



Monitoring report form for CDM project activity
(Version 07.0)

MONITORING REPORT

Title of the project activity	Potrero Hydropower Plant, Peru	
UNFCCC reference number of the project activity	8414	
Version number of the PDD applicable to this monitoring report	12	
Version number of this monitoring report	04	
Completion date of this monitoring report	17/12/2020	
Monitoring period number	01	
Duration of this monitoring period	01/06/2016 to 31/12/2019 (Inclusive of both the days)	
Monitoring report number for this monitoring period	Not Applicable	
Project participants	Empresa Eléctrica Agua Azul S.A	
Host Party	Peru	
Applied methodologies and standardized baselines	ACM0002 ver. 12.3.0 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources Standardized Baseline: Not Applicable	
Sectoral scopes	Sectoral Scope 1 : Energy industries (renewable/ non-renewable sources)	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 tCO ₂ e	159,388 tCO ₂ e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	246,840 tCO ₂ e	

SECTION A. Description of project activity

A.1. General description of project activity

The Project “Potrero Hydropower Plant, Peru” (hereafter referred to as the “Project”) is a run of river hydroelectric power plant located in the Province of San Marcos, Region of Cajamarca, in Peru (Host Country), and it is to be implemented by the company named “Empresa Electrica Agua Azul S.A.”. The total installed capacity of the Project is 20.86 MW.

The project activity is intended to generate renewable electricity by using water from the Crisnejas River, who receives its water from two main river basins, Cajamarca River basin (111.9 km of length) and Condebamba River basin (92.7 km of length). This energy is supplied to the National Interconnected Electricity Grid (SEIN). The reduction of baseline emissions results from the displacement of electricity generated by power plants within the SEIN, which include fossil/fuel power plants emitting CO₂. The spatial extent of the Project boundary is the SEIN.

The project activity involves the construction of a substation located in the left margin of Crisnejas River, called Potrero substation (less than 200 meters away from Power House), it comprises of 2 horizontal Francis turbines for a nominal water flow maximum of 9 m³/s. A transmission line of 60 kV and 4.97 kms length is installed between the Potrero substation and the Aguas Calientes substation.

The scenario prior to the implementation of the project activity was electricity was electricity supplied by the grid and the same has been considered as the baseline scenario i.e. the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid. The project has led to reduced greenhouse gas emissions because it displaces electricity from fossil fuel based electricity generation plants and through the electricity supply to the grid the project activity has a direct environmental benefit by reducing the amount of fossil fuels combusted for energy generation and the associated pollutant emissions (like GHGs, PM, SOx, NOx).

The construction of the project activity started in 15/01/2013 (the date corresponds to the signature of the contract of the equipment like turbines, generators and electromechanical equipment) and has been in operation since 29/04/2017. The project activity is operational with normal operation and maintenance during current monitoring period i.e. 01/06/2016 to 31/12/2019¹. The project activity has supplied 238436.52 MWh electricity to grid during current monitoring period, which has resulted emission reduction of 159,388 tCO₂e.

A.2. Location of project activity

The project is located in the north of Peru, in the district of Eduardo Villanueva, Province of San Marcos, Region of Cajamarca. The intake of the hydroelectric power plant is located in the town Aguas Calientes, at approximately 1,950 m.a.s.l., while the discharge is located in the place called Potrero, at approximately 1,625 m.a.s.l.

¹ Though the crediting period starts from 01/06/2016 but the plant was commissioned on 29/04/2017; The energy meters installed in the project when it was commissioned on 29/04/2017 were not in accordance with COES requirements (in particular those meters not able to give COES a real time access), hence the meters were replaced and the new meters installed on 03/06/2017 (these meters are still existing till the end of monitoring period) and were functional from 03/06/2017, hence electricity generation/emission reductions before that date has been assumed as 0 (zero) and electricity data from 03/06/2017 onwards is considered for ER calculations.

The intake structure is developed in the Crisnejas River. The Project is located at the following geographical coordinates:

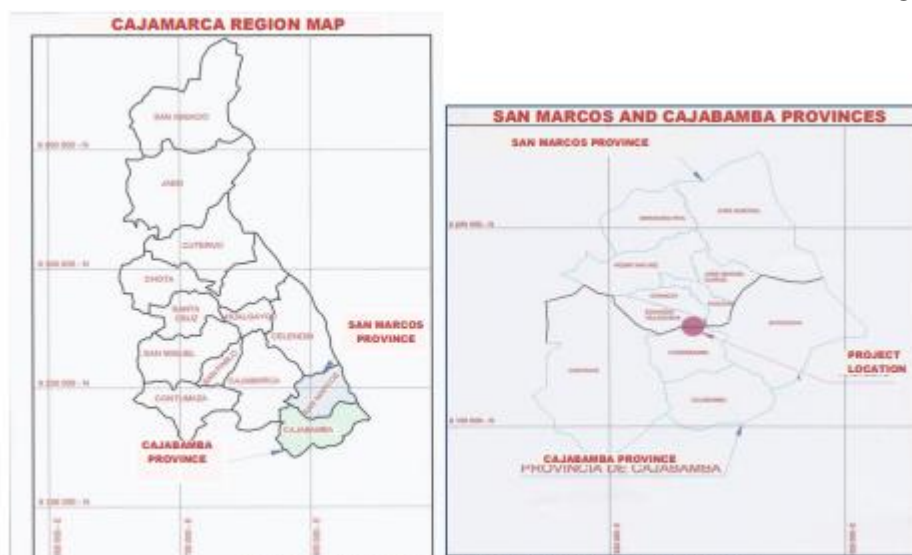
Item	Location	Geo-coordinates	Altitude
Water Intake	UTM WGS84 9 174 661 North 822 399 East	Longitude : - 66.0793 Latitude : -7.4570	1,950 m.a.s.l.
Water Discharge	UTM WGS84 9 174 299 North 825 835 East	Longitude:- -66.0482 Latitude : -7.4600	1,625 m.a.s.l.
Power House	UTM PSAD 56 9 174 283 North 824 238 East	Longitude: -66.0632 Latitude : -7.4598	1,810 m.a.s.l.
Substation Potrero	UTM PSAD 56 9 174 342 North 824 183 East	Longitude: -66.0627 Latitude : -7.4603	1,825 m.a.s.l.
Substation Aguas Calientes	UTM PSAD 56 9 175 235 North 819 689 East	Longitude: -66.1039 Latitude : -7.4520	2,000 m.a.s.l.

The location of the Project can be seen in the following figures.

Figure 1: Project macro- location in Peru



Source: Project report submitted to the Ministry of Energy and Mines



Source: Project report submitted to the Ministry of Energy and Mines.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Peru (host)	Empresa Eléctrica Agua Azul S.A (Private entity)	No

A.4. References to applied methodologies and standardized baselines

Methodology Title: of ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources (Version 12.3.0, EB 58)².

The tools associated with the methodology are:

- Version 02.2.1 of the Tool to calculate the emission factor for an electricity system (EB 63/Annex 19)
- Version 06.1.0 of the Tool for demonstration and assessment of additionality (EB 69/Annex 20)

A.5. Crediting period type and duration

01/06/2016 – 31/05/2023 (7 years Renewable Crediting period)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The project activity is implemented and operated as per registered PDD, there were no incident which affects the applicability of applied baseline and monitoring methodology. The project activity is a 20.86 MW run-of-river hydroelectric project, which utilizes hydro potential to generate GHG emission-free electricity and exports it to the regional grid. The project was commissioned on 29-April-2017 and since then the project is operational.

The technology employed for power generation in the project activity involves the conversion of potential energy available in the water flow into mechanical energy using hydro turbines and then

² <https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG>

into electric energy using alternators. The electricity generated by this project activity is delivered to the National Interconnected Electricity Grid (SEIN).

The project activity is a run-of-river hydropower technology that utilizes the water flow of the Crisnejas River to generate electricity. The water is directly diverted from this river through a submerged intake because it is appropriated to the emplacement configuration and the river slope. Then, the water goes to an absorbing channel which captures the water through the absorbing grillages when it crosses the river channel. The captured water goes through a rock-removal, that retain the rocks passing the absorbing grillages, before going through the intake gates to the derivation channel (that return the excess water to the river). After this, the water goes through sand trap, then through a head-race channel (940 meters length) to a tunnel (790 meters length with a rectangular form and with a circular vault with concrete coating), and then, the water goes into the loading chamber to guarantee hydraulic charge, avoiding air from causing cavitation and efficiency loss. Finally, water is fed through the penstock (455 meters length) into the downstream turbines to transform the potential energy of water into mechanical energy. The measuring equipment is located in the substation. It is important to mention that the Project is not considering any reservoir or regulation tank for its normal operation.

The project activity includes a design flow of maximum 18 m³/s (9 m³/s per turbine) diverted from Crisnejas river, and a net head of 126.288 m. There are 2 turbines with a nominal capacity of 10.228 MW each, each, along with two generators each with rated power 11,590 kVA which totalizes a 20.86³ capacity of Potrero Hydropower plant. The net electricity production is injected into the Interconnected National Electric Grid (SEIN) through a 4.97 km transmission line of 60 KV (Potrero – Aguas Calientes). Aguas Calientes substation connects the Project to the SEIN: Cajamarca – San Marcos – Cajabamba.

The head race channel, the tunnel, load chamber and all civil works and electromechanical equipment, are located at the left margin of the river. The Project employs two new horizontal Francis turbines, with a nominal speed of 600 rpm, a nominal capacity of 9 m³ per second each, a nominal potency of 10.228 MW each and a lifetime of 30 to 50 years, as known in the energy industry. Each generator (two generators, one for each turbine) has the same lifetime of the turbine, a speed of 600 RPM, and a tension of 10 kV. The energy meter is placed in Aguas Calientes SE (substation), in order to monitor the net energy (even discounting transmission losses) that is finally supplied to the SEIN.

Parameter	Value	Unit
Installed Capacity	20.86	MW
Head-race Channel	940	m
Water Tunnel	790	m
Penstock	455	m
Turbine Type	Francis horizontal axis	2 turbines
Turbine Rated Net Head	126.288	m
Turbine and generator lifetime	50	Years

The project activity was operation with normal operation and maintenance during current monitoring period i.e. 01/06/2016 to 31/12/2019⁴. There were no shut down during current monitoring period.

³ Rated capacity of each turbine: 10.228 MW Rated power output per generator: 11590 kVA , power factor : 0.90 that implies total real power 11590*0.9=10431 kW i.e. 10.431 MW and for two generators, total installed capacity is 10.431*2=20.86 MW

⁴ Though the crediting period starts from 01/06/2016 but the plant was commissioned on 29/04/2017; the energy meters installed in the project when it was commissioned on 29/04/2017 were not in accordance with COES requirements (in particular those meters not able to give COES a real time access), hence the meters were replaced and the new meters installed on 03/06/2017 (these meters are still existing till the end of monitoring period) and were functional from 03/06/2017, hence electricity generation/emission reductions

B.2. Post-registration changes**B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents**

There was no deviation from registered monitoring plan and or applied methodology during current monitoring period.

B.2.2. Corrections

The following corrections were requested during post registration changes as per latest PDD template and same was approved on 06/12/2020 by UNFCCC and reflected in PDD v11.

1. Editorial changes as per PDD Template version 11.0
2. Revised general description of the project activity in Section A.1 in order to justify the changes occurred during project implementation stage
3. Change in the statement regarding Letter of Approval (LoA) from host country in Section F

B.2.3. Changes to the start date of the crediting period

There was no change in crediting period start date.

B.2.4. Inclusion of monitoring plan

Not applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

The following permanent changes have been done in registered monitoring plan in the project activity and submitted for Post-Registration Changes. The PRC changes was approved on 06/12/2020 by UNFCCC and reflected in PDD v11

1. Inclusion of Monitoring Parameter $EG_{Gross,y}$ and $EG_{Aux,y}$ in Section B.7.1 of revised PDD in accordance with the change in monitoring plan. Change in the description of the parameter (measurement methods and procedures) $EG_{facility,y}$ as $EG_{facility,y}$ is difference of $EG_{Gross,y}$ and $EG_{Aux,y}$.
2. For Gross Electricity meter which is self-calibrated and hence no any calibration records required. Calibration frequency for Gross Electricity meter is mentioned as Meter self-calibrates every 10 seconds.
3. For Auxiliary electricity meter, calibration frequency is mentioned as 24 months as per Manufacturers recommendation.
4. The cross checking source for gross energy is revised from invoices to records of sold electricity as invoices do not mention electricity quantity

There are two other Post Registration Changes related to monitoring plan that would go in issuance track. As per para 1(c) Appendix (Indicative list of post-registration changes that may be suitable for approval under the issuance track) of “CDM project standard for project activities” version 02.0 these corrections are being submitted under issuance track.

before that date has been assumed as 0(zero) and electricity data from 03/06/2017 onwards is considered for ER calculations.

1. The description of Measurement methods and procedures and QA/QC procedures for parameter $EG_{AUX,y}$ i.e. Quantity of Auxiliary Electricity Consumption has been revised in section B.7.1 – the accuracy class is in accordance with the manufacturer's specification (i.e. 0.4).
2. QA/QC procedures of the parameter Auxiliary Electricity Consumption has been revised in section B.7.1 of PDD.

B.2.6. Changes to project design

The following changes in project design has taken place to the project activity during the monitoring period. The PRC changes was approved on 06/12/2020 by UNFCCC and reflected in v11.

1. The project activity installed capacity has increased from 19.9 MW to 20.86 MW because of change of each turbine nominal capacity from 9.95 MW to 10.228 MW. Besides, there has been an addition of generator capacity as 11590 KVA and change of total installed capacity from 19.9 MW to 20.86 MW. Turbine speed corrected as 600 RPM.
2. Revised description of establishment of project additionality in Section B.5. in accordance with changes in financial indicators for the project.
3. Revision in Section B.6.3 and B.6.4 due to change in $EG_{PJ,y}$ and BE_y in accordance with the change in project design.

B.2.7. Changes specific to afforestation or reforestation project activity

As the project activity falls under Sectoral Scope 1: Energy industries (renewable - / non-renewable sources) this section is not applicable.

SECTION C. Description of monitoring system

The monitoring methodology follows the ACM0002 definition, which states that “the monitoring shall consist of metering the electricity generated by the renewable energy technology.” However, for more accuracy the emission factor will be calculated ex-post according to the *Tool to Calculate the Emission Factor of an Electricity System*.

The project activity needs special monitoring equipment. The project activity implements a Monitoring Plan and use pre-programmed spreadsheets for the emission reduction calculation. The Project Proponent defines a person responsible for the monitoring of the entire data required. Three main participants are identified for the MP, being:

- **The Operation Department:** Obligated to ensure that sufficient and accurate information is available to calculate ERs in a transparent manner, and that adequate information is collected and maintained to facilitate verification of accounted ERs.
- **The Maintenance provider:** Maintenance and calibrations of the measuring equipment have been developed as required by the methodology with a specialized firm, and follows applicable requirements of the COES as well as manufacturer's specifications.
- **General Manager:** The General Manager has final responsibility for all aspects related to data measurements and the monitoring of data recordings.

COES, the dispatch centre, provides the data for the annual ex-post calculation of the project ERs, and the energy generation of the project is provided by the project developer. Further details of the MP are available in Appendix 1.

SECTION D. Data and parameters**D.1. Data and parameters fixed ex ante**

The Project does not have any ex ante parameters.

D.2. Data and parameters monitored

Data/Parameter	EG _{Gross,y}																	
Unit	MWh																	
Description	Gross electricity supplied by the project to the grid in year y																	
Measured/calculated/default	Measured																	
Source of data	On site (measured by an electricity meter): Transferencias i.e. REGISTROS DE MEDIDORES EN BORNES DE GENERACIÓN CADA 15 MINUTOS DE POTENCIA ACTIVA (MW) (English Translation - RECORDS OF METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF ACTIVE POWER (MW))																	
Value(s) of monitored parameter	237,851.48																	
Monitoring equipment	<p>The project uses a bidirectional meter that allows to measure both the electricity acquired by the Project (in case the Project consumes electricity from the grid) and the electricity supplied to the grid. Therefore, the gross electricity supplied to the grid is measured continuously and recorded at least each hour. The gross electricity supplied is net electricity export to grid plus the auxiliary consumption i.e. internal consumption in the project activity. A high level of accuracy of the measurements is being achieved due to the use of high-precision equipment. The project electricity meter is an electronic device with a precision class of 0.2 (as required by COES). The meters are located at the power plant substation.</p> <p>The proportion of data to be monitored is 100% and the data is archived electronically.</p> <p>Meter details are given below</p> <p>Both the meters were installed at the time of commissioning and remained there till the end of the monitoring period. The meters are factory calibrated on 07/05/2017. The meters are self-calibrating(self-calibrates in every 10 seconds) as per manufacturer's specification - meter technical brochure also mentions that⁵</p> <table><tr><td>Meter</td><td>1</td><td>2</td></tr><tr><td>Serial Number</td><td>00000000194632530</td><td>00000000194634633</td></tr><tr><td>Type</td><td>Tri-vector Meter</td><td>Tri-vector meter</td></tr><tr><td>Make</td><td>Electro Industries</td><td>Electro Industries</td></tr><tr><td>Accuracy class</td><td>0.2s</td><td>0.2s</td></tr></table>			Meter	1	2	Serial Number	00000000194632530	00000000194634633	Type	Tri-vector Meter	Tri-vector meter	Make	Electro Industries	Electro Industries	Accuracy class	0.2s	0.2s
Meter	1	2																
Serial Number	00000000194632530	00000000194634633																
Type	Tri-vector Meter	Tri-vector meter																
Make	Electro Industries	Electro Industries																
Accuracy class	0.2s	0.2s																
Measuring/reading/recording frequency	Continuous monitoring and daily measurement and Monthly recording																	
Calculation method (if applicable)	This parameter is measured by the equipment (energy meter) and considered accordingly; hence calculation method is not applicable																	
QA/QC procedures	Measuring equipment are verified with calibrated pattern or calibrated according to relevant industry standards or national regulation. COES requirements ⁶ in Peru on energy meters specifies meter requirements like Precision class: 0.2 and ability to measure (amongst other data) active and																	

⁵ https://electroind.com/products/Nexus_1500+/pdf/brochures/Nexus-1500+-Meter-Brochure_E154718.pdf

⁶ PROCEDIMIENTO TECNICO COES - PR-20. Page 135, Section 3.1

	<p>reactive energy, but do not specify anything about frequency of calibration however as per the manufacturer's technical specification⁷, the meters are self-calibrating (calibrates itself in every 10 seconds) and do not need calibration by any external agency.</p> <p>The meter readings are cross-checked with records of electricity sold as available from official reports (COES statistics)⁸.</p> <p>Any modification in the regulatory framework is applied by the project during the operation phase.</p>
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Complete information of every year during the crediting period will be available from the COES during the first six months of the following year.

Data/Parameter	EG_{Aux,y}
Unit	MWh
Description	The quantity of auxiliary electricity consumption in the CDM project activity in year y
Measured/calculated/default	Measured
Source of data	<p>On site (measured by an electricity meter): Transferencias i.e. REGISTROS DE MEDIDORES EN BORNES DE GENERACIÓN CADA 15 MINUTOS DE LOS SERVICIOS AUXILIARES (MW)</p> <p>(English Translation - RECORDS OF METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF THE AUXILIARY SERVICES (MW))</p>
Value(s) of monitored parameter	415.79

⁷ https://electroind.com/products/Nexus_1500+/pdf/brochures/Nexus-1500+-Meter-Brochure_E154718.pdf

⁸ <https://www.coes.org.pe/Portal/Publicaciones/Estadisticas/>

(for sample sheet - Estadísticas Anuales - 2017 - 01 EXCEL - 08 - PRODUCCIÓN CON ENERGÍAS RENOVABLES EN EL SEIN - 8.4 A , Comité de Operación Económica del Sistema Interconectado Nacional (COES SINAC), a company operating mainly in the Electric Power sector in Peru. The National Interconnected System Financial Operation Committee (COES) is a private Peruvian nonprofit organization made up of generators, distributors, and free users)

Monitoring equipment	<p>The project uses an electricity meter that measures the auxiliary electricity consumption in the project activity. The auxiliary electricity consumption is measured continuously and recorded at least each hour.</p> <p>A high level of accuracy of the measurements is being achieved due to the use of high-precision equipment. The project electricity meter is an electronic device with a precision class of 0.4. The meter is located at the power plant substation.</p> <p>The proportion of data to be monitored is 100% and the data is archived electronically.</p> <p>Meter details are given below: Type: Tri-vector meter Make: WEG Accuracy class : 0.4 Serial no. 0041722</p> <p>The meter was installed at the time of commissioning and remained there till the end of the monitoring period. The meter, in accordance with the manufacturer's specification is factory calibrated on 07/05/2017.</p> <p>The last date of calibration is 01/09/2020 and result of calibration is within permissible limit.</p> <p>Considering the calibration frequency of once in two years (manufacturer's specifications), there have been delays in calibration. Hence, conservative error factor 0.4% has been applied on the values of the quantity of auxiliary electricity consumption for the period 03/06/2017 to 31/12/2019.</p>
Measuring/reading/recording frequency	Continuous monitoring and daily measurement and Monthly recording
Calculation method (if applicable)	This parameter is measured by the equipment (energy meter) and considered accordingly; hence calculation method is not applicable
QA/QC procedures	<p>Measuring equipment is verified with calibrated pattern or calibrated according to relevant manufacturer's specifications. As per manufacturer, meter accuracy class is 0.4 and manufacturer's recommendation says that the interval between two calibrations should be twenty-four months.</p> <p>The auxiliary consumption data are obtained from records of meter in generation terminals every 15 minutes of auxiliary services (MW) as recorded onsite.</p>
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Complete information of every year during the crediting period will be available from the COES during the first six months of the following year.

Data/Parameter	EG_{facility,y}
Unit	MWh
Description	The quantity of net electricity supplied to grid by the CDM project activity in year y
Measured/calculated/default	Calculated
Source of data	<p>On site (measured by an electricity meter: Transferencias i.e. RECORDS OF METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF ACTIVE POWER (MW) and AUXILIARY SERVICES (MW))</p> <p>(English Translation - RECORDS OF METERS IN GENERATION TERMINALS EVERY 15 MINUTES OF THE AUXILIARY SERVICES (MW))</p>
Value(s) of monitored parameter	237,435.69

Monitoring equipment	Not applicable as this is a calculated parameter. $EG_{\text{facility},y} = EG_{\text{Gross},y} - EG_{\text{Aux},y}$
Measuring/reading/recording frequency	Continuous monitoring and Monthly recording
Calculation method (if applicable)	This parameter is calculated by subtracting auxiliary electricity consumption from gross electricity supplied to grid : $EG_{\text{facility},y} = EG_{\text{Gross},y} - EG_{\text{Aux},y}$
QA/QC procedures	Not applicable as this is a calculated parameter
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Complete information of every year during the crediting period will be available from the COES during the first six months of the following year.

Data/Parameter	EF_{grid, CM, y}	
Unit	tCO ₂ e/MWh	
Description	CO ₂ emission factor of the grid electricity in year y	
Measured/calculated/default	Calculated	
Source of data	COES data	
Value(s) of monitored parameter	Year	EF _{grid, CM, y}
	2017	0.67141
	2018	0.67201
	2019	0.67066
Monitoring equipment	-	
Measuring/reading/recording frequency	Yearly	
Calculation method (if applicable)	A combined margin (CM) is being used, consisting of the combination of operating margin (OM) and build margin (BM), according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system". This is included for reference purposes as in the ex-post calculation this monitoring parameter should be monitored each year during the crediting period, as per the "Tool to calculate the Emission Factor for an electricity system"	
QA/QC procedures	Calculated using data available (emission factors and annual statistics), that is monitored 100% by COES.	
Purpose of data/parameter	For the calculation of baseline emissions	
Additional comments	It is envisaged that the diesel generators are not operational for more than 12 hours per year, and therefore, the emissions are lower than 1% of the baseline emissions. The diesel engines are maintained as per the manufacturer specifications in order to assure its proper functioning and that the specific consumption at full load remains within the limit specified by the manufacturer. Data is archived and kept at least for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.	

Data/Parameter	EG_{PJ, h}
Unit	MWh
Description	Electricity displaced by the project activity in hour h of year y
Measured/calculated/default	Default value
Source of data	COES data
Value(s) of monitored parameter	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"

Monitoring equipment	Directly measured and/or based on the information provided by COES. The proportion of data to be monitored is 100% and the data is archived electronically
Measuring/reading/recording frequency	Data is being monitored every 15 minutes and aggregated in an hourly and annual basis.
Calculation method (if applicable)	Not applicable
QA/QC procedures	Information of invoices of electricity sold to the grid is cross-checked with metered information and/or COES information. To ensure consistency, if applicable other records may be used if necessary.
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	EG_{n, h}
Unit	MWh
Description	Electricity generated and delivered to the grid by power units n in hour h
Measured/calculated/default	Default value
Source of data	COES data
Value(s) of monitored parameter	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Monitoring equipment	Directly measured and/or based on the information provided by COES. The proportion of data to be monitored is 100% and the data will be archived electronically
Measuring/reading/recording frequency	Data is monitored every 15 minutes and aggregated in an hourly and annual basis.
Calculation method (if applicable)	Not applicable
QA/QC procedures	Official data
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	EG_{m, y}
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y.
Measured/calculated/default	Default value
Source of data	COES data
Value(s) of monitored parameter	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Monitoring equipment	Directly measured and/or based on the information provided by COES. The proportion of data to be monitored is 100% and the data will be archived electronically
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	Official data
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	$\eta_{m,y}$
Unit	--
Description	Average net energy conversion efficiency of power unit m in year y (ratio).
Measured/calculated/default	Default value
Source of data	COES data
Value(s) of monitored parameter	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Monitoring equipment	Each year this data is being checked with the last available annual report of COES. The proportion of data to be monitored is 100% and the data will be archived electronically
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	If the data used is significantly lower than the default value of the applicable technology, project proponents should assess the reliability of the values, and provide appropriate justification if deemed reliable. Otherwise, the default values above shall be used
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data/Parameter	EF _{CO₂, m, i, y}
Unit	tCO ₂ /GJ
Description	Average CO ₂ emission factor of fuel type i used in power unit m in year y
Measured/calculated/default	Default value
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value(s) of monitored parameter	Data used is presented in the spreadsheet for "Grid Emission Factor calculation"
Monitoring equipment	-
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	Every update of IPCC reports is being taken into account
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. There is no information provided by the fuel supplier of the power plants in invoices, or regional or national average default values, therefore IPCC default values are suitable for these parameters.

D.3. Implementation of sampling plan

Sampling is not applicable in this project activity

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

As described in the section above, the total emission reduction achieved in a year would be

$$ER_y = BE_y - PE_y - LE_y$$

Where,

ER_y is the Emission reductions during the year y

BE_y is the Baseline emissions during the year y

PE_y is the Project emissions during the year y

LE_y is the Leakage emissions during the year y

Baseline emissions:

The baseline emissions are calculated based on the given formula:

$$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$$

Where,

$EG_{facility,y}$ is the net electricity supplied to grid by the project activity

$EF_{CO2,grid,y}$ is CO₂ emission factor of the grid

Net electricity supplied to the grid by the Project during current monitoring period i.e. 01/06/2016 to 31/12/2019⁹ = 237,436.52 MWh (Please refer Spreadsheet for details of calculations)

Year-wise calculation of Baseline Emissions

Year	EG _{BL,y} (MWh)	EF _{CO2, grid, y} (tCO ₂ /MWh)	BE _y (tCO ₂)
03/06/2017 ¹⁰ to 31/12/2017	23,312.59	0.67141	15,652.31
01/01/2018 to 31/12/2018	97,955.49	0.67201	65,827.07
01/01/2019 to 31/12/2019	116,167.61	0.67066	77,908.97
Total	237,435.69		159,388

Total Baseline Emissions (BE_y) = 159,388 tCO₂e (round-down value)

E.2. Calculation of project emissions or actual net removals

As per ACM0002 (Version 12.3.0), for most renewable energy project activities, project emissions are neglected, and following the methodology as the project activity is a run-of-the-river project, it does not lead to any GHG emissions; therefore project emissions are considered equal to zero. Therefore

$$PE_y = 0 \text{ tCO}_2\text{e}$$

⁹ Though the crediting period starts from 01/06/2016 but the plant was commissioned on 29/04/2017; The energy meters installed in the project when it was commissioned on 29/04/2017 were not in accordance with COES requirements (in particular those meters not able to give COES a real time access), hence the meters were replaced and the new meters installed on 03/06/2017 (these meters are still existing till the end of monitoring period) and were functional from 03/06/2017, hence electricity generation before that date has been assumed as 0 (zero) and electricity data from 03/06/2017 onwards is considered for ER calculations.

¹⁰ Though the crediting period starts from 01/06/2016 but the plant was commissioned on 29/04/2017; The energy meters installed in the project when it was commissioned on 29/04/2017 were not in accordance with COES requirements (in particular those meters not able to give COES a real time access), hence the meters were replaced and the new meters installed on 03/06/2017 (these meters are still existing till the end of monitoring period) and were functional from 03/06/2017, hence electricity generation before that date has been assumed as 0 (zero) and electricity data from 03/06/2017 onwards is considered for ER calculations.

E.3. Calculation of leakage emissions

In accordance with the applied methodology ACM0002, Version 12.3.0, no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transportation). Therefore,
LE_y = 0 tCO₂e

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	159,388	0	0	0	159,388	159,388

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante for this monitoring period in the PDD (t CO ₂ e)
159,388	246,840

E.5.1. Explanation of calculation of “amount estimated ex ante for this monitoring period in the PDD”

Considering the annual average emission reductions as per the registered PDD which is 95,644 tCO₂e per year, the number of days covered during the current monitoring period comes out to be 942 days, based upon which the estimated emission reductions attributed to this monitoring period comes out to be 246,840 tCO₂e. The detailed calculation can be referred from the emission reduction sheet.

E.6. Remarks on increase in achieved emission reductions

During this project activity, the actual emission reductions obtained is lower than the estimated value. The electricity generation in the hydro power project relies on natural phenomenon like rainfall and hence water availability and the variation is beyond the control of the project participant.

E.7. Remarks on scale of small-scale project activity

Not applicable to this project as this is a large-scale project activity and it remains so throughout the monitoring period.

Appendix 1: Further background information on Monitoring Plan

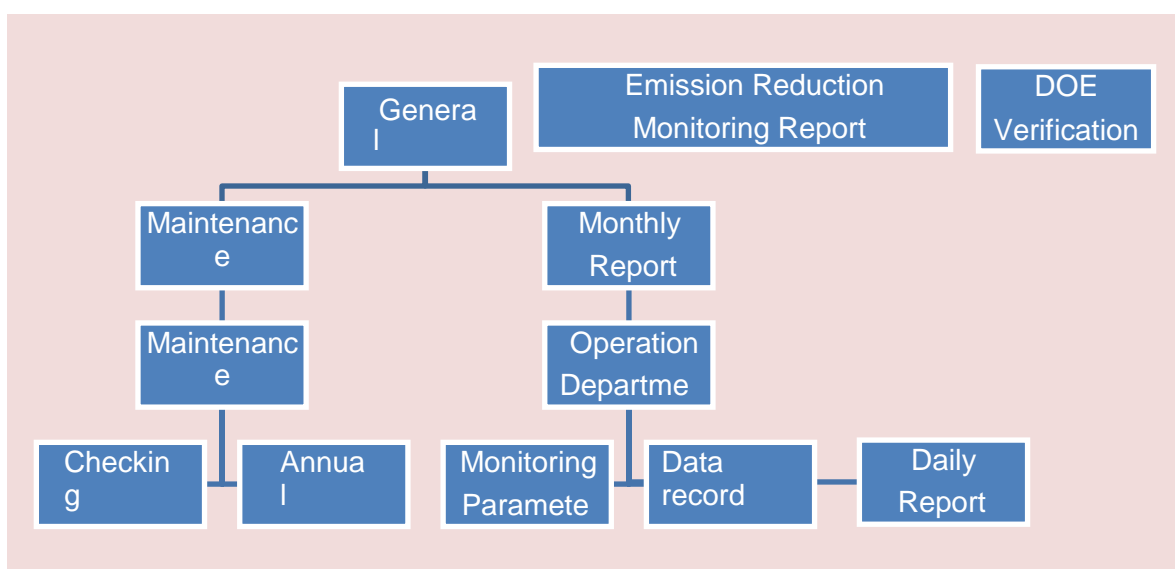
This report presents the Monitoring Plan (MP) for the Project activity. The MP defines a standard against which the performance in terms of the Project's ERs is being monitored, following the selected methodology ACM0002 (version 12.3.0) and in compliance with all relevant requirements of the CDM of the Kyoto Protocol. Both the Baseline and the MP are subject to monitoring procedures.

The MP identifies key performance indicators of the Project activity and sets out the procedures for metering, monitoring and calculating the ERs generated by the Project activity annually. Adherence to the instructions in the MP is necessary for the project operator to successfully measure and track the impact of the Project activity, and to prepare all data required for the periodic audit and verification process that must be undertaken to confirm the attainment of the corresponding ERs.

Organizational:

The following figure outlines the operational and management structure that the project proponent implement to monitor the emission reductions generated by the project activity. The Project Proponent defines a person responsible for the monitoring of the entire data required.

Organization Monitoring



The Operations department

The monitoring performance of the Project requires the fulfilment of operational data collection and processing obligations by the Project operator. The Project operator is obligated to ensure that sufficient and accurate information is available to calculate ERs in a transparent manner, and that adequate information is collected and maintained to facilitate successful verification of accounted ERs.

The Operations department is responsible for:

1. Monitoring of the following parameters

a) The energy and power supplied by the project activity to the national grid. b) The installed capacity of the hydro power plant. c) The quantity of electricity supplied to the SEIN, which is based on latest available data from the COES. d) The net electricity generated by the power plants/units included at the top of the dispatch order, and the power plants/units included in the building margin. e) The average net energy conversion efficiency of thermal power plants/units,

available in the COES annual statistics report. f) The marginal cost. The merit order in which power plants dispatches, available in the COES annual statistics report.

2. Record and store the data of the project meter.
3. Register the values of the monthly invoices of net electricity sold and have the latest COES reports of net electricity supply in order to develop proper crosschecking of the information. In case if discrepancies the official information is used (COES).
4. Control the accurate operation of any meters or equipment needed for monitoring, and preliminarily determine the needs for maintenance or repair work.
5. Elaborate the daily monitoring reports of the Project.
6. The daily reports serve as back-up purpose and archived at the Project site. All the data will be kept for at least for 2 years after the end of the last crediting period.
7. Consolidate daily reports on a monthly monitoring report and send them to the General Manager

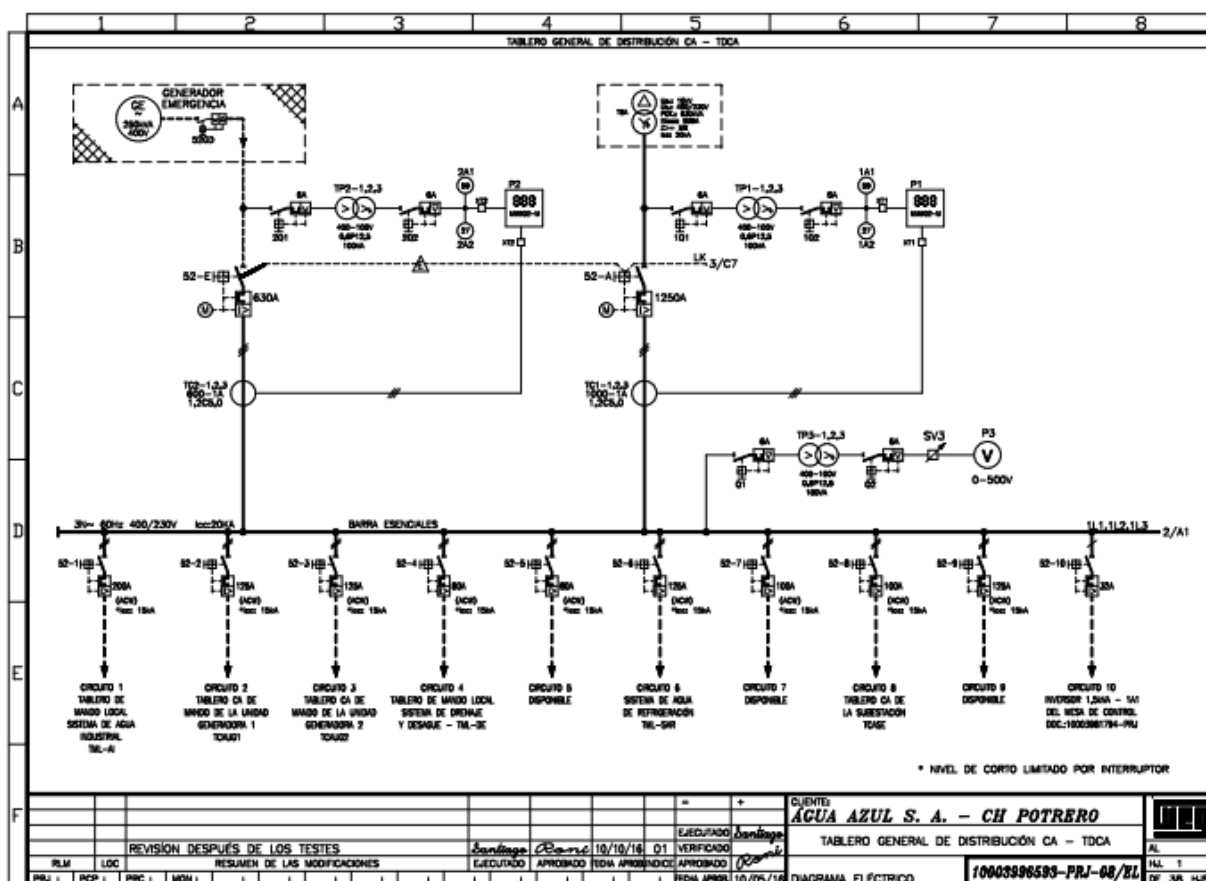
The amount of energy and power generation of the hydropower plant are measured by the project meter. The energy and power generation parameters are checked and monitored in real time in both the power plant and the substation. Energy generation are registered electronically at the power plant and the substation each 15 minutes of every hour, day and month, and will be kept for at least two years after the end of the crediting period.

The substation site has at least a 0.2 class meter working as principal measuring and recording equipment that is used for the net electricity measurements.

The meters could be configured to work either in a unidirectional or bi-directional way, but for the project purposes the meter is configured to work in a bidirectional way. To ensure the quality of the parameters and the recording, all the equipment that are going to be used for monitoring and registering complies with the IEC and ANSI international standards.

In case of failure of the principal recording equipment, a secondary measuring equipment located also in the substation, will continue the monitoring of the project parameters. If there is no other measurement system, COES official information will be used. If problems which can affect the quality of data occur, the Operations Department will initiate and supervise the implementation of corrective actions by the Maintenance Provider. First, the monitoring system will be checked on whether it runs properly and whether the monitored results are correct.

Single line diagram of the Potrero Hydro Power project is given below:



The Maintenance Provider

Maintenance and calibrations of the measuring equipment are developed as required by the methodology with a specialized firm, and follows applicable requirements of the COES as well as manufacturer's specifications. Calibration or verification certificates of the accredited agency, and the relevant certificate document, are collected by the General Manager and archived for at least 2 years after the end of the crediting period.

General Manager

The General Manager has final responsibility for all aspects related to data measurements and the monitoring of data recordings. Mainly:

- Compile and analyze all the monthly monitoring reports every year.
- Elaborate an estimate of emission reductions in an Emission Reduction Monitoring Report.
- Calculate the Combined Margin and recalculate the Grid Emission Factor every year.
- Compile and analyze all the calibration reports in a Maintenance Report Status every year.
- Manage and supervise all monitoring activities under the generation project.
- Ensure that all data is recorded accurately.
- Supervise the maintenance and operation departments.
- Ensure that the operators from the maintenance and operations departments are appropriately trained for monitoring/checking the different parameters/meters with training sessions and an instruction manual.
- Draft the Emission Reduction Monitoring Report with all its attachments, which are verified by the DOE.

Data Collection and Integration

Grid Emission Factor: It is required that the project operator calculate the Project's ERs based on the most recent available information. The CO₂ emission factor for the electricity grid are based on latest available data from the Official COES website.

All data required for calculating the Combined and Build Emission Margins come from the COES information system.

Project performance parameter: Electricity production by the plant and any internal usage are metered continuously to account for the net level of electricity dispatch. Procedures for maintenance and installation of equipment, as well as calibration, are performed according to manufacturer specifications and follows applicable requirements of the Electricity General Direction of the Peruvian Energy and Mines Ministry (these requirements are currently under development by the Ministry).

Data gathering and processing should be done monthly by the operator, as follows:

Monthly Data Collection

	At the end of each month:
COES (Data Provide)	<ul style="list-style-type: none"> • Report the hourly generation of plants in the SEIN (measurement: 15'). • Report dispatch merit orders, data come from COES. • Use real NECs per power plant in the SEIN.
Operator (Data Processor)	<ul style="list-style-type: none"> • Direct measurement. The operator makes a monthly report for the energy and power provided to the grid. • Fill in monthly data in all required spreadsheets. • Issue a monthly report.

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
07.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of am-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

<i>Version</i>	<i>Date</i>	<i>Description</i>
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		