Monitoring report form for CDM project activity
(Version 06.0)

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

MONITORING REPORT		
Title of the project activity	Santa Teresa Hydropower Plant	
UNFCCC reference number of the project activity	9954	
Version number of the PDD applicable to this monitoring report	Version 3.7	
Version number of this monitoring report	01	
Completion date of this monitoring report	26/09/2017	
Monitoring period number	First monitoring period	
Duration of this monitoring period	01/09/2015 to 31/12/2016 (first and last days included)	
Monitoring report number for this monitoring report	01	
Project participants	Luz del Sur S.A.A.	
Host Party	Peru	
Sectoral scopes	1: Energy Industries (renewable /non-renewable sources)	
Applied methodologies and standardized baselines	Approved consolidated baseline and monitoring methodology ACM0002 (version 16): Consolidated baseline and monitoring methodology for grid-connected electricity generation from 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	372,464 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	727,723 tCO_2e	

SECTION A. Description of project activity

A.1. General description of project activity

>>

The project Santa Teresa is a Hydropower Plant, which use the turbinated flow resources of the existing Machu Picchu Hydropower Plant, so there is no need to use a reservoir. The purpose of the project is to generate electricity without emissions of greenhouse gases (GHGs) (zero emission), which will be supplied to the Peruvian National Inter-connected Grid (SEIN). The project is located in the department of Cusco, in the provinces of La Convención and Urubamba, Santa Teresa and Machu Picchu districts, respectively.

The Santa Teresa Hydropower Plant have an installed capacity of 98.12 MW, corresponding to a gross head of 186.8 m and a flow of 61 m3/s, with an estimated average annual generation of 648,544 GWh.

The Santa Teresa Hydropower Plant takes advantage of the existing head between the Machu Picchu Hydropower Plant tailrace works and the Ccollpani area. The scheme of works includes the connection with the Machu Picchu Hydropower Plant tailrace, the forebay, the pressure conveyance tunnel, the surge shaft, the powerhouse and the tailrace tunnel, as well as the hydromechanical and electrical equipment of generation and control and the transmission system to SEIN integration through the 220 kV Suriray Sub-Station.

Regarding the main mechanical equipment, the Santa Teresa Hydropower Plant is equipped with two vertical shafts Francis turbines coupled via an intermediate shaft to the generator.

Relevant dates for the project:

- 02/Nov/2011: The construction of the Project started[1].
- Aug/2014: Ending of installation and testing of the units 1 and 2.
- 01/Jul/2015: Starting testing phase for energy production to SEIN.
- 01/Sep/2015: The dispatch center formalized the commercial operation of the project activity[2].

This monitoring period comprises from 01/Sep/2015 to 31/Dec/2016. In this period the project produced 836,201.97 MWh of net energy to the grid which accounts emission reduction for 372,464 tCO_2e.

A.2. Location of project activity

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The project is located in the department of Cusco, in the provinces of La Convención and Urubamba, Santa Teresa and Machu Picchu districts, respectively. Specifically, the location is near the locality of Santa Teresa (2.5 km away) and the small town of Ccollpani Grande (1.0 km away) located on the left and right bank of the Vilcanota river, respectively.

The accesses to the project are via the Cusco - Santa Maria - Santa Teresa highway and the Cusco - Ollantaytambo – Machu Picchu Hydropower Plant railway line and from that point, via the road to Santa Teresa town.

The Central Point of the project is considered as the location of the powerhouse, the coordinates are:

[1] Letter MWH-001-2011-CST
[2] Letter COES/D/DP-1409-/2015

Coordinates	PSAD56		Geographical coordinates	
	East	North	Latitude (S)	Longitude (W)
Powerhouse	762,673	8,546,132	13.1433	72.5791

Project Location

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Perú (host)	Luz del Sur S.A.A.	No

A.4. Reference to applied methodologies and standardized baselines

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Title and version: "ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", (version 16.0)
Methodological tools: Tool for demonstration and assessment of additionality" (version 07.0.0).
Tool to calculate the emission factor for an electricity system" (version 5.0).

Reference: http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

A.5. Crediting period type and duration

>>

Renewable crediting period, seven (7) years, with the option of renewing the contract for two other 7-year crediting periods (total 21 years).

Starting and end date of the first crediting period is 01/09/2015 - 31/08/2022.

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

>>

Strictly, although the dispatch centre formalized the commercial operation of Santa Teresa Hydropower Plant the 01/Sep/2015, the project started operation in the testing phase the 01/Jul/2015 but the energy production was so small that no net energy was dispatched to the grid. That is why it was selected to define the starting operation date the first of September.

Relevant dates for the project:

- 02/Nov/2011: The construction of the Project started.
- Aug/2014: Ending of installation and testing of the units 1 and 2.
- 01/Sep/2015: Starting testing phase for energy production to SEIN.
- 01/Sep/2015: The dispatch centre formalized the commercial operation of the project activity.

The COES approved the Commercial Operation of the Santa Teresa Hydropower Plant from 00:00 hours on 01/Sep/2015, after having verified compliance with the requirements required by technical procedure No. 20 of COES-SINAC.

Prior to the date indicated, tests had to be carried out to verify that the protection, control and maneuver equipment installed to achieve the interconnection of the plant with SEIN were functioning correctly and that there was no problem in the SEIN due to the entrance of the plant. The tests were carried out during the months of July and August of 2015 and the energy produced that entered to SEIN was registered in the COES.

Relevant events occurred during this monitoring period:

1. During 2015: operation in SEIN approved (testing includes)
2. During 2016, between August 22 to September 09, unit one was in maintenance and out of service. Between September 06 and September 20, unit two was in maintenance and out of service. However, the water flow in the river allowed only one unit to operate, so the maintenance performed in the other unit did not result in production losses

The lower generation, compared to expected, is due to the fact that EGEMSA's water infrastructure is not capable of delivering a continuous and reliable flow of 61 m3/s during the flood months (during the months of November to April), in which the Vilcanota River has a higher flow. The maximum flow delivered is around 54 m3/s.

During the dry season, when the flow of the river is below 61 m3/s, EGEMSA complies with the contract, ie delivering the current flow in the river minus the ecological flow (1 m3/s), although in some months due to operating problems of its new Francis turbine, also fails to deliver the agreed flow rate.

In addition, in this monitoring period, there were 36 internal training activities and 5 external training activities to the staff of the power plant and 10 people were benefit. These external trainings were carried out by the following institutions:

- PRED & ASOCIADOS S.A.C.
- SOLDEX S.A.
- ADD CONSULTORIA Y OBRAS DE ENERGIA E.I.R.L.
- VIBRO TECHNOLOGY S.R.L.

According to the *Guaranteed plant characteristics*[3] The hydraulic system of the Santa Teresa Hydropower Plant has been designed for a 61 m3 /s flow, and its main components are as follows:

- **The connecting tunnel** will run from the discharge chamber of the Machu Picchu Hydropower Plant to the Santa Teresa Hydropower Plant forebay.

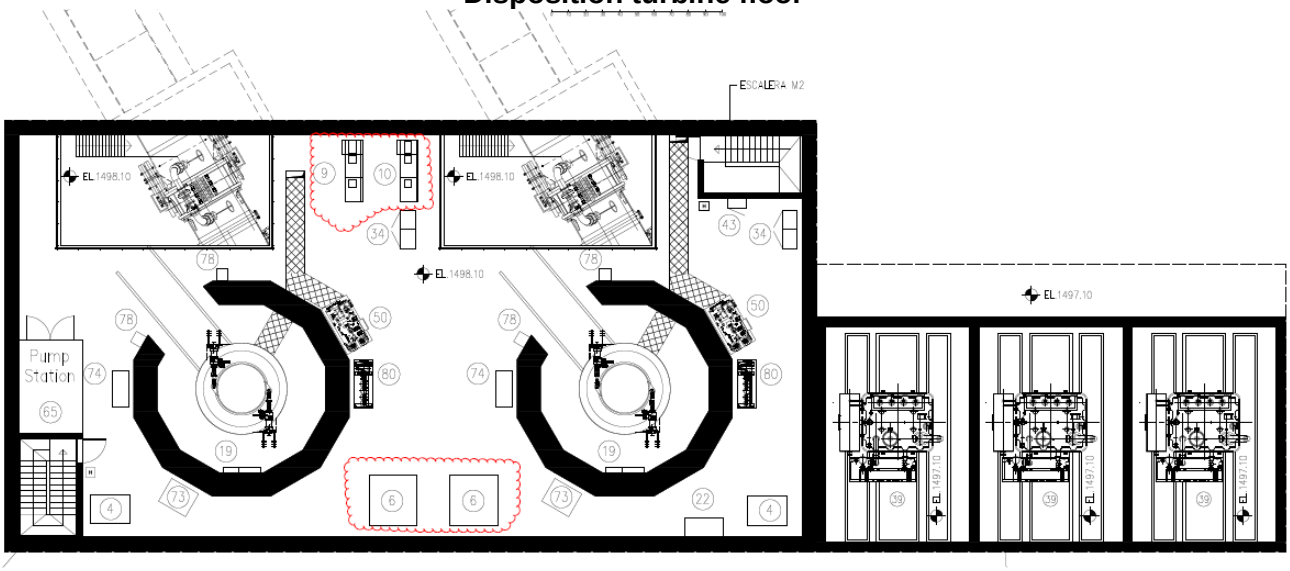
[3] Contractual document from Andritz hydro, supplier of equipment of Santa Teresa.

- **The forebay** has a 7,575 m3 useful capacity, provided with an overflow spillway and a tunnel for the Machu Picchu Hydropower Plant existing discharge.
- **The pressure conveyance tunnel**, with 1.14% slope, 6.50 m in diameter and 3,585 m in length, starts after the collecting system.
- **The surge shaft** is 83.50 m high located at 132.50 m upstream the Y distributor valve.
- **The vertical shaft** is 134 m high located at 82.50 m upstream the Y distributor valve.
- **The Y distributor valve and pressure conveyance pipelines** to the powerhouse.
- The **powerhouse** is 19.5 m wide, 78.00 m long and 36.10 m high.
- **The discharge chamber** is 10.80 m wide, 24.6 m long and 13.30 m high.
- **The tailrace tunnel** has 240 m in length and box-shaped cross sections.

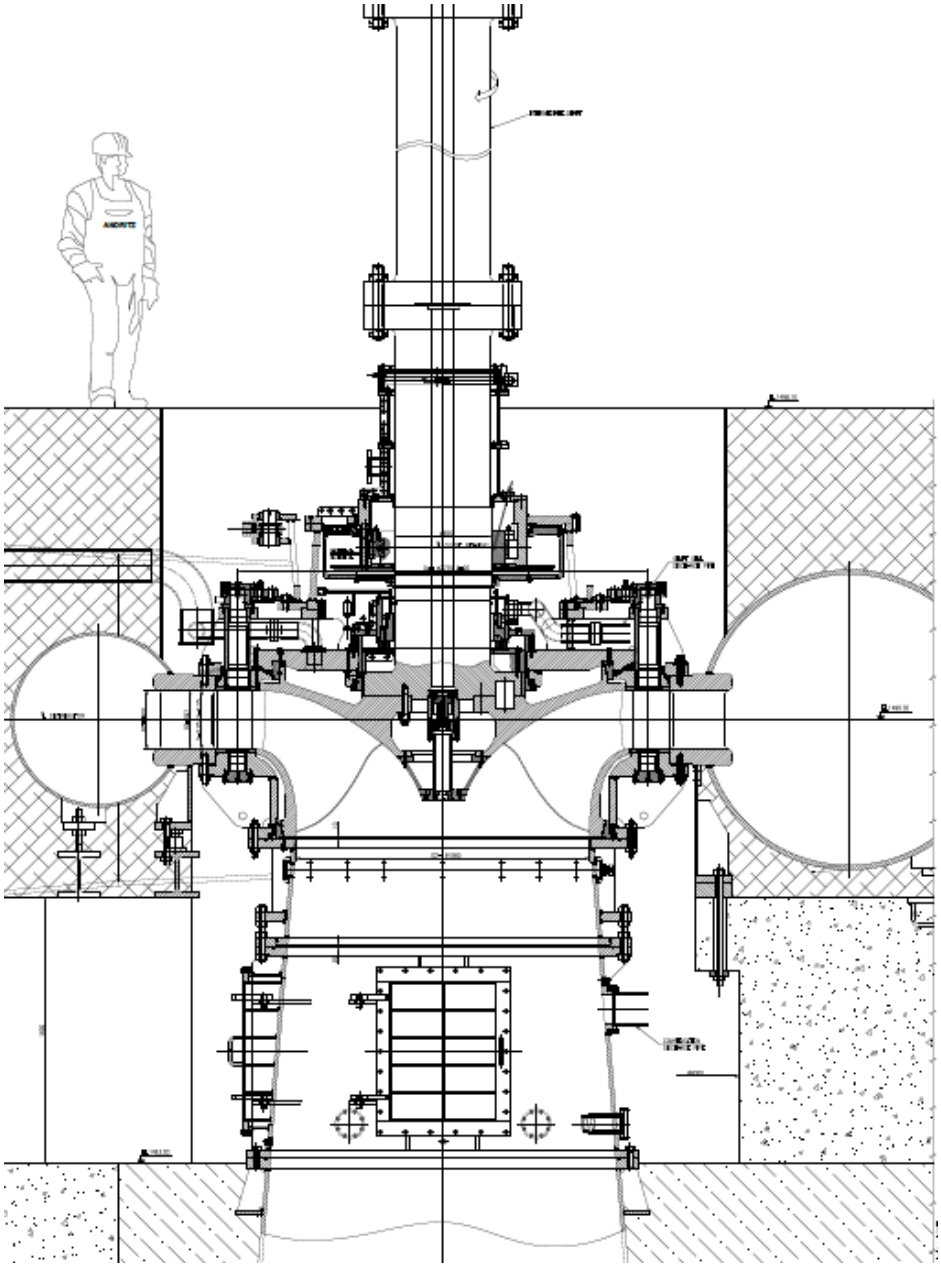
Regarding the main mechanical equipment, the Santa Teresa Hydropower Plant is equipped with two vertical shafts Francis turbines coupled via an intermediate shaft to the generator, designed for the following operating conditions (according to provider's document: Guaranteed plant characteristics):

Nominal net height	177.80 m
Nominal flow rate	30.5 m3/s
Installation level	1501.50 m.a.s.l.
Maximum efficiency	> 94%
Shaft output	52.25 MW
Rotational speed	360 rpm
Specific speed	138.29
Runaway speed	745 rpm

Disposition turbine floor



Turbine cross-section



Electrical equipment consist of the following equipment and systems:

- Generators and excitation and voltage regulation system
- Generator circuit breaker cells
- Generator neutral cells
- Control and protection system
- AC auxiliary services
- DC auxiliary services
- 13,8 kV busbar system
- Control cables and low voltage power cables
- Step-up transformers 13,8/220 kV
- Power cable 220 kV
- Output cells (GIS) 220 kV
- Electrical installations for lighting and power
- Grounding system

The generators are synchronous, three-phase, equipped with static excitation system and grounding equipment. The position of the generator shaft is the same as the turbine shaft and is coupled through an intermediate shaft. The main features of the generator are:

Nominal capacity	64.4 MVA
Efficiency	98%
Nominal capacity factor	0.90
Nominal voltage	13.8 +/- 5%
Nominal frequency	60 Hz
Nominal speed	360 rpm
Runaway speed	745 rpm
Insulation class	F
Excitation	Static excitation because of excitation transformer
Degree of protection	IP23
Refrigeration	Air/water radiators
Maximum audible noise level	80 dB (at 1 m)

Regarding to the substation, it is located inside (in cavern), just like the turbines and generators, and it have two 13.8/220 kV, 57.7 MVA three-phase transformers and their own handling equipments. The outside connection is done through 220 kV power cables to a portal framed structure in which the cable terminations, the surge arresters and the voltage transformers are installed.

Finally, the supplies include the interconnection of the Santa Teresa Hydropower Plant with the Peruvian National Inter-connected Electric Grid (SEIN). For this purpose, the Machu Picchu - Abancay - Cotaruse 220 kV transmission line is used because its route is located near the project area. The Santa Teresa Hydropower Plant connects to this main line in the Suriray Sub-Station using a 220 kV transmission line with the characteristics listed below:

Number of circuits	1
Number of conductors per phase	1
Nominal capacity per circuit	180 MVA
Design capacity per circuit	250 MVA
Approximate length	2.8 km
Short-term overload capacity	30% of the nominal capacity during a period of 30 minutes
System nominal voltage	220 kV
Maximum phase voltage	245 kV
System frequency	60 Hz
Maximum operating temperature	30°C
Conductors disposition	Vertical

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

>>There are no any deviations from the registered monitoring plan or applied methodology.

B.2.2. Corrections

>> There are no corrections.

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

>> Initially, the start date of the crediting period was 01/May/2016 according to the registered PDD. However, according to the latest version of the CDM Project Standard section 13.8.3.2, item 279, the secretariat has been notified of this change.[4]

The validation report for this project was submitted on June 2015, and the documents for the registration were presented to the EB again on April, 2016[5]. However, the registration was approved on July 2016 with a validation date on 9th July 2015. For this reason, the project participant claim the change in the crediting period in order to confirm the real date of the commercial operation of the project activity.

The change in the crediting period is due to the formalization by the dispatch centre of the commercial operation of the project activity which started from the energy distribution to SEIN[6]. This could be corroborated in the 2015 Annual Statistics of COES[7] and in the letter "COES/D/DP-1409-2015"[8].

B.2.4. Inclusion of monitoring plan

>> Not any inclusion of a monitoring plan to the registered PDD was included at registration during this monitoring period.

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

>> There are no any permanent changes from registered monitoring plan or applied methodology.

B.2.6. Changes to project design

>> No any changes to the project design of the project activity have been approved during this monitoring period or submitted with this monitoring period.

SECTION C. Description of monitoring system

>>

The project activity is implemented as mentioned in the registered PDD. No new technology measure or retrofits have been added during this verification period.

All data required for calculating the Emission Margin comes from the COES information system. Electricity production by the plant and any internal usage are metered continuously to account for

[4] Letter to UNFCCC dated July 31st 2017. The change in the crediting period was approved by UNFCCC secretariat on August 16, 2017.

[5]The project was uploaded and submitted for registration on the 16th May 2014.

[6]Peruvian Electricity Grid, according original name: "***S**istema **E**léctrico **I**nterconectado **N**acional*"

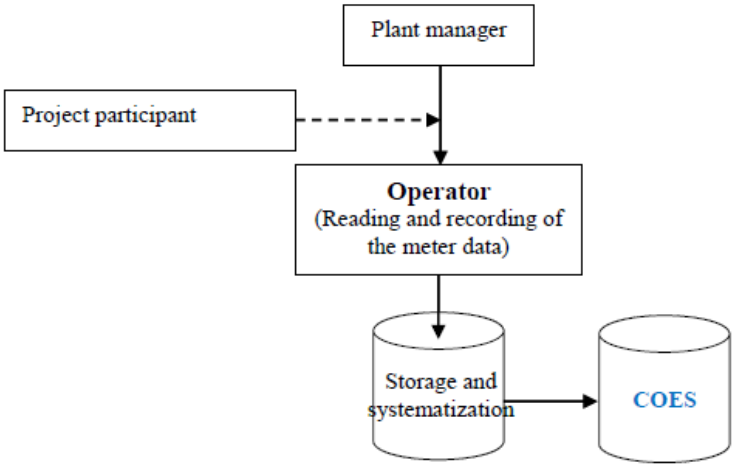
[7]Economic Operation Committee of SEIN

[8]Available at page number 2:
http://www2.osinerg.gob.pe/ProcReg/revdistrib_Gen_resp_pago_SSTySCT2016/2/000227_Tram_010114_Egemsa.pdf

the level of electricity delivered to the grid, and these records are cross-referenced with COES data (which itself contain a record of the plant output, along with all other plants in the SEIN).

Organizational Structure

The data measurement will be based on the official statistics reported by public institutions in the energy sector OSINERGMIN and especially, the COES. The following diagram shows the organization of staff, according to Procedure 30 from COES[9] , in the monitoring tasks:

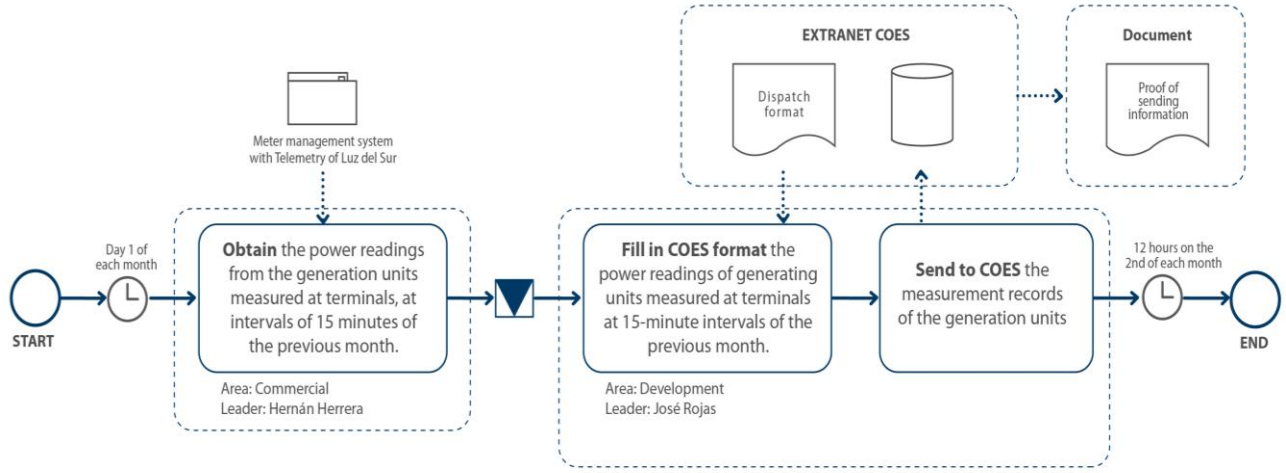


Designation	Responsability
Operator: Hernán Herrera (Commercial área)	Obtaining power readings from the generation units measured at terminals, at intervals of 15 minutes of the previous month.
Storage and Systematization: José Rojas (Development area)	Fill the COEs format with power readings from the generating units measured at terminals, at intervals of 15 minutes of the previous month. Send to COES the measurement records of the generation units.

[9] Procedure 30: Valorisation of power transfers.

The following flow chart shows the details for the storage and systematization:

Flow chart: Production records report
Objective: Comply with 5.2.3 of COES PR-30 Procedure



Source: Luz del Sur Flow Chart

Monitoring Equipment

The Santa Teresa hydropower plant has two electricity meters of the same brand and model ION-7650. These meters are installed in the cell at 220 KV of the output switch, inside the Santa Teresa hydropower plant.

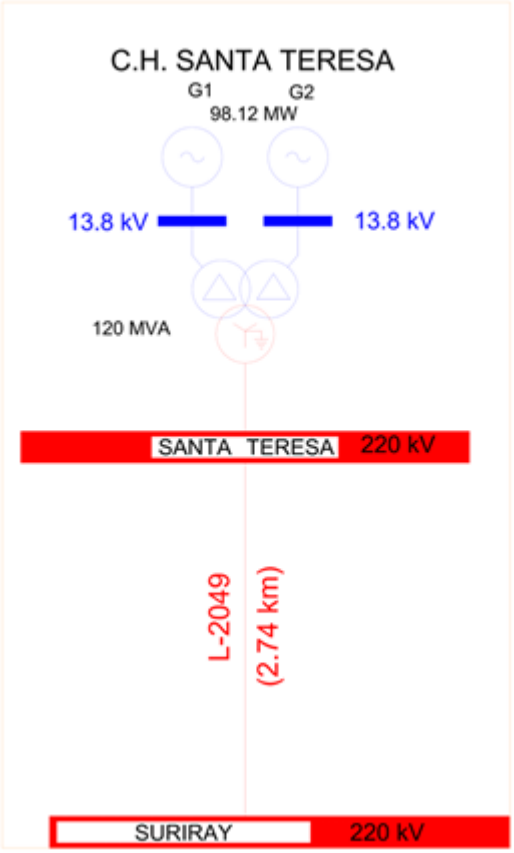
The Generator Delivery Bar (as defined in the Glossary of Abbreviations and Definitions Used in COES-SINAC Technical Procedures) is the Bar where a Power Plant is connected to SEIN, corresponding to the highest voltage bar of the transformer(s), elevator(s) associated with generation.

According to this definition, the delivery bar of Santa Teresa hydropower plant is located on the exit portico. For safety and ease, the meters are installed in the cell at 220 KV of the output switch, inside the Santa Teresa hydropower plant, which is GIS technology. The following coordinates of the table correspond to the exit portico of the Santa Teresa hydropower plant.

Geographic coordinates	
Latitud (S)	Longitude (W)
13.1434	72.6059

The reading of the generated energy are done remotely, since the meters are connected directly to the Luz del Sur data network. Computers permanently download information to a Luz del Sur server which has the ION Reading Software installed. Using the query application of the ION software, the required information of the determined period is extracted in Excel format. There is no third party intervention and OSINERGMIN does not have access to the meters. Every day, Luz del Sur Control Center informs the COES of the previous day's records, loading the information directly into the COES portal.

UNIFILAR SCHEME OF THE GENERATION CENTER

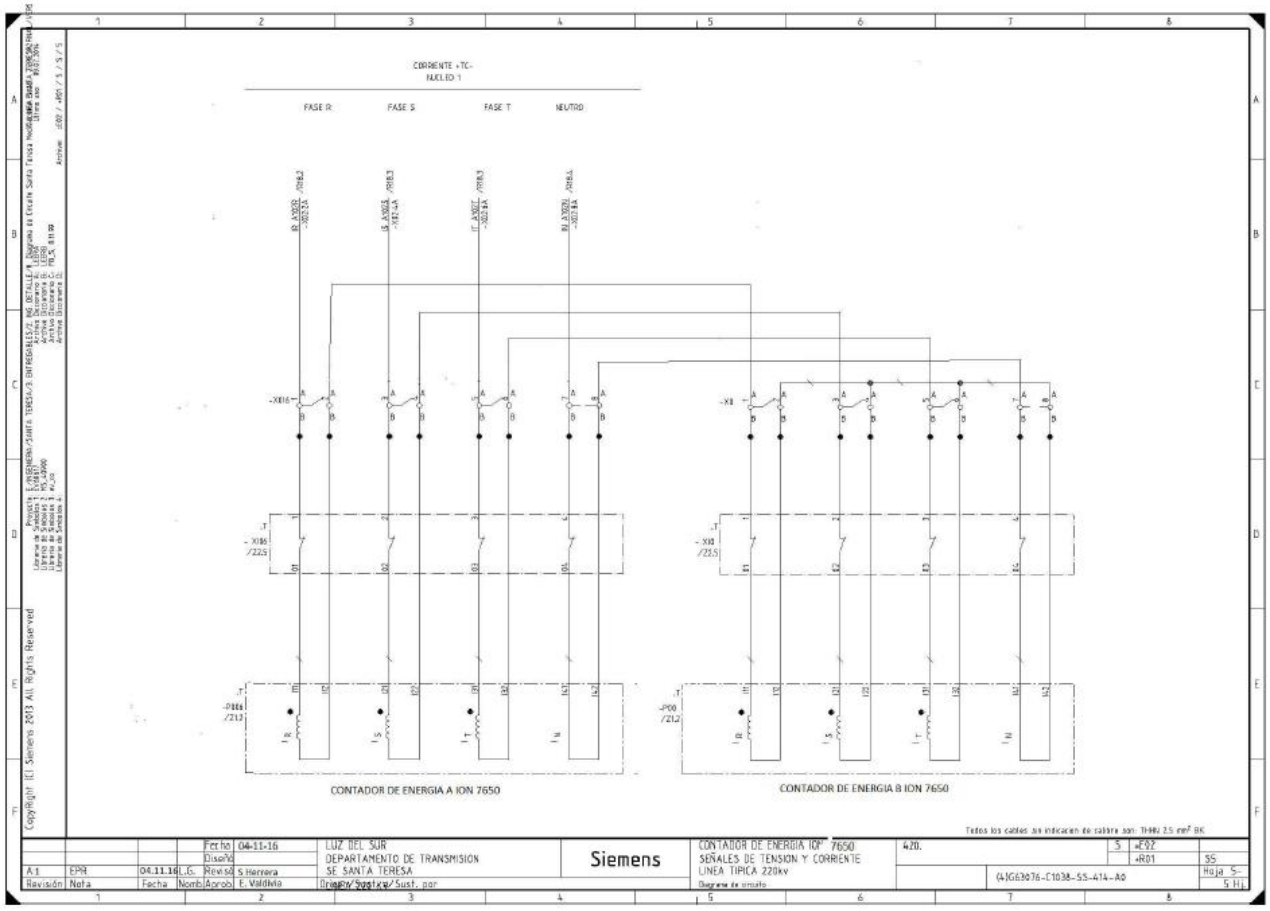


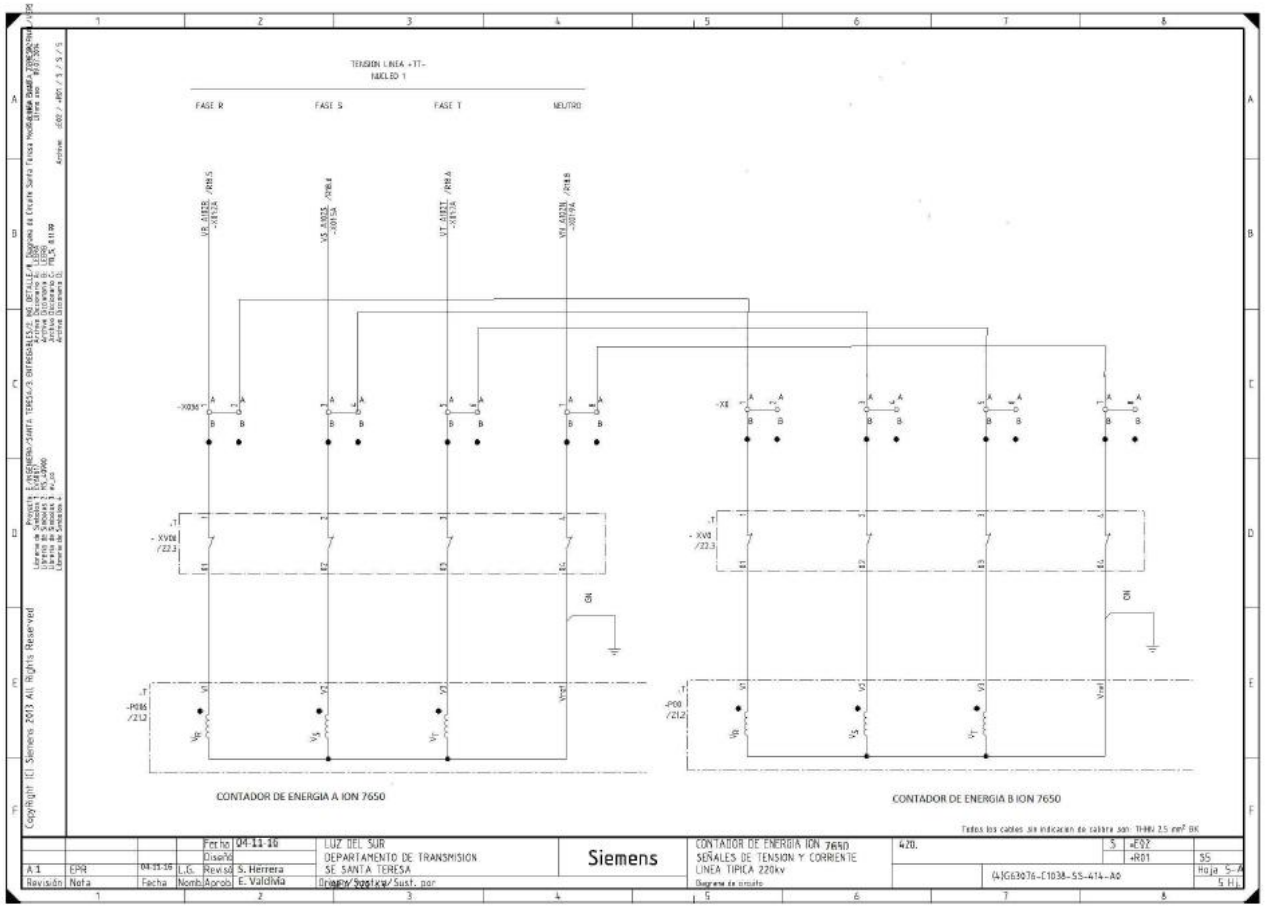
Source: COES, September 2015 available at
http://www.coes.org.pe/Portal/Operacion/CaractSEIN/DiagramaUnifilar

The following table describe the installed meters information:

	Meter
Manufacturer	Schneider Electric
Type	ION 7650
Serial Number	MJ-1208A421-03
Previos Calibration	Aug/12
Date of Last Calibration	There is no date of last calibration
Information to specific uncertainty	% error is within the normal range of operation
Need of change and replacement	None

The following diagram describe voltage and current signals 220kv typical line from meters ION 7650:


CORRIENTE +TC-
NUCLEO 1
FASE R
FASE S
FASE T
NEUTRO
CONTADOR DE ENERGIA A ION 7650
CONTADOR DE ENERGIA B ION 7650
Siemens
LUZ DEL SUR
DEPARTAMENTO DE TRANSMISION
SE SANTA TERESA
CONTADOR DE ENERGIA ION 7650
SEÑALES DE TENSION Y CORRIENTE
LINEA TIPICA 220kv
(4)G63076-C1038-S5-414-A0
Todos los cables sin indicacion de calibre son: THHW 2.5 mm² BK


TENSION LINEA +TT-
NUCLEO 1
FASE R
FASE S
FASE T
NEUTRO
CONTADOR DE ENERGIA A ION 7650
CONTADOR DE ENERGIA B ION 7650
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LINEA TIPICA 220kv
(4)G63076-C1038-S5-414-A0
Todos los cables sin indicacion de calibre son: THHW 2.5 mm² BK

Control measures

Luz del Sur must periodically carry out a testing of measuring equipment, in order to ensure the correct readings. Furthermore, EGEMSA may request a testing of measuring equipment at any time. This testing of measuring equipment is according to previous agreement with the client, but usually is done annually. According to R.M. 496-2005 EM/DM, only if an error is detected the equipment is calibrated by the own manufacturer or an international laboratory.

Note:
In order to ensure correct readings, Luz del Sur carry out the following activities:

- Monthly it is verified that the records of the two measuring equipment installed in 220 kV are into de interval: +/- 0.3%.
- Monthly verification that the records of the equipment of the measure installed in 220 kV and 13.8 kV do into de interval +/-1%, considering that within that percentage are the losses due to the transformation and the own consumption of the plant.
- In addition, COES through the procedure PR-10, number 8.1.2, performs a monthly verification considering a threshold value of 5%. The deviations are published in the monthly report "Desviación_por_Entregas_xx(mes)_xx(año).xlsx" included in the valuation (02-VALORIZACIONES) of active energy (02_ACTIVA) available at: http://www.coes.org.pe/Portal/PostOperacion/ValorizacionTransferencias/ValorizacionTransferenciaEP

The testing of measuring equipment depends on wether it is verfied that the differences of the readings exceed the threshold established for each case. According to the standard (R.M. 496-2005 EM / DM) that regulates the process of Contrast of the Measurement System, only if an error is detected the equipment is calibrated by the own manufacturer or an international laboratory

Capacitation and Personal Training of O&M

Andritz Hydro GmbH is an Austrian company which had an Electro-Mechanical Plant and Design-Built Contract with Luz del Sur. Andritz trained staff during construction, to operate and maintain equipment efficiently. Apart from this, the equipment supplier provided complete manuals and documentation that provided details for the maintenance and required activities associated with it.

There were 36 internal training activities and 5 external training activities to the staff of the power plant and 10 people were benefit. These external trainings were carried out by the following institutions:

- PRED & ASOCIADOS S.A.C.
- SOLDEX S.A.
- ADD CONSULTORIA Y OBRAS DE ENERGIA E.I.R.L.
- VIBRO TECHNOLOGY S.R.L.

The periodic trainings were carried out at the site of the project activity to ensure the proper functioning of the plant and the monitoring of the parameters.

Calibration of equipment
The equipment has not required calibration (which is done at the factory) during the monitoring period because no errors have been reported, above the tolerance, during the test of contrast.

A test of contrast was carried out when the equipment was installed. The equipment has not required calibration during the monitoring period because no error have been reported above the tolerance mentioned for each case as explained in the section C ''control measures''

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	CapBL
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site
Value(s) applied	0
Choice of data or measurement methods and procedures	Value is considered as zero, as the proposed project activity constitutes a new hydropower plant.
Purpose of data/parameter	Calculation of project emissions
Additional comments	

D.2. Data and parameters monitored

Data/Parameter	$EG_{facility,y}$ ($EG_{PJ,y}$)
Unit	MWh/yr
Description	Quantity of net generation supplied by the Santa Teresa Hydropower Plant to the grid in the year *y*
Measured/calculated/ default	Measured
Source of data	Electricity meters Direct measurement by Luz del Sur S.A.A. using bidirectional energy meters (kWh or MWh
Value(s) of monitored parameter	187, 657 MWh / (01/09/2015 to 31/12/2015) 648,544 MWh / (01/01/2016 to 31/12/2016)

Month/year	G1	G2	Total generation [MWh]
Set-15	26,567.87	7,951.72	34,519.59
Oct-15	23,394.52	17,507.77	40,902.28
Nov-15	22,649.29	24,955.07	47,604.35
Dic-15	31,894.75	32,736.93	64,631.69
Ene-16	32,771.07	32,967.43	65,738.49
Feb-16	30,401.49	30,374.95	60,776.43
Mar-16	30,589.32	34,195.95	64,785.27
Abr-16	30,492.93	31,614.70	62,107.63
May-16	31,765.50	30,629.74	62,395.24
Jun-16	20,535.77	22,122.11	42,657.88
Jul-16	19,061.04	30,029.47	49,090.51
Ago-16	20,265.90	22,273.40	42,539.29
Set-16	18,437.34	15,962.07	34,399.41
Oct-16	26,485.08	27,336.93	53,822.01
Nov-16	25,124.30	20,999.90	46,124.20
Dic-16	32,308.52	31,799.16	64,107.68
Total 01/09/2015-31/12/2016	**422,744.68**	**413,457.29**	**836,201.97**

Source: MINEM, Annex 7, Statistical Yearbook of Electricity 2015 and 2016 available at:
http://www.minem.gob.pe/_estadistica.php?idSector=6&idEstadistica=10179
http://www.minem.gob.pe/_estadistica.php?idSector=6&idEstadistica=11738

<table>
<tr><td>Monitoring equipment</td><td>Two bidirectional energy meters (ION 7650 model)

<table><tr><th></th><th>Meter</th></tr><tr><td>Manufacturer</td><td>Schneider Electric</td></tr><tr><td>Type</td><td>ION 7650</td></tr><tr><td>Serial Number</td><td>MJ-1208A421-03</td></tr><tr><td>Previos Calibration</td><td>Aug/12</td></tr><tr><td>Date of Last Calibration</td><td>There is no date of last calibration</td></tr><tr><td>Information to specific uncertainty</td><td>% error is within the normal range of operation</td></tr><tr><td>Need of change and replacement</td><td>None</td></tr></table></td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Daily report, with recordings every 15 minutes.</td></tr>
<tr><td>Calculation method
(if applicable)</td><td>Not applicable</td></tr>
<tr><td>QA/QC procedures</td><td>Calibration documentation, according to Peruvian laws in force (Law 25844) and the COES requirements:
a. Report of measurement of power delivered to the grid every 15 minutes,
b. Digital information storage,
c. Meters accuracy better than or equal to 0.2%</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Additional comments</td><td>Although electricity flow goes in both directions (Santa Teresa hydropower injects and receives electricity in the connecting bar), the kind of energy meter is considered as bidirectional. Bidirectional energy meters were installed at the point of connection between Santa Teresa hydropower and the Peruvian National Inter-connected Grid (SEIN)
Additionally, load factor for generation ex ante estimation is according with: “Guidelines for the reporting and validation of Plant load factors” (version 1, Annex 11, EB48)</td></tr>
</table>

Data/Parameter	***EFgrid,CM,y***
Unit	tCO_2/MWh
Description	Combined margin CO2 emission factor for grid connected power generation in year *y*, calculated using the last version of the "Tool to calculate the emission factor for an electricity system".
Measured/calculated/ default	Calculated
Source of data	Calculated by the Project developer as indicated in the "Tool to calculate the emission factor for an electricity system". These calculations are based on information provided by the COES
Value(s) of monitored parameter	For year 2015: 0.4614 tCO2/MWh For year 2016: 0.4408 tCO2/MWh
Monitoring equipment	No especial monitoring equipment is needed.
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	Calculated as a weighted average of the OM and BM factors

Data/Parameter	***EFgrid,OM-DD,y***
Unit	tCO_2/MWh
Description	Dispatch data Operating margin CO2 emission factor for year *y*
Measured/calculated/ default	Calculated
Source of data	Calculated by the Project developer as indicated in the "Tool to calculate the emission factor for an electricity system". These calculations are based on information provided by the COES
Value(s) of monitored parameter	For year 2015: 0.5751 tCO2/MWh For year 2016: 0.5343 tCO2/MWh The information required comes from the COES, from the annual statistics, as well as from the energy production report in the grid every 15 minutes per connected unit.
Monitoring equipment	No especial monitoring equipment is needed.
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	No additional comments

Data/Parameter	***EFgrid,BM,y***
Unit	tCO_2/MWh
Description	Build margin CO2 emission factor for year y
Measured/calculated/ default	Calculated
Source of data	Calculated by the Project developer as indicated in the "Tool to calculate the emission factor for an electricity system". These calculations are based on information provided by the COES.
Value(s) of monitored parameter	For year 2015: 0.3478 tCO2/MWh For year 2016: 0.3472 tCO2/MWh
Monitoring equipment	No especial monitoring equipment is needed.
Measuring/reading/recording frequency	Annually for the first crediting period and only once for the second crediting period. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	No additional comments

D.3. Implementation of sampling plan

>> Not Applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

>>

The emissions reductions are estimated following the guidance of the last version of the methodology ACM0002 (version 16.0), as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emissions reduction in year *y* (tCO_2e/yr)
BE_y = Baseline emissions in year *y* (tCO_2e/yr)
PE_y = Project emissions in year *y* (tCO_2e/yr)
Baseline emissions (BE_y)

The baseline emissions are calculated as follows:

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

Where
BE_y = Baseline emissions in year y (tCO_2/year).
$EG_{PJ,y}$ = Quantity of net electricity generated and incorporated into the grid in year y (MWh/year).
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the *Tool to calculate the emission factor for an electricity system* (tCO_2/MWh).

The Baseline emission factor is calculated as a combined margin ($EF_{grid,CM,y}$) following the guidance in the *Tool to calculate the emission factor for an electricity system* (version 4.0). According to this tool the baseline emission factor is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$) where the weights w_{OM} and w_{BM}, for a kind of projects like Santa Teresa, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$). This is presented below:

Parameter	SI unit	Description
$EF_{grid,CM,y}$	tCO_2 / MWh	Combined margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,BM,y}$	tCO_2 / MWh	Build margin CO_2 emission factor for the project electricity system in year *y*
$EF_{grid,OM,y}$	tCO_2 / MWh	Operating margin CO_2 emission factor for the project electricity system in year *y*

Note: At the time of PDD's submission to DOE for validation, the available information was from 2010, but only few weeks before submission (February 2012) COES published its Annual Statistics Report 2011. As a consequence, OM and BM were updated with information from 2011, according to the "Tool to calculate the emission factor for an electricity system" recommendation: the data used for the calculation has to be based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation.

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

>>Project emissions (PE_y)

According to the chosen baseline methodology (ACM0002, version 16.0), project emissions are not considered since the follow equation:

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

Where:
$PE_{FF,y}$ = project emissions from fossil fuel consumption in year *y* (tCO_2e / yr):
Santa Teresa hydropower not use fossil fuel for its operational activities, therefore $PE_{FF,y} = 0$
$PE_{GP,y}$ = project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e / yr):
Santa Teresa hydropower not include geothermal power plants. $PE_{GP,y} = 0$
$PE_{HP,y}$ = project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e / yr):
Santa Teresa hydropower is a run-of-river and does not have a reservoir. Therefore, $PE_{HP,y} = 0$
According to the paragraph above, $PE_y = 0$

E.3. Calculation of leakage emissions

>>Leakage is no included in the original formula from ACM0002 methodology

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

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	372,464	0	0	0	372,464	372,464

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_2e)	Amount estimated ex ante (t CO_2e)
01/09/2015: 86,585 Year 2016 : 285,878	01/09/2015: 181,931 Year 2016 : 545,792

E.6. Remarks on increase in achieved emission reductions

>>
The values are different between the PDD estimations and the real ERs claimed due mainly to the ex-post calculation nature of the ERs parameters.

There are two main reasons for this:

- Naturally the emission factor is decreased, that is explained by the Peruvian initiatives for clean generation technologies in the SEIN, as part of Peruvian NDC.
- The energy production has been 16.12% less than the expected annual energy production due to hydrology behaviour smaller than the historic average (for climate change situation in Peru) However, this value is considered normal. Additionally, as an external factor, the flow delivered by EGEMSA has been less than 61m3/s.

Changes in the emission Factors

Emission Factor	PDD	Monitoring Period	Change%
CO2 emission factor for 2011 and assumed equal for the following years	0.7558 tCO_2/MWh	For year 2015: 0.4614 tCO_2/MWh For year 2016: 0.4408 tCO_2/MWh	For year 2015: ↓39.0% For year 2016: ↓41.7%
No more GHG was included			

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Document information

Version	*Date*	*Description*
06.0	7 June 2017	Revision to: • 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: • 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: • 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 *F-CDM-MR* to *CDM-MR-FORM*; • 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.

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