

**VALIDATION OF THE PROJECT:  
SHP MORRO AZUL CDM PROJECT (JUN1164)**

**Risaralda Energía S.A.S. E.S.P.  
(COLOMBIA)**

**REPORT NO. CDMVA-12-023-01**

**DECEMBER, 2012**

# VALIDATION REPORT VVS



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Audit team:	Erika Lucia Urrego Ortiz ICONTEC Lead Auditor Fernando Gomez Gomez ICONTEC Auditor/Technical Expert	Organizational unit:	Instituto Colombiano de Normas Técnicas y Certificación – ICONTEC Calle 53 No.58-33 Bogotá - Colombia
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## Summary

ICONTEC has performed the validation of the project: SHP Morro Azul CDM Project (JUN1164) in Colombia on the basis of UNFCCC criteria for the CDM, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to Article 12 of the Kyoto Protocol, the CDM modalities and procedures and the subsequent decisions by the CDM Executive Board. This validation report summarizes the findings of the validation.

The project activity consists in the construction of the Small Hydropower Plant Morro Azul with final installed capacity of 19.9 MW. The proposed project activity is located on the Risaralda River, Cauca River basin, in the municipalities of Belén de Umbria and Anserma – Risaralda and Caldas Departments, Colombia. The SHP will create a new reservoir with 0.1217 Km<sup>2</sup> and main purpose is to provide electric power to the National Interconnected System, displacing the thermal generation from fossil fuels present in the system with the generation of renewable energy. The plant will be managed by the Risaralda Energía S.A.S. E.S.P., a special purpose society responsible for the power plant construction and operation.

The proposed project activity under validation process is based on methodology ACM0002 version 13.0.0 and the following main tools: Tool to calculate the emission factor for an electricity system - Version 02.2.1, Tool for the demonstration and assessment of additionality - Version 06.1.0 and Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion - Version 02.

The validation process consisted of the following three phases: i) a desk review of the project design documents, ii) follow up interviews with project stakeholders and iii) the resolution of outstanding issues and the issuance of the final validation report and opinion. The first output of the validation process was the list of requests presented in Table 2 of Annex A.

The total emission reductions from the project are estimated to be on average 45,489 tCO<sub>2</sub>e per year over the selected 7 year crediting period, renewable.

In summary, it is ICONTEC's opinion that the project SHP Morro Azul CDM Project (JUN1164), as described in the version 2 of the project design document meets all relevant UNFCCC requirements for the CDM and all relevant host country criteria and correctly applies the baseline and monitoring methodology ACM0002 version 13.0.0. Hence, ICONTEC requests the registration of the project as CDM project activity.

Report No:	CDM-VA 12-023	Subject Group:	1	Indexing terms:
Report title:	Validation of the Project: SHP Morro Azul CDM Project (JUN1164)			Climate Change; Kyoto Protocol; Validation; Clean Development Mechanism

Work verified by	Eng. Francy Ramirez ICONTEC Technical reviewer Eng Cristian Grisales ICONTEC Technical Expert reviewer	<input checked="" type="checkbox"/> No distribution without permission from the Client or responsible organizational unit
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This report should not be read without reference to the annex A, Validation Protocol.

## Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CERs	Certified emission reductions
CL	Clarification Request
CO <sub>2</sub>	Carbon Dioxide
CO <sub>2</sub> e	Carbon dioxide equivalent
DNA	Designated National Authority
DOE	Designated Operational Entity
DR	Document Review
GHG	Greenhouse Gases
I	Interview
ICONTEC	Colombian Institute of technical standards and certification (Instituto Colombiano de Normas Técnicas y Certificación)
IPCC	Intergovernmental Panel on Climate Change
MoC	Modalities of Communication
MoV	Means of verification
MP	Monitoring Plan
PDD	Project Design Document
UNFCCC	United Nations Framework Convention for Climate Change
VVS	CDM Validation and Verification Standard
CHEC	Central Hidroeléctrica de Caldas S.A. E.S.P. (Colombia) (Hydroelectric Central of Caldas)
ANEEL	Agencia Nacional de Energia Elétrica (Brazil) (National Agency of Electric Energy)
UPME	Unidad de planeación minero energética (Colombia) (Mining and Energy Planning Unit)
CARDER	Corporación Autónoma Regional de Risaralda (Regional Autonomous Corporation of Risaralda)
DANE	Departamento Administrativo Nacional de Estadística (National Administrative Department of Statistics)

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## **1. INTRODUCTION**

Risaralda Energía S.A.S. E.S.P. has commissioned ICONTEC to perform the Validation of SHP Morro Azul CDM Project (JUN1164), (hereafter called “the project”).

This report summarizes the findings of the validation of the project, which was performed on the basis of UNFCCC criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

According to the documentation, the project activity consists in the construction of the Small Hydropower Plant Morro Azul with new single reservoir and final installed capacity of 19.9 MW.

### **1.1. OBJECTIVE**

The purpose of a validation is to obtain the opinion of an independent third party in order to assess the project’s design. In particular, the project's baseline, the monitoring plan, and the project’s compliance with relevant UNFCCC, and Host Party’s criteria are validated in order to confirm that the project design, as documented, is sound and reasonable and meets the identified criteria. Validation is a requirement for all CDM projects and is seen as necessary to provide assurance to stakeholders of the quality of the project and its intended generation of certified emission reductions (CERs).

### **1.2. SCOPE**

The validation scope involves an independent and objective revision to determine that the project design meets the following criteria:

- UNFCCC criteria: The Kyoto Protocol Article 12 criteria, modalities and procedures for CDM (Marrakech Accords) and the relevant decisions by the CDM Executive Board, and
- Host Party criteria: National CDM requirements, including sustainable development priorities, and potential specific requirements contained in, for example, the preliminary approval by Designated National Authority or project agreements between involved parties.

ICONTEC, based on its ethics code and internal procedures for carrying out validation, verification and certification audits of CDM project activities (which, in turn, are based on the validation and verification manual) focused on the identification of significant risks for CER generation, as well as verification of the mitigation.

The validation does not signify the providing of any consulting for the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the project design.

### **1.3. GHG PROJECT DESCRIPTION**

The project activity consists in the construction of the Small Hydropower Plant Morro Azul with final installed capacity of 19.9 MW. /1/.

The SHP Morro Azul is located on the Risaralda River, Cauca River basin, in the municipalities of Belén de Umbria and Anserma – Risaralda and Caldas Departments, Colombia. The SHP will create a new reservoir with 0.1217 Km<sup>2</sup>. The plant will be managed by the Risaralda Energía S.A.S. E.S.P., a special purpose society responsible for the power plant construction and operation.

Risaralda Energía S.A.S. E.S.P. is a subsidiary of ALUPAR, which belongs to group ALUSA Holding of Brazil.

The enterprise was conformed according to legal requirements of host country, ICONTEC validated this information with the register of the company in Chamber of Commerce de Bogotá, through of Certificate of Incorporation of the company Risaralda Energía S.A.S E.S.P, on September 6, 2011, registered on September 8, 2011 with the number 01511041 of book IX./13/.

The project activity main purpose is to provide electric power to the National Interconnected System, displacing the thermal generation from fossil fuels present in the system with the generation of renewable energy.

It is expected that more than 318,423 tCO<sub>2e</sub> emitted to the atmosphere will be avoided over a period of 7 years in 1<sup>st</sup> February 2015 to 31<sup>th</sup> January 2022. The resulting emission reductions from the project activity are estimated in average 45,489 tCO<sub>2e</sub> per year. /2/.

The Methodology and tools applicable to the project activity under validation process are:

ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources - Version 13.0.0 - (valid from 11 May 2012 onwards).

- Tool to calculate the emission factor for an electricity system - Version 02.2.1 – (valid from 29 September 2011 onwards);
- Tool for the demonstration and assessment of additionality - Version 06.1.0 – (valid from 13 September 2012 onwards);
- Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion - Version 02 (valid from 2 August 2008 onwards).

All documents referred above can be obtained at the UNFCCC website.

ICONTEC confirmed through the on site visit and interview that the project complies with the accuracy and completeness of the project description.

## **2. METHODOLOGY**

The validation consists of the following three phases:

- i) A desk review of the project design documents
- ii) Follow up interviews with project stakeholders
- iii) The resolution of outstanding issues and the issuance of the final validation report and opinion.

As mentioned in clause 1.2 of this report ICONTEC, based on its ethics code and internal procedures, carries out validation, verification and certification audits of CDM project activities (which, in turn, are based on the validation and verification manual) focused on the identification of significant risks for CER generation, and verification of the contribution to climate change mitigation.

All documentation review during the validation process has been including in the chapter 6 - references.

The validation protocol resulting from the Validation of SHP Morro Azul CDM Project (JUN1164) is enclosed in Annex A of this report.

Findings established during the validation can be seen as:

- A non-fulfillment of validation protocol criteria, or
- An identified risk to the fulfillment of the project objectives

The findings could take the form of a Corrective Action Request (CAR), Forward action request (FAR) or a Clarifications Request (CL).

Corrective action requests (CAR) are issued, where:

- The project participants have made mistakes which directly will influence the ability of the project activity to achieve real, measurable and additional emission reductions;
- The CDM requirements have not been met; or
- There is a risk that emission reductions cannot be monitored or calculated

A Forward Action Request is made to highlight issues related to project implementation that will require review during the next verification of the project activity.

A Clarification is required where information is insufficient, or not clear enough to establish whether a requirement is met.

## 2.1. FOLLOW UP INTERVIEWS

ICONTEC performed interviews with project stakeholders to confirm the selected information and to resolve issues identified during the desk review. The main topics of the interview are summarized in table 1.

**Table 1: Follow up Interview**

DATE	PLACE	INTERVIEW DELEGATE	ORGANIZATION	INTERVIEW TOPICS
06/11/2012	OFFICE'S RISARALDA ENERGIA	ARTHUR MORAES	CARBOTRADER ASSESSORIA E CONSULTORIA EM ENERGIA	ADDITIONALITY CER'S CALCULATION EF CALCULATION FINANCIAL CALCULATION
06/11/2012	OFFICE'S	TATIANA RUEDA	RISARALDA	ENVIRONMENTAL



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	RISARALDA ENERGIA		ENERGIA S.A.S E.S.P	TOPICS
06/11/2012	OFFICE'S RISARALDA ENERGIA	CELSO SILVA	RISARALDA ENERGIA S.A.S E.S.P	ACTIVITY PROJECT DESCRIPTION TECHNOLOGY ADDITIONALITY FINANCIAL CALCULATION
07/11/2012	CITY HALL OF BELEN DE UMBRIA	JAIME GRAJALES	MAYOR BELEN DE UMBRIA	STAKEHOLDER CONSULTATION
07/11/2012	CITY HALL OF BELEN DE UMBRIA	JAIME RENGIFO	COUNCILOR OF BELEN DE UMBRIA	STAKEHOLDER CONSULTATION
07/11/2012	CITY HALL OF BELEN DE UMBRIA	JOHN FREDY MONTES	MUNICIPAL OMBUDSMAN	STAKEHOLDER CONSULTATION
07/11/2012	CITY HALL OF ANSERMA	JORGE IVAN DUQUE	MAYOR ANSERMA	STAKEHOLDER CONSULTATION
07/11/2012	ANSERMA	JORGE ALBERTO ESCOBAR	COMMUNITY	STAKEHOLDER CONSULTATION
07/11/2012	MUNICIPALITY'S BELEN DE UMBRIA AND ANSERMA	ELSY PATRICIA VELASQUEZ	SOCIAL WORKER RISARALDA ENERGIA S.A.S E.S.P	RESPONSIBLE OF THE COMMUNICATION WITH THE COMMUNITY
07/11/2012	MUNICIPALITY'S BELEN DE UMBRIA AND ANSERMA	GONZALO SAAVEDRA	CIVIL ENGINEER RISARALDA ENERGIA S.A.S E.S.P	RESPONSIBLE OF THE IDENTIFY OF LANDS

### 2.2. RESOLUTION OF CLARIFICATION AND CORRECTIVE ACTION REQUESTS

Corrective action and clarification requests raised by ICONTEC, presented to the project participants were resolved through communication and meetings between RISARALDA ENERGIA S.A.S E.S.P and ICONTEC. To guarantee the transparency of the validation process, the concerns raised and the response provided by the project participants are documented in more detail in the validation protocol in Annex A.

Since modifications to the project design document were necessary to resolve ICONTEC's concerns, the client decided to review the PDD and re-submit corrected versions of the PDD. After the period of public consultation (31/08/2012 to 29/09/2012) and after reviewing the last version of the PDD (version 2), ICONTEC issued this validation report and opinion.

### 2.3. INTERNAL QUALITY CONTROL

This report that includes the validation findings underwent a technical review before being submitted to the project participants.

The technical review and the quality control of the process was performed by an internal technical reviewer in accordance with ICONTEC internal procedures for carrying out validation, verification and certification audits of CDM project activities. The technical reviewers are qualified in accordance with ICONTEC qualification scheme for CDM validation and verification.

## 2.4. VALIDATION TEAM

The validation team consists of the following personnel:

**Table 2: Validation Team**

ROLE/QUALIFICATION	LAST NAME	FIRST NAME	COUNTRY
Lead Auditor	Urrego Ortiz	Erika Lucia	Colombia
Energy and financial Technical expert	Gomez Gomez	Fernando	Colombia
ICONTEC CDM and Technical reviewer	Ramirez	Francy	Colombia
ICONTEC financial and energy expert reviewer	Grisales	Cristian	Colombia

The validation team is qualified in accordance with ICONTEC qualification scheme for CDM validation and verification. (CV's: see Annex C).

## 3. VALIDATION FINDINGS

### 3.1. OVERVIEW

The findings of the validation are stated in the following sections. The validation criteria (requirements), the means of verification and the results from validating the identified criteria are documented in more detail in the validation protocol in Annex A.

### 3.2. GENERAL REQUIREMENTS

#### 3.2.1. APPROVAL AND AUTHORIZATION

The project participant of the project is: Risaralda Energía S.A.S. E.S.P.

The participation of the project participant has been approved by the Climate Change Division of Environment and Sustainable Development Ministry, DNA of Colombia under letter of approval dated on 28/11/2012. /3/

The host country meets all participation requirements, and the Designated National Authority of the host country has approved the project with the letter of approval describing as follows:

**Table 3: Approval Letter**

Date of issue:	28/11/2012
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<i>Description:</i>	<i>It provides confirmation that the project contributes to the country in the search of sustainable development</i>		
<i>Supporting documentation (if it is applicable)</i>	<i>Annex B LoA Morro Azul.pdf</i>		
<i>Date of ICONTEC reception</i>	<i>30/11/2012</i>		
<i>Entity that sent the letter to ICONTEC</i>	<i>Project participants</i>	<i>Directly from the DNA</i>	
	<i>X</i>		
<i>Means of validation employed to assess the authenticity</i>	<i>Through of e-mail sent for the DNA to ICONTEC at 17/12/2012, issued by Eng. Maria Margarita Gutierrez Arias, advisor of the Vice-Minister of environment and sustainable development (DNA of the host country), the DOE verify that the letter of approval is authentic.</i>		
<i>Additional specification (if it is applicable)</i>		<i>YES</i>	<i>NO</i>
			<i>version number<sup>1</sup></i>
	<i>PDD</i>		<i>X</i>
			<i>2</i>
<i>ICONTEC Conclusion</i>	<p><i>All parties involved have approved the project activity. The letters is authentic and valid for the proposed CDM project activity under validation. It confirms and it is unconditional with respect to:</i></p> <p><i>(a) The Party is a Party to the Kyoto Protocol;</i></p> <p><i>(b) Participation is voluntary;</i></p> <p><i>(c) In the case of the host Party, the proposed CDM project activity contributes to the sustainable development of the country;</i></p> <p><i>(d) It refers to the precise proposed CDM project activity title in the PDD being submitted for registration.</i></p>		

### 3.2.2. MODALITIES OF COMMUNICATION

According to paragraph 53 of the VVS, ICONTEC validated the corporate identity of focal points included in the modalities of communication (MoC) statement, through of the document Proxy Statement, it is signature by Mr. Guilherme Di Cavalcanti Mello Neto legal representative of Risaralda Energía S.A.S E.S.P.

In this document was indicated that the focal point is Mr. Celso Da Silva, financial and administrative manager. The document has date 01/11/2012. /4/

ICONTEC, confirm that the form Modalities of Communication Statement (Version 02.1), was correctly used.

### 3.3. PROJECT DESIGN

The project has been developed using the methodology ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources - Version 13.0.0.

<sup>1</sup> This version is the same submitted for registration

According to the applied methodology the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. The description of the project has been confirmed through the following document of the enterprise *hicon: Engenharia de recursos hidricos*, ([www.hicon.com.br](http://www.hicon.com.br)), which made by Alupar e hicon on December 2011, the hidrologycal study about the river Risaralda. Document: CH Morro Azul – Estudos Hidrológicos e Energéticos para Projeto Básico – ALUPAR 008/11. File: Estrudos hidrológicos.pdf /5/. During the validation the audit team issued the CAR 1, CL 1 and CL 2 for clarify the description of the project activity. This situation was corrected on the last version of the PDD and the description of how each finding was closed it is found in the Table A 2: Resolution of Corrective Action, Forward Action and Clarification Request of Annex A validation protocol.

The emissions sources and GHGs involved are CO<sub>2</sub> emissions from electricity generation in fossil fuel fired power plants in the national interconnected system.

The technology used in the enterprise is the use of hydro energy potential of the Risaralda river for electricity generation by the gravitational energy of the water, which is used to move the turbines and trigger generators that enable the generation of electricity. This is a source of clean and renewable energy that presents low impact on the environment.

The capacity installed will be 19.90 MW, using 3 generators and turbines type Francis. It is expect have an annual generation of 123,691 MWh, with flow 15.27 m<sup>3</sup>/s average.

The Small Hydropower plant Morro Azul will dispatch generated energy to the National Interconnected Grid in the Substation Anserma 33 kV owned by CHEC, through its step-up substation (13.8 / 33 KV) located close to the machine house of the plant. This information was confirmed through of web page of Central Hidroeléctrica de Caldas S.A. E.S.P. - CHEC <http://www.chec.com.co/drupal3/node/48>. CHEC is responsible for the administration of this substation.

The assured energy reported on the PDD is 14.12 MW average, this information was confirmed through of document: CH Morro Azul – Estudos Hidrológicos e Energéticos para Projeto Básico – ALUPAR 008/11. File: Estrudos hidrológicos.pdf /5/. This document presents the energy, of the study of power. It was made by Alupar e hicon on December, 2011.

30 years will be the lifetime of the equipments average according to technical specifications of the manufacturer. This information was confirmed through of document: *Estudo de Vida Útil Econômica e Taxa de Depreciação.pdf*, /6/ consulted on line on [http://www.aneel.gov.br/aplicacoes/audiencia/arquivo/2006/012/documento/relatorio\\_vida\\_util\\_vOLUME\\_2.pdf](http://www.aneel.gov.br/aplicacoes/audiencia/arquivo/2006/012/documento/relatorio_vida_util_vOLUME_2.pdf). This study was made by Escola Federal de Engenharia de Itajubá and CERNE - Centro de Estudos em Recursos Naturais e Energia on November, 2000 for Agencia Nacional de Energia Elétrica – ANEEL of Brazil.

Through reviewing of physical document: Study of Connection hydroelectric generation project Morro Azul , with a capacity of 20 MW in the department of Risaralda. Version October 2012, Revision 1 (*Estudio de conexión del proyecto de generación hidroeléctrico Morro Azul con una capacidad de 20 MW en el departamento de Risaralda. Version Octubre de 2012, Revision 1*) /7/, ICONTEC could validate that the energy will be transported in single circuit line of 33 kV and delivered to Anserma's substation. This document is the single line diagram. This study was made by Applus Norcontrol Colombia Ltda (third party company). [www.appluscorp.com.co](http://www.appluscorp.com.co).

The enterprise MEK Engenharia (<http://www.mek.com.br>), was responsible for the design of the project. This enterprise is Brazilian and was contracted by Risaralda Energía S.A.S E.S.P. for development physical planes of the project.

These documents were consulted by ICONTEC to confirm the descriptive design of the Project /8/:

- Name: Plano No. MZL-PBC-036 Proyecto Básico Consolidado. Casa de maquinas, plano general Escala 1:200. Realizado el 28/09/2012. (Consolidated basic project. power machine, general plan scale 1:200. Made on 28/09/2012).
- Name: Plano N. MZL – PRE-021 Proyecto básico. Plano general de emprendimiento. Planta. Realizado el 21/09/2012. (Basic Project. General plan of entrepreneurship. Plant. Made on 21/09/2012).

For the measured of the energy generated will be installed two electrical meters (main and back up) on the plant's substation and two electrical meters (main and back up) in the commercial frontier at CHEC's Anserma substation that make the invoicing. The electrical meters will be bidirectionals. This information was obtained by interview during the on site visit.

The project is large scale and complies with the applicability criteria of the methodology ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources - Version 13.0.0, as was verified by ICONTEC, as follows:

**Table 4: Methodology Applicability Conditions Analysis**

Applicability condition	Means of validation
This methodology is applicable to grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	During the on site visit, the audit team confirmed that the project is new and comply the option a) of the methodology. This information is supported with the references /5/ and /8/.
The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or	Not applicable. During the on site visit at place of the project, the audit team confirm that there is not reservoir. By this, the designs of the project include the construction of a reservoir. /5/ /8/.
The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir the project activity, as per the definitions given in the Project Emissions section, is greater than 4 W/m <sup>2</sup> after the implementation of the project activity	Not applicable. During the on site visit at place of the project, the audit team confirmed that there is not reservoir. By this, the designs of the project include the construction of a reservoir. /5/ /8/.
The project activity results in new single	The project design /5/, /8/ and /9/ show that the

or multiple reservoirs and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m<sup>2</sup>.

area of the reservoir will be of 12.17 ha. This information was confirmed with the document: *Reservatorio da PCH Morro Azul. Made by Alupar on 10/08/2011. File: Reservatorio Morro\_Azul.pdf. /9/.*

The result of the power density is:  $19.9 \times 10^6 / 12.17 \times 10^4 = 163 \text{ W/m}^2$ , is greater than 4 W/m<sup>2</sup>. It complies the applicability condition of the methodology.

In accordance with the project activity and the selected methodology the emission sources are properly described in the PDD version 2 in compliance with Guidelines for completing the project design document form (Version 01.0) and the “F-CDM-PDD - Project Design Document form, version 04.1”. The greenhouse gas emissions occurring within the project boundary as a result of its implementation are all addressed by the applied methodology. There are no greenhouse gas emissions within the project boundary and caused by the implementation of the project activity that contribute to more than 1% of the expected annual emission reductions and that are not addressed by the applied methodology. This was verified by ICONTEC by means of the onsite visit.

ICONTEC concludes that the project description, as included in the PDD version 2, is sufficiently complete and accurate as to meet CDM requirements.

### 3.4. BASELINE DETERMINATION

The baseline determination has been developed using methodology ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources - Version 13.0.0.

According to this methodology, the baseline has been identified as: *“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 generating sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.*

The baseline emissions are the product of electrical energy baseline  $EG_{BL,y}$  expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

#### Electrical energy baseline $EG_{BL}$ :

For ex-ante estimation of baseline emissions, the electric energy baseline  $EG_{BL,y}$  was assessed as 123,691 MWh, corresponding to the “assured energy” of 14.12 MW.

#### Grid emission factor calculation:

The grid emission factor has been calculated by the PP by applying the Tool to calculate the emission factor for an electricity system - Version 02.2.1 /42/, using the data provided by the national sectorial authorities. The DOE verified each source provided on the spreadsheet as explained at the end of the steps /30/.



Next is the validation by the DOE of the grid emission factor calculation.

### Step 1. Identify the relevant electricity system

For determining the electricity emission factor, the PP has defined the Colombian National Interconnected System as the relevant project electricity system. The DOE agrees, taking into account that the project will provide electricity to the national grid, and in the project boundary presentation it is clear that Colombian national grid satisfies the conditions for the relevant electricity system as claimed by the tool.

### Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants decided to include only grid power plants in the calculation (**Option I**), which is accepted by the DOE, since it is optional to the PP.

### Step 3: Select a method to determine the operating margin (OM)

The PP selected the method (b), Simple adjusted OM, with data vintage ex-ante. It is known by the validation team that in the Colombian interconnected system low-cost/must-run resources constitute more than 50% of total grid generation in average of the five most recent years or based on long-term averages for hydroelectricity production, as it was demonstrated by the PP in the spreadsheet *CERs\_MA\_v2*, tab *EF grid /2/*. Therefore the Simple OM method cannot be used and Simple adjusted OM is acceptable. Besides, the PP justified the use of ex-ante vintage of data, and the OM emission factor does not require to be recalculated during the crediting period.

### Step 4: Calculate the operating margin emission factor according to the selected method

Formula (7) of the Tool was used to calculate the OM emission factor, as follow:

$$EF_{grid, OM-Adj, y} = (1 - \lambda_y) \frac{\sum_m EG_{m, y} * EF_{EL, m, y}}{\sum_m EG_{m, y}} + \lambda_y \frac{\sum_k EG_{k, y} * EF_{EL, k, y}}{\sum_k EG_{k, y}}$$

Where,

$EF_{grid, OM-adj, y}$	=	Simple adjusted operating margin CO <sub>2</sub> emission factor in year y (tCO <sub>2</sub> /MWh)
$\lambda_y$	=	Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year y
$EG_{m, y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EG_{k, y}$	=	Net quantity of electricity generated and delivered to the grid by power unit k in year y (MWh)
$EF_{EL, m, y}$	=	CO <sub>2</sub> emission factor for power unit m in year y (tCO <sub>2</sub> /MWh)
$EF_{EL, k, y}$	=	CO <sub>2</sub> emission factor for power unit k in year y (tCO <sub>2</sub> /MWh)
m	=	All grid power units serving the grid in year y except low-cost/must-run power units
k	=	All low-cost/must run grid power units serving the grid in year y

$y$  = The relevant year as per the data vintage chosen in Step 3

To calculate the CO<sub>2</sub> emission factors  $EF_{EL,(m,k),y}$  of power unit  $(m,k)$  in year  $y$  (tCO<sub>2</sub>/MWh), Option A2 was used, as data on electricity generation and the fuel types and the efficiency of the power unit are available. However, under this option the following approach was used by the PP, instead of formula (3) of the Tool:

$$EF_{EL,(m,k),y} = HR_{(m,k)} * EF_{CO2,i,(m,k),y}$$

Where

$EF_{EL,(m,k),y}$  = CO<sub>2</sub> emission factor of power unit  $(m,k)$  in year  $y$  (tCO<sub>2</sub>/MWh)

$HR_{(m,k)}$  = Heat Rate, inverse of the efficiency of power unit  $(m,k)$  (MBTU/MWh), (GJ/MWh)

$EF_{CO2,i,(m,k),y}$  = CO<sub>2</sub> emission factor of fuel type  $i$  used in power unit  $n$  in year  $y$  (tCO<sub>2</sub>/TJ) obtained from IPCC

$i$  = Type of fuel used by the unit  $(m,k)$

This approach is deemed satisfactory for the DOE, since is equivalent to the original formulation (eq. (3)) in the Tool.

Regarding the parameter  $\lambda_y$ , the DOE verified that it was calculated according to formula (8) of the Tool, following adequately the four steps described in the Tool and using the right data.

#### Step 5: Calculate the build margin (BM) emission factor

In calculating BM emission factor option 1 (ex-ante) for vintage of data was selected. This choice was adequately justified by the PP.

In order to select the group of power unit  $m$  to calculate the BM emission factor, the procedure (a) to (d) indicated in the Tool was properly followed by the PP (steps (e), (f) were not necessary). The set of plants selected was that comprising at least 20% of the annual electricity generation.

The BM emission factor was calculated using the formula (12) of the Tool, as follow:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where,

$EF_{grid,BM,y}$  = Build margin CO<sub>2</sub> emission factor in year  $y$  (tCO<sub>2</sub>/MWh)

$EG_{m,y}$  = Net quantity of electricity generated and delivered to the grid by power unit  $m$  in year  $y$  (MWh)

$EF_{EL,m,y}$  = CO<sub>2</sub> emission factor of power unit  $m$  in year  $y$  (tCO<sub>2</sub>/MWh)

$m$  = Power units included in the build margin

$y$  = Most recent historical year for which power generation data is available

In calculating the CO<sub>2</sub> emission factors  $EF_{EL,m,y}$  of power unit  $m$  in year  $y$  (tCO<sub>2</sub>/MWh), an approach similar to that used in operating margin calculations was used. Therefore this approach is deemed satisfactory by the DOE.



Step 6 : Calculate the combined margin emissions factor

*The combined margin emissions factor is calculated as follows:*

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

Where,

$EF_{grid,BM,y}$  = Build margin CO2 emission factor in year y (tCO2/MWh)  
 $EF_{grid,OM,y}$  = Operating margin CO2 emission factor in year y (tCO2/MWh)  
 $W_{OM}$  = Weighting of operating margin emissions factor (%)  
 $W_{BM}$  = Weighting of build margin emissions factor (%)

The weights  $W_{OM}$  and  $W_{BM}$  have been given default value according to the methodological Tool, thereby:

For the first crediting period:

$$W_{OM} = 0.5; W_{BM} = 0.5$$

For the second and third crediting periods:

$$W_{OM} = 0.25; W_{BM} = 0.75$$

The PP presented the spreadsheet *Emission factor calculation for MAzul\_v1.xls /30/*, comprising the following tabs:

Gen SIN 2010  
 Gen per hour 2008  
 Gen per hour 2009  
 Gen per hour 2010  
 OM 2008  
 OM 2009  
 OM 2010  
 HR  
 Fuel EF  
 BM 2010  
 Lambda 2008  
 Lambda 2009  
 Lambda 2010  
 EF Analysis  
 Operational Date

The DOE revised in deep detail the spreadsheet and tabs /30/, and verified the correct application of the formulae just described for calculate the grid emission factor. The sources of data were also verified in deep detail and a number of random cross checks were made with successful results.

Therefore the DOE is able to validate the following grid emission factors calculated by the PP for the first crediting period:

$$EF_{grid,OM,y} = 0.54340 \quad (\text{tCO}_2/\text{MWh})$$

$$EF_{grid,BM,y} = 0.19215 \quad (\text{tCO}_2/\text{MWh})$$

$$EF_{grid,CM,y} = 0.36777 \quad (\text{tCO}_2/\text{MWh})$$

According to the previous description ICONTEC found that the project participant has correctly applied the selected methodology with respect to the Baseline identification. The scenario selected reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the proposed CDM project activity. All estimates of the baseline emissions can be replicated using the data and parameter values provided in the PDD.

Additionally, ICONTEC verified by reviewing the project design documentation and the on-site visit that the project is not expected to result in emissions other than those allowed by the methodology.

### 3.5. ADDITIONALITY

#### 3.5.1. PRIOR CONSIDERATION OF THE CDM

The start date of the project was identified as 01/01/2013, was confirmed on interview with administrative and financial manager and cross check with the project activity implementation schedule /12/ signed for general manager. This is the date forecasted to the small hydro power plant implementation start. According to this date the project is considered as a new project activity with a start day after 02 August 2008. In this framework, ICONTEC verified the following evidence to ensure the early consideration of the CDM.

- A PDD version 1 has been published for global stakeholder consultation during the period 31/08/2012 to 29/09/2012. ICONTEC verified on: <http://cdm.unfccc.int/Projects/Validation/DB/XYXMUHIP6FZFBPHZ16PDW9W0CQZNN/C/view.html>
- PP has notified (Form F-CDM-Prior consideration) to the UNFCCC Secretariat of their intention to seek CDM status by means of communication published in the UNFCCC at 20/10/2011, as the DOE verified in <http://cdm.unfccc.int/Projects/PriorCDM/notifications/index.html>.
- Letter No. ALP-562-11 sent from Alupar to Ministry of Environment with the form prior consideration of the UNFCCC. 17/10/2011. File: 1 - Ofício PCH Morro Azul.pdf /10/.
- PP has notified (Form F-CDM-Prior consideration) to the Colombian DNA with Letter of Ministry of Environment and Sustainable Development issued 24th November 2011. /11/. The audit team found an inconsistency and issued the CL 3. This situation was corrected on the last version of the PDD and the description of how each finding was closed it is found in the Table A 2: Resolution of Corrective Action, Forward Action and Clarification Request of Annex A validation protocol.
- October 10, 2011 was the time of the investment decision taken by the project participant. This data was confirmed on minutes of council administration of Alupar. File: 2011 10 10 ARCA - iniciar trabalhos hidreletrica Agua Limpa.pdf /12/.

Hence, in accordance with the VVS /39/ paragraphs § 106, 107 and 108, the project activity complies with the requirements of prior consideration of the CDM.

### 3.5.2. ADDITIONALITY ANALYSIS

According to the “Methodology ACM0002 - Consolidated baseline methodology for grid connected electricity generation from renewable sources” (version 13.0.0),/40/ the additionality of the project activity has been demonstrated and assessed applying the “Tool for the demonstration and assessment of additionality” (Version 06.1.0) /41/.

The following are the validation issues related to the steps of the tool, as addressed by the PP inside the PDD (section B.5) and cross checked by ICONTEC during the review documentation process:

#### **Step 1: Identification of alternatives to the project activity consistent with current laws and regulations.**

##### **Sub-step 1a: Define alternatives to the project activity:**

Given that the applied methodology (ACM0002 - Consolidated baseline methodology for grid connected electricity generation from renewable sources” (version 13.0.0)) prescribes the baseline scenario, according to Paragraph 115 of the VVS analysis of alternatives is not required.

##### **Sub-step 1b: Consistency with mandatory laws and regulations:**

In sub-step 1b the PDD establishes the regulatory mark applicable to the Morro Azul power plant. The DOE, based on its knowledge and expertise with the Colombian electricity sector deems that this project is in compliance with mandatory laws and regulations applicable. As evidence, the DOE verified that the project has been registered under number 20121500017671 issued at 30/05/2012 /15/ in the Mining and Energy Planning Unit (UPME - from Spanish *Unidad de Planeación Minero-Energética*). This register was confirmed through webpage: [http://www.siel.gov.co/siel/documentos/documentacion/Generacion/PROYECTOS\\_2012\\_SEPT.pdf](http://www.siel.gov.co/siel/documentos/documentacion/Generacion/PROYECTOS_2012_SEPT.pdf)

Through the following records was validated legislation compliance:

Files: B&U 1.pdf and B&U 2.pdf. /14/ In these documents of November, 2012, the enterprise Brigard & Urrutia lawyers indicate the legal requirements applied to Morro Azul project.

ICONTEC verified that the project company is being advised by the law firm *Brigard & Urrutia Abogados* one of the most prestigious in the country, therefore the DOE considers that the project participant has capacity for comply the legislation applicable.

#### **Step 2: Investment analysis:**

An investment analysis was performed in order to demonstrate that the Morro Azul power project is not economically/financially feasible without the revenues from the Certified Emission Reductions (CERs).

A benchmark analysis (Option III of the “Tool for the demonstration and assessment of additionality”) was used. The DOE considers that this is the right decision, taking into account

that there are no project alternatives to be compared, and the project does generate economic benefits other than CDM related income.

The financial indicator selected was the project internal rate of return (Equity IRR) and the benchmark indicator was the Cost of Equity (Ke) extracted from the Weighted Average Costs of Capital (WACC) calculation. These financial indicators are deemed suitable by the DOE, as they are appropriate for this kind of project, taking into account also that this is a common practice in analyzing energy projects.

### **Cost of Equity (Benchmark) determination:**

The cost of equity was calculated as the sum of a tax free of risk plus a host country (Colombia) risk premium plus a global risk premium to the equity investment. The data are presented on the file: WACC\_Morro Azul\_v2\_1.xls /24/:

$$K_e = GB + PE_g$$

Where:

$K_e$  = Cost of equity;

GB = Tax Free of Risk ( $R_f$ ) + Host country risk premium (ERP)

$PE_g$  = Global Equity risk premium

The DOE agrees that this methodology of calculation follows the recommendations to the calculation of the Cost of Equity presented in the "Guidelines on the assessment of investment analysis" (EB 62 Annex 5).

Next are the values used and calculations. Ahead is the DOE validation

$$\text{Tax Free of Risk } (R_f) = 5.8\%$$

$$\text{Host country risk premium (ERP)} = 3.3\%$$

$$\text{So that, } GB = 5.8\% + 3.3\% = 9.1\%$$

$$\text{Global Equity Risk Premium } (PE_g) = \beta_l * RP$$

Where,

$$\beta_l: \text{Levered } \beta \text{ for Risaralda Energía S.A.S. E.S.P.} = 0.55$$

$$RP: \text{Total country risk premium} = 8.0\%$$

$$\text{So that, } PE_g = 0.55 * 8.0 = 4.4\%$$

Then,

$$K_e = 9.1 + 4.4 = 13.5\%$$

Finally, inflation rate was excluded to obtain real terms:

$$K_e \text{ (real terms)} = 13.5\% - 3.16\% = 10.34\% \text{ (rounded figures)}$$

Ke (real terms) = 10.29% (exact figures in the spreadsheet)

## DOE Validation:

- Rf (Tax free of risk, 5.8%) was estimated as the average of return rates of American Bond (T-Bond) for the period 2001-2010. Verified by the DOE in:

[http://pages.stern.nyu.edu/~adamodar/New\\_Home\\_Page/datafile/histret.html](http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histret.html)

- ERP (Host country risk premium, 3.3%) was estimated as the average of Colombian Risk Premium, based on data from JP Morgan corresponding to years 2001 to 2010. Verified by the DOE in

<http://www.ambito.com/economia/mercados/Riesgo-historico.asp?idpais=4>

-  $\beta_l$  (Levered  $\beta$  for Risaralda Energía S.A.S. E.S.P., 0.55) was calculated using in reverse the known formula:

$$\beta_i^{Desalavancado} = \left( \frac{\beta_i^{Alavancado}}{1 + \frac{D_i}{E_i}(1-T)} \right)$$

Where:

$\beta$  (unlevered  $\beta$ ) was calculated with the average  $\beta$  for the power industry companies in Colombia (unlevered  $\beta = 0.33$ ), the ratio Debt/Equity for the project ( $D/E=1.0$ ) and the corporate tax rate ( $T=0.33$ , as per fiscal regulation)

The DOE verified that unlevered  $\beta$  for the electric energy companies in Colombia was suitably selected from

<http://www.stern.nyu.edu/~adamodar/pc/archives/emergcompfirm10.xls>

D/E ratio for Cost of Equity calculations is assumed equal 1 (50/50), in spite of in IRR calculations Debt is considered as 60% of the total investment (60/40). Nevertheless, the DOE deems this assumption is conservative.

- RP (Total country risk premium, 8.0%) was taken from Aswath Damodaran -

[http://pages.stern.nyu.edu/~adamodar/New\\_Home\\_Page/datafile/ctryprem.html](http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html), which was verified by the DOE.

- The inflation adjustment (3.16%) was made based on the relative variation of the Colombian inflation respect to the US inflation, as the average variation from the period 2001 to 2010. The DOE verified the data used in

[http://www.dane.gov.co/index.php?option=com\\_content&view=article&id=348&Itemid=76](http://www.dane.gov.co/index.php?option=com_content&view=article&id=348&Itemid=76),

where the spreadsheet *IPC\_Variacion DANE.xls* /31/ was obtained and used to confirm the inflation data used in the PDD. (DANE: National Administrative Department of Statistics, is the official source of economics data in Colombia; IPC: Consumers Index Price).

ICONTEC considers that the calculation of the Cost of Equity (Benchmark) is based on methodologies generally accepted. The parameters used were validated and cross checked through the given references, they are publicly available and standard in the market, as appropriate, given that the project could be developed by an entity other than the project participant. Also, the DOE confirms that the data used to benchmark calculations are valid at the investment decision time, namely 10/10/11.

Therefore, ICONTEC considers that a cost of equity of 10.29% is a suitable and reasonable benchmark to analyze the financial attractive of SHP Morro Azul CDM project.

### Equity IRR calculations:

Equity IRR for the project was calculated by the PP by means of the finance model executed in the spreadsheet Analise\_Fin\_MA\_v2\_2.xls /24/.

Following the directions of EB 41 Annex 12, next is the list of all input values, with sources and references, used in the cash flow calculations for determining the Equity IRR, as presented by the PP in the spreadsheet Analise\_Fin\_MA\_v2\_2.xls, tab "Assumptions".

**Table 5: Investment Analysis Parameters**

ITEM	VALUE	UNIT	Validation Analysis
<b>Total Investment</b>	<b>(117,060,441)</b>	COP (000)	The data present on the budget, file: Oramento Alupar_Morro /25/ and Letter from Financial Institution (Bancolombia) /26/
<b>Equity</b>	<b>(46,824,176)</b>	COP (000)	PP Estimation on file Analise_Fin_MA_v2_2.xls /24/ and Letter from Financial Institution (Bancolombia) /26/
<b>Debt</b>	<b>(70,236,265)</b>	COP (000)	PP Estimation on file Analise_Fin_MA_v2_2.xls /24/ and Letter from Financial Institution (Bancolombia) /26/
<b>Loan Interest</b>	<b>7.25%</b>	per year	PP Estimation on file Analise_Fin_MA_v2_2.xls /24/ and Letter from Financial Institution (Bancolombia) /26/
<b>Installed Power</b>	<b>19.9</b>	MW	Expert Independent Study (Hicon page 35 Frame 20) /5/ and Letter from Financial Institution (Bancolombia) /26/
<b>Assured Energy</b>	<b>14.12</b>	Mwmed	Expert Independent Study (Hicon page 35 Frame 20) /5/ and Sponsor Budget /25/
<b>Net generated electricity</b>	<b>123,691</b>	MWh/year	Expert Independent Study (Hicon page 35 Frame 20) /5/ and Sponsor Budget /25/
<b>Energy Price (possible to be sold in the Regulated market23%)</b>	<b>130.27</b>	COP/KWh	Validated through of: <a href="http://www.xm.com.co/Informe%20Mensual%20Analisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf">http://www.xm.com.co/Informe%20Mensual%20Analisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf</a> Page 2. /27/
<b>Energy Price</b>	<b>103.03</b>	COP/KWh	Validated through of:

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(possible to be sold in No Regulated market 77%)			<a href="http://www.xm.com.co/Informe%20Mensual%20Analisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf">http://www.xm.com.co/Informe%20Mensual%20Analisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf</a> Page 2. /27/
<b>Energy Price Average</b>	<b>109.30</b>	COP/KWh	Validated through of: <a href="http://www.xm.com.co/Informe%20Mensual%20Analisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf">http://www.xm.com.co/Informe%20Mensual%20Analisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf</a> Page 2. /27/
<b>CERs</b>	<b>5.00</b>	US\$/CER	Blue Next <a href="http://www.bluenext.eu/">http://www.bluenext.eu/</a>
<b>Operation</b>	<b>30</b>	years	PP Estimation (based on the Main Equipments lifetime expectation) on document Estudo de Vida Útil Econômica e Taxa de Depreciação.pdf. Page 608 and 614. File: relatorio_vida_util_volume_2.pdf /6/ and Tool to determine the remaining lifetime of equipment"(Version 01). /43/
<b>Income Tax</b>	<b>33%</b>	On base value	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>Administrative Cost and O&amp;M</b>	<b>1,999,988</b>	COP (000)	Costs composition worksheet File: Resumo SPE OM_morro azul_Set11.pdf /28/ and Document "Diretrizes para Estudos e Projetos de PCH".pdf pag 18 /29/
<b>CREG and SPSPD</b>	<b>2.00%</b>	on gross revenue	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>Predial Fee</b>	<b>1.70%</b>	% on Capex (Lands)	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>CND - ASIC (National Dispatch Center Fee)</b>	<b>1.00%</b>	on gross revenue	Country's Laws (Resolution 081 from 2007 CREG) File: Legal_marco generadoras_das_mcj_jar.pdf /14/
<b>ICA Fee</b>	<b>1.20%</b>	on gross revenue	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>FAZNI (No Interconnected Zones Fee)</b>	<b>1.10</b>	COP/KWh	Country's Laws (Law 633 from 2000) File:Legal_marco generadoras_das_mcj_jar.pdf /14/
<b>Law 99 of 1993 (Fee Base)</b>	<b>56.18</b>	COP/KWh	Country's Laws (Law 99 of 1993) File:Legal_marco generadoras_das_mcj_jar.pdf /14/
<b>Law 99 of 1993</b>	<b>6.0%</b>	MWh*Law 99 Fee	Country's Laws (Law 99 of 1993) File:Legal_marco generadoras_das_mcj_jar.pdf /14/
<b>Water Use Tariff</b>	<b>-</b>	per year	Fee for water use in the hydropower sector. Pursuant to the established in Article 45 paragraph 3 of Law 99 from 1993, in the percentage of transfers to the environmental sector that the hydropower



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			sector makes , consisting of hydroelectric and thermal plants, is included the payment of fees for water use. Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>Depreciation (IR)</b>	<b>4.50%</b>	per year	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>Residual</b>	<b>40%</b>	on total asset	As per brazilian study "Lifetime and Depreciation Study" (free translation) from ANEEL"/6/ 50 years of depreciation (the longest element: turbine), so 2% / year after 30 years is equal to 40% of residual value (in a conservative aproach)
<b>4 X 1000 Fee (2012 - 2014)</b>	<b>0.40%</b>	% On Cash Outflow	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>4 X 1000 Fee (2015 - 2016)</b>	<b>0.20%</b>	% On Cash Outflow	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/
<b>4 X 1000 Fee (2017 - 2018)</b>	<b>0.10%</b>	% On Cash Outflow	Legal Report on file: Legal_marco generadoras_das_mcj_jar.pdf, Colombian tax status and Country's Laws /14/

Validation of main parameters used in the cash flow calculations for determining the Equity IRR, are in line with VVS paragraph 120 and Guidelines on the assessment of investment analysis, version 05.0, follows.

### Total investment cost with breakup:

The project total investment cost has been assessed by the PP in US\$60.512.301, equivalent to thousand COP\$117,060,441, (exchange rate 1,934 COP\$/US\$, valid at 30/09/2011). A detailed breakup of the total investment cost is showed in the table in the file Orçamento Alupar\_Morro Azul.pdf./25/

Based on their expertise and sectorial knowledge, the validation team considers that items included in the breakup and their share, are adequate and reasonable, given the specific characteristics of the project, including conduction tunnel in a steep mountain. The total budget is obtained from proposals received by the PP for each main cost category (civil works, supply and montage of electromechanical equipment, environmental...) as indicated in the table mentioned. The proposals were revised by ICONTEC and were found certain and reasonable.

The total investment cost of US\$60.512.301 yields a unit cost of 3,040 US\$/kW. This unit cost is less than 15% higher than other somewhat similar CDM registered hydro projects in the country, as depicted in the following table:

Name	Installed	Total cost	Unit cost	Source
------	-----------	------------	-----------	--------



	capacity MW	Thousand US\$	US\$/kW	
Bajo Tuluá Minor Hydroelectric Power Plant	20.0	53,442	2,672	UNFCCC
Alto Tuluá Minor Hydroelectric Power Plant	20.0	53,346	2,667	UNFCCC

The validation team also cross checked the project unit cost with statistics published by the International Energy Agency /32/ which indicates that, for medium output range (10-100 MW), the Investment costs range is 2,000-3,000 US/kW. Given that Morro Azul installed capacity is near the bottom of the range, their cost is consistent with the top of the cost range.

By the above and considering that each hydropower project has unique nature and characteristics, ICONTEC confirm that underlying assumptions are appropriate and the financial calculations are correct for SHP Morro Azul CDM Project (JUN1164).

#### Debt/Equity ratio and Loan interest:

The adopted D/E ratio (60/40) and the loan interest rate (7.25%) used for IRR calculations are consistent with the conditions agreed with the bank Bancolombia S.A. /26/

#### Assured energy – Net generated electricity:

**The annual net energy (123,691 MWh – 14.12 MW)** has been estimated on hydrological studies about the Risaralda river made by the enterprise *hicon: Engenharia de recursos hidricos*, ([www.hicon.com.br](http://www.hicon.com.br)), at December 2011, Document: *CH Morro Azul – Estudos Hidrológicos e Energéticos para Projeto Básico – ALUPAR 008/11. /5/*. The DOE revised the document and found that energy calculations were adequately made based on duration curves of the river flow time series, as usual. Risaralda river flow time series were taken from studies, driven by the national official entity HIMAT, today IDEAM Instituto de Hidrología, Meteorología y Estudios Ambientales. (Institute of Hydrology, Meteorology and Environmental Studies) /5/, /33/.

#### Energy price:

Sell Price of energy was assessed by the PP, assuming the energy produced is going to be sold in the Regulated Market (RM) and in the No Regulated Market (NRM) in the ratio 23/77. In the view of the DOE, given that in the Colombian bulk energy market the price in the RM is consistently higher than the NRM price, this is a conservative sharing. The values used (RM: COP\$130.27/kWh; NRM: COP\$103.03/kWh; Weighted price: COP\$109.30/kWh) were the current prices at the time of the investment decision, as verified by the DOE in the database of NEON system, consulted on <http://sv04.xm.com.co/neonweb/> /34/. (NEON is the official information service on the Colombian bulk energy market, managed by XM – Market Experts). The DOE cross checked the contract price used by the PP with the real average contract price in the market by the time, which was COP\$118.85/kWh, therefore the DOE could conclude that the PP estimation is accuracy and realistic.

### Administrative Cost and O&M:

The project annual administrative and O&M costs were assessed by the PP in thousand COP\$1,999,998, equivalent to US\$1,034,125 (exchange rate 1,934 COP\$/US\$, valid at 30/09/2011). A detailed breakup of the annual administrative and O&M costs is showed in the table in the file Resumo SPE OM\_morro azul\_Set11.pdf /28/

The annual budget includes the usual cost item categories (manpower, outsourcings, transport, public services...) as indicated in the table mentioned. Based on their expertise and sectorial knowledge, the validation team considers that items included and their values are adequate and reasonable.

The annual administrative and O&M costs of US\$1,034,125 yield an operative energy cost of 8.4 US\$/MWh. This operative energy cost is equal or lower than other somewhat similar CDM registered hydro projects in the country, as depicted in the following table:

Name	Annual generation MWh	Annual fixed O&M US\$	US\$/MWh	Source
Project 3599: Bajo Tuluá Minor Hydroelectric Power Plant	117,400	981,236	8.4	UNFCCC: <a href="http://cdm.unfccc.int/filestorage/U/6/Q/U6QBF8IHKL5SNAGPJOE2Z90Y4CWT7R/U6QBF8IH.5?t=aVd8bWUzbN22fDAQuidubm2GNnXLujlW5wEq">http://cdm.unfccc.int/filestorage/U/6/Q/U6QBF8IHKL5SNAGPJOE2Z90Y4CWT7R/U6QBF8IH.5?t=aVd8bWUzbN22fDAQuidubm2GNnXLujlW5wEq</a>
Project 3570: Alto Tuluá Minor Hydroelectric Power Plant	114,400	1,062,631	9.3	UNFCCC: <a href="http://cdm.unfccc.int/Projects/DB/AENOR1269848466.91/view">http://cdm.unfccc.int/Projects/DB/AENOR1269848466.91/view</a>

The validation team also cross checked the project administrative and O&M costs with statistics published by the International Energy Agency /32/ which indicates that, for medium output range (10-100 MW), the Investment costs range is 5-20 US/MWh. It can be seen that Morro Azul administrative and O&M costs are near the bottom of the range.

By the above the DOE deems that the estimated administrative and O&M costs for Morro Azul hydro project are conservative, credible and accuracy.

### IRR Results

As already mentioned, Equity IRR for the project was calculated by the PP by means of the finance model executed in the spreadsheet Analise\_Fin\_MA\_v2\_2.xls /24/, using the data just validated.

The DOE found that, in executing this finance model the applicable paragraphs of the “Guidelines on the assessment of investment analysis, version 05.0” were adequately followed by the PP in cash flow calculations.

According to the cash flow, the Equity IRR is 6.61%, far lower than the IRR benchmark of 10.29%, which demonstrates that the project is not financially feasible without the revenues from the CERs. Considering CDM revenues at the rate of 5 US\$/CER, the Equity IRR raise to 7.04%, even remaining lower than the IRR benchmark.

### Sensitivity analysis

A sensitivity analysis respect to the main variables was made. By this analysis the necessary variation in each variable in order to reach the IRR benchmark was found, with the following results:

Investment – Equity: -30.60%: File: Analise\_Fin\_MA\_v2\_2\_SA\_Inv.xls /35/

Assured Energy: +36.60%: File: Analise\_Fin\_MA\_v2\_2\_SA\_AssEnergy.xls /35/

Energy price – NRM: +35.40%: File: Analise\_Fin\_MA\_v2\_2\_SA\_EnergyPrice.xls /35/

Operation and Maintenance: -100% (Not enough): File: Analise\_Fin\_MA\_v2\_2\_SA\_O&M.xls /35/.

As can be seen, all variations performed overcome the range of +/-10% recommended by the “Guidelines on the assessment of investment analysis”. Indeed, variations of this magnitude are highly unlikely.

Based on this analysis it can be concluded that is highly unlikely that the project become financially feasible.

### Step 3: Barrier Analysis (if applicable)

The PP does not apply barrier analysis.

### Step 4: Common practice analysis:

This step was addressed by the PP using the step 4 of the Tool for the demonstration and assessment of additionality (Version 06.1.0), paragraph 47. .

Next is the validation by the DOE of the application of paragraph 47, as presented in the PDD.

Firstly, the geographical area considered was the entire host country, according to the applicable geographical area definition.

**STEP 1:** The applicable output range was properly assessed as +/-50% of the design capacity of the proposed project activity (19.9 MW), resulting in the range 9.95 – 29.85 MW.

**STEP 2:** In order to obtain  $N_{all}$ , a list of power plants that became operative in the national grid along the period 2005-2011 was first elaborated. Such a list of 32 power plants is in the

spreadsheet *Common Practice v1.xls*, tab *2005-2011* /36/. Then, power plants out of range were discarded, and a list of 12 power plants was obtained, as showed in tab *Step 1*. Only one of the twelve power plants is registered as CDM project, so that  $N_{all}=11$ . First of all, the DOE agrees that power plants that became operatives in the period 2005-2011 fit the criteria established in the paragraph 47 of the Tool for the demonstration and assessment of additionality of having started commercial operation before the start date of the project. The DOE cross checked the list of projects in tab *2005-2011* with information in the Mines and Energy Statistics Bulletin 2007 – 2011 of UPME, Electric Sector, Table 8, page 101 /37/. The list of projects was also cross checked with information in the Colombian Electric System Description of XM /38/. The CDM project discarded was verified by the DOE in the UNFCCC framework.

**STEP 3:** In order to obtain  $N_{diff}$ , in the list of  $=11$  power plants of Step 2, 8 power plants were identified as different technology, so  $N_{diff} = 8$ . The DOE verified that the 8 power plants identified as different technology correspond to fossil fuel or biomass (cogeneration) power plants.

**STEP 4:** Applying the formula  $F=1-N_{diff}/N_{all}$  the factor F was calculated as  $F=0.27$ , and  $N_{all}-N_{diff} = 3$ .

According to the Tool, the proposed project activity is a “common practice” within a sector in the applicable geographical area if the factor F is greater than 0.2 and  $N_{all}-N_{diff}$  is greater than 3. Given that the first condition is met but the second one is not, the project SHP Morro Azul CDM Project (JUN1164), proved not to be common practice.

### e) Additionality conclusion

In conclusion, it has been verified, from the investment analysis that the project is not the most likely baseline scenario. Hence, the emission reductions occurring from the project are deemed additional to those that would occur in the absence of the project activity.

## 3.6. MONITORING PLAN

Monitoring plan presented on PDD complies with requirements of approved methodology ACM0002 (version 13.0.0) and all applied tools. During validation, three requests (CL 5, CL 9 and CL 10) were raised with regard to the completeness of the monitoring plan. These situations were corrected on the last version of the PDD and the description of how each finding was closed it is found in the Table A 2: Resolution of Corrective Action, Forward Action and Clarification Request of Annex A validation protocol. Monitoring of GHG Emission reduction is based on the electricity generation by the project activity, which is transparently presented in section B.7 of the PDD.

ICONTEC verified through interviews with relevant personnel and document review (technical and commercial proposals by globally recognized companies) /7,8/, that the project will be equipped with an extensive monitoring system. Staff training and the monitoring plan will be established to maintain installed equipment and technology performance, as well as to ensure the measurements accuracy and the data reported.

Validation team checked all parameters presented at the monitoring plan of the latest version of the PDD /1/, against methodology and applied tools requirements; no deviations to the project activity were found.

### 3.6.1 Parameters ex-post:

The main monitoring parameter is: Quantity of net electricity generation supplied by the project activity to the grid, in year y. The DOE confirms that the latest PDD clearly states that it will be measured as required by the methodology.

Baseline parameters to be monitored ex post were indicated in Section B.7.1 of PDD and are as follows:

**Table 6: Data and parameters ex-post**

<i>Data/Parameter</i>	<i>ICONTEC's means of validation</i>
<i>EG<sub>Morro Azul,y</sub> MWh/year</i>	<p>The electricity generation will be measured with 4 electricity meter bidirectionals that comply with national standards and industrial regulations.</p> <p>According to figure 4 of the PDD, the electricity meters M3 (main) and M4 (backup), will be used for the calculation CER's, of this way, if the main meter fails, the backup meter record of the electricity generation.</p> <p>The data recording shall be performed through software that is to be defined, but which ensure the storage daily of information and a back-up to safeguard generation information reported. The viability of this activity was confirmed on interview with the administrative and financial manager.</p>
<i>Cap<sub>PJ – Morro Azul</sub> W</i>	This parameter will be checked through plaque inspections or manufactures specification, this information was confirmed on interview with the administrative and financial manager.
<i>APJ – Morro Azul</i>	The measure will be by topographical surveys or satellite pictures. The viability of this activity was confirmed on interview with the administrative and financial manager.

The methodology request a cross check with the energy sales records, in Colombia, the billing is done by contract and often this is not for the same billing period production or verification of energy, so the cross check will be made with XM, (extracted from the: <http://www.xm.com.co>). Frequency yearly and by a third party.

The monitoring will be conducted by a structure that will be create three months before the start of project operation, for operation, maintenance and recording of information.

With the above information, ICONTEC confirmed that the monitoring plan established by the PP, is feasible and that the PP has the ability and means of implementation sufficient to ensure that the emission reductions achieved as a result of the proposed project activity, can be reported ex-post and verified. It is according with paragraph 131 of VVS.

### 3.7. CALCULATION OF GHG EMISSIONS

According to equation 11 of the methodology ACM0002, version 13.0.0, emission reductions shall be calculated as follows:

$$ER = BE_y - L_y - PE_y$$

Given that in this project, the result of the power density is:  $19.9 * 106 / 12.17 * 104 = 163 \text{ W/m}^2$ , is greater than  $10 \text{ W/m}^2$ .  $PE_y = 0$ .

For this type of project activity, according to Methodology the  $Ly = 0$ .

$$ER = BE_y$$

As referred in Section 3.4 BASELINE DETERMINATION, the baseline emissions are the product of electrical energy baseline  $EG_{BL,y}$  expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

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

For ex-ante estimation of baseline emissions, the electric energy baseline  $EG_{BL,y}$  was assessed as 123,691 MWh, corresponding to the “assured energy” of 14.12 MW, and the Grid emission factor was calculated as  $EF_{grid,CM,y} = 0.36777 \text{ (tCO}_2\text{/MWh)}$

So the baseline emissions are:

$$BE_y = 123,691 * 0.36777 = 45,489 \text{ tCO}_2\text{e/year}$$

The calculation of ERs was made in accordance with the methodology ACM0002, version 13.0.0. All data that are not monitored were correctly applied and values were cross-checked with publicly available data or supporting documents (see section References) and are thus deemed precise and conservative. The values for the monitoring parameters are plausible. The estimation of emission reductions is deemed plausible and conservative, as described in detail in section B.6 of the PDD.

The PP presented the equation result in section B.3 and B.4 of PDD in accordance with the CER Spreadsheet calculation /2/. To conclude, the summary of ex ante estimation of emission reductions are in the section B.6.4 on PDD /1/ and CER Spreadsheet calculation /2/.

Year	EGy (MWh)	PEy (tCO <sub>2</sub> )	BE (tCO <sub>2</sub> )	CERs
2015 (Feb)	113,384	0	41,699	41,699
2016	123,691	0	45,489	45,489
2017	123,691	0	45,489	45,489
2018	123,691	0	45,489	45,489
2019	123,691	0	45,489	45,489
2020	123,691	0	45,489	45,489
2021	123,691	0	45,489	45,489
2022 (Jan)	10,308	0	3,790	3,790
<b>Total</b>	<b>865,838</b>	<b>0</b>	<b>318,423</b>	<b>318,423</b>
<b>Annual Average</b>	<b>123,691</b>	<b>0</b>	<b>45,489</b>	<b>45,489</b>

The assumptions and data used to determine the emission reductions are listed in the PDD. All the sources were checked and confirmed by ICONTEC, and the calculations can be replicated. Based on the information reviewed it can be confirmed that the sources used are correctly quoted and interpreted in the PDD, the calculations are complete, and the numbers are reasonable and accurate. The steps taken and equations applied to calculate the emission reductions comply with the requirements of the selected baseline and monitoring methodology ACM0002 version 13.0.0 and tools, and these were correctly applied.



### **3.8. ENVIRONMENTAL IMPACTS**

ICONTEC confirmed that according to legislation of host country, the PP made an Environmental Impact Study, was elaborated by Eng. Zapata, on 2008. This study was updated by Ramirez and Sabogal Engineers, on 2012. /16/.

Permits granted by the regional environmental authority (CARDER) are:

Resolution 059, January 20, 2009, environmental license issued by CARDER. In this document was authorized the use of 16.8m<sup>3</sup>/seg of the water of the river Risaralda for the project. Valid by 10 year. /17/.

Resolution 568, February 5, 2010, indicates the ecological flow of 2.77m<sup>3</sup>/seg. Issued by CARDER on 05/02/2010. /18/

According to this information, ICONTEC validate that the PP made environmental impact assessment in accordance with procedures as required by Colombia.

### **3.9. COMMENTS BY LOCAL STAKEHOLDERS**

Risaralda Energía S.A.S E.S.P, performed an environmental and social survey /19/, to 20 farms affected by the project on August, 2012. During this visit, the people manifested your approval for the performance of the project.

According to Resolution 2734 of 2010 issued by Colombian Ministry of Environment, the PP organized two meetings for introduce the information of the project to stakeholders.

ICONTEC, could confirm the invitation of the meeting /20/, with the note published at the office of the Anserma and Belen de Umbria municipalities from 28<sup>th</sup> August 2012 until 10<sup>th</sup> September 2012. During this time the invitation was communicated by newspaper and radio.

The meeting was made on 11<sup>th</sup> September 2012, in Anserma with 43 people and in Belen de Umbria with 50 participants. ICONTEC confirmed this information with the list of participants. /21/. During these meetings the PP presented the description of the project /22/ and attended questions of the participants.

The results of the meetings were registered on the minutes of meeting. /23/. ICONTEC, identified in this document that the main comments of stakeholders are: generation of job and if the project affect the property. The questions were answered for the PP.

ICONTEC considered that the local stakeholder consultation was appropriate and met the procedures and requirements established by Colombia.

#### 4. GLOBAL STAKEHOLDERS CONSULTATION

The PDD version 01 submitted by Risaralda Energía S.A.S E.S.P, was made publicly available at UNFCCC website during the period 31/08/2012 to 29/09/2012. ICONTEC verified on: <http://cdm.unfccc.int/Projects/Validation/DB/XYXMUHIP6FZFPHZ16PDW9W0CQZNNC/view.html>

Parties, stakeholders and NGOs were invited to provide comments through the website. No comments were received during the public consultation until the submission of this report.

#### 5. VALIDATION OPINION

ICONTEC has performed a validation of the SHP MORRO AZUL CDM PROJECT (JUN1164), in Colombia. The validation was performed on the basis of UNFCCC criteria for the Clean Development Mechanism and host country criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The review of the Project Design Documentation and the subsequent follow up interviews has provided ICONTEC with sufficient evidence to determine the fulfillment of the stated criteria.

The project activity is being proposed as unilateral project by Risaralda Energía S.A.S. E.S.P. Colombia has provided approval of voluntary participation and meets all requirements to participate in CDM. The Colombian DNA confirmed that the project helps in achieving sustainable development.

The project involves the construction of the Small Hydropower Plant Morro Azul with final installed capacity of 19.9 MW. It is demonstrated that the project is not a likely baseline scenario. Emission reductions attributable to the project are hence additional to any that would occur in the absence of the project activity.

The total emission reductions from the project are estimated to be on the average of 45,489 tCO<sub>2</sub>e per year over the selected 7 year crediting period, renewable for two times. The emission reduction forecast has been checked and it is deemed likely that the stated amount is achieved because the underlying assumptions do not change.

In summary, it is ICONTEC's opinion that the "SHP Morro Azul CDM Project (JUN1164)" in Colombia, as described in the PDD version 2, meets all relevant UNFCCC requirements for the CDM and all relevant host country criteria and correctly applies the baseline and monitoring methodology "ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources - Version 13.0.0.". ICONTEC thus requests the registration of the project as a CDM project activity.

Bogotá D.C., December, 2012



Diego Caballero  
Director of conformity assessment  
ICONTEC



## 6. REFERENCES

Documents provided by the project proponent that relate directly to the project and secondary sources used by ICONTEC:

/1/	PDD SHP Morro Azul CDM Project (JUN1164). Version 1. Dated: 20/08/2012. File: PDD_MA_v1.pdf PDD SHP Morro Azul CDM Project (JUN1164). Version 2 Dated: 12/11/2012. File: PDD_MA_v2_2.pdf
/2/	Spreadsheet CER's calculation version 1. File: CERs_MA_v1.xls Spreadsheet CER's calculation version 2. File: CERs_MA_v2.xls
/3/	Letter of approval of the DNA. File: Annex B LoA Morro Azul.pdf
/4/	File: Declaración de poder.pdf
/5/	CH Morro Azul – Estudos Hidrológicos e Energéticos para Projeto Básico – ALUPAR 008/11. File: Estrudos hidrológicos.pdf Made by hicon: Engenharia de recursos hidricos, ( <a href="http://www.hicon.com.br">www.hicon.com.br</a> ).
/6/	Estudo de Vida Útil Econômica e Taxa de Depreciação.pdf. Page 608 and 614. Lifetime and Depreciation Study (free translation) from ANEEL File: relatorio_vida_util_volume_2.pdf
/7/	Study of Connection hydroelectric generation project Morro Azul , with a capacity of 20 MW in the department of Risaralda. Version October 2012, Revision 1 (Estudio de conexión del proyecto de generación hidroeléctrico Morro Azul con una capacidad de 20 MW en el departamento de Risaralda. Version Octubre de 2012, Revision 1). Made by Applus Norcontrol Colombia Ltda. <a href="http://www.appluscorp.com.co">www.appluscorp.com.co</a>
/8/	Descriptive design: Name: Plano No. MZL-PBC-036 Proyecto Básico Consolidado. Casa de maquinas, plano general Escala 1:200. Realizado el 28/09/2012. (Consolidated basic Project. House machine, general plan scale 1:200. Made 28/09/2012). Name: Plano N. MZL – PRE-021 Proyecto básico. Plano general de emprendimiento. Planta. Realizado el 21/09/2012. (Basic project. General plan of entrepreneurship.Plant. Made 21/09/2012).
/9/	Reservatorio da PCH Morro Azul. Made by Alupar on 10/08/2011. File: Reservatorio Morro_Azul.pdf.
/10/	Letter No. ALP-562-11 sent from Alupar to Ministry of Environment with the form prior consideration of the UNFCCC. 17/10/2011. File: 1 - Ofício PCH Morro Azul.pdf
/11/	Letter from Ministry of Environment answering to Alupar the prior consideration of the project. 24/11/2011. File: MINISTERIO Morro Azul-Guatica II.pdf.
/12/	Minutes of council administration of Alupar. File: 2011 10 10 ARCA - iniciar trabalhos hidreletrica Agua Limpa.pdf. File: Cronograma_MA_v2.pdf
/13/	Certificate from the Chamber of Commerce of Bogota issued on August 10, 2012. File: Certificado de existencia y Rep legal.pdf
/14/	Brigard & Urrutia lawyers. November, 2012. File: B&U 1.pdf and B&U 2.pdf. File: Legal_marco generadoras_das_mcyj_jar.pdf <a href="http://www.bu.com.co/ingles">http://www.bu.com.co/ingles</a>
/15/	Register of project in UPME with the number 20121500017671 on 30/05/2012
/16/	PCH Morro Azul. Environmental Study for the Environmental License Modification – Annex impact assessment. (Estudio Ambiental para Modificación de la Licencia Ambiental – Anexo Evaluación de Impactos).

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	File: Anexo 8 Evaluación de impactos. pdf.
/17/	Resolution 059 of 20/01/2009. Corporación Autónoma Regional de Risaralda (Regional Autonomous Corporation of Risaralda). File : resolucion-059-20012009.pdf
/18/	Resolution 568 of 05/02/2010. Corporación Autónoma Regional de Risaralda (Regional Autonomous Corporation of Risaralda). File : resolucion-568-05022010.pdf
/19/	Survey social and environmental. File: Encuesta 1.pdf
/20/	Invitation of meeting.pdf
/21/	File: Lista asistentes Anserma.pdf File: Lista asistentes Belén de Umbría.pdf
/22/	Description of the project. File: Socialización PCH Morro Azul1.ppt
/23/	The results of the meeting were registered on the minutes of meeting. File: Acta No. 1- Socialización Anserma.doc File: Acta No.2 – Socialización B.U.doc
/24/	File: Analise_Fin_MA_v2_2.xls File: WACC_Morro Azul_v2_1.xls
/25/	Document with the information sponsor budget. File: Orçamento Alupar_Morro Azul.pdf
/26/	File: 14-08-12 Términos y Condiciones Indicativos Alupar- Energía de Risaralda - Cliente.pdf (Terms and conditions, Indicators Alupar – Energia de Risaralda- customer)
/27/	<a href="http://www.xm.com.co/Informe%20Mensual%20Anlisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf">http://www.xm.com.co/Informe%20Mensual%20Anlisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_09_2011.pdf</a> Page 2.
/28/	Cost composition. File: Resumo SPE OM_morro azul_Set11.pdf
/29/	Document " <i>Diretrizes para Estudos e Projetos de PCH</i> ".pdf page 18 Consulted on: <a href="http://www.eletrabras.com/elb/data/Pages/LUMIS4AB3DA57PTBRIE.htm">http://www.eletrabras.com/elb/data/Pages/LUMIS4AB3DA57PTBRIE.htm</a>
/30/	Spreadsheet Emission factor calculation for MAzul_v1.xls
/31/	Spreadsheet IPC_Variacion DANE.xls
/32/	Renewable Energy Essentials: Hydropower © OECD/IEA 2010, <a href="http://www.iea.org">www.iea.org</a>
/33/	<a href="http://www.ideam.gov.co">www.ideam.gov.co</a> (Institute of Hydrology, Meteorology and Environmental Studies)
/34/	<a href="http://sv04.xm.com.co/neonweb/">http://sv04.xm.com.co/neonweb/</a> NEON is the official information service on the Colombian bulk energy market, managed by XM – Market Experts
/35/	File with sensitive analysis: Analise_Fin_MA_v2_2_SA_Inv.xls Analise_Fin_MA_v2_2_SA_AssEnergy.xls Analise_Fin_MA_v2_2_SA_EnergyPrice.xls Analise_Fin_MA_v2_2_SA_O&M.xls
/36/	Common Practice v1.xls
/37/	<a href="http://www.upme.gov.co/Docs/Boletin_Estad_Minis_Energy_2007_2011.pdf">http://www.upme.gov.co/Docs/Boletin_Estad_Minis_Energy_2007_2011.pdf</a>
/38/	<a href="http://www.xm.com.co/Pages/DescripciondelSistemaElectricoColombiano.aspx">http://www.xm.com.co/Pages/DescripciondelSistemaElectricoColombiano.aspx</a>

Background documents related to the design and/or methodologies employed in the design or other reference document

/39/	Clean development mechanism validation and verification standard (Version 03.0)
/40/	Methodology ACM0002 - Consolidated baseline methodology for grid connected electricity generation from renewable sources" (version 13.0.0),
/41/	Tool for the demonstration and assessment of additionality.(Version 06.1.0)

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/42/	Tool to calculate the emission factor for an electricity system.( Version 02.2.1)
/43/	Tool to determine the remaining lifetime of equipment”(Version 01)

## **7. ANNEXES**

**Annex A**

**Validation Protocol**

## Annex A VALIDATION REPORT



The audit team conducts a thorough, independent assessment of the registered project activities.

The next table contains questions that the audit team follows in order to determine whether the project activity complies with the requirements of paragraph 37 of the CDM modalities and procedures. The audit team ensures that the only validation activities, undertaken after the publication of the PDD on the UNFCCC CDM website, were used as a basis for the ICONTEC to conclude the validation and submit a request for registration of the project activity to the board.

Questions were answered on the right column using the following scores:

- Full: When the audit team had full access to the required information, the information is complete and satisfactory
- Partial: When the audit team did not have access to the information, or the information is incomplete, or not satisfactory. In this case, indicate finding type and number.
- Resolved: When a partial score is assigned, indicate the date when the finding was closed
- N/A: Shall be used when the question does not apply.

When raising a clarification request, corrective action request and forward action, it is in accordance to VVS v 03.0 § 24-29.

**Table A 1: Validation Protocol**

<b>CHECKLIST QUESTION</b>	<b>REFERENCES</b>	<b>Final Conclusion</b>
<b>1. Global Stakeholder Consultation</b>		
1.1 Has the validation team received and taken into account all comments on the PDD of the proposed project activity during the whole validation process? (not only during GSC) VVS § 34,35	Section 4, Global Stakeholder Consultation	Full
1.2 If comments indicate that the proposed project activity does not comply with the CDM requirements, Did the validation team request further clarification from the entity providing the comment? <sup>2</sup> VVS § 34	N/A	N/A

<sup>2</sup> In accordance with VVS § 36: the DOE is not required to enter into a dialogue with Parties, stakeholders or NGOs, that comment on the CDM requirements

## Annex A VALIDATION REPORT



CHECKLIST QUESTION	REFERENCES	Final Conclusion
<b>2. Approval</b>		
2.1 Has the designated national authority (DNA) of each Party indicated (as being involved in the proposed CDM project activity in the PDD) provided a written letter of approval? VVS § 38	Section 3.2.1	Full
2.2 Does the letter(s) of approval issued by the respective Party's DNA the confirmation of: (a) The Party is a Party to the Kyoto Protocol; (b) Participation is voluntary; (c) In the case of the host Party, the proposed CDM project activity contributes to the sustainable development of the country; (d) It refers to the precise proposed CDM project activity title in the PDD being submitted for registration? VVS § 39 and 50	See Table 3.	Full
<b>3. Authorization</b>		
3.1 All project participants have been listed in a consistent manner in the project documentation, and their participation in the project activity has been approved by a Party to the Kyoto Protocol. VVS § 46	See Table 3.	Full
3.2 Are there entities other than those authorized as project participants included in these sections of the PDD? VVS § 47	N/A	N/A
3.3 The approval of participation has been issued from the relevant DNA. VVS § 48	See Table 3.	Full
<b>4. Modalities of communication</b>		
4.1 All focal points included in the MoC, as well as the personal identities, including specimen signatures and employments status and has been validated by directly evidence for corporative, personal identify and other relevant documentation like notarized documentation. VVS § 53	Section 3.2.2	Full

## Annex A VALIDATION REPORT



CHECKLIST QUESTION	REFERENCES	Final Conclusion
<p>4.2 Does the MoC correctly completed and duly authorized?</p> <ul style="list-style-type: none"> <li>- The last version of the form F-CDM-MOC has been used?</li> <li>- The information required as per the F-CDM-MOC, including its annex 1, is correctly completed.</li> <li>-The project participants authorized signatories signing the F-CDM-MOC correspond to the project participants authorized signatories included in F-CDM-MOC, annex 1.</li> </ul> <p>VVS § 59 - 60</p>	Section 3.2.2	Full
<b>5. Project design document</b>		
<p>5.1. The PDD was completed using the last version of the PDD form and guidance appropriated to the type of project activity.</p> <p>VVS § 62</p>	Yes, see section 3.3	Full
<b>6. Description of the project activity</b>		
<p>6.1 The PDD is accurate, complete, and provides an understanding of the proposed CDM project activity. (by reviewing available designs and feasibility studies and conducting comparison analysis with equivalent projects)</p> <p>VVS § 64</p>	Yes, see section 3.3	Partial See CAR 1, CL 1 and CL 2 Resolved
<p>6.2 The project is correctly classified as large scale, non-bundled small-scale projects with emission reductions exceeding 15,000 tonnes per Year or bundled small-scale projects, each with emission reductions not exceeding 15,000 tonnes per year.</p> <p>VVS § 65</p>	Yes, see section 3.3	Full
<p>6.3 For other individual proposed small-scale CDM project activities with emission reductions not exceeding 15,000 tonnes per year, the DOE should conduct a physical site visit as appropriate. If not, it shall be justified by the DOE.</p> <p>VVS § 66</p>	N/A	N/A
<p>6.4 If apply, the use of any sampling approach was made according to the "Standard for sampling and surveys for CDM project activities and programme of activities"?</p> <p>VVS § 66</p>	N/A	N/A
<b>7. Application of the selected Baseline and monitoring methodology</b>		
<p>7.1 The baseline and monitoring methodologies selected by the project participants are the valid versions of those approved by the Board.</p> <p>The selected version is valid at the time of submission of the proposed project activity</p>	Yes, see section 3.3	Full



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CHECKLIST QUESTION	REFERENCES	Final Conclusion
for registration. VVS § 70 and 73		
7.2 The selected methodology applies to the project activity and was correctly applied with respect to: Project Boundary, baseline identification, algorithms and/ formulae used to determine emission reduction, additionality, monitoring methodology. VVS § 72 and 74	Yes, see section 3.3	Full
7.3 Has been confirmed each applicability condition listed in the approved methodology selected. VVS § 77	Yes, see table 4.	Full
<b>8. Deviation from an approved methodology</b>		
8.1 Did the project request a deviation from an approved methodology before the publication of the PDD? VVS § 78	N/A	N/A
8.2 if there are any request for deviation from an approved methodology, the applicability of the appendix 1 of Project standard must be applied. VVS § 79	N/A	N/A
<b>9. Clarification on the applicability of an approved methodology</b>		
9.1 Was requested any clarification on the applicability of the approved methodology since the DOE cannot make a determination regarding the applicability of the selected methodology to the proposed project activity? VVS § 81	N/A	N/A
<b>10. Project boundary</b>		
10.1 Are all main GHG emission sources, the physical delineation of the proposed project activity and other relevant project and baseline emission sources covered in the methodology, included within the project boundary for the purpose of calculating project and baseline emissions for the proposed project activity? VVS § 82	Yes, section 3.3	Full
10.2 Does the methodology allow project participants to choose whether a source or gas is to be included within the project boundary? -Have the project participant justified that choice?	N/A	N/A

## Annex A VALIDATION REPORT



CHECKLIST QUESTION	REFERENCES	Final Conclusion
The DOE shall determine whether the justification provided is reasonable, based on an assessment of supporting documented evidence provided by the project participants and corroborated by observations if required. VVS § 84		
10.3 For the project activities that have both A/R and non-A/R components, please confirm that the emissions associated with the A/R activity will be accounted for and documented by the A/R project activity. VVS § 85	N/A	N/A
<b>11. Baseline scenario identification and description</b>		
11.1 The Baseline identified for the proposed project activity is the scenario that reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the proposed project activity. VVS § 88	See section 3.4	Full
11.2 Please confirm that all tools required by the methodology have been used by the PP. VVS § 89	See section 3.4	Partial See CL 7 Resolved
11.3 Assess the baseline scenarios based on financial expertise and local and sectoral knowledge, make crosscheck of the information provided in the PDD with other verifiable and credible sources, such as local expert opinion, if available, relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector. VVS § 90, 91, 92	See section 3.4	Full
<b>12. Algorithms and/or formulae used to determine emission reductions</b>		
12.1 Does the steps taken and equations applied to calculate project emissions, baseline emissions, leakage and emission reductions comply with the requirements of the selected baseline and monitoring methodology. VVS § 96	See section 3.7	Partial See CL 6 Resolved
12.2 If the methodology allows for selection between options for equations or parameters, the DOE shall determine whether adequate justification has been provided and if the justification provided is reasonable, based on an assessment of supporting	See section 3.7	Full

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
documented evidence provided by the project participants and corroborated by observations if required VVS § 97		
12.3 Verify the justification given in the PDD for the choice of data and parameters used in the equations (appropriate, conservative and reasonable). Data sources must be provided for each parameter. VVS § 98	See section 3.7	Full
<b>13. Additionality of a project activity</b>		
13.1 Assess and verify the reliability and credibility of all data and any assumptions, justifications and documentation provided by project participants to support the demonstration of additionality. Critically assess the evidence presented, using local knowledge and sectoral and financial expertise. VVS § 102	See section 3.5.2	Full
13.2 Please confirm that all tools required by the methodology have been used by the PP. VVS § 103	See section 3.5.2	Partial see CL 7 Resolved
13.3 For small scale project activities or micro scale project activities, the project participant used the applicable Guidelines, procedures and document issued by the EB VVS § 158 - 160	N/A	N/A
<b>14. Assessment of prior consideration of the clean development mechanism</b>		
14.1 has been identified the start date of the project activity in accordance with the CDM glossary of terms. VVS § 106	Yes ,see section 3.5.1	Partial see CL 3 Resolved
14.2 Prior consideration assessment must be done according to the VVS. VVS § 106, 107, 108	See, section 3.5.1	Full
14.3 Depending of the gap between the evidence documented, does the PP justify the validation opinion of the CDM status? VVS § 110, 111	N/A	N/A
<b>15. Identification of alternatives (if apply)</b>		

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
15.1 Has been identified the alternatives in accordance with the approved methodology and/or the tool of additionality. VVS § 113	N/A	N/A
15.2 Does the DOE evaluate if the list of alternatives includes as one of the options that the project activity is undertaken without being registered as a proposed project activity, contain all plausible alternatives to be viable means of supplying the comparable outputs or services that are to be supplied by the proposed project activity and comply with all applicable and enforced legislation? VVS § 114	N/A	N/A
<b>16. Investment analysis (if applicable)</b>		
16.1 Was applied for the PP's the latest version of Guidelines on the assessment of investment analysis? VVS § 118	Yes, see section 3.5.2. Step 2.	Full
16.2 Does the DOE verify if the project activity is not the most economically or financially attractive alternative: <ul style="list-style-type: none"> <li>Does not produce financial or economic benefits other than CDM-related income,</li> <li>Is less economically or financially attractive than at least one other credible and realistic alternative:</li> <li>The financial returns of the proposed project activity would be insufficient to justify the required investment?</li> </ul> VVS § 119	Yes, see section 3.5.2. Step 2.	Full
16.3 Was verified: <ul style="list-style-type: none"> <li>suitability of the financial indicator selected,</li> <li>assessment of all parameters and assumptions used in calculating such financial indicators, and determine the accuracy and suitability</li> <li>Cross-check the parameters against third-party,</li> <li>review, as appropriate, feasibility reports, public announcements, annual financial reports</li> <li>sensitivity analysis</li> <li>The computations</li> <li>The correctness of carry out and documented by PP's</li> </ul> VVS § 120	Yes, see section 3.5.2. Step 2.	Partial see CL 8 Resolved
16.4 Was verified: <ul style="list-style-type: none"> <li>Determine whether the type of benchmark applied is suitable for the type of</li> </ul>	Yes, see section 3.5.2. Step 2.	Full

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
<p><i>financial indicator presented</i></p> <ul style="list-style-type: none"> <li>• Ensure that any risk premiums applied in determining the benchmark reflect the risks associated with the project type or activity</li> <li>• Determine whether it is reasonable to assume that no investment would be made at a rate of return lower than the benchmark.</li> </ul> <p>VVS § 121</p>		
<p>16.5 Was verified (if apply):</p> <ul style="list-style-type: none"> <li>• The FSR is the basis for the decision to proceed with the investment in the project, i.e. that the period of time between the finalization of the FSR and the investment decision is sufficiently short that it is unlikely in the context of the underlying project activity that the input values would have materially changed</li> <li>• The values used in the PDD and associated annexes are fully consistent with the FSR, and where inconsistencies occur the DOE shall assess the appropriateness of the values</li> <li>• The input values from the FSR are valid and applicable at the time of investment decision. The DOE shall confirm this on the basis of its specific local and sectoral expertise and by cross-checking or other appropriate means.</li> </ul> <p>VVS § 122</p>	Yes, see section 3.5.2. Step 2.	Full
<b>17. Barrier Analysis (if applicable)</b>		
<p>17.1 Does the DOE determine whether the proposed project activity faces barriers that:</p> <p>(a) Prevent the implementation of this type of proposed project activity (See the latest "Guidelines for objective demonstration and assessment of barriers")</p> <p>(b) Do not prevent the implementation of at least one of the alternatives.</p> <p>VVS § 124</p>	N/A	N/A
<p>17.2 Did the DOE determine if the issues that have a direct impact on the financial returns of the project activity are not considered barriers and shall be assessed by investment analysis?. This does not refer to either:</p> <p>(a) Risk related barriers, for example risk of technical failure, that could have negative effects on financial performance; or</p> <p>(b) Barriers related to the unavailability of sources of finance for the project activity.</p> <p>VVS § 125</p>	N/A	N/A
<p>17.3 Did the DOE apply the two step process to evaluate the barrier analysis performed determining if the barriers are real and if prevent the implementation of the project activity but not the implementation of at least one of the possible alternatives?</p>	N/A	N/A

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
VVS § 126		
<b>18. Common Practice Analysis (if applicable)</b>		
18.1 For proposed large-scale project activities, unless the proposed project type is first-of-its-kind as determined in accordance with the relevant guidelines, the DOE assess whether the project participants have conducted a common practice analysis. VVS § 128	Yes, see section 3.5.2 step 4.	Full
18.2 Did the DOE use official sources and its local and sectoral expertise to: (a) assess whether the geographical scope (e.g. the defined region) of the common practice analysis is appropriate for the assessment of common practice related to the project activity, (b) Determine to what extent similar and operational projects (e.g. using similar technology or practice), other than project activities, have been undertaken in the defined region; (c) Assess, if similar and operational projects, other than project activities, are already “widely observed and commonly carried out” in the defined region, whether there are essential distinctions between the proposed project activity and the other similar activities. (See the Tool for assessing the additionality and/or the latest version of the Guidelines for assessing the common practice) VVS § 129	Yes, see section 3.5.2 step 4.	Full
<b>19. Monitoring Plan</b>		
19.1 The Audit team identified the list of parameters required by the selected approved methodology including applicable tool(s), and confirmed that are includes the data management and quality assurance and quality control procedures to ensure that the proposed project activity can be reported ex post and verified.  To assess the implementation of the plan the DOE shall, by means of review of the documented procedures, interviews with relevant personnel, project plans and any physical inspection of the proposed project activity site. VVS § 132	Yes, see section 3.6	Partial See CL 5, CL 9 and CL 10 Resolved
<b>20. Environmental Impacts</b>		

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
20.1 Did the project participants develop an environmental impact analysis including trans boundary impacts VVS § 134	Yes, see section 3.8	Full
20.2 Did the project participant conduct an environmental impact assessment, if required to do so by the host Party, in accordance with the host Party's procedures?	Yes, see section 3.8	Full
<b>21. Local stakeholder consultation</b>		
21.1. Has the project participants completed a local stakeholder consultation process and that due steps were taken to engage stakeholders and solicit comments for the proposed project activity? VVS § 138	Yes, see section 3.9	Full
21.2 The DOE determine whether: (a) Comments have been invited from local stakeholders that are relevant for the proposed project activity; (b) The summary of the comments received as provided in the PDD is complete; (c) The project participants have taken due account of all comments received and have described this process in the PDD. VVS § 139	Yes, see section 3.9	Full
<b>22. Specific validation requirements</b>		
23.1. For certain specific validation activities such as SSC, A/R, and PoA, the DOE shall comply with the general validation requirements described in the sections above as well as those that follow, including the simplified modalities and procedures for small-scale project activities, the modalities and procedures for afforestation and reforestation project activities, and Standards for PoA. VVS § 149	N/A	N/A
<b>23. Small-scale project activities (if applicable)</b>		
<b>1. Project activity eligibility</b>  - The project activities qualified within the threshold of the three possible types of small project activities. - The DOE verified that the small-scale methodologies were applied in conjunction with the general guidance to the methodologies.	N/A	N/A



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CHECKLIST QUESTION	REFERENCES	Final Conclusion
<ul style="list-style-type: none"> <li>The DOE verified that the project activity is not a debundled component of a large-scale project, in accordance with the rules defined in the appendix C of the simplified modalities for small-scale CDM project activities V/V Standard (v 02.0) art. 150-153</li> </ul>		
<b>2. Debundling</b> <ul style="list-style-type: none"> <li>The DOE shall verified that the proposed small-scale project activity to be a debundled component of a large-scale project activity if there is a registered small-scale project activity or an application to register another small-scale project activity.</li> <li>The DOE where appropriate, has taken into account specific debundling requirements for Type I project activities and small-scale transport project activities. V/V Standard (v 02.0) art. 154-157</li> </ul>	N/A	N/A
<i>The proposed small-scale project activity is not a debundled component of a large-scale project activity in accordance with the Guidelines on assessment of debundling for SSC project activities</i> VVS § 154	N/A	N/A
<i>The proposed small-scale project activity is a debundled component of a large-scale project activity if there is a registered small-scale project activity or an application to register another small-scale project activity.</i> VVS § 155	N/A	N/A
<i>The Project participant takes into account specific debundling requirements for Type I project activities and small-scale transport project activities.</i> VVS § 156	N/A	N/A
<b>3. Additionality</b> <ul style="list-style-type: none"> <li>The DOE verified that the proposed SSC project activity is additional in accordance with CDM requirements applicable for small-scale project activities.</li> <li>For the activities type I, II and III, the DOE assessed the fulfillment of the relevant criteria to establish the automatic additionality for these projects</li> <li>The DOE detailed all the steps taken to make the cross-check of the information contained in the PDD V/V Standard (v 02.0) art. 158-161</li> </ul>	N/A	N/A
<b>24. Afforestation or reforestation project activities</b>		

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
<p>Addition to the requirements listed above, the DOE verified the specific requirements for A/R CDM project activities, which include:</p> <ul style="list-style-type: none"> <li>- Project boundary for A/R CDM;</li> <li>- Selection of carbon pool;</li> <li>- Eligibility of land;</li> <li>- Approach proposed to address non permanence;</li> <li>- Timing of management activities, including harvesting cycles and verifications;</li> <li>- Socio economics environmental impacts, including impacts on biodiversity and natural ecosystem.</li> </ul> <p>V/V Standard (v 02.0) art. 162</p>	N/A	N/A
<p><b>1. Project boundary</b></p> <p>The DOE described the documentation assessed and oral statements delivered by persons interviewed and conclude on their acceptability under the legal system of the host country.</p> <p>In a case the DOE has applied a sampling approach; the validation report shall describe how many sites have been assessed and how these were selected.</p> <p>V/V Standard (v 02.0) art. 163-166</p>	N/A	N/A
<p><b>2. Selection of carbon pool</b></p> <p>The DOE verified whether the selection of carbon pool complied with the applied approved methodology. And if the exclusion of certain pool is allowed for the methodology and is justified correctly.</p> <p>V/V Standard (v 02.0) art. 167-169</p>	N/A	N/A
<p><b>3. Eligibility of land</b></p> <p>DOE verified the reliably discriminates between forest and non-forest land according to the particular threshold adopted by the host country.</p> <p>V/V Standard (v 02.0) art. 170-172</p>	N/A	N/A
<p><b>4. Addressing non permanence</b></p> <p>DOE verified the specification of proposed approach to address non performance in accordance with paragraph 38 of the modalities and procedures for A/R CDM projects activities.</p> <p>V/V Standard (v 02.0) art. 173-175</p>	N/A	N/A
<p><b>5. Timing of management activities</b></p>		

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
<p>The DOE verified how the project participants have ensured that a systematic coincidence of verification and peaks in carbon stocks would be avoided.</p> <p>V/V Standard (v 02.0) art. 176-178</p>		
<p><b>6. Socio economics and environmental impacts</b></p> <p>The DOE verified using local official source whether the project participants have undertaken an analysis of socio-economic and environmental impacts, including impacts on biodiversity and natural ecosystem, and impacts outside the project boundary.</p> <p>V/V Standard (v 02.0) art. 179-183</p>	N/A	N/A
<p><b>25. Small-scale A/R project activities</b></p>		
<p>The DOE determined whether:</p> <p>The project activities qualifies as a proposed small-scale A/R CDM project activity and complies with the threshold for the proposed small-scale A/R projects in accordance with the decision 5/CMP.1, annex paragraph 1(i).</p> <p>The project activity complied with one of the types of small-scale A/R project activities defined in appendix B of the annex to decision 6/CMP.1.</p> <p>The base line, monitoring methodology and the methodology is applied correctly.</p> <p>The proposed CDM project activity is not a part of a debulde large-scale A/R project activity, in accordance the rules defined in appendix C of the annex to decision 6/CMP.1.</p> <p>The proposed CDM project activity has been development or implemented by low-income communities and individuals as confirmed by the host Party in accordance with the decision 5/CMP.1, annex paragraph 1(i).</p> <p>V/V Standard (v 02.0) art. 184.</p>	N/A	N/A
<p><b>26. Programme of activities / Component project activities</b></p>		
<p><b>1. Coordinating/managing entity and participants in a PoA</b></p> <p>The DOE assessed the management system described in the PoA design document (CDM PoA-DD) in accordance with the .Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities</p> <p>V/V Standard (v 02.0) art. 186</p>	N/A	N/A

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
<b>2. CPA design document</b> <i>The DOE assessed the proposed CPA that a coordinating/managing entity wished to include in the PoA.</i> <i>V/V Standard (v 02.0) art. 187-188</i>	N/A	N/A
<b>3. Description of a PoA/CPAs</b> <i>The DOE assessed the CDM-PoA-DD and the PoA-specific CDM-CPA-DD that It was submitted by the coordinating/managing entity and confirmed the framework developed for the implementation of the PoA, and defined a CPA under the PoA.</i> <i>V/V Standard (v 02.0) art. 189</i>	N/A	N/A
<b>4. Application of multiple methodologies</b> <i>The DOE assessed the application of multiple methodologies in accordance with the .Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities</i> <i>V/V Standard (v 02.0) art. 190</i>	N/A	N/A
<b>5. Boundary for the PoA in terms of geographical area</b> <i>The DOE verified the boundary of the PoA within which all CPAs included in the PoA will be implemented and if the project participant have taken in account all the applicable national and/or sectoral policies and regulations</i> <i>V/V Standard (v 02.0) art. 191-192</i>	N/A	N/A
<b>6. Start date of PoA/CPA</b> <i>The DOE verified that the start date of the CPA is not prior to the commencement of the validation of the PoA, which is the date the CDM-PoA-DD is first published for global stakeholder consultation.</i> <i>V/V Standard (v 02.0) art. 193</i>	N/A	N/A
<b>7. Prior consideration of the CDM</b> <i>The DOE is not required to assess prior consideration of CDM for PoAs, as it is expected that no component of the programme will commence prior to the start date of validation.</i> <i>V/V Standard (v 02.0) art. 194</i>	N/A	N/A

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
<b>8. Demonstration of additionality of the PoA as a whole</b> <i>The DOE verified the additionality of a PoA in accordance with the .Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities.</i> <i>V/V Standard (v 02.0) art. 195</i>	N/A	N/A
<b>9. Eligibility criteria for inclusion of a CPA in the PoA</b> <i>The DOE assessed the eligibility criteria for inclusion of a CPA in the PoA in accordance with the .Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities.</i> <i>V/V Standard (v 02.0) art. 196</i>	N/A	N/A
<b>10. Crediting period of a PoA/CPA</b> <i>The DOE determined that the length of a PoA does not exceed 28 years (60 years for A/R).</i> <i>V/V Standard (v 02.0) art. 197</i>	N/A	N/A
<b>11. Monitoring plan for a PoA/CPA</b> <i>The DOE verified that the monitoring plan for a CPA is in accordance with the approved monitoring methodology, including applicable tool(s).</i> <i>V/V Standard (v 02.0) art. 198</i>	N/A	N/A
<b>12. Environmental Analysis of a PoA</b> <i>The DOE determined that It was realized an analysis of the environmental impacts of the PoA in accordance with CDM-PoA-DD and the CDM-CPA-DD.</i> <i>V/V Standard (v 02.0) art. 199-200</i>	N/A	N/A
<b>13. Local stakeholder consultation</b> <i>The DOE verified that the local stakeholder consultation process It was carried out for the whole PoA or at the CPA level.</i>  <i>DOE verified that the comments were summarized and that are completes and that were taken in account.</i> <i>If the local stakeholder consultation is conducted at the CPA level, the DOE shall determine whether it is in accordance with the level of consultation</i>	N/A	N/A

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
specified by the coordinating/managing entity and whether the local stakeholder comments were taken into account and described in the CDM-PoA-DD and the CDM-CPA-DD. V/V Standard (v 02.0) art. 201-202		
<b>14. Determination of occurrences of debundling under a PoA</b>  <i>The DOE verified that the proposed small-scale CPA of a PoA is not a debundled component of a large-scale project activity in accordance with the Guidelines on assessment of debundling for SSC project activities.</i> V/V Standard (v 02.0) art. 203	N/A	N/A
<b>15. Inclusion or renewal of a crediting period of a CPA under a registered PoA</b>  <i>The DOE verified that the specific CDM-CPA-DD is in accordance with the latest version of the PoA and determined that the CPA meets the requirements of the PoA.</i> V/V Standard (v 02.0) art. 204	N/A	N/A
<b>27. Validation status and outcomes, opinion, and report</b>		
<b>1. Validation status and outcomes</b>  <i>The DOE provided an update of the status of its validation activity, unless the project activity has been submitted for registration 180 days subsequent to the end of the period for the submission of public comments.</i> <i>The updated status presented for the DOE, must contain one of the following conditions:</i> Finalization of the validation contract A negative validation opinion Summary of the issues raised and update or reconfirm of the validation status at three month intervals Which party/parties involved in the absence of sending of a valid letter of approval Explanation about the length of the validation activity and the update of the validation status if the validation activities are ongoing and has not sent yet CAR or CL to the project participant.	N/A	N/A

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CHECKLIST QUESTION	REFERENCES	Final Conclusion
V/V Standard (v 02.0) art. 141-142		
<p><b>2. Validation opinion</b></p> <p><i>It was emitted an opinion of the likelihood of the project activity achieving the anticipated emission reductions stated in the PDD, where is informed to the PP the validation outcome, positive or negative opinion.</i></p> <p><i>The DOE's opinion must include:</i></p> <ul style="list-style-type: none"> <li>- <i>A summary of the validation methodology and process used and the validation criteria applied</i></li> <li>- <i>A description of project components or issues not covered by the validation process</i></li> <li>- <i>A summary of the validation conclusions</i></li> <li>- <i>A statement on the validation of the expected emission reductions</i></li> <li>- <i>A statement as to whether the proposed project activity meets the stated criteria.</i></li> <li>- <i>The validation opinion confirms whether the project meets the stated criteria and that the methods presented in the project design documentation are acceptable and have been correctly applied.</i></li> </ul> <p>V/V Standard (v 02.0) art. 143-146</p>	See section 5.	Full
<p><b>3. Validation Report</b></p> <p><i>The validation report is in line with IN-P-CC-01</i></p> <p><i>The DOE included in the validation report a validation opinion that integrated:</i></p> <p><i>Conclusions regarding the proposed project activity's conformity with applicable CDM requirements</i></p> <p><i>Overview of the validation activities</i></p> <p><i>Findings and conclusions</i></p> <p><i>Information on the global stakeholder consultation process carried out.</i></p> <p><i>A list of interviewees and documents reviewed</i></p> <p><i>Details of the validation team</i></p> <p><i>Information on quality control within the team and in the validation process</i></p> <p><i>Appointment certificates or curricula vitae of the DOE's validation team</i></p>	Yes, this information was indicated in all content of the validation report.	Full



**Annex A  
VALIDATION REPORT**



CHECKLIST QUESTION	REFERENCES	Final Conclusion
members, technical experts and internal technical reviewers for the project activity. V/V Standard (v 02.0) art. 147-148		

## Annex A VALIDATION REPORT



**Table A 2: Resolution of Corrective Action, Forward Action and Clarification Request**

<i><b>Report clarifications and corrective action requests</b></i>	<i><b>Reference</b></i>	<i><b>Summary of project owner response</b></i>	<i><b>Validation conclusion</b></i>
<p>CAR 1</p> <p>Net power or assured energy value used in CER's calculation (MW average) is not consistent with the hicon's hidrology study.</p>	96 and 98 of VVS	The PDD and also the CER's calculation were adjusted to the Assured Energy contained in the HICON's hydrology study.	<p><i>Validation team response:</i></p> <p><i>19/11/2012: The assured energy was corrected on the PDD and spreadsheet CER's calculation.</i></p> <p><i>Conclusion</i></p> <p><i>Closed</i></p>
<p>CL 1</p> <p>Section A.1 of the PDD does not provide the estimate of annual average and total GHG emission reductions for the chosen crediting period.</p>	Guidelines for Completing the Project Design Document Form (Version 01.0) EB 66 Annex 8.	The GHG reduction estimations were included in the PDD version 2 (Section A.1).	<p><i>Validation team response:</i></p> <p><i>19/11/2012: The values were included on the PDD.</i></p> <p><i>Conclusion</i></p> <p><i>Closed</i></p>
<p>CL 2</p> <p>Section A.3 of the PDD does not include in the description information about the age and average lifetime of the equipment based on manufacturer's specifications and industry standards, and existing and forecast installed capacities, load factors and efficiencies. The</p>	Guidelines for Completing the Project Design Document Form (Version 01.0) EB 66 Annex 8.	The related informations were included in the PDD version 2 (A.3 Section).	<p><i>Validation team response:</i></p> <p><i>19/11/2012: The information was included on the PDD according to Guidelines.</i></p> <p><i>Conclusion</i></p> <p><i>Closed</i></p>

## Annex A VALIDATION REPORT



<i><b>Report clarifications and corrective action requests</b></i>	<i><b>Reference</b></i>	<i><b>Summary of project owner response</b></i>	<i><b>Validation conclusion</b></i>
monitoring equipments and their location in the systems are of particular importance.			
CL 3  Letter of Ministry of Environment and Sustainable Development issued 24th November 2011 referred to a project different to PCH Morro Azul.	3.5.1 Prior consideration on the PDD 105 of VVS	The PP delivered the correction request to the Ministry of Environment and Sustainable Development responsible. She agreed to change the SHP name and to issue a new Letter.	<i>Validation team response:</i>  <i>26/11/2012: The Ministry of Environment and Sustainable Development, sent the letter No. 8250-2-139068, clarifying the name of the project.</i>  <i>Conclusion</i>  <i>Closed</i>
CL 4  In the sub-step 1a of the additionality, the PDD indicated wind power plant, please clarify.	Pag 9 of the PDD 102 of VVS	This information was corrected in the PDD version 2. The correct is hydro power plant instead wind.	<i>Validation team response:</i>  <i>19/11/2012: The type of energy was corrected on the PDD.</i>  <i>Conclusion</i>  <i>Closed</i>
CL 5  In the monitoring plan, specification about bidirectional or unidirectional meter must be given.	131 and 132 VVS	In the PDD version 2 are specified that the meters should be bidirectional.	<i>Validation team response:</i>  <i>19/11/2012: The specification of electrical meter was included on the PDD.</i>  <i>Conclusion</i>  <i>Closed</i>
CL 6  Clarify the value used for the	96 of VVS	In the PDD version 2 the Power Density values was adjusted	<i>Validation team response:</i>

## Annex A VALIDATION REPORT



<b>Report clarifications and corrective action requests</b>	<b>Reference</b>	<b>Summary of project owner response</b>	<b>Validation conclusion</b>
power density, because there are inconsistency between Page 7 and page 18 of PDD version 01.		accordingly (163 W/m <sup>2</sup> ).	19/11/2012: All document is consist with the value 163 W/m <sup>2</sup> for power density.  Conclusion  Closed
CL 7 Updated the version of Tool for demonstration of additionality.	103 of VVS	The Tool for demonstration of additionality was updated in the PDD version 2.	Validation team response:  19/11/2012: The tool was updated and correctly applied.  Conclusion  Closed
CL 8 Clarify the source of the Colombia risk on the spreadsheet WACC_Morro Azul_v0.xls  The formula used for calculate the levered beta, use an income tax different as the one at used in the tab WACC in spreadsheet WACC_Morro Azul_v0.xls  Clarify the source of the data of bank loan rate used and taxes not included in the legal report.  List all the inputs values of the investment analysis on the PDD.	Guidelines on the assessment of investment (version 05)	The source of the Colombia risk was adjusted in the spreadsheet version 2 (Based on the EMBI+ from JP Morgan).  The Income Tax was adjusted in the spreadsheet version 2 (the correct is 33%).  The sources of the Bank Loan and also Taxes not included in the legal report were clarified in the spreadsheets version 2.  All the input values were listed in the PDD version 2.	Validation team response:  The clarifications for the financial analysis were made on the version 02 of PDD and spreadsheet Analise_Fin_MA_v2_2.xls.  Conclusion  Closed
CL 9	Section B.6.2 of PDD	The operating margin method was	Validation team response:

## Annex A VALIDATION REPORT



<i>Report clarifications and corrective action requests</i>	<i>Reference</i>	<i>Summary of project owner response</i>	<i>Validation conclusion</i>
In the parameter $EF_{gridCM,y}$ the operating margen method mentioned does not correspond with the used method.		adjusted accordingly in the PDD version 2.	<p><i>The method for calculate <math>EF_{gridCM,y}</math> was corrected on the section B.6.2 of the PDD.</i></p> <p><i>Conclusion</i></p> <p><i>Closed</i></p>
CL 10 $EF_{res}$ is not applicable for this project because the power density is greater than $10W/m^2$	ACM 0002 Version 13.0.0	The information was removed from the PDD version 2.	<p><i>Validation team response:</i></p> <p><i>19/11/2012: The information was eliminated of the PDD.</i></p> <p><i>Conclusion</i></p> <p><i>Closed</i></p>

**Annex B**

**Letter of Approval (LoA)**

Uploaded directly on the UNFCCC website.

## **Annex C**

### **Audit Team Experience and Knowledge**



**Erika Lucia Urrego Ortiz**

CDM Lead Auditor and expert sector 13

Currently a student at the Magister in quality and integral management, 2012

Zootechnician, Universidad Agraria De Colombia, Bogotá D.C. August 1997.

Specialist in Environmental Management Systems. Universidad Externado de Colombia. Bogotá D.C. September 2002

ISO 14001 Diploma, ICONTEC, Bogotá D.C. 2002.

Food Harmlessness Management System under ISO 22000 standard Course, ICONTEC, Bogotá D.C. March, 2003

Quality Management Systems under ISO 9001:2000 standard Course, ICONTEC, May 2007.

Updating on CDM Course, Ministry of Environment, Housing and Territorial Development, Bogotá D.C 2006

OHSAS 18001 Diploma, ICONTEC, Bogotá D.C. July 2005.

**WORK EXPERIENCE****2006 – Actual ICONTEC**

To prepare and perform the certification services assigned as per her Career Plan qualification, according to the procedures. To provide guidance to the certification costumers about the technical aspects of the assigned services provision. To participate in changing or designing Certification services, by changing or creating the respective procedures.

**2003 – 2006****ASOCIACION COLOMBIANA DE PORCICULTORES-FNP**

To coordinate the activities to be performed by the Environmental Window Program in the various country areas. To allocate and execute resources engaged under the Cleaner Production agreements signed by pork producers with several environmental authorities. To lead the CDM project, focused on reducing methane (CH<sub>4</sub>) emissions issued by animal waste.

To be aware of the Ecuadorian and Chilean methodologies already approved by the CDM Executive Board for Hog Breeding Sector to elaborate a proposal for the hog breeding sector together with the Ministry of Environment, Housing and Territorial Development in order to join farms to CDM projects.

**2001 – 2002****FICHTNER GmbH & Co. KG**

To prepare, design and apply surveys focused on the identification of power consumption in the sector of slaughter, processed meat and food concentrate for animals.

1998 – 2001

Regional Environmental Authority (Regional Autonomous Corporation of Cundinamarca - CAR)

To support the environmental management units on technical concepts of processes, permissions, sanctions, control, monitoring and assessment in the proper and timely management of the Sumapaz area's natural resources.

Experience in CDM activities:

Lead Auditor:

- Validation of project ECC methane capture and combustion from AWMS at dairy farms in Mexico I.
- Validation of project Macano Small Hydro Power Plant.
- Validation of the Project Montenegro Landfill Gas Recovery and Flaring.
- Validation of the Project Montería Landfill Gas Recovery and Flaring.
- Validation of the Project Pigua Landfill Gas Recovery and Flaring
- Verification of the Doña Juana Landfill Gas to Energy Project
- Validation of "La Vegona Hydroelectric project"
- Validation of "Chamalecón 280 Hydroelectric project"
- Verification of "Doña Juana Landfill gas-to-energy project"
- Verification of "Landfill Gas to Energy Facility at the Nejapa Landfill Site
- Verification La Venta II Project
- Verification VCS Scheme: Fuel-Switching Project from Fossil Fuels to Biomass in La Providencia, Arcor
- Verification Biogas energy plant from palm oil mill effluent
- Validation of "Los Angeles Landfill Gas Flaring Project"
- Verification of "Hydroelectric Santa Ana"
- Verification of "BRASCARBON Methane Recovery Project BCA-BRA-01, Brazil"
- Verification of "BRASCARBON Methane Recovery Project BCA-BRA-02, Brazil"
- Verification of "BRASCARBON Methane Recovery Project BCA-BRA-03, Brazil"
- Validation CTR Catanduva Landfill Gas Project, Brazil
- Validation CTR Maceio Landfill Gas Project, Brazil
- Validation BRASILM 1 - Avoidance of Methane Emissions through Composting of Manure Waste.
- Validation CTR Teresina Landfill Gas Project, Brazil
- Validation Macaúbas Landfill Gas Project

Lead auditor in voluntary schemes:

- Validation and verification of VCS "BRASCARBON Methane Recovery Project BCA-BRA-01, Brazil"
- Validation and verification of VCS "BRASCARBON Methane Recovery Project BCA-BRA-02, Brazil"
- Validation and verification of VCS "BRASCARBON Methane Recovery Project BCA-BRA-03, Brazil"
- Validation and verification Gold Standard Paramonga Bagasse Boiler Project, Peru.

**Eng. Fernando Gómez Gómez**  
**Energy and financial expert**

Electrical Engineer. Universidad Nacional of Colombia (1967)  
Master of Power Systems - Instituto Tecnológico de Monterrey (Mexico) (1970)  
EAFIT Financial Specialist (Colombia) (1984)

**ECONOMETRÍA S.S. - Technical Advisory**

Technical Advisory to Unidad de Planeación Minero Energética to incorporate international electrical interconnections into the Colombian electrical planning carried by UPME, October 2002 - March 2003 (including use of SUPEROLADE, MPODE, NEPLAN and REAL models).

**ECOENERGIA S.S. ESP - Founding Member and Manager**

Management of private projects of generation, distribution and commercialization of power.

Unidad de Planeación Minero Energética - UPME-: Elaboration of Catalog of Generation Projects for National Energy Plan, October 1996 - October 1997.

**AUDITORES ENERGÉTICOS - AENE LTDA**

Advisory to the company in the application of the new regulatory scheme of Colombian electrical sector to private and public entrepreneurial management through the following studies:

Development of competent rate models, October 1994 - March 1995

CORELCA: Determination of marginal costs and development of innovative rate structures for power generation companies and big industrial customers, October 1994 - March 1995.

CORELCA: Development and application of rate models to prepare proposal on power sale in the wholesale market, July 1995 - September 1995.

**EMPRESA DE ENERGIA DE BOGOTÁ - EEB**

Chief of the Department of generation planning, interconnection and sub-transmission, 1978 - 1979

Chief of Electric Planning Division, 1979 - 1986.

Assistant for Technical Sub-management, 1986 - 1987

Chief of Special Projects Division, 1987

Chief of expansion and Development Division, 1987 - 1994

Management Advisor, 1994

**INTERCONEXIÓN ELÉCTRICA S.A - ISA**

Engineer Specialist in electric planning research and development of models for planning and operation of electric systems. 1976 - 1978

National Coordinator of Colombian electric system planning in the project "Study of Electric Power Sector (Estudio del Sector de Energía Eléctrica), ESEE" winner of the National Award of Engineering.

**EXPERIENCE IN CDM ACTIVITIES** (Main references)

Technical Reviewer and participation as Energy and Financial expert (onsite visit) in more than 60 project activities, from 2006 to 2012, inter alias:

- Verification of three verification periods of Santa Ana Hydroelectric plant project
- Verification of first verification period of Agua Fresca Multipurpose and Environmental Services Project
- Verification of two verification of La Vuelta and la Herradura Hydroelectric Project
- Verification of Rio Amazon Woods residues power plant
- Verification of Cristalino small hydroelectric power plant project
- Verification of Faxinal small hydro project in Faxinal dos Guedes
- Validation of El Bote small hydroelectric plant project
- Verification of "La Joya hydroelectric project"
- Validation Thuan Nhen Phong - Viet Nam
- Validation Phuong Mai 3 - Viet Nam
- Verification La Venta II Project
- Verification Biogas Energy plant from palm oil mill effluent
- Validation Ferreira Gomes Hydro power plant CDM project activity
- Verification Toachi – Pilton Hydroelectric Project
- Validation of "Fuel Switching through change of furnaces at Imusa S.A."
- Verification of "Los Algarrobos hydroelectric project"
- Validation CTR ROSARIO Landfill Gas Project
- Validation CTR Feira de Santana Landfill Gas Project

**TEAM TECHNICAL REVIEW****Team audit experience and knowledge**

**Francy Milena Ramírez Torres**  
**CDM Lead Auditor and Specialist**

Electrical Engineer. Universidad Los Andes, 2001

Postgrade: Assessment of Social Projects. Universidad Los Andes, 2005

University of Oxford. Course: Applying Knowledge Management, Principle and Practices (December 1 de 2009).

University of Oxford. Course: Successful Change Management for Engineers, Scientists and Staff in Hi-tech Companies (Diciembre 2 de 2009).

University of Oxford. Course: Essentials of Project Management for Engineers, Scientists and Staff in Hi-tech Companies (December 3 de 2009).

University of Oxford. Course: Advanced Project Management for Engineers, Scientists and Staff in Hi-tech Companies (December 4 de 2009).

Climate Change, Trade and Standardization - in a development perspective".  
Estocolmo, Suecia (23 y 25 de Noviembre de 2009)

ISO global workshop on Greenhouse Gas Schemes Addressing Climate Change –  
How ISO Standards Help, Estocolmo, Suecia. (20 y 21 de Noviembre de 2009)

Conference on Climate Change – Deforestation and Standardization. Bali, Indonesia  
(31 de mayo y 1 de junio de 2010)

### PROFESSIONAL EXPERIENCE

- ICONTEC. (2005 – Actually)

#### Professional of Standardization

Planning, coordinate, implement and ensure compliance with the program of national standardization in technical committees among which are electrical installations, electrical power quality, electrical transformers, substations and equipment for medium and high voltage, lighting, appliances and electrical accessories, protection against lightning strikes and electrical equipment. Develop technical standards. Develop and manage special projects assigned. Participate in programs of regional and international standardization.

- CODENSA (2002 – 2005)

#### Inspections and electrical works coordinator

Supervise field work and download the results in the central information system, evaluate the inspections performed, reconciled with contractors, addressing the results of inspections to different areas of the company, charging inspections and electrical work to clients of the firm, coordination and support group field sales engineers, technical training for technical staff, administrative support to department business processes and lost control, maintenance of the database for internal management inspections. Project Leader for the Optimization of Technical Processes and Regional Trade in Cundinamarca.

### EXPERIENCE IN CDM ACTIVITIES

- Verification of four crediting periods of Santa Ana Hydroelectric plant project
- Verification of two periods Agua Fresca Multipurpose and Environmental Services Project.
- Validation of Chamelecón 280 Hydroelectric Project
- Validation of La Vegona Hydroelectric project
- Validation of Bonyic hydroelectric project
- Validation of Cambará and Embaúba SHPs and LOGICarbon CDM Project
- Validation of Pardos SHPs and LOGICarbon CDM Project
- Validation of Pequi and Sucupira SHPs and LOGICarbon CDM Project
- Validation of Rio Bonito and Baitaca SHPs and LOGICarbon CDM Project
- Validation of METALDOM Fossil fuel switch from reheat furnace.
- Verification of Los Algarrobos hydroelectric project
- Verification of Bio energy in General Deheza –Electric power generation from peanut hull and sunflower husk-
- Validation of Toachi – Pilaton Hydroelectric Project

- Validation of Energy efficiency at Malvinas Gas Plant
- Validation of Marañon Hydroelectric Project
- Validation of Santa Rita Hydroelectric Plant
- Validation of Ventana, Suba and Usaquén Hydroelectric CDM Bundled

### **Eng. Cristian Grisales**

Audit

Electrical Engineer  
UNIVERSIDAD NACIONAL DE COLOMBIA

Work Experience  
Professional climate change  
2012 – Actual  
ICONTEC

Participation as an Energy expert in:

- Validation Gold Standard Energy Efficiency and Partial Fuel Switch at Ladrillera Alcarraza
- Validation Project Biogas project, Olmeca I, Santa Rosa

2009 – 2012

EMGESA S.A E.S.P

Electrical Maintenance Engineer.

Hydroelectric Power Plants Guaca, Tinta, Junca, Bogotá River Hydroelectric Plants.

Preventive, predictive and corrective maintenance of the generating units, auxiliary services, power transformers and electrical substation, developed of the investment projects, inventory in accordance with annual operating budget, implementation of maintenance plans from systems analysis as RCM decision sheets, monthly service availability in the plant, and availability of full-time in failure attention, electrical testing of generators, transformers, motors and substation equipment.

### **Experience in CDM activities:**

Participation as an Energy expert in:

- Validation Gold Standard Energy Efficiency and Partial Fuel Switch at Ladrillera Alcarraza
- Validation Project Biogas project, Olmeca I, Santa Rosa