation)	171-3 Backup meter#2 (at 110kV substation)
Type	Landis+Gyr	Landis+Gyr	Landis+Gyr	Landis+Gyr	Landis+Gyr
Accuracy	0.5s	0.5s	0.2s	0.5s	0.5s
Serial number	97815977	97815978	97539354	97815959	97815974
First calibration date	09/08/2015	09/08/2015	08/08/2015	08/08/2015	08/08/2015
Second calibration date	15/10/2016	15/10/2016	14/10/2016	14/10/2016	14/10/2016
Next calibration date	15/10/2018	15/10/2018	14/10/2018	14/10/2018	14/10/2018

Parameter	Main meter (at Nam Tha 4 HPP)	Backup meter (at Nam Tha 4 HPP)	171-1 Main meter (at 110kV substation)	171-2 Backup meter#1 (at 110kV substation)	171-3 Backup meter#2 (at 110kV substation)
Calibration frequency <sup>34</sup>	2 year	2 year	2 year	2 year	2 year

According to the registered CPA-DD, the main meter has an accuracy class of 0.2s; however, actual installed main meter has an accuracy class of 0.5s. For conservativeness reason, the accuracy difference of 0.003 has been applied in determining the power export and import throughout this monitoring period. Details are presented in Section G.2 and H.1 of this monitoring report.

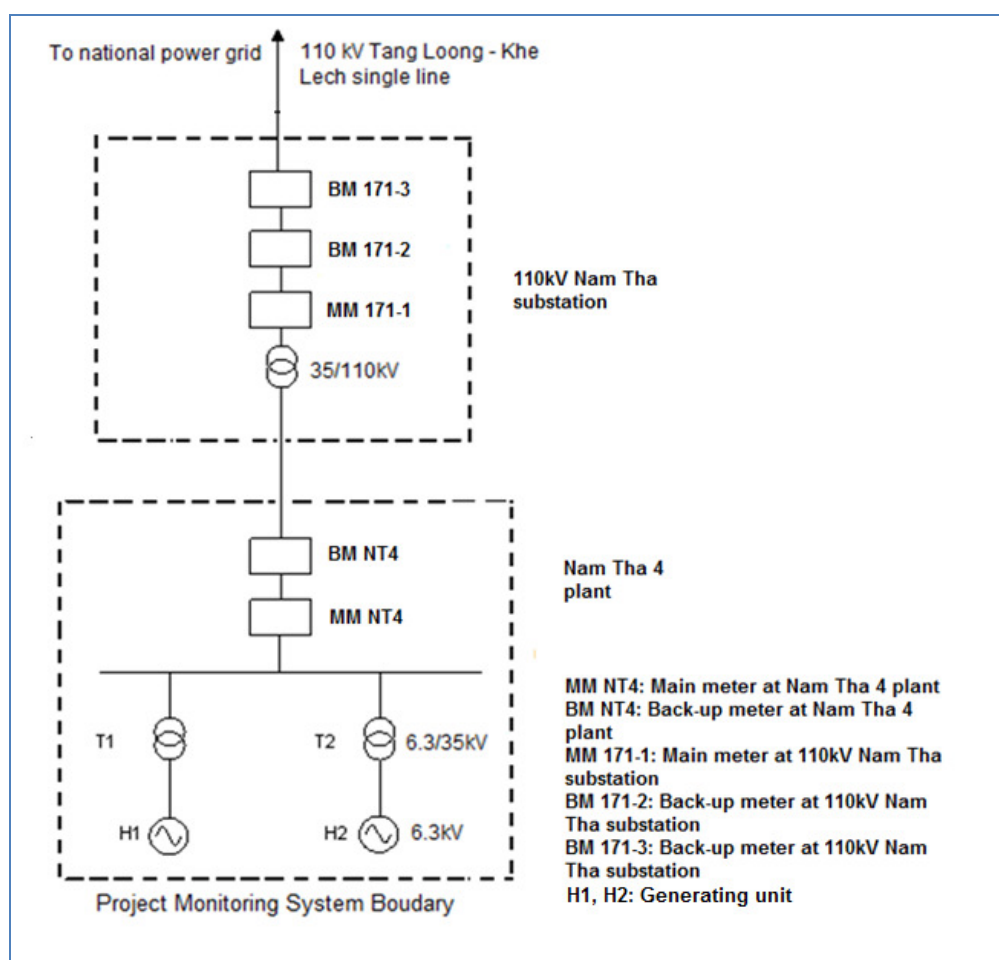
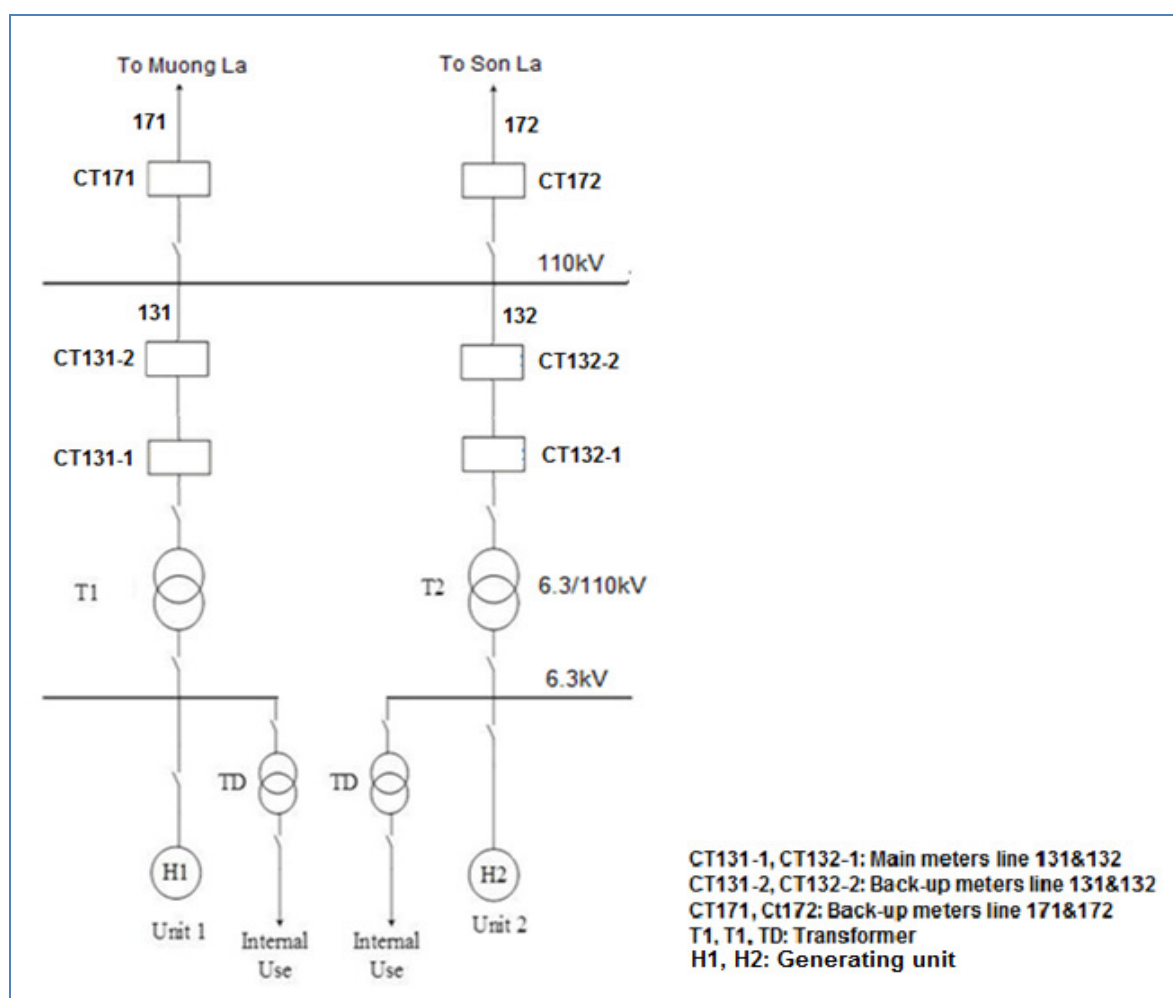


Figure 13. Diagram of grid connection at Nam Tha 4

<sup>34</sup> Based on the power purchase agreement dated 2013, calibration of meters was required every 1 year. The frequency has been requested to change to every 2 years by grid company via the revised power purchase agreement 2016 (Appendix C).

Table 15: Technical details of power meters installed at Pa Chien plant

Parameter	CT131-1 Main meter	CT131-2 Back-up meter	CT132-1 Main meter	CT132-2 Back-up meter	CT171 Back-up meter	CT172 Back-up meter
Type	Landis&Gyr	Landis&Gyr	Landis&Gyr	Landis&Gyr	Landis&Gyr	Landis&Gyr
Accuracy	0.2s	0.5s	0.2s	0.5s	0.5s	0.5s
Serial number	50302964	97815942	50302963	97815941	97815943	97815963
First calibration date	12/05/2015	12/05/2015	12/05/2015	12/05/2015	12/05/2015	12/05/2015
Second calibration date	15/11/2016 <sup>35</sup>	15/11/2016	15/11/2016	15/11/2016	15/11/2016	15/11/2016
Third calibration date	29/11/2017	29/11/2017	29/11/2017	29/11/2017	29/11/2017	29/11/2017
Calibration frequency	1 year	1 year	1 year	1 year	1 year	1 year



<sup>35</sup>The calibrating entity/CPA implementer confirmed the issuance dates were also the calibration conducted dates

Figure 14. Detailed diagram of grid connection at Pa Chien

Table 16: Technical details of power meters installed at Song Rieng plant

Parameter	173 Main meter	173 Back-up meter#1
Model	Elster UK	Elster UK
Type	A1700	A1700
Accuracy	0.5s	0.5s
Serial number	11017595	11017600
First Calibration date	26/05/2015	26/05/2015
Second calibration date	15/03/2016	15/03/2016
Third calibration date	15/03/2017	15/03/2017
Calibration frequency	1 year	1 year

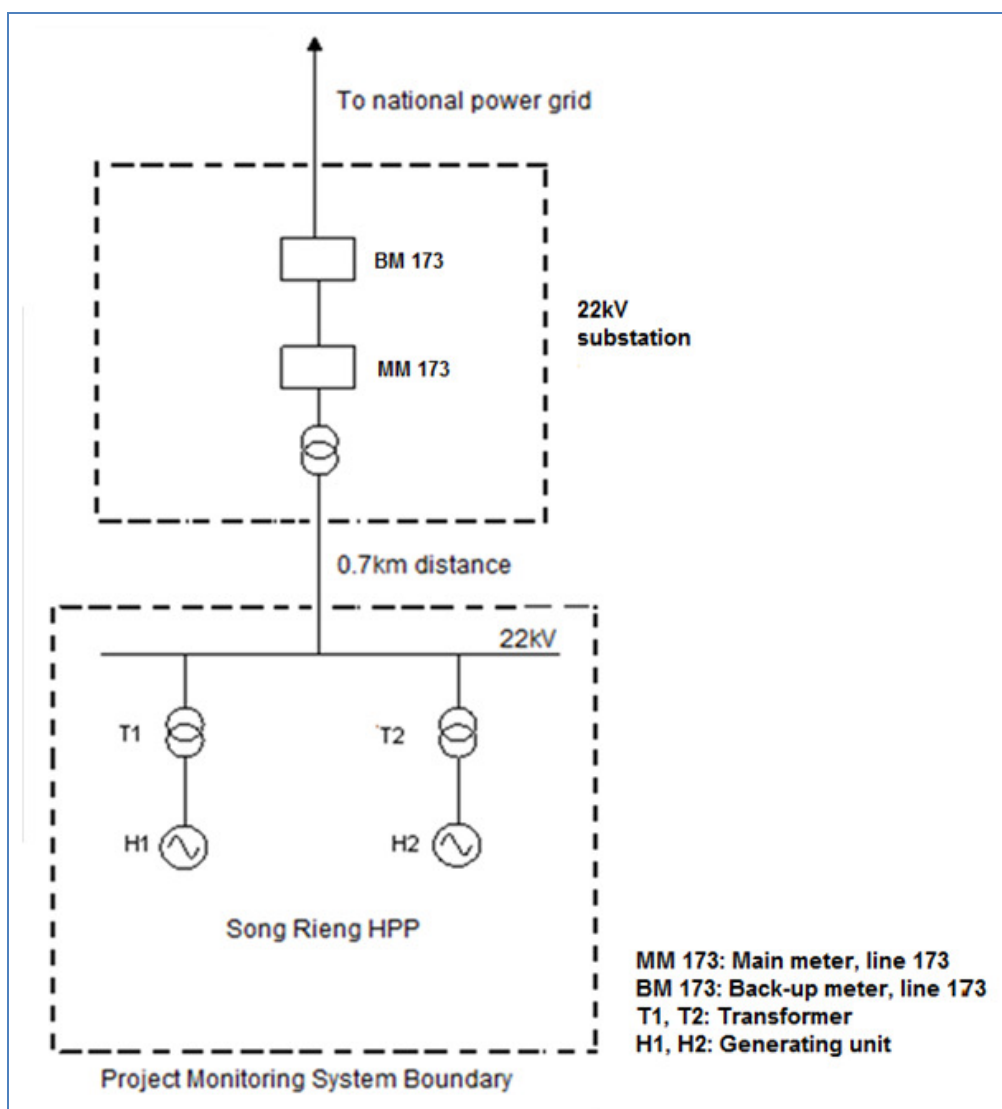


Figure 15. Detailed diagram of grid connection at Song Rieng<sup>36</sup>

Table 17: Technical details of power meters installed Hoa Phu plant

Parameter	173 Main meter (at 110kV Cu Jut substation)		173 Back-up meter#1 (at 110kV Cu Jut substation)	171 Back-up meter#2 (at Hoa Phu plant)
Model	Elster UK	Elster UK	Elster UK	Elster UK
Type	A1700	A1700	A1700	A1700
Accuracy	0.2s	0.2s	0.5s	0.5s
Serial number	14159513	16083436	14031620	14031619
First calibration date	10/08/2015	-	10/08/2015	10/08/2015
Second calibration date	06/08/2016	24/08/2016 <sup>37</sup>	06/08/2016	06/08/2016
Third calibration date	14/08/2017 <sup>38</sup>		14/08/2017	14/08/2017
Calibration frequency	1 year		1 year	1 year

<sup>36</sup>This grid connection diagram is designed for phase 1 installed capacity, hence only two generating units and two transformers have been installed at this stage.

<sup>37</sup> Calibration was conducted on 24/08/2016 and meter was installed on 27/08/2016 based on minute of meter replacement and acceptance conducted at Cu Jut 110 kV substation

<sup>38</sup> On 14/08/2017, meter serial 16083436 was found erroneous and replaced with meter serial 14159513

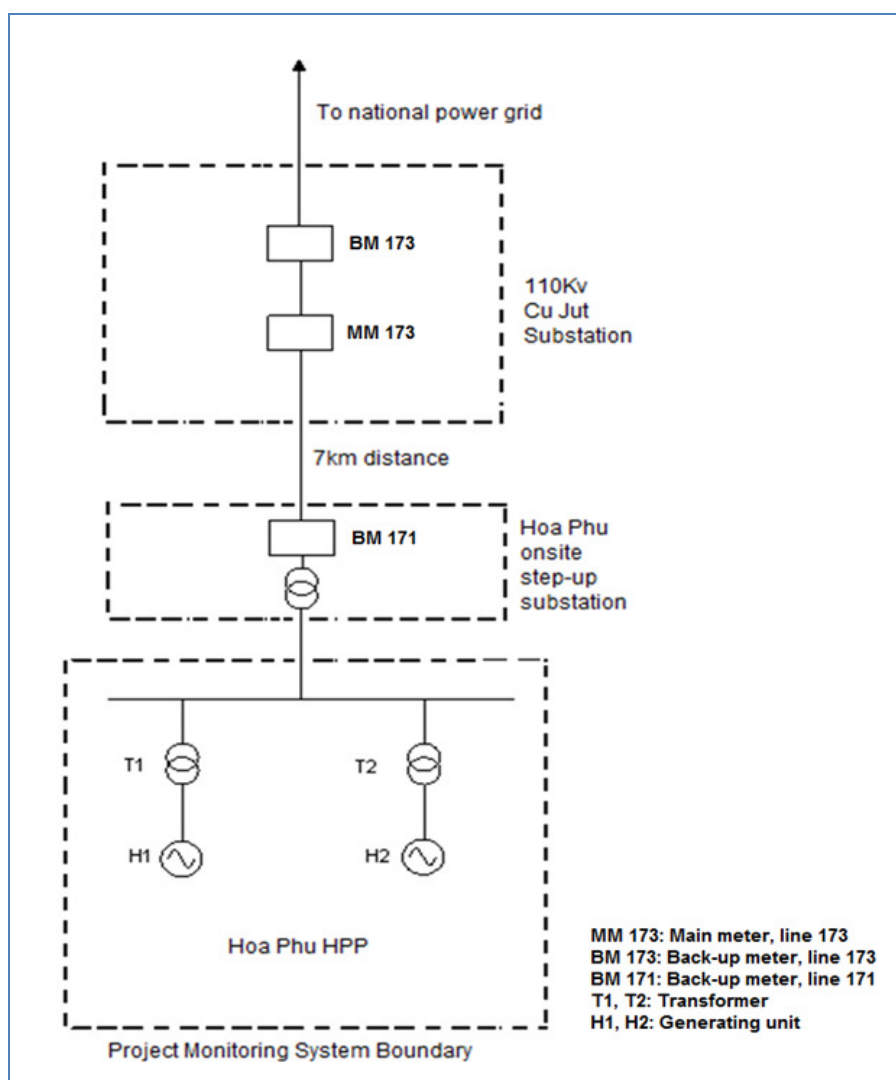


Figure 16. Detailed diagram of grid connection at Hoa Phu

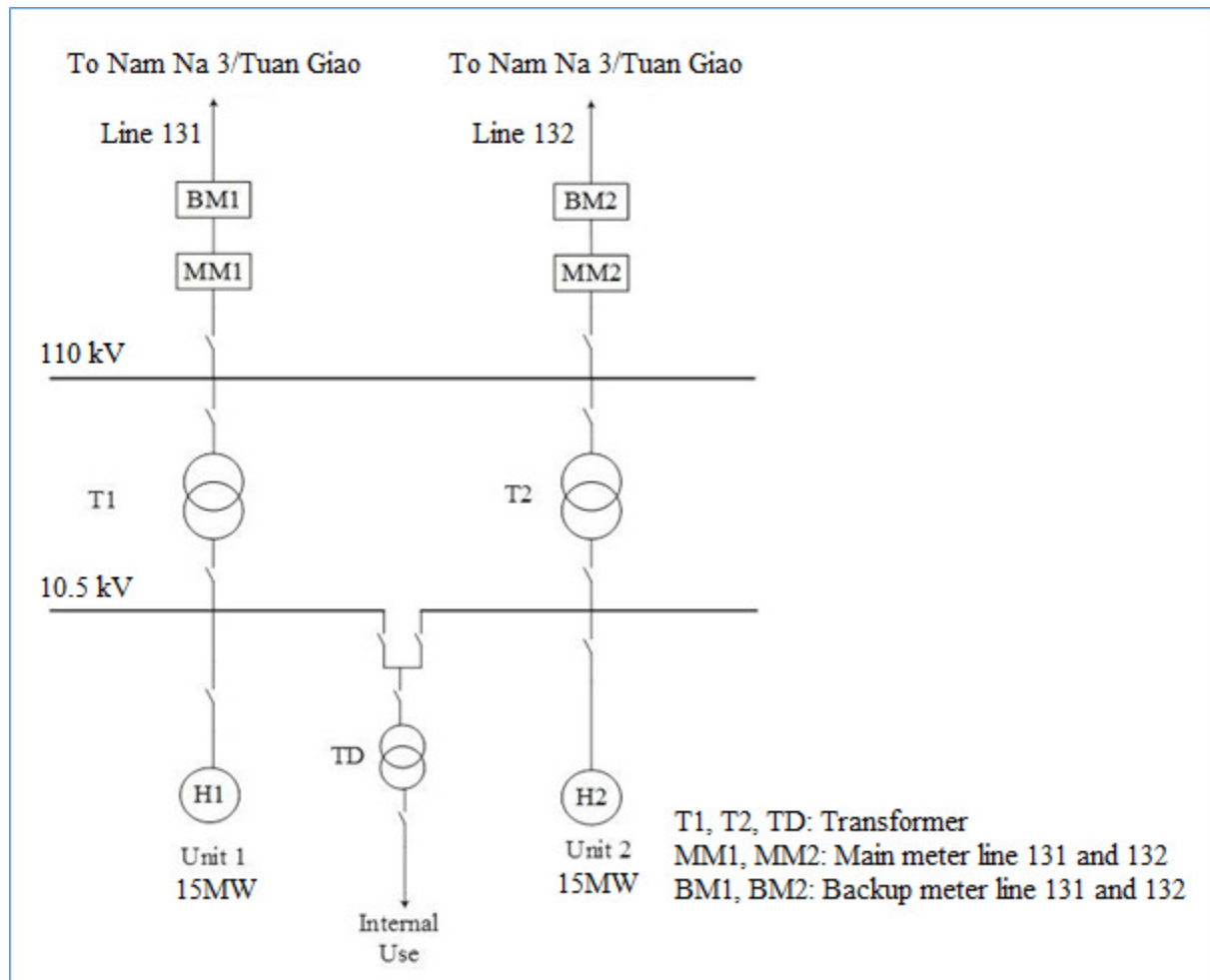
Table 18: Technical details of power meters installed Trung Thu plant

Parameter	Line 131 Main meter	Line 131 Back-up meter	Line 132 Main meter	Line 132 Back-up meter
Model	Elster UK	Elster UK	Elster UK	Elster UK
Type	A1700	A1700	A1700	A1700
Accuracy	0.2s	0.5s	0.2s	0.5s
Serial number	16083440	16076315	16083439	16076314
First calibration date	18/08/2016	18/08/2016	18/08/2016	18/08/2016
Second calibration date <sup>39</sup>	02/04/2018	02/04/2018	02/04/2018	02/04/2018
Calibration frequency	1 year <sup>40</sup>	1 year	1 year	1 year

<sup>39</sup> This is the date of calibration report issue date, which is more conservative since issue dates are always on or after the calibration dates



Figure 17. Detailed diagram of grid connection at Trung Thu



<sup>40</sup>The calibration frequency is based on Appendix C of the power purchase agreement dated 07/2016

Table 19: Technical details of power meters installed at Bao Lam 1 plant

**Initial metering diagram (start of operation up to 10/11/2017):**

Parameter	Line 173 Main meter	Line 173 Back-up meter 1	Line 131 Back-up meter 2	Line 132 Back-up meter 2
Model	Elster UK	Elster UK	Elster UK	Elster UK
Type	A1700	A1700	A1700	A1700
Accuracy	0.2s	0.2s	0.2s	0.2s
Serial number	16083443	16076421	16083437	16083438
First installation date	28/11/2016	28/11/2016	29/11/2016	29/11/2016
First calibration date	No calibration <sup>41</sup> report is available	No calibration report is available	18/08/2016	18/08/2016
Calibration frequency <sup>42</sup>	1 year	1 year	1 year	1 year

**Revised metering diagram (from 11/11/2017 onwards):**

Parameter	Line 131 Main meter	Line 131 Back-up meter	Line 132 Main meter	Line 132 Back-up meter
Model	Elster UK	Elster UK	Elster UK	Elster UK
Type	A1700	A1700	A1700	A1700
Accuracy	0.2s	0.5s	0.2s	0.5s
Serial number	16083437	16076316	16083438	16076317
Start date of usage <sup>43</sup>	11/11/2017	11/11/2017	11/11/2017	11/11/2017
First calibration date <sup>44</sup>	18/08/2016	18/08/2016	18/08/2016	18/08/2016
Calibration frequency <sup>45</sup>	1 year	1 year	1 year	1 year

**Figure 18. Detailed diagram of grid connection at Bao Lam 1**

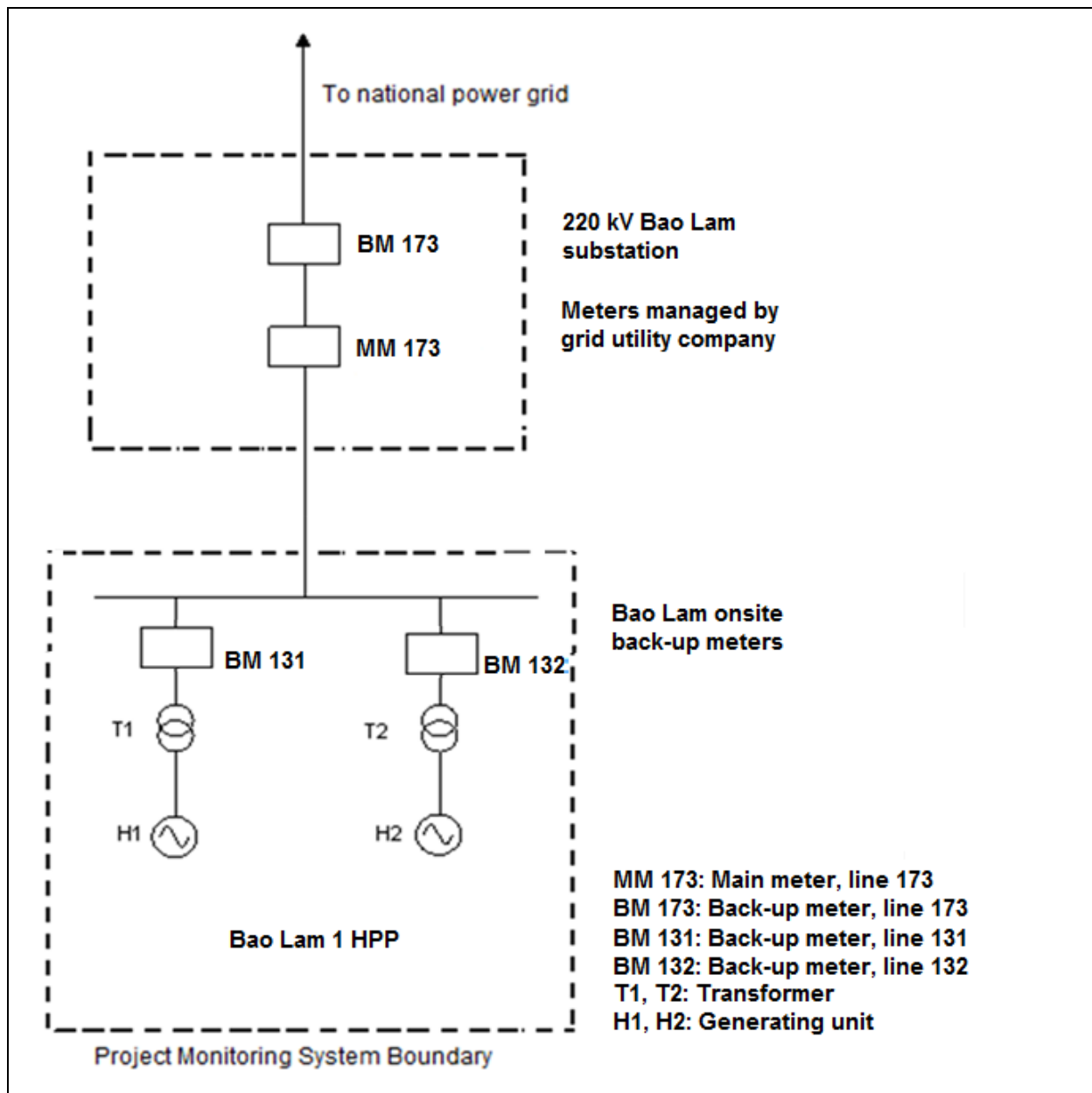
<sup>41</sup> 02 meters serial 16083443 and 16076421 installed at line 173 are controlled by the local grid company management, no calibration reports are available

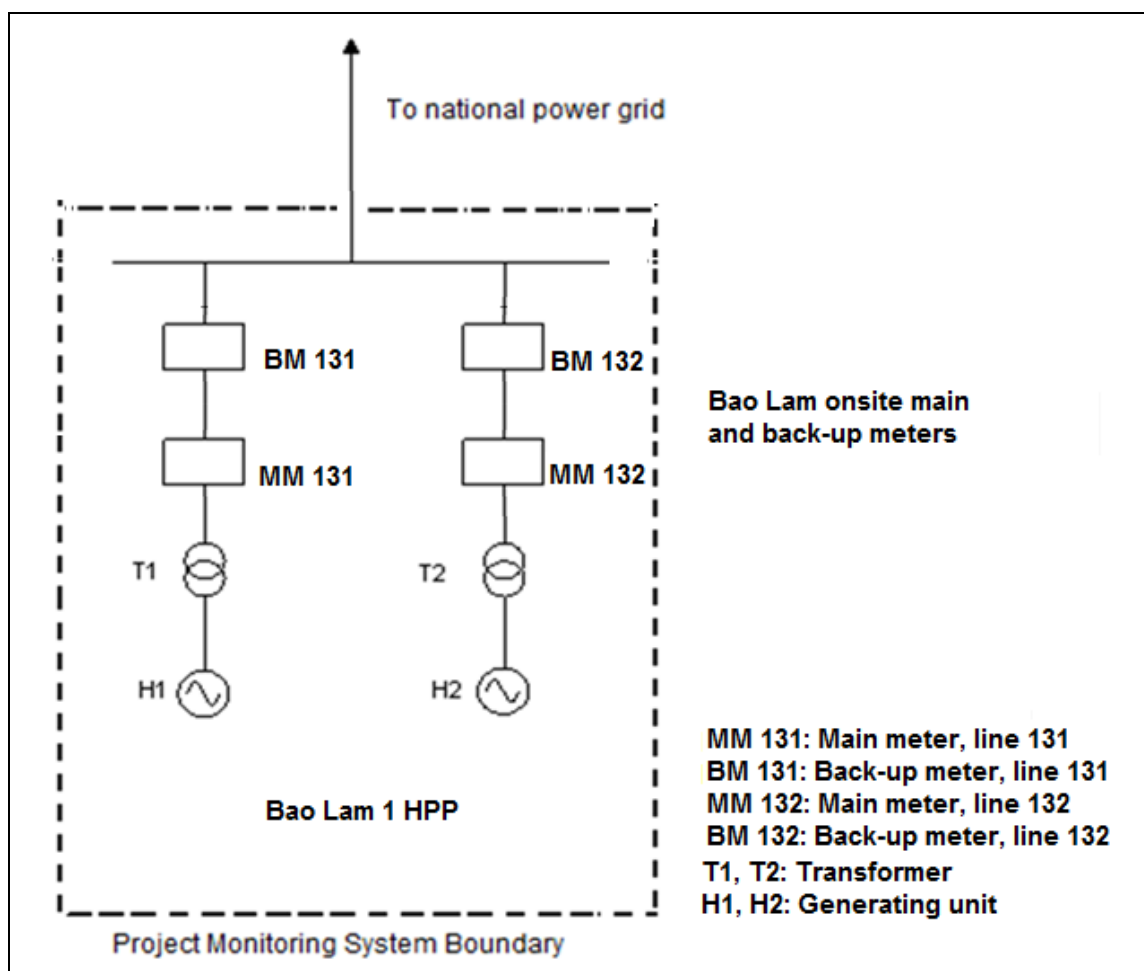
<sup>42</sup> Based on Appendix C of the power purchase agreement signed with grid utility company

<sup>43</sup> Based on the 11/2017 monthly protocol for line 173, which indicates the power was confirmed for invoicing up to 10/11/2017

<sup>44</sup> Second calibration reports in 2017 are not available since the use of new metering system started as of 11/11/2017, based on which next calibration will be conducted within 01 year, i.e. November 2018.

<sup>45</sup> Based on Appendix C of the power purchase agreement signed with grid utility company.

Initial metering location (start of operation up to 10/11/2017):

**Revised metering location (from 11/11/2017 onwards):****Table 20: Technical details of power meters installed at Ban Ang plant**

Parameter	Line 331 Main meter	Line 331 Back-up meter	Line 332 Main meter	Line 332 Back-up meter
Model	Elster UK	Elster UK	Elster UK	Elster UK
Type	A1700	A1700	A1700	A1700
Accuracy	0.2s	0.2s	0.2s	0.2s
Serial number	16083474	16083475	16083472	16083473
First calibration date	25/08/2017	25/08/2017	25/08/2017	25/08/2017
Next calibration date	25/08/2018	25/08/2018	25/08/2018	25/08/2018
Calibration frequency	1 year	1 year	1 year	1 year <sup>46</sup>

**Figure 19. Detailed diagram of grid connection at Ban Ang**

<sup>46</sup> The power meters are required to be calibrated once a year in accordance with Appendix C of the Power Purchase Agreement signed in November 2016 for Ban Ang Hydropower Plant

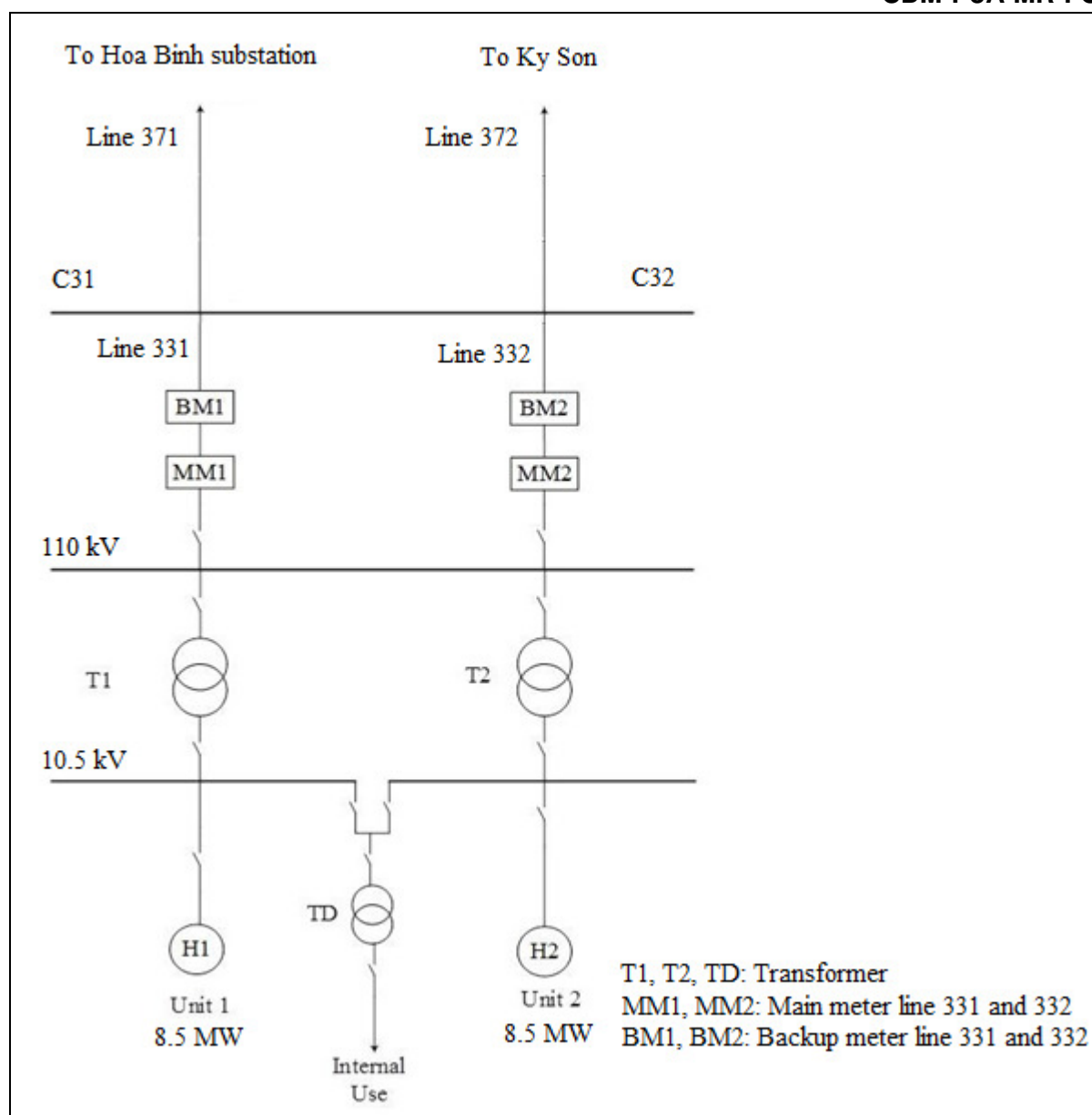


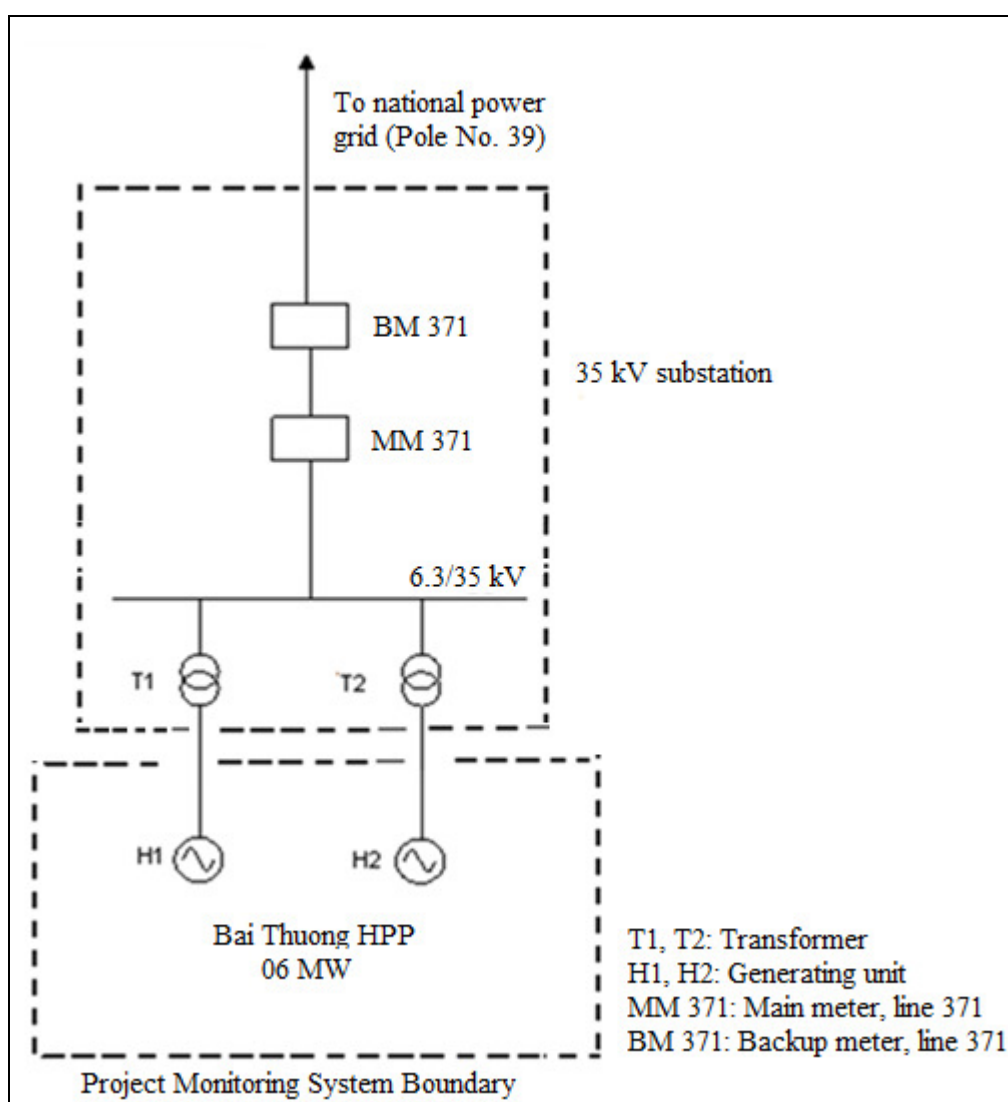
Table 21: Technical details of power meters installed Bai Thuong plant

Parameter	371 main meter		371 back-up meter	
	Old meter	New meter installed	Old meter	New meter installed
Model	Elster UK	Elster UK	Elster UK	Elster UK
Type	A1700	A1700	A1700	A1700
Accuracy	0.5s	0.5s	0.5s	0.5s
Serial number	16076476	17051431 <sup>47</sup>	16076475	17051432 <sup>48</sup>

<sup>47</sup> This meter was installed to displace meter serial 16076476 on 01/11/2017.

<sup>48</sup> This meter was installed to displace meter serial 16076475 on 01/11/2017.

Parameter	371 main meter		371 back-up meter	
	Old meter	New meter installed	Old meter	New meter installed
First calibration date	10/10/2016		10/10/2016	
Date of replacement		01/11/2017		01/11/2017
Calibration frequency	02 years <sup>49</sup>	02 years	02 years	02 years



**Figure 20. Detailed diagram of grid connection at Bai Thuong**

### 1. Power exported to and imported from the grid:

The electricity export and import, at the grid connection point on the transmission line, is measured continuously by the digital main meters and back-up meters. The detail of meters and their calibration statuses are provided in Table 13 to Table 21. The metering instruments record two readings namely, the power delivered to the grid and power received from the grid. These meters

<sup>49</sup>The calibration frequency is based on Appendix 3 of the signed power purchase agreement dated 10/2014.

are calibrated in accordance with national regulation and the grid company during the monitoring period.

For Sung Vui, Nam Tha 4 and Pa Chien, the power meters are tested by the Northern Electrical Testing Company, which belongs to Northern Power Corporation. For Song Rieng and Hoa Phu the power meters are calibrated by Central Electrical Testing One member Company Limited<sup>50</sup> which is licensed to conduct such power meter calibration in Viet Nam. For Trung Thu and Bao Lam 1, the power meters are calibrated by Quality Assurance And Testing Center No. 1 (QUATEST1). For Bai Thuong, the power meters are calibrated by Northern Electrical Testing One Member Company Limited, under the Northern Power Corporation. For Ban Ang, the power meters are calibrated by the Northern Electrical Testing One Member Company Limited, under the Northern Power Corporation.

Calibrations are carried out by the grid company or by a certified company appointed by the grid company in accordance with the procedures and cycles as stipulated in the Decision 25/2007/QĐ-BKHCN dated 05 Oct 2007 by the Ministry of Science and Technology and the local calibration method standard DLVN 39:2012. There were no discrepancies found in the meter readings throughout its operation during this monitoring period.

If there is any accuracy difference between the value mentioned in the CPA DD and the actual monitoring, then the accuracy difference is applied in determining the power export and import throughout this monitoring period. Details are presented in Section G.2 and H.1 of this monitoring report.

The electricity supplied by the project and imported from the main power line(s) (in kWh) is continuously measured by the main meter (evidenced by monthly electricity generation agreement), monthly recorded and are cross-checked against the records for sold electricity (electricity bill provided by EVN).

## **2. Power received through other back-up sources:**

As per the methodology, the use of fossil fuels for the back up or emergency purposes (e.g., diesel generators) can be neglected. Hence, no monitoring is carried out.

## **3. Installed capacity of the hydropower plant:**

The installed capacity of the hydropower plants were fixed during commissioning. The details of plant capacity for all the power plants are provided in Table 3 to Table 11. Thus, there was no capacity addition or change in power plant capacity during the monitoring period. Photos were taken showing the date of checking, the status of generators and the name plates with specifications of generators.

Bai Thuong hydropower plant is taking advantage of the existing irrigation reservoir to generate power therefore, in accordance with the applied monitoring methodology, the monitoring of the installed capacity is not required.

## **4. Surface area of the reservoir:**

For Sung Vui, the level of the water reservoir was measured using a height scale installed at the water reservoir. The frequency of water level recording is daily (at frequent intervals). The surface area of the reservoir is calculated annually subsequent to the implementation of the project activity using the design schematics and the area maps, to check whether the actual reservoir has deviated substantially from the design.

<sup>50</sup><http://www.etc3.com.vn/gioithieu.asp>

For Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Trung Thu, Bao Lam 1 and Ban Ang, the reservoir area measurement is conducted annually by a third party entity which is licensed in the host country to have sufficient qualifications to conduct such measurements.

Bai Thuong hydropower plant is taking advantage of the existing irrigation reservoir to generate power therefore, in accordance with the applied monitoring methodology, the monitoring of the reservoir surface area is not required.

**Addressing of FAR 01 raised in previous verification report:**

**Trung Thu:**

In the previous monitoring period, a forward action request had been raised to request for reservoir surface measurement and related evidence. The CPA implementer has hired an external party to conduct such reservoir surface measurement and such measurement result has been reported in Section E.2 of this monitoring report. The measurement report is also made available to the DOE to check.

**5. Data collection, reporting, archiving and preparation for periodic verification**

The electricity export and import on the transmission line are measured continuously by digital main meters and digital back-up meters, recorded monthly and are documented both in paper as well as in electronic forms.

According to the Power Purchase Agreement, the electricity generation protocol is made based on the value of the main meters. If the main meters are damaged, then the value of the backup meter is used. If both the meter readings are not available due to any failure, then, the electricity value is estimated based on the value during the same period in the previous year and is adjusted according to the operation parameters such as rainfall, water flow rate, operating hours and internal electricity use during the time of meter failure. When there is no reliable value, the generated electricity is estimated based on the average value of the last 6 months before (or less, if the plant has operated for less than 6 months) the failure or break down of the meters and must be adjusted according to the operation parameters.

On the first day of every month, the data recording personnel from hydropower project along with the staff from the grid company, EVN, reads and collects data from the main and back-up power meters at the project site. The electricity export and import are filled in the Electricity Confirmation Form and then signed and kept by both the parties.

The CPA implementers have collected internal records, sales receipts for power supplied to the grid and billing receipts for power received from the grid as evidences of monitoring and the records are stored in a central place. The net supply (i.e., gross generation minus supply by the grid to the project) is used for the calculations of emission reductions.

The CPA implementers send a copy of the archived data to the CME on monthly basis. Based on these data, the CME calculates the emission reduction also on monthly basis. All the data will be stored for 2 years after the crediting period of the PoA.

The final version of all the project documents such as monitoring report, emission reduction calculation sheets, PoA and CPA DD and its related documents, etc. are kept with the CME.

**6. Emergencies/Damage to metering equipment**



Nam Tha 4: The frequency of calibrating power meters has changed from every 1 year to every 2 years. This change was requested by the local grid utility company.<sup>51</sup>

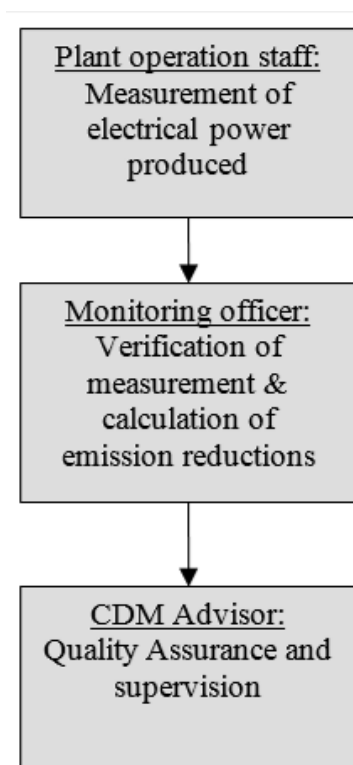
Hoa Phu: The main power meter 16083436 installed at 110 kV Cu Jut substation has been replaced with meter 14159513 as of 14/08/2017 due to meter failure.<sup>52</sup>

Bai Thuong: Both main and back-up power meters 16076476 and 16076475 have been replaced with new meters 17051431 and 17051432 as of 01/11/2017, in the aftermath of a serious flood that swept through the meter cubicle.<sup>53</sup>

Other than this, there were no other emergency or damage to the metering equipment in other CPAs.

## 7. Operational and management structure for monitoring

The monitoring of the emission reductions has been carried out according to the scheme shown in Figure 21. A monitoring officer has been appointed to undertake the day-to-day supervision responsibility. The measurement of the electrical energy supplied to and imported from the grid and reporting of daily operations was carried out by the plant operation staff.



**Figure 21. Management structure for monitoring emission reductions**

The monitoring officer is responsible for checking the measurements, collection of sales receipts, collection of billing receipts of the power supplied by the grid to the hydropower plant and the calculation of the emission reductions. He/she is also responsible for preparing operational reports

<sup>51</sup> Based on revised power purchase agreement dated 2016, Appendix C

<sup>52</sup> Based on the minute of meter calibration & replacement at 110Kv substation dated 14/08/2017

<sup>53</sup> Based on the minute of replacement and acceptance for new meters dated 01/11/2017

of the project activity, recording the daily operation of the hydropower station, including operating periods, power delivered to the grid, equipment defects, etc.

Finally, the monitoring reports are reviewed by a CDM advisor, who is engaged by the CME to assure that all the monitoring requirements are met.

## 8. Training

Before the project activities enter into operation, all the operation staffs are sent for operation training at colleges/universities, centres or other hydropower plants. The training is to ensure all the staffs are thoroughly acquainted with the procedures for all activities related to metering, data recording & processing and data archiving. In addition, the professional technicians and engineers from the equipment supplier also train the plant operational staff in the monitoring procedures, operation regulations, maintenance procedures and relevant others, before the operation of the hydropower plant. New employees, substituting former employees, receive equivalent training certificate and prove that they thoroughly know the procedures for all activities related to metering, data recording & processing and data archiving.

All 09 CPAs have sent staff for operation training and received certificates before they start working for the hydropower plants. A CDM training course was designed and conducted so that the monitoring officer and the technical staff are fully familiar with the procedures set out in the Manual and the latest EB guidelines on monitoring for preparation of the monitoring report.

## SECTION E. Data and parameters

### E.1. Data and parameters fixed ex ante

*(Copy this table for each piece of data and parameter)*

Data/parameter	EF <sub>Res</sub>
Unit	kgCO <sub>2</sub> e/MWh
Description	Default emission factor for emissions from reservoirs
Source of data	Decision by EB 23
Value(s) applied	09 CPAs: 0 Bai Thuong: not applicable
Choice of data or measurement methods and procedures	08 CPAs consist of new hydropower projects with no reservoir existing. Bai Thuong CPA takes advantage of the existing Bai Thuong irrigation reservoir and this parameter is not applicable according to the applied methodology.
Purpose of data	For calculating project emissions from the reservoir
Additional comments	Parameter is not applicable for these CPAs.

Data/parameter	Cap <sub>BL</sub>
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero
Source of data	Operations Manual of REDP
Value(s) applied	09 CPAs: 0 Bai Thuong: not applicable
Choice of data or measurement methods and procedures	08 CPAs construct new hydropower plants, so Cap <sub>BL</sub> is zero according to Version 13.0.0 of ACM0002. Bai Thuong CPA takes advantage of the existing Bai Thuong irrigation reservoir and this parameter is not applicable according to the applied methodology.

Purpose of data	For calculating project emissions from the reservoir
Additional comments	Parameter is not applicable for these CPAs.

<b>Data/parameter</b>	<b>A<sub>BL</sub></b>
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> ). For new reservoirs, this value is zero
Source of data	Operations Manual of REDP
Value(s) applied	09 CPAs: 0 Bai Thuong: Not applicable
Choice of data or measurement methods and procedures	08 CPAs build new reservoirs, so A <sub>BL</sub> is considered to be zero according to Version 13.0.0 of ACM0002 Bai Thuong CPA takes advantage of the existing Bai Thuong irrigation reservoir and this parameter is not applicable according to the applied methodology.
Purpose of data	Calculation of project emissions
Additional comments	These CPAs consist of new hydropower project (greenfield) with no reservoirs existing before. For Bai Thuong, this parameter is not applicable.

<b>Data/parameter</b>	<b>EF<sub>grid,CM,y</sub></b>
Unit	tCO <sub>2</sub> /MWh
Description	Combined margin CO <sub>2</sub> emission factor of grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data	Department of Meteorology, Hydrology and Climate Change (DNA Viet Nam)
Value(s) applied	For Sung Vui: 0.5656 For Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu: 0.5874 Trung Thu, Bai Thuong, Ban Ang, Bao Lam 1: 0.5464
Choice of data or measurement methods and procedures	Calculate as per the tool to calculate the emission factor for an electricity system
Purpose of data	For calculating the baseline emissions
Additional comments	CM emission factor is published by DNA Viet Nam. The calculation was made as per the "Tool to calculate the emission factor for an electricity system"  Sung Vui: The EF was recalculated using data from the Department of Meteorology, Hydrology and Climate Change (DNA Viet Nam) for data vintage years 2006, 2007 and 2008.  Nam Tha 4, Pa Chien, Song Rieng and Hoa Phu: The EF was recalculated using data from the Department of Meteorology, Hydrology and Climate Change (DNA Viet Nam) for data vintage years 2009, 2010 and 2011.  Trung Thu, Bai Thuong, Ban Ang, Bao Lam 1: The EF was recalculated using data from the Department of Meteorology, Hydrology and Climate Change (DNA Viet Nam) for data vintage years 2011, 2012 and 2013.

<b>Data/parameter</b>	<b>EG<sub>y</sub></b>
Unit	MWh

Description	Net electricity generated and delivered to the grid by all the power sources serving the system, not including low-cost/must-run power plants/units, in year $y$ (MWh)
Source of data	Department of Meteorology, Hydrology and Climate Change (DNA Viet Nam)
Value(s) applied	Sung Vui: See Appendix 4 of CPA-DD for 2006, 2007 and 2008 data <sup>54</sup>  Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu: See Appendix 4 of CPA-DD for 2009, 2010 and 2011 data.  Trung Thu, Bai Thuong, Ban Ang, Bao Lam 1: See Appendix 4 of the CPA-DD for 2011, 2012, and 2013 data.
Choice of data or measurement methods and procedures	Electricity generation data are used for OM and BM calculations
Purpose of data	For calculating the baseline emissions
Additional comments	Electricity generation data are used for OM and BM calculations

<b>Data/parameter</b>	<b>NCV<sub>i,y</sub></b>
Unit	TJ/10 <sup>3</sup> tonnes or TJ/Gg
Description	Net calorific value (energy content) of fossil fuel type $i$ in year $y$
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	Nine CPAs: See Appendix 4 of registered CPA DDs
Choice of data or measurement methods and procedures	No data for the fuels used in Viet Nam is available hence IPCC defaults are used
Purpose of data	For calculating the baseline emissions
Additional comments	No data for the fuels used in Viet Nam is available hence IPCC defaults are used.

<b>Data/parameter</b>	<b>FC<sub>i,m,y</sub></b>
Unit	mass (tonnes) or volume unit (m <sup>3</sup> )
Description	Amount of fossil fuel type $i$ consumed by power plant / unit $m$ in year $y$
Source of data	Department of Meteorology, Hydrology and Climate Change (DNA Viet Nam)
Value(s) applied	Sung Vui: See Appendix 4 of registered CPA DD for 2006, 2007 and 2008 data <sup>55</sup>  Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu: See Appendix 4 of registered CPA DD for 2009, 2010 and 2011 data  Trung Thu, Bai Thuong, Ban Ang, Bao Lam 1: See Appendix 4 of registered CPA DD for 2011, 2012 and 2013 data
Choice of data or measurement methods and procedures	Fuel consumption data are used for OM and BM calculations
Purpose of data	For calculating the emission factor
Additional comments	Fuel consumption data are used for OM and BM calculations in the estimation of grid emission factor

<sup>54</sup>Appendix 4 of CPA-DD version 09.

<sup>55</sup>Appendix 4 of CPA-DD version 09.

Data/parameter	EF <sub>CO<sub>2</sub>,i,y</sub>
Unit	tCO <sub>2</sub> /TJ
Description	CO <sub>2</sub> emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	Sung Vui: See Appendix 4 of registered CPA DD for 2006, 2007 and 2008 data <sup>56</sup>  Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu: See Appendix 4 of registered CPA DD for 2009, 2010 and 2011 data  Trung Thu, Bai Thuong, Ban Ang, Bao Lam 1: See Appendix 4 of registered CPA DD for 2011, 2012 and 2013 data
Choice of data or measurement methods and procedures	Emission factor of fuels is not available in Viet Nam. As such IPCC default values must be used and considered the best approximation for Viet Nam
Purpose of data	For calculating the emission factor
Additional comments	IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chapter1 of Vol.2 (Energy)

## E.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data/parameter	EG <sub>facility,y</sub>																						
Unit	MWh																						
Description	Quantity of net electricity generation supplied by the CPA to the grid in year y																						
Measured/calculated/default	Measured and calculated																						
Source of data	Sung Vui: Meters Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Trung Thu, Bai Thuong, Ban Ang, Bao Lam 1: Measured from applicable meter(s) and calculated from export and import power																						
Value(s) of monitored parameter	<p>The net electricity generation from CPAs are given below</p> <table border="1"> <thead> <tr> <th>CPA</th><th>Net power export (MWh)</th></tr> </thead> <tbody> <tr> <td>Sung Vui</td><td>75,484</td></tr> <tr> <td>Nam Tha 4</td><td>53,153</td></tr> <tr> <td>Pa Chien</td><td>74,088</td></tr> <tr> <td>Song Rieng</td><td>15,681</td></tr> <tr> <td>Hoa Phu</td><td>155,520</td></tr> <tr> <td>Ban Ang</td><td>62,476</td></tr> <tr> <td>Bao Lam 1</td><td>95,909</td></tr> <tr> <td>Trung Thu</td><td>112,719</td></tr> <tr> <td>Bai Thuong</td><td>17,629</td></tr> <tr> <td><b>Total</b></td><td><b>662,659</b></td></tr> </tbody> </table>	CPA	Net power export (MWh)	Sung Vui	75,484	Nam Tha 4	53,153	Pa Chien	74,088	Song Rieng	15,681	Hoa Phu	155,520	Ban Ang	62,476	Bao Lam 1	95,909	Trung Thu	112,719	Bai Thuong	17,629	<b>Total</b>	<b>662,659</b>
CPA	Net power export (MWh)																						
Sung Vui	75,484																						
Nam Tha 4	53,153																						
Pa Chien	74,088																						
Song Rieng	15,681																						
Hoa Phu	155,520																						
Ban Ang	62,476																						
Bao Lam 1	95,909																						
Trung Thu	112,719																						
Bai Thuong	17,629																						
<b>Total</b>	<b>662,659</b>																						
Monitoring equipment	Electricity meters. Meter details and calibration details of respective CPAs are given in Table 13 to Table 21.																						
Measuring/reading/recording frequency	Continuous measurement and monthly recording.																						

<sup>56</sup>Appendix 4 of CPA-DD version 09

Calculation method (if applicable)	<p>The data is calculated from the import and export readings measured by the two-way electronic power meters installed at the power plant. The meter will measure both the electricity supplied by the power plant to the grid (positive value) and the electricity supplied by the grid to the power plant (negative value) through the main cycle.</p> <p>Proportion of data monitored: 100% Recording frequency: Continuous measurement and monthly recording Accuracy level:</p> <p>Sung Vui: 0.5s for both main meters and backup meters Nam Tha 4: 0.5s for both main meters and backup meters</p> <p>For Sung Vui and Nam Tha 4, the main meter installed is of 0.5s accuracy levels. Due to difference in main meters' accuracy class between 0.2s as defined in the registered CPA-DD and 0.5s as actually installed, the monthly power export is deducted to 0.3% while the monthly power import is added with 0.3% in determining net power export and ER calculation for conservative purpose. The 0.3% error application is in accordance with Appendix. Calibration of the CDM validation and verification standard for programmes of activities version 01.0.</p> <p>Pa Chien: 0.2s for main meter and 0.5s for back-up meters Song Rieng: 0.5s for both main meter and back-up meter Hoa Phu: 0.2s for main meter and 0.5s for back-up meters Trung Thu: 0.2s for main meters and 0.5s for back-up meters Bai Thuong: 0.5s for both main and back-up meters Ban Ang: 0.2s for both main and back-up meters Bao Lam 1: 0.2s for both main and back-up meters (initial metering location) and 0.2s for main meters and 0.5s for back-up meters (revised metering location)</p> <p>Also, due to delayed calibration of meters for Pa Chien, Hoa Phu and Trung Thu, the MPE has also been applied in determining the net power exports of CPAs for periods from 15/11/2017 to 28/11/2017 and from 06/08/2017 to 13/08/2017 and from 18/08/2017 to 31/12/2017 respectively.</p> <p>The net electricity export to grid is determined as a difference between (i) the quantity of electricity supplied by the project plant/unit to the grid and ii) the quantity of electricity delivered to the project plant/unit from the grid.</p>
QA/QC procedures	Measurement results were cross checked with the records for sold electricity (electricity bill provided by EVN). Meter calibration is made by a certified third party in accordance with the Ministry of Science and Technology decision (25/2007/QĐ-BKHCN) on "Regard of the calibration procedure and frequency of the measurement equipment" dated 05/10/2007. The frequency of calibration for respective CPAs is as described in Table 13 through Table 21.
Purpose of data	Baseline emission calculation
Additional comments	Data will be recorded electronically and kept during the crediting period and two years after.

<b>Data/parameter</b>	<b>TEG<sub>y</sub><sup>57</sup></b>
Unit	<b>MWh</b>
Description	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y
Measured/calculated/default	Not applicable
Source of data	Project owner

<sup>57</sup>This parameter is included for compliance with registered CPA-DD of Sung Vui. This parameter is not included in the CPA-DDs of Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Trung Thu and Bai Thuong

Value(s) of monitored parameter	<p>Sung Vui: Not applicable as this is required only in cases where CPA results in new reservoir or extension of existing reservoir and where a power density of the reservoir (PD) is greater than 4 W/m<sup>2</sup> and less than or equal to 10 W/m<sup>2</sup>. The CPA consists of a new hydropower project (greenfield) with no reservoirs existing.</p> <p>The calculated power density of the power plants is more than 10 W/m<sup>2</sup> (refer section E2.). Thus, this parameter is not applicable.</p>
Monitoring equipment	Not applicable
Measuring/reading/recording frequency	Not applicable
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data	To calculate project emissions
Additional comments	-

Data/parameter	Cap <sub>PJ</sub>			
Unit	W			
Description	Installed capacity of the hydro power plant after implementation of the project activity.			
Measured/calculated/default	Not applicable			
Source of data	Sung Vui: Project site Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Trung Thu, Ban Ang, Bao Lam 1: Nameplate of generating equipment Bai Thuong: The monitoring of this parameter is not applicable according to the applied methodology.			
Value(s) of monitored parameter				
	CPA	Installed capacity (Generator) MW	Number of units	Total installed capacity MW
	Sung Vui	9	2	18
	Nam Tha 4	5.75	2	11.5
	Pa Chien	11	2	22
	Song Rieng	1.475	2	2.95
	Hoa Phu	14.5	2	29
	Ban Ang	8.5	2	17
	Bao Lam 1	15	2	30
	Trung Thu	15	2	30
Bai Thuong	Not applicable	Not applicable	Not applicable	
Monitoring equipment	Name plate of generator units			
Measuring/reading/recording frequency	Yearly			
Calculation method (if applicable)	Not applicable			
QA/QC procedures	Photos taken showing the status of generators and the nameplates with specifications of generators. It is cross checked with the Maintenance Logbook for any modification or replacement.			
Purpose of data	For calculating PD, from which determine EF <sub>Res</sub> and PE <sub>y</sub>			
Additional comments	-			

<b>Data/parameter</b>	<b>A<sub>PJ</sub></b>
Unit	<b>m<sup>2</sup></b>

Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.																				
Measured/calculated/default	Calculated																				
Source of data	Sung Vui: Project site Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Trung Thu, Ban Ang, Bao Lam 1: Measurement reports by third party consultants Bai Thuong: The monitoring of this parameter is not applicable according to the applied methodology.																				
Value(s) of monitored parameter	<table border="1"> <thead> <tr> <th>CPA</th><th>Surface area (m<sup>2</sup>)</th></tr> </thead> <tbody> <tr> <td>Sung Vui</td><td>24,000</td></tr> <tr> <td>Nam Tha 4</td><td>10,000</td></tr> <tr> <td>Pa Chien</td><td>16,000</td></tr> <tr> <td>Song Rieng</td><td>62,000</td></tr> <tr> <td>Hoa Phu</td><td>1,601,000</td></tr> <tr> <td>Ban Ang</td><td>481,000</td></tr> <tr> <td>Bao Lam 1</td><td>1,190,000</td></tr> <tr> <td>Trung Thu</td><td>2,881,000</td></tr> <tr> <td>Bai Thuong</td><td>Not applicable</td></tr> </tbody> </table>	CPA	Surface area (m <sup>2</sup> )	Sung Vui	24,000	Nam Tha 4	10,000	Pa Chien	16,000	Song Rieng	62,000	Hoa Phu	1,601,000	Ban Ang	481,000	Bao Lam 1	1,190,000	Trung Thu	2,881,000	Bai Thuong	Not applicable
CPA	Surface area (m <sup>2</sup> )																				
Sung Vui	24,000																				
Nam Tha 4	10,000																				
Pa Chien	16,000																				
Song Rieng	62,000																				
Hoa Phu	1,601,000																				
Ban Ang	481,000																				
Bao Lam 1	1,190,000																				
Trung Thu	2,881,000																				
Bai Thuong	Not applicable																				
Monitoring equipment	Not applicable																				
Measuring/reading/recording frequency	Yearly																				
Calculation method (if applicable)	<p>Sung Vui: The surface area of the reservoir is determined using the correlation diagram between the water level (Z), measured on-site and the reservoir surface area (F) as provided in feasibility study (p.7 volume 7).</p> <p>Nam Tha 4, Pa Chien, Song Rieng, Hoa Phu, Trung Thu, Ban Ang, Bao Lam: The measurement method will be applied by a third party consultant in accordance with the local industry practices.</p> <p>Bai Thuong: The monitoring of this parameter is not required according to the applied methodology.</p>																				
QA/QC procedures	The actual water level is measured on-site. The uncertainty level of the data is low.																				
Purpose of data	For calculating PD, from which determine EF <sub>Res</sub> and PE <sub>y</sub>																				
Additional comments	-																				

### E.3. Implementation of sampling plan

&gt;&gt;

Not applicable

## SECTION F. Calculation of emission reductions or net anthropogenic removals

### F.1. Calculation of baseline emissions or baseline net removals

&gt;&gt;

According to methodology, ACM0002 (version 13.0.0), baseline emissions (BE<sub>y</sub>) are the product of the baseline emissions factor (EF<sub>y</sub>) calculated below, times the electricity supplied by the project activity to the national grid (EG<sub>y</sub>), as per the formula given below:

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



Where:

$BE_y$	tCO <sub>2</sub> /yr	Baseline emissions in year y (tCO <sub>2</sub> /yr)
$EG_{PJ,y}$	MWh/yr	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
$EF_{grid,CM,y}$	tCO <sub>2</sub> /MWh	Combined margin CO <sub>2</sub> emission factor for grid connected power generation in year y calculated using the latest version of the “ <i>Tool to calculate the emission factor for an electricity system</i> ”

The quantity of net electricity generation by the CPA in year y is determined as:

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

Where:

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

It is determined as a difference between (i) the quantity of electricity supplied by the project plant to the grid and (ii) quantity of electricity delivered to the project plant from the grid.

The import and export readings and the net export calculated for respective CPAs during the 5<sup>th</sup> monitoring period from 16/12/2016 to 31/12/2017 is shown in Table 23. For electricity export measurements, the values in the monthly power generation protocols are compared with the monthly sale invoices issued by the CPA implementer to the grid company.

Regarding Sung Vui, since the five hydropower plants namely Sung Vui, Trung Ho, Van Ho, Ngoi Xan 1 and Ngoi Xan 2 are connected to same 110kV Ngoi Xan substation and therefore the sale invoices are issued as summation of electricity generated by these five plants. The monthly generation protocols are issued for individual plants. The total values in monthly generation protocols are always higher than those in the sale invoice. This is because, in exporting power to the national grid, plants sometime received reactive power from the national grid. Hence in determining electricity amount for billing purpose, the grid company had deducted this reactive power amount (compensating power) to monthly generation protocols values.

The monthly power export by Sung Vui HPP during the monitoring period is determined by subtracting compensating loss (amount difference between protocols and invoices) by other 04 plants, including Sung Vui HPP from the Sung Vui monthly power export to grid, this is conservative. For power import from the grid, the values from the monthly generation protocols are applied in the calculation of net power export.

In the current monitoring period, Van Ho, one of the five hydropower cascades, only resumed exporting electricity to the national power grid in July 2017 due to a serious flood destroying the plant in 2016.

Similar approach is followed in case of Nam Tha 4 hydropower plant since there are three other power plants, namely Name Tha 3, Nam Tha 5 and Nam Tha 6 that export power to same 110 kV substation.

For Pa Chien, Song Rieng, Hoa Phu, Trung Thu, Bao Lam 1, Ban Ang and Bai Thuong, the minimum of the metered or invoiced value at the plant level is taken for CER calculation.

Furthermore, in case of Sung Vui and Nam Tha 4, the main meters installed are of 0.5s accuracy levels. Due to the difference in main meters' accuracy class between 0.2s, as defined in the registered CPA-DD and 0.5s, as actually installed, the monthly power export is deducted to 0.3% while the monthly power import is added with 0.3% in determining net power export and ER calculation for conservative purpose.

#### **Addressing of delayed calibration of meters:**

During the current monitoring period, delayed calibration of meters was observed for Pa Chien, Hoa Phu and Trung Thu CPAs as described **Table 22** below. The MPE of power meters had been applied in calculation of both export and import power for these CPAs in accordance with Appendix. Calibration of the CDM validation and verification standard for programmes of activities version 01.0. as below.

**Table 22. Delayed calibration of meters in current monitoring period**

CPA	Meter serial number	Applicable delayed period	MPE application period
Pa Chien	50302964 & 50302963	15/11/2017 to 28/11/2017	Entire November 2017
Hoa Phu	14159513	06/08/2017 to 13/08/2017	Entire August 2017
Trung Thu	16083440 & 16083439	18/08/2017 to 31/12/2017	Entire August, September, October, November and December 2017

The details of comparison are provided in the ER calculation sheet. The baseline emissions calculated during the monitoring period are provided in **Table 23** as follows.

**Table 23. Conservative electricity exported to the grid and imported from the grid**

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity generation EG <sub>facility,y</sub>
From	To	(MWh)	(MWh)	(MWh)
		A	B	C = A – B
<b>Sung Vui</b>				
01/01/2017	31/01/2017	2,267.232	10.532	2,256.700
01/02/2017	29/02/2017	2,154.474	7.372	2,147.102
01/03/2017	31/03/2017	3,490.354	10.532	3,479.823
01/04/2017	30/04/2017	4,878.709	8.425	4,870.284
01/05/2017	31/05/2017	3,536.502	11.585	3,524.917
01/06/2017	30/06/2017	7,014.285	7.372	7,006.913
01/07/2017	31/07/2017	12,584.269	1.053	12,583.215
01/08/2017	31/08/2017	9,826.945	5.266	9,821.680
01/09/2017	30/09/2017	10,803.412	0.000	10,803.412

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity generation EG <sub>facility,y</sub>
From	To	(MWh)	(MWh)	(MWh)
		A	B	C = A – B
01/10/2017	31/10/2017	10,370.462	3.159	10,367.303
01/11/2017	30/11/2017	5,202.595	7.372	5,195.223
01/12/2017	31/12/2017	3,435.509	8.425	3,427.084
<b>Total</b>		<b>75,565</b>	<b>81</b>	<b>75,484</b>
<b>Nam Tha 4</b>				
01/01/2017	31/01/2017	2,588.952	11.163	2,577.788
01/02/2017	29/02/2017	1,618.316	12.006	1,606.311
01/03/2017	31/03/2017	1,789.041	12.322	1,776.719
01/04/2017	30/04/2017	1,442.738	12.111	1,430.627
01/05/2017	31/05/2017	1,513.084	11.374	1,501.710
01/06/2017	30/06/2017	2,174.620	9.478	2,165.141
01/07/2017	31/07/2017	8,352.502	1.474	8,351.028
01/08/2017	31/08/2017	8,053.626	1.053	8,052.573
01/09/2017	30/09/2017	8,923.924	0.527	8,923.397
01/10/2017	31/10/2017	9,395.399	0.421	9,394.978
01/11/2017	30/11/2017	4,133.801	4.634	4,129.167
01/12/2017	31/12/2017	3,254.068	10.953	3,243.116
<b>Total</b>		<b>53,240</b>	<b>88</b>	<b>53,153</b>
<b>Pa Chien</b>				
01/01/2017	31/01/2017	3,249.740	24.670	3,225.070
01/02/2017	29/02/2017	278.220	25.490	252.730
01/03/2017	31/03/2017	1,603.960	25.510	1,578.450
01/04/2017	30/04/2017	4,561.090	21.620	4,539.470
01/05/2017	31/05/2017	1,996.520	28.650	1,967.870

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity generation EG <sub>facility,y</sub>
From	To	(MWh)	(MWh)	(MWh)
		A	B	C = A – B
01/06/2017	30/06/2017	4,581.820	24.380	4,557.440
01/07/2017	31/07/2017	12,017.560	7.200	12,010.360
01/08/2017	31/08/2017	11,641.770	5.920	11,635.850
01/09/2017	30/09/2017	11,641.400	2.030	11,639.370
01/10/2017	31/10/2017	12,007.160	1.810	12,005.350
01/11/2017	30/11/2017	4,548.006	26.563	4,521.443
01/12/2017	31/12/2017	6,169.940	15.510	6,154.430
<b>Total</b>		<b>74,297</b>	<b>209</b>	<b>74,088</b>
<b>Song Rieng</b>				
01/01/2017	31/01/2017	2,055.559	0.170	2,055.389
01/02/2017	29/02/2017	1,700.460	0.040	1,700.420
01/03/2017	31/03/2017	770.592	2.890	767.702
01/04/2017	30/04/2017	602.896	3.212	599.684
01/05/2017	31/05/2017	867.306	2.618	864.688
01/06/2017	30/06/2017	1,112.474	1.369	1,111.105
01/07/2017	31/07/2017	1,673.737	0.218	1,673.519
01/08/2017	31/08/2017	1,009.077	0.274	1,008.803
01/09/2017	30/09/2017	1,004.855	1.247	1,003.608
01/10/2017	31/10/2017	1,340.505	1.398	1,339.107
01/11/2017	30/11/2017	1,650.948	0.321	1,650.627
01/12/2017	31/12/2017	1,909.412	2.617	1,906.795
<b>Total</b>		<b>15,698</b>	<b>16</b>	<b>15,681</b>
<b>Hoa Phu</b>				
01/01/2017	31/01/2017	13,221.514	3.945	13,217.569

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity generation EG <sub>facility,y</sub>
From	To	(MWh)	(MWh)	(MWh)
		A	B	C = A – B
01/02/2017	29/02/2017	7,501.019	12.626	7,488.393
01/03/2017	31/03/2017	5,006.378	25.385	4,980.993
01/04/2017	30/04/2017	6,334.608	20.395	6,314.213
01/05/2017	31/05/2017	12,763.750	7.010	12,756.740
01/06/2017	30/06/2017	17,422.296	0.000	17,422.296
01/07/2017	31/07/2017	12,867.617	1.154	12,866.463
01/08/2017	31/08/2017	5,296.794	0.238	5,296.555
01/09/2017	30/09/2017	17,486.806	0.342	17,486.464
01/10/2017	31/10/2017	19,370.267	0.230	19,370.037
01/11/2017	30/11/2017	19,322.002	0.603	19,321.399
01/12/2017	31/12/2017	18,999.518	0.697	18,998.821
<b>Total</b>		<b>155,593</b>	<b>73</b>	<b>155,520</b>
<b>Ban Ang</b>				
01/01/2017	15/01/2017	0	0	0
16/01/2017	31/01/2017	1,495.710	6.490	1,489.220
01/02/2017	29/02/2017	1,907.530	19.080	1,888.450
01/03/2017	31/03/2017	1,638.500	35.620	1,602.880
01/04/2017	30/04/2017	1,265.240	33.570	1,231.670
01/05/2017	31/05/2017	3,869.870	33.470	3,836.400
01/06/2017	30/06/2017	4,169.430	23.840	4,145.590
01/07/2017	31/07/2017	8,832.780	11.760	8,821.020
01/08/2017	31/08/2017	11,643.060	6.460	11,636.600
01/09/2017	30/09/2017	10,218.740	3.430	10,215.310
01/10/2017	31/10/2017	9,598.050	9.960	9,588.090

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity generation EG <sub>facility,y</sub>
From	To	(MWh)	(MWh)	(MWh)
		A	B	C = A – B
01/11/2017	30/11/2017	4,692.260	22.060	4,670.200
01/12/2017	31/12/2017	3,377.160	26.220	3,350.940
<b>Total</b>		<b>62,708</b>	<b>232</b>	<b>62,476</b>
<b>Bao Lam 1</b>				
01/01/2017	31/01/2017	3,592.40		
01/02/2017	29/02/2017	1,675.70		
01/03/2017	31/03/2017	3,051.70		
01/04/2017	30/04/2017	3,678.10	137.20 <sup>58</sup>	12,950.90
01/05/2017	31/05/2017	2,377.40	41.80	2,335.60
01/06/2017	30/06/2017	10,344.00	21.80	10,322.20
01/07/2017	31/07/2017	17,945.30	0.40	17,944.90
01/08/2017	31/08/2017	17,700.50	4.30	17,696.20
01/09/2017	30/09/2017	17,957.20	1.20	17,956.00
01/10/2017	31/10/2017	8,523.80	36.00	8,487.80
01/11/2017	30/11/2017	5,448.68	0.00	5,448.68
01/12/2017	31/12/2017	2,853.29	86.70	2,766.59
<b>Total</b>		<b>95,148</b>	<b>329.4</b>	<b>94,819</b>
<b>Trung Thu</b>				
01/01/2017	31/01/2017	5,466.324		
01/02/2017	29/02/2017	3,046.477		
01/03/2017	31/03/2017	3,294.110	117.100 <sup>59</sup>	11,689.811
01/04/2017	30/04/2017	3,920.042	38.000	3,882.042
01/05/2017	31/05/2017	4,498.385	40.300	4,458.085

<sup>58</sup> The data is sourced from invoice, which was issued for 5 months together

<sup>59</sup> The date is sourced from invoice, which was issued for 2 months together

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity generation EG <sub>facility,y</sub>
From	To	(MWh)	(MWh)	(MWh)
		A	B	C = A – B
01/06/2017	30/06/2017	8,661.161	30.000	8,631.161
01/07/2017	31/07/2017	20,031.890	6.000	20,025.890
01/08/2017	31/08/2017	21,825.455	1.603	21,823.851
01/09/2017	30/09/2017	19,785.196	4.810	19,780.387
01/10/2017	31/10/2017	11,257.692	21.543	11,236.149
01/11/2017	30/11/2017	6,496.623	34.469	6,462.154
01/12/2017	31/12/2017	4,767.456	38.477	4,728.979
<b>Total</b>		<b>113,051</b>	<b>332</b>	<b>112,719</b>
<b>Bai Thuong</b>				
01/01/2017	31/01/2017	820.504	8.090	812.414
01/02/2017	29/02/2017	622.520	0.000	622.520
01/03/2017	31/03/2017	1,129.053	14.810	1,114.243
01/04/2017	30/04/2017	146.418	12.860	133.558
01/05/2017	31/05/2017	1,693.415	5.580	1,687.835
01/06/2017	30/06/2017	2,285.327	2.230	2,283.097
01/07/2017	31/07/2017	2,878.229	1.730	2,876.499
01/08/2017	31/08/2017	3,019.828	1.350	3,018.478
01/09/2017	30/09/2017	2,795.036	0.780	2,794.256
01/10/2017	31/10/2017	1,216.922	0.520	1,216.402
01/11/2017	30/11/2017	0.000 <sup>60</sup>	0.000	0.000
01/12/2017	31/12/2017	1,081.383	11.340	1,070.043
<b>Total</b>		<b>17,689</b>	<b>59</b>	<b>17,629</b>

The baseline emissions calculated for each CPA are provided in **Table 24**

<sup>60</sup> Plant stopped operation in November 2017



Table 24. Baseline Emission

Time period		Net electricity generation EG <sub>facility,y</sub>	Grid emission factor EF <sub>grid,CM,y</sub>	Baseline Emission BE <sub>y</sub>
From	To	(MWh)	(tCO <sub>2</sub> /MWh)	(tCO <sub>2</sub> )
		C	D	E = C*D
Sung Vui				
01/01/2017	31/12/2017	75,484	0.5656	42,693
Nam Tha 4				
01/01/2017	31/12/2017	53,153	0.5874	31,221
Pa Chien				
01/01/2017	31/12/2017	74,088	0.5874	43,519
Song Rieng				
01/01/2017	31/12/2017	15,681	0.5874	9,211
Hoa Phu				
01/01/2017	31/12/2017	155,520	0.5874	91,352
Ban Ang				
01/01/2017	31/12/2017	62,476	0.5464	34,137
Bao Lam 1				
01/01/2017	31/12/2017	94,819	0.5464	51,808
Trung Thu				
01/01/2017	31/12/2017	112,719	0.5464	61,589
Bai Thuong				
01/01/2017	31/12/2017	17,629	0.5464	9,632
Total baseline emissions				375,162

## F.2. Calculation of project emissions or actual net removals

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For the project activity, which involves construction of a new hydropower project with a new accumulated reservoir, project emissions associated with reservoir must be accounted if the power density of the project activity is greater than 4 W/m<sup>2</sup> and less than 10 W/m<sup>2</sup>.

Power density is calculated as follows.

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

The power density (PD) of the project is calculated as below:

$$PD = (Cap_{PJ}/A_{PJ})$$

Where:

PD	W/m <sup>2</sup>	Power density of the project activity
Cap <sub>PJ</sub>	W	Installed capacity of the hydro power plant after the implementation of the project activity
Cap <sub>BL</sub>	W	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero
A <sub>PJ</sub>	m <sup>2</sup>	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
A <sub>BL</sub>	m <sup>2</sup>	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new hydro power plants, this value is zero.

For example, installed capacity of Sung Vui plant is 18 MW or 18,000,000 W. The power density is calculated as follows:

$$PD = (Cap_{PJ} - Cap_{BL})/(A_{PJ} - A_{BL}) = (18,000,000 - 0)/(24,000 - 0) = 750 \text{ W/m}^2$$

Similarly, the power density is calculated for respective CPAs as below.

**Table 25. Baseline Emission**

CPA	Capacity (MW)	Reservoir surface area (m <sup>2</sup> )	Power density (W/m <sup>2</sup> )
Sung Vui	18	24,000	750
Nam Tha 4	11.5	10,000	1,150
Pa Chien	22	16,000	1,375
Song Rieng	2.95	62,000	47.5
Hoa Phu	29	1,601,000	18.11
Ban Ang	17	481,000	35.3
Bao Lam 1	30	1,190,000	25.21
Trung Thu	30	2,881,000	10.41
Bai Thuong	Not applicable	Not applicable	Not applicable

The power densities of all CPAs are much greater than 10 W/m<sup>2</sup>. Therefore, according to the methodology ACM0002, the reservoir emission is considered to be zero.

Also, as per the methodology, the use of fossil fuels for the back up or emergency purposes (e.g., diesel generators) can be neglected and hence, not included.

Therefore, the project emission (PE<sub>y</sub>) is zero.

### F.3. Calculation of leakage emissions

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The project results into no leakage.

Therefore:  $LE_y = 0$

### F.4. Calculation of emission reductions or net anthropogenic removals

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO <sub>2</sub> e)	Project GHG emissions or actual net GHG removals (t CO <sub>2</sub> e)	Leakage GHG emissions (t CO <sub>2</sub> e)	GHG emission reductions or net anthropogenic GHG removals (t CO <sub>2</sub> e)		
				Before 01/01/2013	From 01/01/2013	Total amount
CPA_6810-0001 <sup>61</sup>	42,693	0	0	0	42,693	42,693
CPA_6810-0003	31,221	0	0	0	31,221	31,221
CPA_6810-0002	43,519	0	0	0	43,519	43,519
CPA_6810-0004	9,211	0	0	0	9,211	9,211
CPA_6810-0005	91,352	0	0	0	91,352	91,352
CPA_6810-0006	34,137	0	0	0	34,137	34,137
CPA_6810-0007	51,809	0	0	0	51,809	51,808
CPA_6810-0008	61,589	0	0	0	61,589	61,589
CPA_6810-0009	9,633	0	0	0	9,633	9,632
<b>Total</b>	<b>375,162</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>375,162</b>	<b>375,162</b>

<sup>61</sup>PRC without prior approval was done for this CPA during monitoring period from 01/01/2013 to 31/12/2013. Changes are corrected and accepted in the revised CPA-DD version 08, dated 08/09/2014. [https://cdm.unfccc.int/PoAIssuance/iss\\_db/poais761634785/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poais761634785/view)

**F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs**

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO <sub>2</sub> e)	Amount estimated ex ante (t CO <sub>2</sub> e)
CPA_6810-0001 <sup>62</sup>	42,693	30,115
CPA_6810-0003	31,221	26,932
CPA_6810-0002	43,519	48,120
CPA_6810-0004	9,211	8,204
CPA_6810-0005	91,352	77,050
CPA_6810-0006	34,137	37,059
CPA_6810-0007	51,808	62,270
CPA_6810-0008	61,589	66,994
CPA_6810-0009	9,632	13,306
<b>Total</b>	<b>375,162</b>	<b>370,050</b>

**F.6. Remarks on increase in achieved emission reductions**

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The overall CER generation from the PoA is **1.38% higher** than the estimation. Out of the 09 CPAs, Nam Tha 4, Song Rieng, Hoa Phu and Sung Vui achieved higher emission reductions as compared with ex-ante values. This increase in net CER of these CPAs is attributable to the overall higher rainfall and eventually higher electricity generation at the respective hydropower plant sites in 2017.

**Nam Tha 4:**

The CPA achieved 16% higher emission reductions in the current monitoring period. This is due to higher water availability at the project site. According to the approved FSR document, the Hydrology Book, the annual rainfall at the project site is estimated at 1,790 mm. Meanwhile, the actual average rainfall in Lao Cai in 2017 is 2,671.0 mm.<sup>63</sup> This has resulted in more operating hours and therefore higher electricity generation in 2017.

**Song Rieng:**

<sup>62</sup>PRC without prior approval was done for this CPA during monitoring period from 01/01/2013 to 31/12/2013. Changes are corrected and accepted in the revised CPA-DD version 08, dated 08/09/2014. [https://cdm.unfccc.int/PoAIssuance/iss\\_db/poais761634785/view](https://cdm.unfccc.int/PoAIssuance/iss_db/poais761634785/view)

<sup>63</sup> <https://www.weatheronline.co.uk> (screenshot presented in ER excel worksheet)

Song Rieng CPA achieved 12.3% higher emission reductions in the current monitoring period. This is due to higher water availability at the project site. According to the approved FSR, operating hours is 3,891 meanwhile the actual operating hours is 5,957 hours, which is based on the plant operation records. This has resulted in more operating hours and therefore higher electricity generation in 2017.

#### **Hoa Phu:**

Hoa Phu CPA achieved 19% higher emission reductions in the current monitoring period. This is due to higher water availability at the project site. According to the approved FSR, operating hours is 4,568 meanwhile the actual operating hours in 2017 is 7,476 hours based on the plant operation records on hourly operation of the two generating units. This has resulted in more operating hours and therefore higher electricity generation in 2017.

#### **Sung Vui:**

Sung Vui CPA achieved 42% higher emission reductions than the estimated value in the registered CPA-DD for 365 days of plant operation. Such higher increase is attributed to the continued higher rainfall in Lao Cai province and the non-construction of the upstream Can Ho hydropower plant up to the current monitoring period.

An analysis into the causes of such higher emission reductions is presented in

**Table 26** below.

**Table 26. Analysis of causes of higher emission reductions in 2017**

<b>Indicator</b>	<b>Ex-ante</b>	<b>Actual</b>	<b>%difference</b>
Annual rainfall	1,712.70 <sup>64</sup>	2,671.00 <sup>65</sup>	55.95%
Operating hours	3,200 <sup>66</sup>	5,307 <sup>67</sup>	65.84%
Net electricity supply	53,246 <sup>68</sup>	75,484	41.76%

It is evidenced from the above table that the natural conditions at the project site has been changing significantly as compared with the estimates established by the FSR developer at time of conducting project feasibility study. Since FSR was conducted by a qualified and licensed engineering company in Vietnam and had been duly approved by Vietnam's competent authorities, the ex-ante estimates and calculations by the FSR developer should be appropriate and credible at time of project feasibility study and CPA investment decision date. The FSR developer had also utilized multiple year historical data in its assumptions and estimates.

On the other hand, Vietnam is also experiencing abnormal rainfall patterns, sea level rise, and typhoons in recent years as a result of global warming and Lao Cai, as part of Vietnam, is not an exception.

<sup>64</sup> Based on approved FSR of Sung Vui CPA

<sup>65</sup> <https://www.weatheronline.co.uk> (screenshot presented in ER excel worksheet)

<sup>66</sup> Based on approved FSR of Sung Vui CPA

<sup>67</sup> Based on plant operation records of Sung Vui CPA

<sup>68</sup> Based on registered CPA-DD of Sung Vui CPA

Furthermore, until the end of current monitoring period, the CPA implementer has not started construction of the upstream Can Ho HPP yet. This has contributed to the higher availability of water flow into Sung Vui reservoir, resulting in plant's more operating hours in 2017.

**Addressing of FAR 02 in previous verification report:**

During the 4<sup>th</sup> monitoring period, the FAR 02 was raised with regards to the continued increases in the annual net electricity supply of the CPA and the status of constructing an upstream hydropower plant, which is Can Ho HPP. In this monitoring period, Sung Vui CPA achieved a net electricity supply of 75,484 MWh, an equivalent to 42% higher than the ex-ante net power supply and up to now, the CPA implementer has not constructed the upstream Can Ho hydropower plant project yet.

The causes of increased electricity supply to the grid is due to natural conditions happening at the project site during the monitoring period, which goes beyond the CPA implementer's control.

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**Document information**

<i>Version</i>	<i>Date</i>	<i>Description</i>
02.0	7 June 2017	Revision to: <ul style="list-style-type: none"><li>• Ensure consistency with version 01.0 of the “CDM project standard for programmes of activities (CDM-EB93-A07-STAN);</li><li>• Make editorial improvements.</li></ul>
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