**MONITORING REPORT FORM (CDM-MR) ***
**Version 01 - in effect as of: 28/09/2010**

***CONTENTS***



* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

**MONITORING REPORT**
**Version 01 18/10/2011**

**Project for the reduction of green house emissions of Hidroelectrica La Confluencia S.A.**
**Project 4229**
**1st Monitoring Period: 02/02/2011 to 30/09/2011**

## SECTION A. General description of the project activity

### A.1. Brief description of the project activity: >>

>>

La Confluencia Project (hereafter, the Project) was developed by Hidroeléctrica La Confluencia S.A. (HLC). The Project was originally conceived in 2002 as part of a larger project, La Higuera, which was designed as a 300MW single scheme run of river project. However, due to the excessive risks associated with such a large project and a landowner unwilling to accept the project the design was modified. The resulting reengineering established two schemes, La Higuera and the upstream La Confluencia. La Confluencia was originally approved under the same environmental impact study as the La Higuera project in August 2004. Full time development and design work on La Confluencia only commenced in 2006, after La Higuera project reached financial close and was registered as a CDM project activity. Subsequent optimizations made to the Project were submitted and approved under the Environmental Impact Assessment System (SEIA). HLC undertook additional public consultation meetings regarding these modifications, despite not being required to under the SEIA.

The Project consists of a 163.22 MW run of river hydropower facility comprising a two branch water conveyance system. The purpose of the project is to utilize the hydrological resources of the Tinguiririca, Portillo and Azufre Rivers in a run of river scheme to generate and supply zero emission energy to the Chilean Central electricity grid (SIC). The Project will deliver an average of 656 GWhel p.a. into the SIC. The Project generates certified emission reductions (CERs) by displacing electricity generation from grid connected fossil fuel-fired power plants that would otherwise be generating electricity. The Project is immediately upstream of the La Higuera Hydroelectric Project and is designed to operate independently and in conjunction with La Higuera. When operating in conjunction water from the La Confluencia powerhouse tailrace is discharged directly into the La Higuera intake system.

The Project has a 13 year Power Purchase Agreement (PPA) with Chile's largest distribution company, Chilectra, for 345-390GWh p.a. This contract was required in order to raise non-recourse project financing. Delivery obligations commenced in January 2011.

The Project uses the consolidated methodology ACM0002 version 12.1 to establish the emissions reductions resulting from the Project Activity. Based on the ex ante application of this methodology the Project is conservatively estimated to reduce emissions by 423,120 tonnes of CO2 per year that would have otherwise been emitted via the baseline operation of the Chilean grid to which the Project is connected. The emission reductions are expected to increase as the thermal electric capacity of the grid switches to coal from natural gas. As a run of river project with significant socio-economic benefits and no significant environmental impacts the additional sustainable development benefits in the face of new coal burning investments in the power sector highlight the importance of this Project to the Chilean energy sector and the global environment.

### A.2. Project Participants

>>

| Name of Party involved ((host) indicates a host Party) | Private and/or public entity(ies) project participants (as applicable) | Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Chile (Host) | Hidroeléctrica La Confluencia S.A (HLC) | No |

## A.3. Location of the project activity:

>>

The Project is located on the Tinguiririca, Portillo and Azufre rivers, between the elevations of 1100 m.a.s.l. and 1460 m.a.s.l., The powerhouse is located on the northern bank of the Tinguiririca river, some 500 m upstream from the junction with the Portillo river, at approximately UTM(PSAD56) 358,100, 6,144,550. The La Confluencia project can be divided in two branches, Tinguiririca and Portillo rivers, where the main intakes take the water from. The area of the Project activity is shown in the Figure below:

**Figure 1. Project Location**

## A.4. Technical description of the project

>>

The Project consists of intakes and conveyance systems on two branches diverting flows to a surface powerhouse. The Portillo branch comprises a low weir and spillway on the Portillo River at 1460 m.a.s.l. Water is passed through a desander and short open channel before entering an 11 km low pressure tunnel that runs to the surge chamber above the powerhouse at the confluence of the Portillo/Azufre and Tinguiririca rivers. Minor high mountain intake structures and desanders capture water from the Azufre, Los Humos and Riquelme streams and are injected into the Portillo tunnel. The Tinguiririca Branch consists of a low diversion weir and spillway across the Tinguiririca River at 1444 m.a.s.l. that diverts partial flows through a desander and short open channel to an off-river hourly regulation pondage of 1.2 million $m^3$ live storage capacity. Water from this is taken via a canal to the La Gloria portal, where it enters a 9.3 km low pressure tunnel that joins the surge chamber above the powerhouse. High mountain intakes on the El Ciruelo and La Gloria capture additional flows from these minor streams.

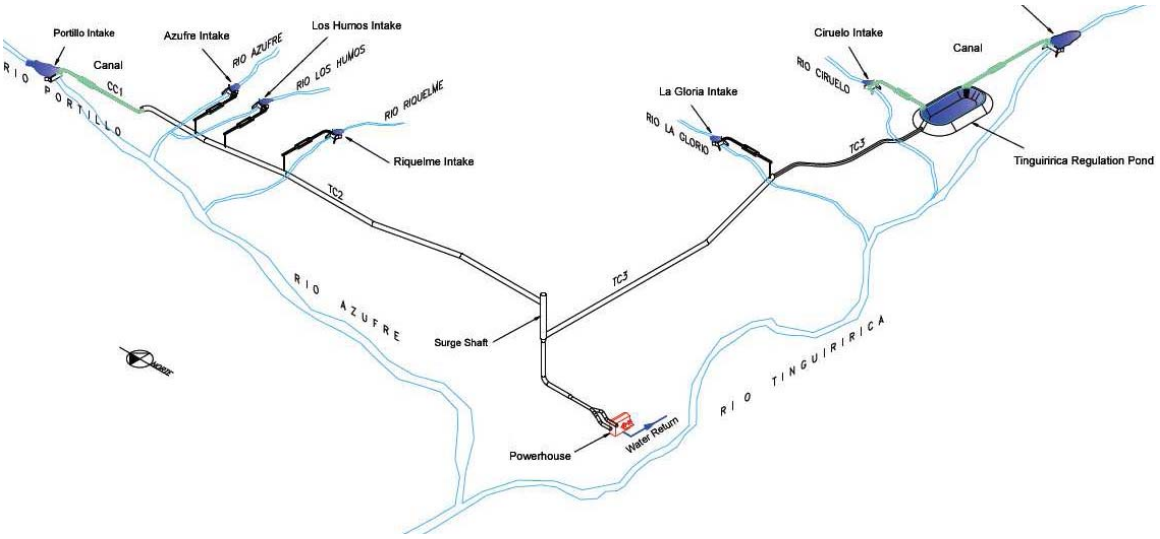


**Figure 2** - Schematic layout of Project Activity.

The Tinguiririca and Portillo branch tunnels terminate at a concrete lined vertical shaft dropping to the open air powerhouse via a concrete and steel lined high pressure tunnel. Two Francis type turbines convert the 52.5 cubic meters per second flow into electricity via twin generators. This is conventional hydroelectric technology selected to optimize generation and efficiency based on the historical hydrological data. The water is then discharged into the La Higuera conveyance scheme on the north bank of the Tinguiririca, where it enters a pipe bridge to cross the river prior to entering the La Higuera low pressure tunnel system on the southern side of the Tinguiririca. Water can be spilled directly into the river if La Higuera project is not operating. The electricity is evacuated to the SIC via a 20 km 154/220kv transmission line to the La Higuera power project switchyard, then shares the 38 km transmission line of the La Higuera project to connect to the SIC grid near San Fernando.

Voith Siemens, a leader in hydro mechanical and electrical engineering, is providing state of the art electro-mechanical and control equipment and safety systems, while the turbines are a technology that has been utilised for more than half a century. The turbines and generators will be manufactured in Brazil, while the other equipment will be sourced from Brazil, Chile and other manufacturing bases.

**Table 1** - Summary of project specifications.

| La Confluencia Project | Unit |
|---|---|
| Gross head | 347.5 m |
| Design Flow | 52.5 m3/s |
| Annual average Net | 656 GWh |

| La Confluencia Project | Unit |
|---|---|
| Generation expected | |
| Generator Type | Synchronous with salient pole |
| Generator Capacity (each unit) | 95.8MVA |
| Normal rotational speed | 500 rpm |
| Frequency | 50Hz |
| Storage facilities | Capacity |
| Off channel | 1,200,000 $m^3$ |

Source: EPC Contract

**A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:**

>>

Version 12.1 of ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

**A.6. Registration date of the project activity:**

>>

February 02st 2011 *(Date of registration action April 26th 2011)*

**A.7. Crediting period of the project activity and related information (start date and choice of crediting period):**

>>

February 02st 2011 - February 01st 2018 (Renewable)
Changed from: April 01st 2011 - March 31st 2018

**A.8. Name of person(s)/entity(ies) responsible:**

>>

**Project Participants**:
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This form was completed by:
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Consultants: María Luz Farah (marialuz.farah@poch.cl), Soledad Palma (soledad.palma@poch.cl).

## SECTION B. Implementation of the project activity

### B.1. Implementation status of the project activity

The project started its operation on December 16th 2010. The first stage of operation was intended for testing purposes before starting commercial operation on May 01th 2011.

The units never generated during a complete day, because the plant was on test period and was regulating the level of weighting of gaps.

During the operation, the following unscheduled downtimes have been reported:

| Date (Year 2011) | Unit | Events sequence |
|---|---|---|
| 08-Feb | Unit 1 | Emergency stop |
| 08-Mar | Unit 1 | Generation tests |
| 19-Mar | Unit 2 | Equipments and generator tests |
| 03-Apr | Unit 1 | Synchronization and load tests |
| 04-Apr | Unit 2 | Synchronization and load tests |
| 05-Apr | Unit 2 | Synchronization and load tests |
| 06-Apr | Unit 1 | Synchronization and load tests |
| 07-Apr | Unit 1 | Synchronization and load tests |
| 08-Apr | Unit 1 | Down for the wrong speed signal of RV |
| 24-Apr | Unit 1 | Load test in 154 kV line CLH-TING. |
| 29-Apr | Unit 1 | Stop, then to SITR CDEC tests |
| 29-Apr | Unit 2 | Stop, then to SITR CDEC tests |
| 30-Apr | Unit 1 | SITR CDEC data tests |
| 30-Apr | Unit 2 | SITR CDEC data tests |
| 24-Jun | Unit 1 | Trip 86M, EDAG tests |
| 24-Jun | Unit 2 | Trip 86M, EDAG tests |
| 28-Jun | Unit 1 | Performance testing |
| 28-Jun | Unit 2 | Performance testing |
| 31-Aug | Unit 1 | Tests for CHT requirement |
| 31-Aug | Unit 2 | Tests for CHT requirement |
| 09-Sep | Unit 1 | Emergency stop |
| 09-Sep | Unit 2 | Emergency stop |
| 21-Sep | Unit 2 | Automatic operation of Relé 86M. |

### B.2. Revision of the monitoring plan

>> N/A

### B.3. Request for deviation applied to this monitoring period

>>N/A

### B.4. Notification or request of approval of changes

>>N/A

## SECTION C. Description of the monitoring system

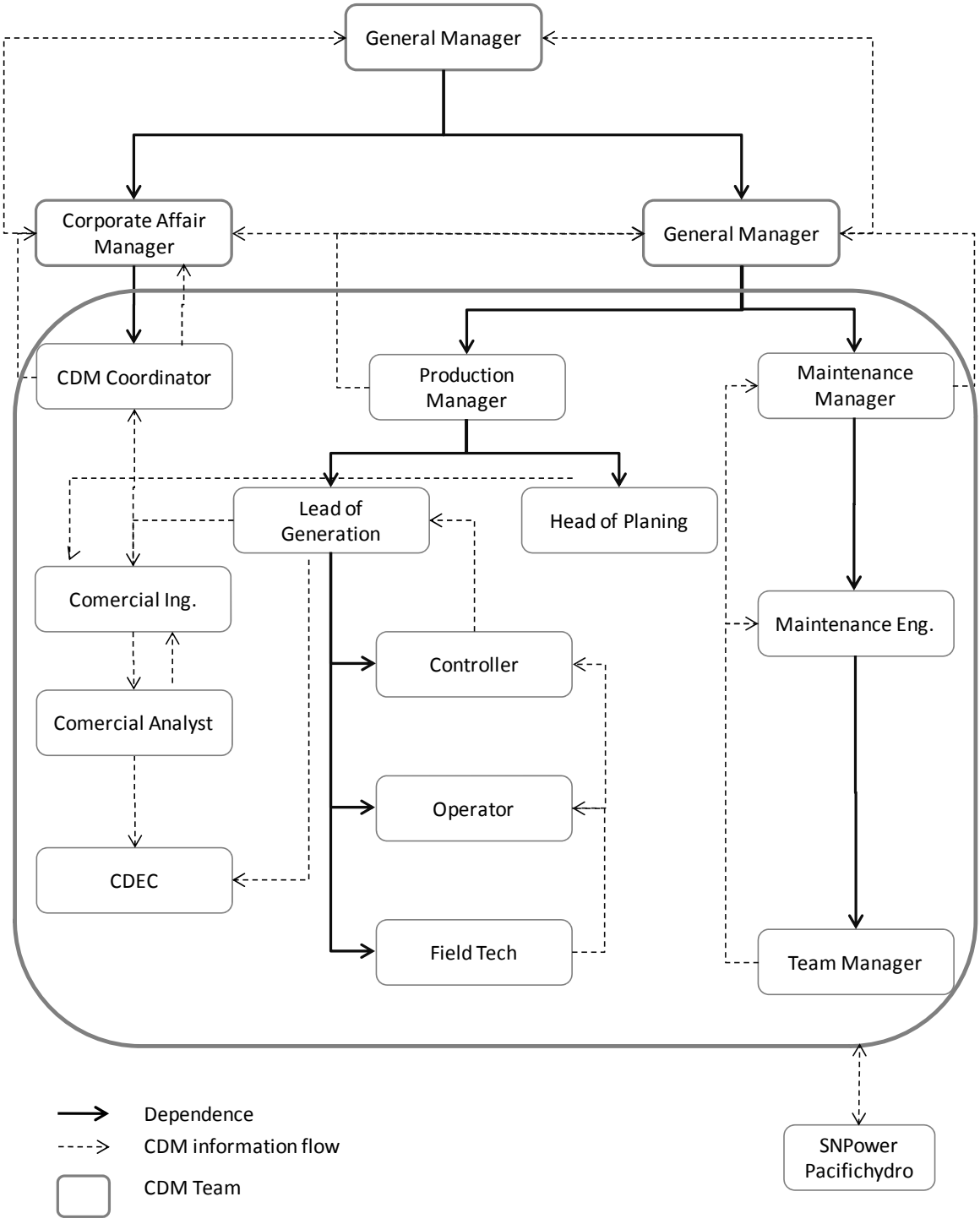
>>

The monitoring system of the project activity consists of continuous measurement of the electricity generated by La Confluencia hydro power project.

**Organization Structure and Responsibilities – Monitoring Team:**

The following diagram represents the monitoring Structure of La Confluencia hydro power project for the current monitoring period:

**Figure 3. Monitoring structure**



CDM roles and responsibilities:

General Manager:

- Legal Representative of the Project.
- Ultimately responsible for the CDM team, allocating resources for implementation, maintenance and development.

Environmental Manager:

- Contact Person for the CDM project activity.
- Responsible for advising the General Manager on CDM issues.
- Responsible for monitoring the progress of the CDM team's performance.
- Responsible for consolidating the information generated by the CDM project.
- Internal audit's coordinator.

Operations Manager:

- Coordinates all the Operations Staff.
- Ultimately responsible for the Operations CDM team, allocating resources for implementation, maintenance and development.
- Reports operation performance.

CDM Coordinator:

- Responsible for completing the Monitoring Report Form (CDM-MR).
- Gathers and reviews the information sent by operators and controllers.
- Reviews the ER calculation sent by the Commercial Engineer.
- Reports to the Environmental Manager on CDM issues.
- Monitors the implementation of CDM procedures.
- Responsible for staff training on CDM issues.
- Develops a Monthly Report of CDM project.
- Elaborate Reports ER calculation.
- Calculates the Build Margin for the grid with data from CDEC-SIC, at the beginning of each crediting period.
- Calculates the Emission Factor and Operating Margin for the grid with data from CDEC-SIC, in a monthly basis.

Maintenance Manager:

- Coordinates and leads the maintenance and contractors.
- Reports the CDM maintenance activities of the area to the Operations Manager.

Production Manager:

- Coordinates and directs all staff, contractors and equipment in the production area to ensure the generation of electric power.
- Reports maintenance activities of the area to the Operations Manager related to the CDM project.

Maintenance Engineer:

- Technical and logistical support on site. Reviews technical information related to the equipment and systems of each generation plant, so as to:

(a) Ensure the availability and reliability of equipment, systems and projects in operation,
(b) Supports the processes associated with the projects going into operation, and
(c) Provides technical support for projects to be developed in the future as part of La Confluencia hydro power project.

- Reports maintenance activities of CDM project to the Maintenance Manager.

Head of Planning:

- Responsible for the relationship with CDEC-SIC, programming of generation, applications disconnection, scheduled maintenance and reports of failures.

- Responsible for the development of reports of production management, in a weekly and monthly basis.
- Responsible for implementation of the procedures for the operation of the Software Maintenance management Jobtech in Production.
- Responsible for the development, changes and upgrades of operational procedures and guide to maneuvers.
- Responsible for procedures of environmental management in functions related to production and CDM project.

Commercial Analyst:

- Responsible for sending a copy of the monthly billing record to the Commercial Engineer and CDM Coordinator.
- Informs the Lead of Generation in a timely manner if an anomaly is detected in the information after the secondary review.
- Responsible for processing, organizing and summarizing information provided by the Lead of Generation to generate the billing record and sending to CDEC-SIC[1] before the 5th working day of the month following the month of measurement, making the allocation of energy charged to La Higuera hydro power project and La Confluencia hydro power project.

Lead of Generation:

- Responsible for management of daily office operations and La Higuera hydro power project and relationships in real time with the CDEC-SIC.
- Verifies the consistency of data sent and received, detecting losses of data or gaps between meters sent by the operator.
- Sends the register of generation hourly to the Commercial Engineer.
- Responsible for the water flow management for daily schedule of generation adhering to water rights.
- Responsible for the safety management in operations, maintenance and third party's work.
- Reports operations activities to the Production Manager.

Controller:

- Responsible for performing the crossed verification of the data in the meters.
- Sends data to the Commercial Engineer.
- Responsible for uploading data in ".rpn" format, directly via the CDEC-SIC website.
- Resolves shortcomings in the systems' operation and maintenance of the power plant, in addition to recommend and develop solutions to avoid or prevent its recurrence.

Operator:

- Responsible for processing raw data within the first three days of the month after the measurements (Generation Data) and sending it to the controller.
- Verifies the consistency of data sent and received, detecting losses of data or gaps between meters.

Field Tech:

- Collects raw data from the meters.
- Sends information to the Operator.

**Electricity measurement:**

The Electricity produced by La Confluencia hydro power project is transmitted to La Confluencia Substation, which is located next to the power plant. This substation is connected via a double circuit transmission line (of approximately 17.9 km in length) with la Higuera Substation. This last Substation

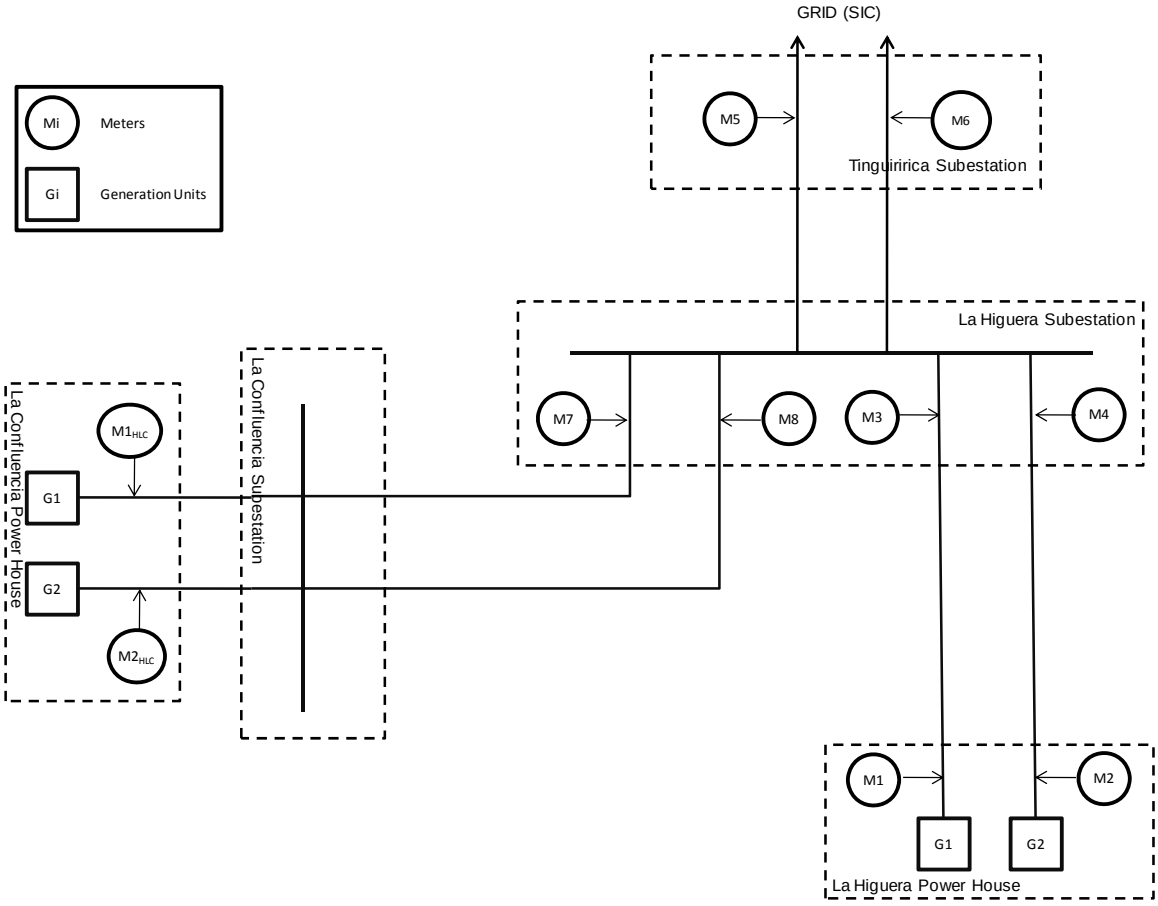
[1] Economic Load Dispatch Centre of the SIC

is connected to the grid through the Tinguiririca Substation located near San Fernando. There is a double circuit transmission line (of approximately 38 km in length) between La Higuera substation and the Tinguiririca substation (SIC's injection substation).

As shown in Figure 4, the system has ten electricity meters relevant for the CDM monitoring, located at different stages. First, an electricity meter is placed at the terminals of each generator of La Confluencia hydro power plant (meters $M1_{HLC}$ and $M2_{HLC}$). Second, two electricity meters (M3 and M4) are located in La Higuera Substation measuring electricity generated by La Higuera hydro power project, and other two electricity meters (M7 and M8) measure electricity from La Confluencia power plant. Finally, a set of two meters are placed in the Tinguiririca Substation (M5 and M6) in order to measure the energy generated by La Higuera hydro power project plus La Confluencia hydro power project. As the electricity produced by La Confluencia hydro power project is injected to the grid through the Tinguiririca Substation, main meters are considered to be M5 and M6.

A diagram of the location of these meters is presented in the following figure:

**Figure 4. Diagram of Monitoring points**




The gross generation of La Confluencia Project is collected by meters $M1_{HLC}$ and $M2_{HLC}$. The gross generation of the La Higuera Project is collected by meters M1 and M2. Net generation from both projects injected into the SIC grid is measured by meters M5 and M6. All data is collected by the SCADA control systems every 15 minutes and stored as a summed hourly total. This information is automatically transmitted to the CDEC-SIC Dispatch Centre and the respective powerhouses, where it is electronically stored.

The net injection from the project is determined on the basis of an algorithm that deducts transmission losses along the La Confluencia high voltage transmission line, HVLC, and the shared La Higuera high voltage transmission line, HVLH, and calculates the net generation of each project from the energy injected and measured by M5 and M6.

CDEC-SIC reports on the net generation injected into the SIC from the Project at the end of each month. This report summarises the hourly generation in the month for which the Project receives revenues. This generation and electricity invoice is checked against internal records for integrity.

**Equation 1**

$$\text{Energy for invoicing HLC} = \text{EHLC} = (M5 + M6) \bullet \frac{(M7 + M8)}{(M7 + M8) + (M3 + M4)}$$

Where,

Mi = Amount of Electricity generation measured at electricity meter number *i* (according to Figure 4).
$E_{HLC}$ = Amount of electricity generated by La Confluencia hydro power project.

This calculation assumes the proportional distribution of transmission losses in the Transmission line from La Higuera substation to Tinguiririca substation in function of the hourly energy injected by each power plant to La Higuera substation.

Grid connected generation projects are obliged under the *Normas Técnicas* to install metering that has 0.2% accuracy, which is extremely high precision equipment. This equipment is tested at Complete commissioning prior to the Owner Takeover of the Project for commercial operation. Meters are tested according to requirements of the system operator, but at least once every two years according to the Project's maintenance procedures.

**Data collection, recording, calculation:**

The energy meters are interconnected with the SCADA control system of the project and have remote access connection with CDEC-SIC. The SCADA collects the relevant information from these meters, as per CDEC-SIC specifications and automatically transmits this information via telecommunication network. SCADA information is electronically stored at the powerhouse, thus two data sets are maintained for recording Project output.

Electricity generated by La Confluencia hydro power project and supplied to the grid is measured in the injection point at Tinguiririca Substation (meters M5 and M6). Meters located at this point are owned by Transelec.

Generation by project is monitored on a daily basis by La Confluencia. The Lead of Generation is responsible for the monitoring and processing of all information sent to the SIC and the Project, including generating daily, weekly and monthly generation summaries. Net generation of the Project is derived applying the algorithms to account for transmission losses to the CDEC-SIC at the Tinguiririca Substation and is checked against the monthly balance received from CDEC. Thus the Project will have two records of hourly project generation; one supplied by the official CDEC-SIC, and those maintained internally by the Project.

**Data Quality Control:**

Generation projects are obliged to have communications systems, with 100% redundancy, for transmittal of all information from the meters to the CDEC-SIC control room. As such all information will be sent and stored by both the CDEC-SIC and the Project.

At the end of each month CDEC-SIC reviews and sends out the net generation of each project connected to the grid to the relevant Energy Generation Company for invoicing purposes. HLC reviews each invoice on a monthly basis to correlate Project its own generation data with the billing information provided by CDEC-SIC. As such there is a thorough data verification process and method established to ensure accuracy. Receipts from the sale of energy and firm capacity are kept for documentation. For the purposes of determining emissions reductions as a result of the Project activity, the Project utilizes the information from CDECSIC as the official source for all information about generating plants connected to the SIC Grid. In this manner internal information on Project output is used to verify CDEC-SIC data, providing for improved data integrity and transparency.

**Emergency Procedures:**

Failures of electricity metering at Tinguiririca substation:

In case of any failure on the data recording of Tinguiririca substation electricity meters (owned by Transelec) the generation data of the project at the injection point should be obtained by using the electricity measured at La Higuera substation with meters M3 + M4 (as in Figure 4) and deducting the typical average value of transmission losses in the La Higuera substation - Tinguiririca substation. This typical average value for transmission losses will be obtained based on previous records of the measurements at Tinguiririca substation and La Higuera substation, as is described in the procedure "Validation of meters' data and monthly energy assignment for invoicing to the La Higuera hydro power project and La Confluencia hydro power project".

Failures of electricity metering at La Higuera substation:
In case of metering failures of all the meters at La Higuera substation (M3, M4, M7 and M8) from Figure 4, while La Confluencia hydro power plant is operating, the following formula should be used in order to estimate electricity produced by La Higuera hydro power project:

**Equation 2**

$$EG_y = (M1_{HLC}+M2_{HLC}) - [(M1 +M2) + (M1_{HLC}+M2_{HLC}) – (M5 + M6)] / 2$$

Where,

M5 + M6 = Represents the total amount of electricity from both La Higuera and La Confluencia hydro power projects measured at Tinguiririca substation.
M1 + M2 = Represents the total amount of electricity measured at the generator terminals of La Higuera hydro power plant.
$M1_{HLC} + M2_{HLC}$ = Represents the total amount of electricity measured at the generator terminals of La Confluencia hydro power plant.

In case of metering failures at one of the meters M3, M4, M7 or M8, or one of the pairs of meters M3 and M4 or M7 and M8, from Figure 4 located at La Higuera substation, the following formula should be used in order to estimate missing data from failed meters:

**Equation 3**

$$(M5 + M6) = \left[(M3 + M4) + (M7 + M8)\right] \cdot (1 - \text{TL}\ \textit{from HLH to TinSS})$$

Where,
M5 + M6 = Represents the total amount of electricity from both La Higuera and La Confluencia hydro power projects measured at Tinguiririca substation.
M3 + M4 = Represents the electricity provided by La Higuera hydro power project and measured in the electricity meters located at La Higuera substation.
M7 + M8 = Represents the electricity provided by La Confluencia hydro power project and measured in the electricity meters located at La Higuera substation.

TL from HLH to TinSS = Transmission losses from La Higuera substation to Tinguiririca substation.

The losses are calculated as the total generation at the La Higuera substation less the total injection at Tinguiririca substation, as follows.

**Equation 4**

TL = ((M7 + M8) + (M3 + M4)) – (M5 + M6)

Metering failures in all the main electricity meters outside the ownership control of the project participant (M3-M8):

Under this scenario, data should be calculated by using data from the electricity meters $M1_{HLC}$ and $M2_{HLC}$, located at the terminals of each unit of La Confluencia hydro power project as needed. One meter is located at the terminals of each generation unit of the power plant connected to the La Higuera substation.

Transmission and other losses related to each unit should be deducted in order to reconstruct missing data due to the failure of electricity meters located at Tinguiririca or La Higuera substation according to the calculation methodology described in the procedure "Validation of meters' data and monthly Energy assignment for invoicing to the La Confluencia hydro power project and La Higuera hydro power project".

**Calibration/Verification procedures**:

Grid connected generation projects are obliged under the *Normas Técnicas* to install metering that has 0.2% accuracy, which is extremely high precision equipment. This equipment is tested at Complete commissioning prior to the Owner Takeover of the Project for commercial operation. Meters are tested according to requirements of the system operator, but at least once every two years according to the Project's maintenance procedures.

## SECTION D. Data and parameters

### D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

| **Data / Parameter:** | $EF_{grid,CM,y}$ |
|---|---|
| Data unit: | $tCO_2/MWh$ |
| Description: | Combined margin $CO_2$ emission factor for grid connected power generation in year *y*, which is ex-ante according to the applied methodology |
| Source of data used: | Calculated with Equation 9 |
| Value(s) : | 0.645 |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emissions |
| Additional comment: | |

### D.2. Data and parameters monitored

| **Data / Parameter:** | $EG_{PJ,y} = EGfacility,y$ |
|---|---|
| Data unit: | MWh/yr |
| Description: | Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* |
| Measured /Calculated /Default: | Measured |
| Source of data: | Project activity site |
| Value(s) of monitored parameter | Values in a monthly basis:<br><br>February: 12,393,4 MWh (between 02nd to 28th of February)<br>March: 9,559.9 MWh<br>April: 5,444.3 MWh<br>May: 5,351.7 MWh<br>June: 4,060.1 MWh<br>July: 4,030.4 MWh<br>August: 5,136.5 MWh<br>September: 9,533.7 MWh |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emissions |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Two Electricity meters located at Tinguiririca substation:<br>Type: Jemstar<br>Model: JS-09R5102 B8<br>Serial numbers: 08 43 10966 and 08 43 10974<br>Accuracy class: 0.2<br>Date of last verification: Both on April 12th 2010<br>Verification frequency: Every 3 years<br><br>Two Electricity meters located at La Higuera substation for La Higuera hydro power project electricity generation:<br>Type: JEMSTAR (Ametex)<br>Model: JS-09R5102-B6<br>Serial numbers: 08 43 10967 and 08 43 10969<br>Accuracy class: 0.2 |

| | | |
|---|---|---|
| | Date of last verification | Both on March 17th 2010 |
| | Verification frequency | Every 3 years. |

Two Electricity meters located at La Higuera substation for La Confluencia hydro power project electricity generation:

| | |
|---|---|
| Type | SCHNEIDER ELECTRIC |
| Model | ION 8600B |
| Serial numbers | PT-0811A787-01 and PT-0811A800-01 |
| Accuracy class | 0.2 |
| Date of last verification | Both on January 13th 2011 |
| Verification frequency | Every 3 years. |

Two Electricity meters located at La Confluencia power plant:

| | |
|---|---|
| Type | SCHNEIDER ELECTRIC |
| Model | ION 8600B |
| Serial numbers | PT-0811A033-01 and PT-0811A187-01 |
| Accuracy class | 0.2 |
| Date of last verification | Both on January 13th 2011 |
| Verification frequency | Every 3 years. |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Continuous measurement and at least monthly recording. |
| Calculation method (if applicable): | N/A |
| QA/QC procedures applied: | Meter quality is governed by the *Normas Técnicas* and is required to have a maximum error of 0.2% under Chilean law. Meters are verified periodically according to local standards for electricity transactions in CDEC-SIC. The data is utilized by CDEC-SIC for determining the energy balance between generators. |

## SECTION E. Emission reductions calculation

### E.1. Baseline emissions calculation

>>

Baseline emissions include only CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \qquad \textbf{(Eq. 5)}$$

Where:

$BE_y$ = Baseline emissions in year y ($tCO_2$/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into de grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin $CO_2$ emissions factor for the Central Chilean grid (SIC) in year y ($tCO_2$/MWh)

### E.2. Project emissions calculation

>>The project activity does not consider any project emmissions, *PEy* = 0.

## E.3. Leakage calculation

>>As it is stated in ACM0002 version 12.1, no leakage emissions are considered.

## E.4. Emission reductions calculation / table

>> The ex-ante emission reductions are as follows:

$$ER_y = BE_y - PE_y \qquad \textbf{(Eq. 6)}$$

Where

$ER_y$ = Emission reduction in year y ($tCO_2e/yr$)
$BE_y$ = Baseline emissions in year y ($tCO_2e/yr$)
$PE_y$ = Project emissions in year y ($tCO_2e/yr$)
$y$ = a given year

As it was mentioned and according to the methodology ACM0002, emission reductions are equal to baseline emissions since there are no project emissions because generation is based on a renewable source and no leakage is expected. Therefore:

$$ER_y = BE_y \qquad \textbf{(Eq. 7)}$$

Then there are estimated the baseline emissions:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \qquad \textbf{(Eq. 8)}$$

Where

$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ **(Eq. 9)**

$EF_{grid,CM,y}$ = 0.797 * 0.5 + 0.494 * 0.5
$EF_{grid,CM,y}$ = 0.645 $tCO_2/MWh$

And

$EG_{PJ,y}$ = 55,510.4 MWh

Therefore, considering the estimation of the electricity supplied by the project to the grid ($EG_{PJ,y}$ = 55,510.4 MWh) and the Combined Emission factor ($EF_{grid,CM,y}$= 0.645 $tCO_2/MWh$) calculated as weighted average of the Operating Margin and the Build Margin of the grid (SIC), the baseline emissions, and consequently the Emissions reduction will be 35,804.2 $tCO_2e$.

**Estimation of Emission Reductions (Period: February 02nd 2011 – September 30th 2011)**

| Year | Estimation of baseline emissions reductions (tonnes of $CO_2$) | Estimation of project activity emissions reductions (tonnes of $CO_2e$) | Estimation of Leakage (tonnes of $CO_2e$) | Estimation of Emission Reduction (tonnes of $CO_2e$) |
|---|---|---|---|---|
| February 02nd 2011 – September 30th 2011 | 35,804.2 | 0 | 0 | 35,804.2 |
| **Total ($tCO_2e$)** | **35,804.2** | **0** | **0** | **35,804.2** |

Total baseline emissions: **35,804.2 $tCO_2e$**
Total project emissions: **0**
Total leakage: **0**

Total emission reductions: **35,804.2 $tCO_2$ e**

## E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>> Ex ante emission reductions from the PDD are 279,375 $tCO_2$. The monitoring period is from February 02nd 2011 – September 30th 2011.

| Year | Values applied in ex-ante calculation of the registered CDM-PDD ($tCO_2e$) | Actual values reached during the monitoring period ($tCO_2e$) |
|---|---|---|
| February 02nd 2011 – September 30th 2011 | 279,375 | 35,804.2 |
| **Total Emission Reductions ($tCO_2$ e)** | **279,375** | **35,804.2** |

## E.6. Remarks on difference from estimated value in the PDD

>>

Actual values of emissions reductions are 87% less than a pro rata estimate based on the annual PDD values, because the actual plant load factor has been lower than assumed. There are three main reasons for this:

- **Test period:** Full commercial operation was not reached until May 1st 2011. The initial period leading up to this date was a test period, where generation was sporadic.
- **Partial commissioning:** A realinement tunnel to bring water from the Portillo river into the scheme had to be constructed, and was not commissioned until December 2011. Until this date, only the Tingiririca branch was operational, and approximately 52% of the water was not available for generation.
- **Extreme drought:** 2011 has been a year of extreme drought in Chile. Very low precipitation has given approximately 90% lower inflow compared to a normal year.

## History of the document

| Version | Date | Nature of revision |
|---|---|---|
| 01 | EB 54, Annex 34<br>May 28, 2010 | Initial adoption. |
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