acueducto
AGUA Y ALCANTARILLADO DE **BOGOTÁ**

SANTA ANA HYDROELECTRIC PLANT
A SMALL-SCALE CDM PROJECT

MONITORING REPORT OF CO_{2e} EMISSIONS REDUCTIONS ACHIEVED DURING THE FOURTH ACCREDITATION PERIOD August 1, 2008 – July 31, 2009

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1. Objectives of this Monitoring Report

The regulatory framework of the UNFCCC requires that the emissions reductions from duly registered CDM projects has to be reviewed and verified by a Designated Operational Entity (DOE), in order to certify the CO_{2e} emissions reductions. The monitoring report, verification and certification are required to enable the UNFCCC to emit with precision the number of Certificates of Emission Reduction (CERs) of the CDM project. This Monitoring Report is prepared in order to document the amount of CO_{2e} displaced from the national interconnected grid by the Santa Ana Hydroelectric Plant during its fourth verification period, from August 1, 2008 – July 31, 2009.

The Santa Ana Hydroelectric Plant PDD, was duly validated by the DOE *TUV Industrie Service GMBH SUD Group*[1], and was officially registered as a small scale CDM project by the CDM Executive Board on May 11, 2006.

The Colombian Institute for Technical Standards and Certification - ICONTEC, as Designated Operational Entity for Verification and Certification Energy Industries (renewable / non-renewable sources), was retained by the *Empresa de Acueducto y Alcantarillado de Bogotá (EAAB)* for the official verification and certification of the CO_{2e} emissions reduced by Santa Ana Hydroelectric Plant, CDM project 0275, during its fourth accreditation period.

2. Description of the Project

2.1 Supply Systems

The water system available to the city of Bogota, also supplies some surrounding municipalities: in the north, Gachancipá, Tocancipá, Sopo, Cajicá and Chia; in the east, the town of La Calera; in the western, municipalities as Funza, Madrid and Mosquera and in the south the town of Soacha.

The population served is close to 8 million people, representing nearly 1,500,000 users and require an average daily flow of 15.15 m³/s (period August 2008 - July 2009).

The system has an installed capacity of 26.5 m³/s to produce potable water. This means that the city of Bogotá and surrounding municipalities require 57% of installed capacity. The total installed capacity can only be used by building elements and structures needed in the transmission of raw and treated water to enable their distribution.

The three main systems that supply water to the city of Bogotá and surrounding municipalities are:

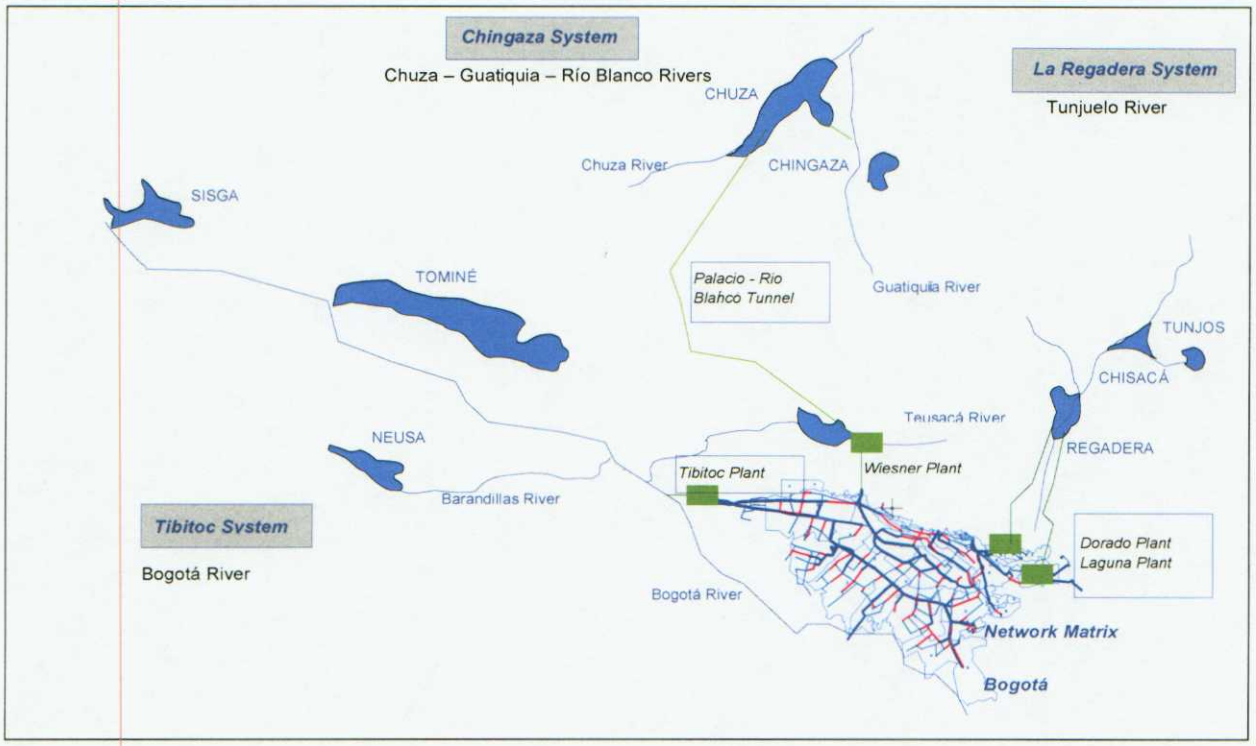
- Chingaza System (East), associated with the treatment plant Wiesner
- Tibitoc System (north), associated with the treatment plant Tibitoc.

[1] *TUV Industrie Service GMBH SUD Group:* **Validation Report No. 673631**. Revision 01. April 3 de 2006.

- The Regadera System (south), associated with treatment plants El Dorado, Vitelma and Laguna, the last two used as a contingency endorsement.

FIGURE 1

DIAGRAM OF SUPPLY SYSTEMS



The east supply system is located northeast of the city at the top of the east mountain range. It comprises the Chuza reservoir, some pick up wells (Río Blanco system) and the San Rafael reservoir, which receives water from the Chuza reservoir through an overflow structure located before entering the treatment plant and a minimum input from high Teusacá River. The Chuza water reservoir, which mainly regulates the upstream flow of Guatiquía and Chuza rivers, is conducted at the treatment plant through a tunnel system which initiates conduction of pressurized water and then by regulating a flow control valve, passes to a free flowing condition. San Rafael Reservoir is used during contingency periods, when there is suspension of supply from the Chuza reservoir, especially during inspection and maintenance operations between Chuza reservoir and treatment plant. The treatment plant is called Francisco Wiesner, whose wealth of production supplies approximately 70% of total demand.

The northern supply system comprises Bogota River and a group of reservoirs that allow the regulation flow of this river and the reservoir chamber that allows the regulation of low Teusacá river. The water collected by gravity from Bogota River and by pumping from Teusacá River, is

treated at the Tibitoc plant, whose wealth of production supplies approximately 28% of total demand.

The supply system in the south is formed by a group of dams that regulate the flow of the river's upper basin Tunjuelo. Treatment plants associated with this system are: El Dorado, Vitelma and La Laguna. The last two are used as a contingency endorsement. The production rate of this system provides about 2% of total demand[2].

TABLE 1

STORAGE CAPACITY AND TREATMENT OF THE WATER SUPPLY SYSTEMS

SUPPLY SYSTEM	RESERVOIRS (MILLIONS OF m^3)		TREATMENT PLANTS (m^3/s)	
Tibitoc (north)	Tominé	690	Tibitoc	10.5
	Sisga	102		
	Neusa	102		
	Aposentos	0.8		
Chingaza	Chuza	257	Francisco Wiesner	14
	San Rafael	75		
La Regadera (south)	Chisacá	6.7	El Dorado	1.6
	La Regadera	3.3	La Laguna	0.45
	Los Tunjos	2.4	Vitelma	0.4

2.2 Localization

The treated water flow in the Chingaza System is conducted through a tunnel known as alternate Usaquén. It is a conventional concrete covered tunnel, with 2.5 km in length, which leads the treated water from the Wiesner plant, located in La Calera, to the Santa Ana and Suba tanks[3], located in north Bogotá, and to others storage tanks located in center, south east, south west and south of the city, through Rosales tunnel.

In order to take advantage of the difference in available height between the Wiesner plant, located at 2,825 meters above sea level, and Santa Ana tank, located at 2,709 meters above

[2] The Yomasa treatment plant is also considered as part of the southern supply that captures water from a creek that bears its name and has a treatment capacity of 0.025 m^3.
[3] The storage capacity of Santa Ana Tank is 30,000 m^3 and Suba Tank is 90,000 m^3

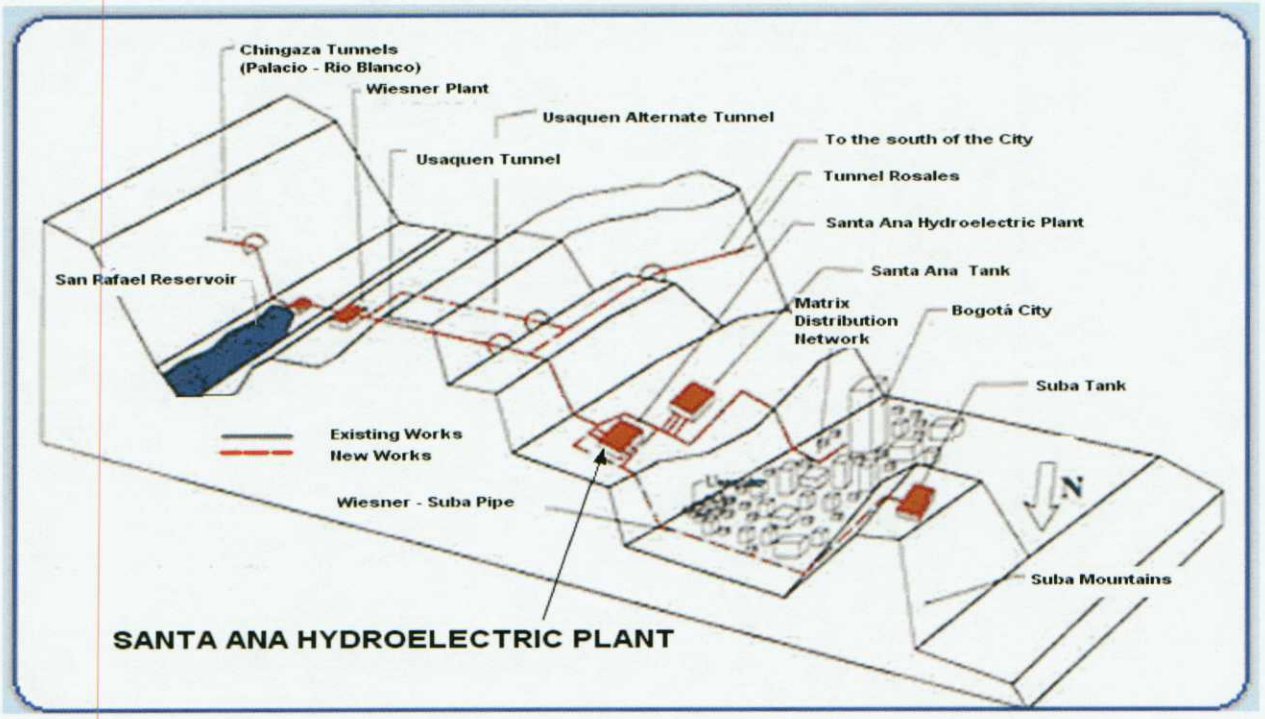
sea level, as well as the water flow delivered to the city through the Suba and Santa Ana control structures, was built between the years 2001 and 2003, the Santa Ana Hydroelectric Plant[4].

The Santa Ana Hydroelectric Plant is located in northern Bogota, at 119th Street at top east, in the place known as "*Santa Ana Complex*", exactly at coordinates 110324.65 North and 105849.56 East.

The feeding flow for the Suba and Santa Ana control structures, in normal operation is approximately 70% of treated flow at the Wiesner Plant, which corresponds to 55% of the city demand, and provides the aqueduct service to the northern, north-east and west of Bogotá.

FIGURE 2

LOCATION OF THE SANTA ANA HYDROELECTRIC PLANT



[4] The turbine is located at 2,704 meters above sea level. That implies a useful gross height of approximately 120 meters between the Wiesner plant and the turbine.

2.3 Technical Characteristics

The main technical characteristics of the Santa Ana Hydroelectric Plant are: Francis turbine horizontal axis; net design head 105.9 meters[5]; design flow[6] 13.5 m^3/s; installed capacity 13.43 MW; nominal capacity 12 MW; rotation speed 600 rpm; synchronous generator; power transformer 15 MW.

The water flow that is normally transported[7] is used by the plant to produce electric energy delivered into the national interconnected grid through local distribution system.

2.4 Annual Generation Expected

The Santa Ana Hydroelectric Plant was designed to generate around 90 GWh/year, with 13.5 m^3/s water flow, considering the Chingaza System - Wiesner Plant expansion project to treat an approximately 21 m^3/s water flow[8].

However, the reliable generation flow was significantly reduced compared to the design flow of the plant, due mainly to the reduction in the trend of water consumption in the city since the late nineties[9], which was of 17.6 m^3/s in 1996 to about 15 m^3/s in recent years.

The reduction in city water demand, due to EAAB´s efficiency measures, as well as the adoption of measures to ensure the water supply required for the city, reduced the generation expectations of the Santa Ana Hydroelectric Plant to 47 GWh/year approximately.

One of the most important measures taken by the EAAB to ensure a reliable supply of water required to meet the demand of the city, a overlapped goal with any other objective, was the Vulnerability Mitigation Program implementation of the water supply systems. This program was designed to identify any potential risks that could affect the drinking water supply to the city. As a part of it the Chingaza Tunnels Maintenance and Coating Program[10], seeks to mitigate as much as possible their risk of detachment, coating the tunnels in conventional concrete[11].

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[5] The net design head 105.9 m is the average operation of the turbine. The maximum net design head is 109.5 m and the nominal net design head is 100 m. The net head is in function of the flow, due to the hydraulic structure loss that depends on the led flow from the Wiesner Plant to Santa Ana Hydroelectric Plant. Additionally, the net head also depends on the downstream pressure turbine imposed by the hydraulic network of the city.

[6] The efficient operation flows are between 5.2 m^3/s and 13.5 m^3/s.

[7] The flow required by Santa Ana and Suba tanks is normally used by the Santa Ana Hydroelectric Plant to produce electricity. However, when the turbo group is unavailable (in the event of failure, low flow or maintenance) the flow will be conducted automatically by a multijet valve installed in a parallel pipe. In the event that the turbo group and multijet valve are unavailable, the flow may be conducted through a derivation of high pressure.

[8] EAAB: **Designs for Construction of the Usaquen Alternate Tunnel and Santa Ana Hydroelectric Plant**. Report No. 5. Optimization of the Central. Contract No.1-02-4000-0122-96. Contractor: INGETEC S.A.

[9] EAAB: **Expansion Plan of Water Supply System of the Bogota city and its Neighbor Municipalities**. Report. No. 4. Optimal Dispatch Adjustment of the Plants. Contract No. 2-02-25300-332-2004. Contractor: INGETEC S.A.

[10] Chingaza tunnels are: Siberia (3 km), Palacio - Blanco River / free flow (10 km), Palacio - Blanco River / under pressure (18.4 km), El Faro (0.97 km). Total: 32.4 km

[11] Ibid. Report No. 3. Rehabilitation Program, Vulnerability Supply System and Service Life of Assets.

In order to make the coating and maintenance activities of the Chingaza tunnels there has to be a change in the operation of the water supply systems, from a normal operation stage (see Figure 3) to an operation stage that considers the implementation of those activities.

Initially, the coating program of the tunnels considered:

- *First*, shutting down each of the Chingaza tunnels for complete inspection and maintenance during a three month period per year. This operation reduces the total flow of drinking water from Chingaza System.

- *Second*, increasing the drinking water supply from the Tibitoc System to compensate the loss of supply from Chingaza System.

During the three months established annually to the maintenance of the tunnels, it is necessary to reduce the treated flow provided by the Wiesner plant to the Santa Ana and Suba tanks, limited by the ability of the San Rafael reservoir and operating conditions of the aqueduct system.

When considering a scenario of reduced water flow available for generation, below the minimum flow required for operating the Santa Ana Hydroelectric Plant[12], it is expected that during the annual maintenance activities of Chingaza tunnels it is not allowed to operate the hydroelectric plant. As a result of this scheme of operation, it is estimated that over the 10 year term of the Chingaza tunnels maintenance and coating program, the annual generation mean of Santa Ana Hydroelectric Plant will be around the 47 GWh/year[13].

Despite the above, the available flows for generation in the Santa Ana Hydroelectric depend on the magnitude and spatial distribution of potable water demand in Bogota and the optimal release from treatment plants, giving priority to the coverage, quality and security of water service, considering the behavior of water sources, the operation of production systems and water distribution and maintenance requirements of these systems.

Due to maintenance needs and dynamics of proper operation of the water system, covering activities for Chingaza tunnels can be made in one or two periods per year, each period lasting two to three months depending on the backup capacity of San Rafael reservoir and climate factors in the maintenance period (see Figure 4).

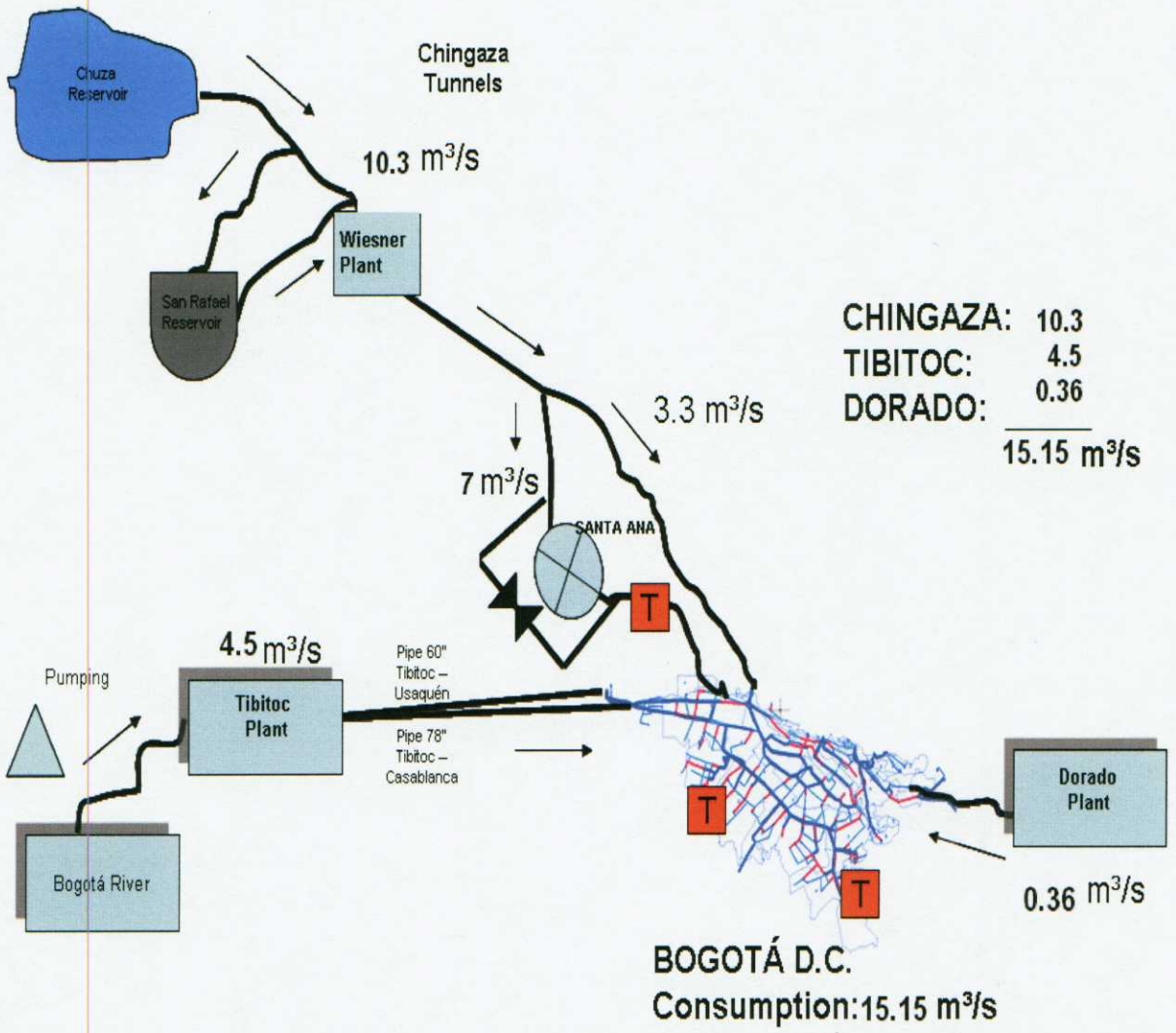
[12] The Santa Ana Hydroelectric Plant could generate using flows > 3.7 m^3/s and < 5.2 m^3/s but is a special operation in which it is required to control vibrations in the turbo group to approach the cavitation region.

[13] EAAB: **Studies and consultancy for the marketing and launch of operations of the Santa Ana Hydroelectric Plant and to define the optimal release of drinking water, taking into account the plant along with other generation options**. Document No. 2. Study of optimal release aqueduct system including the Santa Ana Plant. Contract No. 2-02-4200-305-2001. Contractor: INGETEC S.A. In the recommendations chapter of this study, it is determine that the probable average annual generation in the Santa Ana Hydroelectric Plant for 10 years of the coating and maintenance of Chingaza tunnels could be around 47 GWh/year and the average flows likely during the maintenance period would be 3.5 m^2/s and in normal operation in 8.6 m^2/s.

By the previous, the projection of power generation at Santa Ana Hydroelectric Plant is being reviewed and are currently estimated that this could be between 30 GWh / year and 48 GWh / year [14].

FIGURE 3

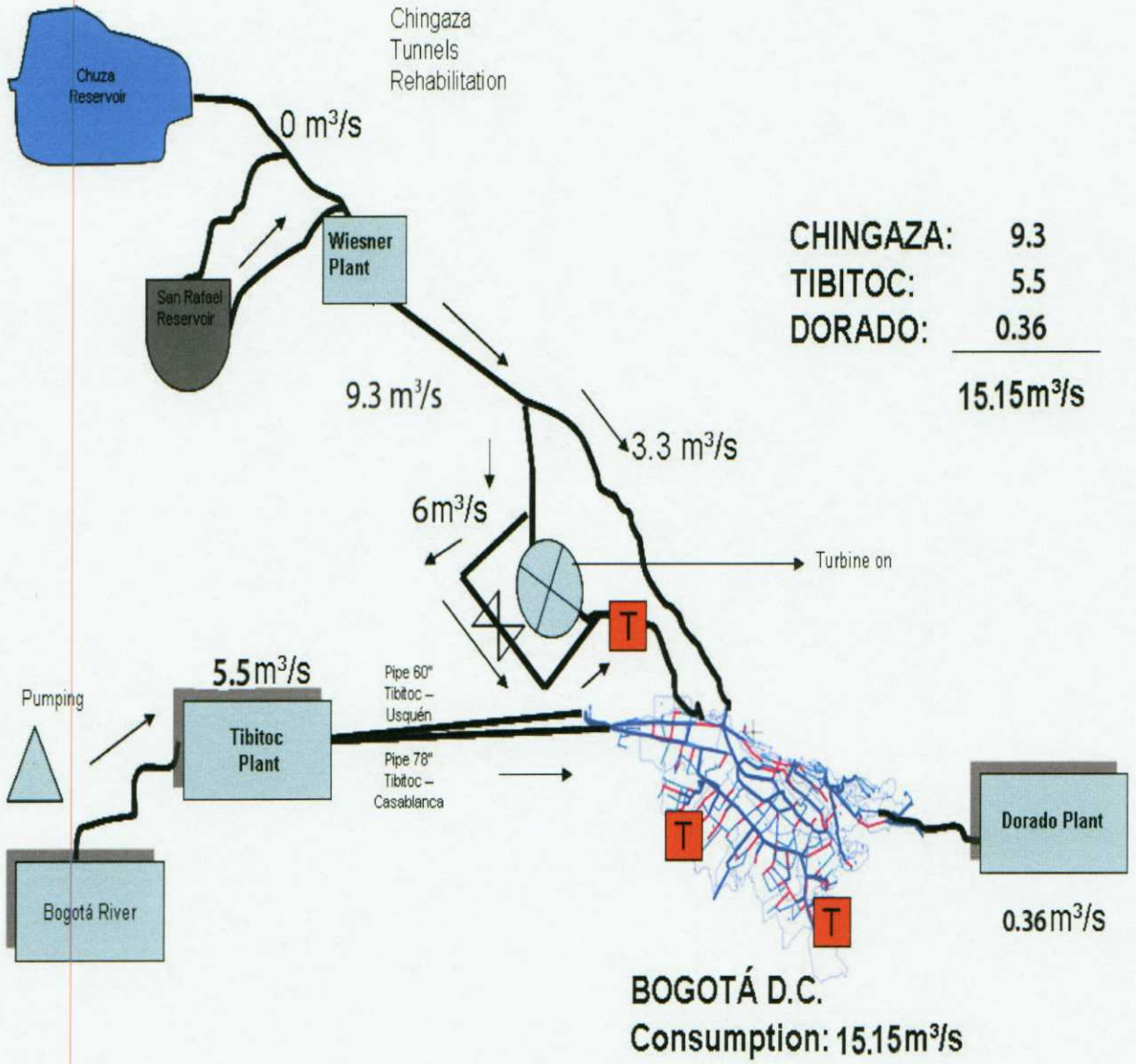
CONDITIONS NORMAL OPERATION WATER SUPPLY SYSTEMS



[14] EAAB: **Planning Energy Generation. Period August 2008 - December 2012**. Document prepared by the Network Matrix Aqueduct Office. 2008.

FIGURE 4

**CONDITIONS OPERATION WATER SUPPLY SYSTEMS
MAINTENANCE AND COATING CHINGAZA TUNNELS (TIME: 70 DAYS)**



3. Operation of the Project during the Fourth Accreditation Period

3.1 Operational and Administrative Structure

Figure 5 shows the part of the organizational structure of the EAAB[15] who was responsible for the administration, operation, maintenance and monitoring CDM project Santa Ana Hydroelectric Plant, during the fourth accreditation period.

FIGURE 5

OPERATIONAL AND ADMINISTRATIVE STRUCTURE SANTA ANA HYDROELECTRIC PLANT

As an operating point of the distribution system of the city's drinking water, the Network Matrix Aqueduct Direction is the responsible area for the overall operation of the hydroelectric power station in Santa Ana, and to exercise supervision and monitoring of the energy generated in the plant, as part of implementing the quality management system under ISO 9001.

[15] EAAB: Agreement 11 of 2007. By means of which is modified the Organizational Structure of Empresa de Acueducto y Alcantarillado de Bogota - ESP and identify the functions of its dependencies.

The Network Matrix Aqueduct Direction executes the operating activities of the Santa Ana Hydroelectric Plant considering the planning , operation and maintenance of the supply systems, as part of an Industrial Agreement signed between the Supply and Network Matrix Aqueduct Directions. The Water Supply Direction joins the organization as providing drinking water for the Network Matrix Aqueduct Direction.

The technical and commercial operation related to the process of generating and selling electric power is headed by the Technology Corporate Management Office, through the Electromechanical Services Direction.

The scheduled maintenance of electrical, electronic and mechanical components equipment of the plant is headed by the Electromechanical Services Direction. This maintenance is part of a service agreement signed between the Network Matrix Aqueduct Direction and the Electromechanical Services Direction.

The tracing of the CDM component project is headed by the Environmental Corporate Management Office, which is responsible for preparing the monitoring report with the support of the Electromechanical Services and Network Matrix Aqueduct Directions.

3.2 General Operation

For the period from August 2008 to July 2009, the average demand for potable water monthly stood at around 15.15 m^3/s, which was produced by flow supply systems as follows:

1. Chingaza System: 9.5 m^3/s.
2. Tibitoc System: 5,29 m^3/s.
3. La Regadera System: 0.36 m^3/s.

As part of controlling the generation of electrical energy in the Santa Ana Hydroelectric Plant, management primarily monitors Aqueduct Matrix hydraulic parameters such as pressure and flow entering the *Santa Ana Complex*[16] (flow is measured over the finish line to the turbine) and unexpected downtime due to power failure at the *Santa Ana Complex*.

Table 2 presents the average monthly flow of Santa Ana entrance to the compound during the period August 2008 - July 2009.

[16] The Santa Ana system is a drinking water pipeline that feeds three derivations: entrance to the Santa Ana tank, entrance to Suba tank and the " Northeast Line". The first two pipelines are average flow available for generation while the third pipeline doesn´t. This is because the " Northeast Line" diverts around the 1.5% flow of Santa Ana system and this flow doesn´t go through the turbine because is necessary the Wiesner plant pressure to supply drinking water at the northeast area of the city. The flow meter of the Santa Ana system is located between the end of the Usaquén alternate tunnel and Santa Ana Hydroelectric Plant.

TABLE 2

MONTHLY AVERAGE FLOW OF THE SANTA ANA COMPLEX

YEAR	MONTH	REGISTERED FLOW (m^3/s)
2008	AUG	4,99
	SEP	5,16
	OCT	4,83
	NOV	4,96
	DEC	4,92
2009	JAN	4,71
	FEB	6,21
	MAR	6,74
	APR	6,81
	MAY	7,04
	JUN	6,75
	JUL	6,31

Source: Control Center. Network Matrix Aqueduct Direction.

During the fourth quarter period of verification, the monthly average flow turbine inlet was hit by aqueduct system operational events, which reflects the dynamics of the sections as cable maintenance, structures and mechanical elements located in the network adduction and distribution lines.

For the period between August 2008 and July 2009, the Network Matrix Aqueduct and Water Supply Directions implemented the following activities, which modified the stage of operation of the Santa Ana Hydroelectric Plant and decreased inflow to the turbine:

1) Inspection and evaluation of the intake at Santa Ana – Usaquén pipe by the Network Matrix Aqueduct Direction[17]. This line was kept out of operation since May 06/2008 to March 08 /2009. This condition created an operation scheme in which Santa Ana tank and Santa Ana-Usaquén line went out of service and was unable to regulate the service at nearby areas. Under this new scheme of operation is not possible the water supply tank through the Santa Ana, decreasing the flow entering the Santa Ana complex about 2.1 m^3/s.

2) Restoration and structural reinforcement of the Santa Ana tank, by Network Matrix Aqueduct Direction[18]. The tasks were completed on May 31/2008. However, the tank

[17] EAAB - ESP. Network Matrix Aqueduct Direction. Contract No. 2-01-25400-849-2008. Contractor: Nema Ingeniería Ltda. Start date: 13-01-2009. Completion date: 28-03-2009.
[18] EAAB - ESP. Network Matrix Aqueduct Direction. Contract No. 1-01-25400-570-2007. Contractor: Aplicaciones Técnicas y Servicios ATS LTDA. Start date: 21-01-2008. Completion date: 21-08-2008.

was kept out of operation at all 2008 due to in the Santa Ana-Usaquén described in the preceding paragraph. The tank works were completed but not available online distribution.

3) Chingaza tunnels maintenance, by the Water Supply Direction[19]. These jobs were implemented in two periods[20]. The first maintenance was conducted between November 13/2008 and January 19/2009, period in which the Wiesner plant operated pumping San Rafael reservoir and during this period left the city without 1.2 m^3/s, compensated by Tibitoc flow. The service delivery from the Chingaza system began on January 22/2009 but the available flow for generation is not normalized by the constraint that generates the Santa Ana tank maintenance and the Santa Ana - Usaquén line out of service (see previous paragraph).

   The second maintenance started on July 13/2009 and ended September 17/2009, and like the previous maintenance, Wiesner plant operated pumping San Rafael reservoir and during this period left the city without 1 m^3/s, compensated by Tibitoc flow.

   Chingaza tunnels maintenance was made in two periods under three months for one year, owing to considerations of supply and demand compensation volume of the reservoir of San Rafael, seasonal climate periods affecting the execution of civil works and contractual considerations associated with the scope of the lining works of the tunnels.

4) Rehabilitation works of the concrete channel of raw water adduction, as well as columns and walls of Wiesner Plant tank[21].

Other events that reduced the generation were intermittent faults occurring on power circuits operated by CODENSA. These unforeseen events left 508 hours in which there were no energy for the national interconnected system.

For all the above, for the fourth quarter accreditation period of the project, power generation at Santa Ana Hydroelectric Plant was reduced by 29% compared to the estimated annual generation in the Project Design Document (PDD)[22].

3.3 Technical Operation

The electric power generated by the Santa Ana Hydroelectric Plant is sent into the national interconnected grid through the local distribution system, according to the contract signed between the EAAB and the operator of the local grid, CODENSA (*Comercializador y Distribuidor*

[19] From a total of 32.4 km of tunnels had been coated, to October 2009, 20.5 km.
[20] EAAB - ESP. Water Supply Direction. Contract No. 1-01-25300-550-2008. Contractor: Consorcio Chingaza SBCC 2008. Start date: 13-11-2008. Completion date: 13-10-2009.
[21] EAAB: Water Supply Direction. Contract No. 1-01-25300-667-2007. Contractor: Consorcio Obras Civiles 2007. Start date: 22-02-2008. Completion date: 20-02-2009.
[22] The energy actually generated and delivered to the national interconnected system during the period August 2008 - July 2009 accounted for 91.5% of the energy estimated for the same period in the "Planning of Power Generation," prepared by the Network. Matrix Aqueduct Direction.

de Energía S.A)[23], in compliance with the provisions made by resolutions 025 of 1995 and 070 of 1998 of *Comisión de Regulación de Energía y Gas* – CREG[24].

The administration, operation and maintenance of network assets, according to the contract signed between the EAAB and CODENSA[25], complies with CREG resolutions 003 of 1994, 082 of 2002 and 070 of 1998.

The daily measurement of the electric power generated is carried out in the Usaquén Electrical Substation, owned by CODENSA, through the commercial frontier power meter SIEMENS No. 30031, complying with all the technical requirements established by CREG resolutions 025 of 1995 and 006 of 2003 and the provisions of the *Administrador de Intercambios Comerciales* - ASIC.

The power meter calibration SIEMENS No. 30031 complies with all the provisions in the CREG resolutions 070 of 1998 and 006 of 2003 and the Technical Colombian Standard NTC - ISO / IEC 17025. This meter has a Calibration Certificate No. CAM-IM0806-000778 of June 26, 2008.

The verification and validation of the daily measurement that makes the power meter SIEMENS 30031 is done by the EAAB through, automatic and electronic interrogation of the power meter AMETEK No. 14600821, Model JemSTAR, which is in the Usaquén Electrical Substation, owned by the EAAB.

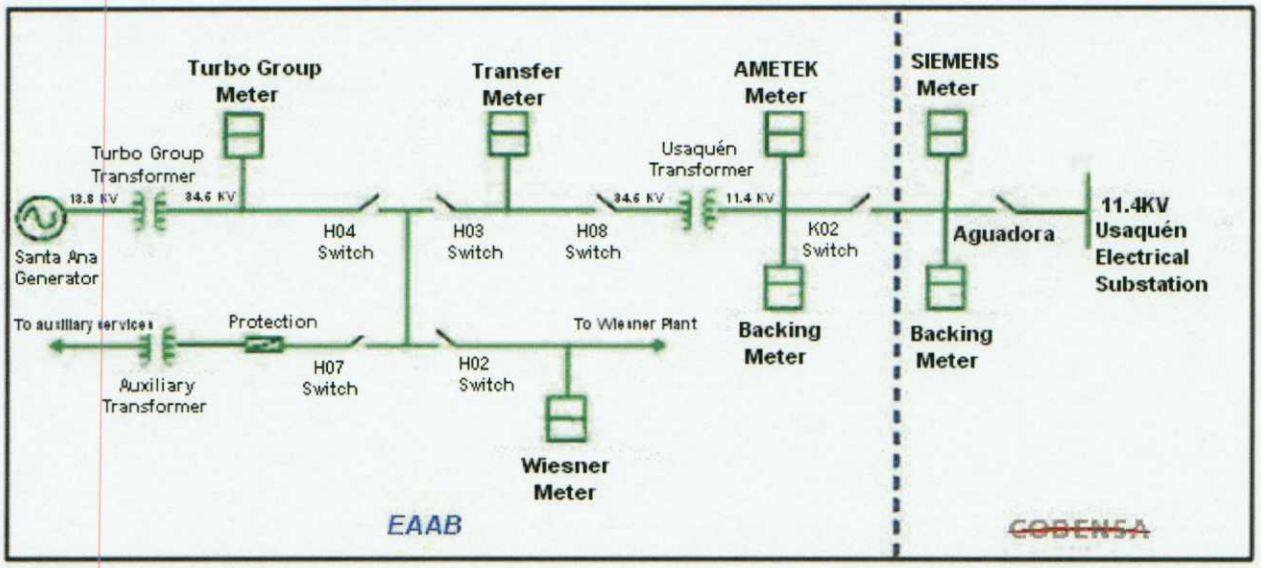
The power meter AMETEK No. 14600821 has protocols testing and calibration certificates issued by the manufacturer. It does not have the formality of registration with the ASIC and therefore is under full responsibility of the EAAB. This meter has a Calibration Certificate No. CAM-IM0806-003273 of June 26, 2008.

The Single Line Diagram of Santa Ana Hydroelectric Plant (see Figure 6) shows the main line driving the power generated from the plant to the commercial frontier power meter, which is delivered to the interconnected national grid. The two additional lines showed, are output energy lines: one to provide energy to the auxiliary services of the Hydroelectric Plant, and the other one, as an emergency line to supply energy to the Wiesner Plant. In none of the cases, the control system allows importation of energy from another grid that could be counted as energy generated by the Santa Ana Hydroelectric Plant[26].

[23] EAAB: Contract No. 9-99-25400-566-2004. Duration: 25 years.
[24] The Energy and Gas Regulatory Commission – CREG – is the Colombian authority that regulates the sector of Energy and Gas.
[25] EAAB: Contract No. 1-99-26300-742-2006. Duration: 1 year. Contract No. 1-99-26300-941-2007. Duration: 1 year.
[26] The Clause 12 of the connecting contract for operation of the Santa Ana Hydroelectric Plant No. 9-99-25400-566-2004 signed on December 23, 2004 between the EAAB and the grid operator, CODENSA, expressed regarding new connections that "The EAAB-ESP cannot connect in parallel to the assets of connection object this contract, the grid that goes to the Wiesner Plant, unless the Wiesner Plant is disconnected from the La Calera Electrical Substation. It is also considered an emergency condition that must be informed to the Local Dispatch Center (LDC) of CODENSA S.A. E.S.P. and coordinated by the latter, following the rules of operation to assure the disconnection power from La Calera Electrical Substation. No other grid can be connected to the assets to this contract. If the EAAB – ESP fail to fulfill this part of the contract, CODENSA, assumes that the EAAB-ESP terminates the contract and will proceed to disconnect the connection point previously assigned".

FIGURE 6

SINGLE LINE DIAGRAM SANTA ANA HYDROELECTRIC PLANT



3.4 Commercial Operation

The electricity generated by the Santa Ana Hydroelectric Plant is commercialized by EMGESA[27] *(Empresa Generadora de Energía Eléctrica S.A.)*, acting as a representative of the plant in the Wholesale Power Market of Colombia, as part of the marketing contract signed with the EAAB[28].

As smaller plant began commercial operations on June 10, 2005,[29] after the official registration of the commercial frontier in the ASIC, with an effective capacity of 8 MW under the following characteristics[30]:

SIV CODE	METER SERIAL NUMBER	EXPORTER	IMPORTER	VOLTAGE LEVEL (kV)	METER CLASS	CR	START
ESNT 1001	30031	EMGESA	CODENSA	11.4	0.2	CR21	2005-06-09

CR: Collection Center (where the meter data are reported)

The registration of the electricity generation makes daily EMGESA, trough CAM[31] (*Compañía Americana de Multiservicios*), with information obtained through the interrogation, automatic and electronic, of the commercial frontier meter[32].

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[27] Electricity Generating Company.
[28] EAAB: Contract No. 1-99-26300-671-2005. Duration: 3 years and 7 months.
[29] The period from June 10 up to July 31, 2005, corresponds to the period of testing and adjustments.
[30] Communication No. 010916-1 from ISA to EMGESA, dated June 9, 2005.
[31] Multi Services American Company.
[32] CAM is a company that provides services to EMGESA for interrogation and recording commercial frontier power meters. Additionally CAM has accredited laboratory in Colombia for the revision of power meters.

The data is recorded by CAM in the ASIC (Experts Market - XM) [33] and communicates to both EAAB as CODENSA. This information is analyzed independently by EMGESA, CODENSA and the EAAB in accordance with the procedures of verification and validation defined by each entity and by Resolution CREG 006 of 2003. The data that is registered in the ASIC is officially published on the website of XM and corresponds to the electricity measure and delivered to the interconnected national grid through the local distribution system[34].

Additionally, the ASIC and other market agents checked once this information is available for consultation in the database NEON, administered by XM[35].

CREG Resolutions 006 and 015 of 2009 regularized handling confidential information of wholesale energy market, which lets you know after 3 months, all information of national generation. These resolutions are currently suspended by CREG resolutions 127 and 159, 2009, due to Ministry of Mines and Energy considerations regarding the planned natural gas rationing and the presence of the climatic phenomenon "El Niño".

4. Monitoring of Emissions Reduction of CO2e during the Fourth Period Accreditation.

4.1 Data Monitored

The data monitored during the fourth accreditation period, correspond to the electricity generated and delivered daily by the Santa Ana Hydroelectric Plant to the national interconnected grid, which are officially registered and available for consultation on the website of XM (see Annex 1).

Based on the data monitored and application of the emission factor of the national interconnected grid, 0.4392 kg CO_2e per KWh[36], Table 3 presents the monitoring report of CO_2e emissions reduced monthly during the fourth period of accreditation of the project. The daily monitoring report is on file ***CO2e Emissions Reduction Santa Ana Hydroelectric Plant (1-08-08 to 31-07-09). xls***.

[33] XM is a company of ISA that is created in 2005, responsible for managing the ASIC and the CND (Despatch National Center). It provides operation, administration and development services of the Wholesale Power Market of Colombia.
[34] http://sv04.xm.com.co/neonweb/
[35] NEON database is operated and managed by XM, there are stored all transactions of the Wholesale Power Market of Colombia.
[36] Ministry of Mines and Energy. *Planning Unit of Mining and Power* : Resolution 181421, 2005.

TABLE 3

ELECTRIC POWER DELIVERED TO THE NATIONAL INTERCONNECTED GRID AND ESTIMATION OF CO_2e EMISSIONS REDUCED AUGUST 1, 2008 – JULY 31, 2009

YEAR	MONTH	ELECTRICITY (MW/h)	EMISIONS REDUCED (Ton CO_2e)
2008	AUG	2.465	1.083
	SEP	2.575	1.131
	OCT	1.961	861
	NOV	2.437	1.070
	DEC	2.016	886
2009	JAN	1.395	613
	FEB	3.014	1.324
	MAR	3.708	1.628
	APR	3.450	1.515
	MAY	4.130	1.814
	JUN	3.555	1.562
	JUL	2.819	1.238
Total		33.526	14.725

4.2 The authority and responsibility roles

The authority and responsibility roles that were identified for different aspects associated with the monitoring of these data, between August 1, 2008 and July 31, 2009, are presented in Table. 4.

TABLE 4

AUTHORITY AND RESPONSIBILITY ROLES OF MONITORING PLAN

	Measurement		Registration		Verification		Report		Calibration and Maintenance Equipment	
	Internal	External	Internal	External	Internal	External	Internal	External	Internal	External
Authority	Network Matrix Aqueduct Office Director/ Electromechanical Services Office Director	EMGESA	Network Matrix Aqueduct Office Director/ Electromechanical Services Office Director	EMGESA	Network Matrix Aqueduct Office Director/ Electromechanical Services Office Director	XM EMGESA CODENSA	Network Matrix Aqueduct Office Director/ Electromechanical Services Office Director	EMGESA	Network Matrix Aqueduct Office Director/ Electromechanical Services Office Director	EMGESA CODENSA
Responsibility	Plant Thecnical Operator / Power Negociator	CAM	Plant Thecnical Operator / Power Negociator	CAM	Control Center Chief / Power Negociator	CAM CODENSA EMGESA	Control Center Chief / Power Negociator	CAM	Control Center Chief / Power Negociator	CAM

4.3 Quality Assurance Procedure

In Committee on Quality of Water Supply Matrix Management Network (Management Review 08/11/07)[37] it was decided to modify the *Quality Management System for Driving and Drinking Water Distribution Networks* and arrays to broaden its scope including power generation activities.

To accomplish this, there were several activities related to the adjustment of the *Quality Management System for Conduction and Distribution of Drinking Water in Matrix Networks*:

A. Planning Processes:

1) **Strategic Planning**: Strategic Plan for the macro-process of drinking water conduction and distribution in matrix networks was amended to include all aspects of power generation. By Quality Committee (Management Review 08/11/07) there was approved: mission, vision, quality policy, quality objectives and customers - suppliers.

2) **Work Plans:** Tha Action Plan for each year 2008 and 2009 was done in both cases in January in order to plan the activities from Network Matrix Aqueduct Direction. That document included the aspects related to power generation. Also, was held the power generation planning for the period 2008 to 2012.

3) **Planning Systems Management**: The Quality Manual and Plan for drinking water conduction and distribution macro-process in matrix networks were modified to include all

[37] Report of the Meeting of Committee on Quality – Management Review – is in the folder EAAB/2541001/080.139/2007 – Management Review 2007.

aspects of power generation. These documents were in adopted in Quality Committee (Management Review 26/06/08)[38].

B. Business Process Operations

The following processes, procedures and instructions were modified to include the activities of power generation and thus to comply with numerals of the standard NTC ISO 9001:2008:

Process: Investment Planning.
Process: Operation and Maintenance Planning.
Process: 0SA201505 "System Operation".
Process: 0AF101005 "Preventive Maintenance of Matrix System Structures".
Process: 0AF101015 "Corrective Maintenance".
Procedure: 1SA20051005 "Operation Planning".
Procedure: 1SA20051010 "Maintenance Planning".
Procedure: 1SA20150505 "Coordination of the Operation".
Procedure: 1AF10101510 "Repairing Matrix System Structures ".
Procedure: 1SA20150540 "Power Generation".
Procedure: 1AF10100525 "Preventive Maintenance of Santa Ana Hydroelectric Plant".
Instructions: 7SA2015050502 "Santa Ana Station Routine ".
Instructions: 7SA2015054001 "Start-up and Operation of Small Hydroelectric Plant".
Instructions: 8SA2015054001 "Measurement and Data Analysis".
Instructions: 8SA2015054002 "Conciliation of Results".
Instructions: 7SA2015054002 "Load Rejection".

C. Resource Management Processes

1) **Information Management:** To develop and updating all documents of the Quality Management System applied the procedure "Process Documentation" 1GD0505.

2) **Document Management**: each record was filed in accordance with the Manual of Archive of the Company.

3) **Financial and Administrative Management**:

[38] Report of the Meeting of Committee on Quality – Management Review – is in the folder EAAB/2541001/080.139/2007 – Management Review 2008.

- Process: 0SA202005 "Financial and Administrative Management."
- Procedure: 1SA20200550 "Power Marketing".
- Procedure: 1SA20200555 "Management of Certified Emission Reduction (CER)".

4) **Control of Measurement Equipment**:

- 1AC1015 "Control of Measuring Equipment Power Generation". Includes resumes and measuring equipment calibrations.

D. Continuous Improvement Process

1) **Customer Care and Satisfaction:** for this process is carried out satisfaction surveys to the Environmental Corporate Management, who received all the information to monitor the project Clean Development Mechanism, and to the Electromechanical Services Direction as the area that manages the marketing of the power generated by the plant.
2) **Non-Compliance Treatment:** in order to follow up non-compliant of power generation in the Quality Plan was created the "Power Generation Control" 3SS2015054003.
3) **Measurement Systems**: During the period being reported it has continued with the calculation of the Power Generation Indicator, which allows you to track the power generation, power generation income, issuance of Certified Emission Reductions (CER) and revenues marketing of such certificates. In monthly meetings for monitoring action plans and indicators are analyzed the indicators results.
4) **Internal Audit**: During the period being reported the internal audit (July 2007 and November 2008) comments has been attended. The certification audit was programmed for the month of December in order to expand the scope of the *Quality Management System for Conduction and Distribution of Drinking Water in Matrix Networks* and to include the power generation activities.
5) **Improvement Opportunities:** For the period 6 were documented improvement opportunities related to the incorporation of energy-generating activities: 1. Consider planning for power generation 2. Consider the characterization of the process of operating the diversion system in the generation of energy generated on the planned 3. Make clear that in formulating the indicator of generation planning is considered 4. Detail in characterizing risks as mentioned in general, 5. Include in the characterization CREG Resolution 006 of 2003, the software and Emgesa JEMRA as supplier and customer. 6. Consider the statistics of "nonconforming product" for tracking the activity of generation.

In December 2008, ICONTEC conducted the certification audit in order to broaden the scope of quality management system for driving and drinking water distribution networks and matrices include power generation activities. This certification was obtained in January 2009 and its scope, under ISO 9001:2008, is: *"Planning, Design and Construction Management, Operation, Control and Maintenance of Water Utility Systems for the Conduction and Distribution of Drinking Water in Mains Pipes and Clean Development Mechanism (CDM) Management for the Main Water System".*

5. Environmental and Social Aspects

The Santa Ana Hydroelectric Plant was built in compliance with all environmental permissions required by the national and regional environmental regulations, as stipulated in the Environmental Management Plan approved by Resolution 1913 of 2000 by the Environmental Authority responsible, the Autonomous Regional Corporation Cundinamarca - CAR. *("Corporación Autónoma Regional de Cundinamarca")*.

It was duly consulted with the concerned parties and neighboring communities, following compliance with the environmental and sectorial laws and regulations.

The operation plant does not generate any negative social or environmental impact. Rather, it comes generate environmental benefits associated with a small-scale renewable energy project: in addition to reducing greenhouse gases in the national interconnected grid, reduces local emissions of particulate thick and thin, SO2, SOx, NOx and heavy metals when fuel shifted of the grid for fossil power generation is coal.

Additionally, from 2009 there has been progress in the design and implementation of an Environmental Management System under ISO 14001:2004 for the EAAB - ESP, in which there will be included activities related to power generation and the operation of the Santa Ana Hydroelectric Plant.

Finally, it is important to note that a significant portion of the proceeds from the sale of Reduced Emissions Certificates (CERs) from CDM project is investing in conservation and restoration of the catchment areas of sources of supply of the moor Chingaza, in accordance with the provisions of the Project Design Document (PDD, pp. 4 and 5). The definition of these activities is being developed in the framework of Convention No. 002 of 2009 signed between the EAAB - ESP and the Special Administrative Unit of the System of National Parks of Colombia (UAESPNN).

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Información generada por Neón entre 01/08/2008 y 31/08/2008 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/08/2008	88,684.00
02/08/2008	98,956.00
03/08/2008	77,456.00
04/08/2008	86,704.00
05/08/2008	88,268.00
06/08/2008	88,800.00
07/08/2008	78,636.00
08/08/2008	87,142.00
09/08/2008	72,924.00
10/08/2008	70,262.00
11/08/2008	81,894.00
12/08/2008	85,028.00
13/08/2008	82,350.00
14/08/2008	85,012.00
15/08/2008	84,974.00
16/08/2008	89,134.00
17/08/2008	68,008.00
18/08/2008	56,354.00
19/08/2008	84,030.00
20/08/2008	86,460.00
21/08/2008	87,546.00
22/08/2008	79,780.00
23/08/2008	53,310.00
24/08/2008	78,640.00
25/08/2008	81,732.00
26/08/2008	84,482.00
27/08/2008	83,648.00
28/08/2008	84,184.00
29/08/2008	48,518.00
30/08/2008	60,758.00
31/08/2008	81,522.00

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Información generada por Neón entre 01/09/2008 y 30/09/2008 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/09/2008	84,926.00
02/09/2008	86,148.00
03/09/2008	89,218.00
04/09/2008	86,976.00
05/09/2008	71,864.00
06/09/2008	99,134.00
07/09/2008	82,634.00
08/09/2008	86,684.00
09/09/2008	87,890.00
10/09/2008	87,872.00
11/09/2008	90,768.00
12/09/2008	92,592.00
13/09/2008	99,880.00
14/09/2008	84,366.00
15/09/2008	87,294.00
16/09/2008	86,054.00
17/09/2008	87,310.00
18/09/2008	78,078.00
19/09/2008	72,174.00
20/09/2008	94,826.00
21/09/2008	74,934.00
22/09/2008	82,102.00
23/09/2008	88,602.00
24/09/2008	85,592.00
25/09/2008	76,824.00
26/09/2008	84,768.00
27/09/2008	93,874.00
28/09/2008	78,940.00
29/09/2008	86,050.00
30/09/2008	86,544.00

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Información generada por Neón entre 01/10/2008 y 31/10/2008 [DD/MM/YYYY]	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/10/2008	84,428.00
02/10/2008	81,688.00
03/10/2008	86,062.00
04/10/2008	93,542.00
05/10/2008	47,600.00
06/10/2008	76,046.00
07/10/2008	75,522.00
08/10/2008	55,914.00
09/10/2008	75,168.00
10/10/2008	54,966.00
11/10/2008	53,088.00
12/10/2008	29,958.00
13/10/2008	11,574.00
14/10/2008	79,548.00
15/10/2008	82,168.00
16/10/2008	80,216.00
17/10/2008	80,954.00
18/10/2008	61,934.00
19/10/2008	76,316.00
20/10/2008	77,238.00
21/10/2008	46,608.00
22/10/2008	0.00
23/10/2008	0.00
24/10/2008	96.00
25/10/2008	36,294.00
26/10/2008	76,706.00
27/10/2008	84,486.00
28/10/2008	86,454.00
29/10/2008	86,734.00
30/10/2008	87,254.00
31/10/2008	92,478.00

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Información generada por Neón entre 01/11/2008 y 30/11/2008 [DD/MM/YYYY]	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/11/2008	90,928.00
02/11/2008	46,226.00
03/11/2008	34,072.00
04/11/2008	81,580.00
05/11/2008	92,190.00
06/11/2008	87,900.00
07/11/2008	91,988.00
08/11/2008	91,548.00
09/11/2008	84,866.00
10/11/2008	88,732.00
11/11/2008	78,702.00
12/11/2008	81,534.00
13/11/2008	53,968.00
14/11/2008	87,232.00
15/11/2008	88,932.00
16/11/2008	41,712.00
17/11/2008	44,830.00
18/11/2008	86,856.00
19/11/2008	89,436.00
20/11/2008	89,014.00
21/11/2008	84,340.00
22/11/2008	100,000.00
23/11/2008	87,054.00
24/11/2008	91,206.00
25/11/2008	90,604.00
26/11/2008	81,302.00
27/11/2008	90,738.00
28/11/2008	95,290.00
29/11/2008	99,140.00
30/11/2008	85,342.00

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Información generada por Neón entre 01/12/2008 y 31/12/2008 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/12/2008	93,318.00
02/12/2008	96,326.00
03/12/2008	86,216.00
04/12/2008	65,032.00
05/12/2008	26,934.00
06/12/2008	99,182.00
07/12/2008	29,810.00
08/12/2008	40,772.00
09/12/2008	86,696.00
10/12/2008	95,062.00
11/12/2008	92,808.00
12/12/2008	94,070.00
13/12/2008	94,156.00
14/12/2008	57,928.00
15/12/2008	87,846.00
16/12/2008	48,068.00
17/12/2008	92,620.00
18/12/2008	87,278.00
19/12/2008	83,550.00
20/12/2008	90,188.00
21/12/2008	26,546.00
22/12/2008	66,114.00
23/12/2008	90,244.00
24/12/2008	78,682.00
25/12/2008	0.00
26/12/2008	0.00
27/12/2008	0.00
28/12/2008	0.00
29/12/2008	49,530.00
30/12/2008	86,936.00
31/12/2008	70,422.00

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Información generada por Neón entre 01/01/2009 y 31/01/2009 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/01/2009	0.00
02/01/2009	0.00
03/01/2009	0.00
04/01/2009	0.00
05/01/2009	52,900.00
06/01/2009	57,462.00
07/01/2009	48,680.00
08/01/2009	79,564.00
09/01/2009	78,928.00
10/01/2009	78,434.00
11/01/2009	0.00
12/01/2009	0.00
13/01/2009	57,798.00
14/01/2009	85,844.00
15/01/2009	87,076.00
16/01/2009	70,580.00
17/01/2009	0.00
18/01/2009	0.00
19/01/2009	0.00
20/01/2009	0.00
21/01/2009	0.00
22/01/2009	0.00
23/01/2009	0.00
24/01/2009	0.00
25/01/2009	47,908.00
26/01/2009	114,080.00
27/01/2009	80,766.00
28/01/2009	104,548.00
29/01/2009	118,980.00
30/01/2009	119,006.00
31/01/2009	112,672.00

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Información generada por Neón entre 01/02/2009 y 28/02/2009 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/02/2009	101,066.00
02/02/2009	117,198.00
03/02/2009	45,708.00
04/02/2009	46,524.00
05/02/2009	117,096.00
06/02/2009	124,848.00
07/02/2009	125,966.00
08/02/2009	112,088.00
09/02/2009	124,064.00
10/02/2009	88,192.00
11/02/2009	105,784.00
12/02/2009	120,108.00
13/02/2009	117,858.00
14/02/2009	118,308.00
15/02/2009	109,288.00
16/02/2009	85,482.00
17/02/2009	107,322.00
18/02/2009	120,320.00
19/02/2009	120,646.00
20/02/2009	119,748.00
21/02/2009	124,770.00
22/02/2009	116,056.00
23/02/2009	121,608.00
24/02/2009	122,650.00
25/02/2009	123,178.00
26/02/2009	112,590.00
27/02/2009	41,616.00
28/02/2009	123,770.00

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Información generada por Neón entre 01/03/2009 y 31/03/2009 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/03/2009	109,042.00
02/03/2009	123,216.00
03/03/2009	125,130.00
04/03/2009	124,276.00
05/03/2009	129,602.00
06/03/2009	133,152.00
07/03/2009	134,596.00
08/03/2009	89,672.00
09/03/2009	114,516.00
10/03/2009	122,664.00
11/03/2009	125,558.00
12/03/2009	128,266.00
13/03/2009	100,034.00
14/03/2009	112,388.00
15/03/2009	130,052.00
16/03/2009	132,066.00
17/03/2009	127,776.00
18/03/2009	124,068.00
19/03/2009	132,392.00
20/03/2009	125,314.00
21/03/2009	119,056.00
22/03/2009	91,916.00
23/03/2009	95,762.00
24/03/2009	105,764.00
25/03/2009	91,070.00
26/03/2009	128,776.00
27/03/2009	129,444.00
28/03/2009	136,578.00
29/03/2009	123,894.00
30/03/2009	120,358.00
31/03/2009	121,180.00

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Información generada por Neón entre 01/04/2009 y 30/04/2009 [DD/MM/YYYY]	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/04/2009	115,050.00
02/04/2009	113,290.00
03/04/2009	129,956.00
04/04/2009	134,698.00
05/04/2009	121,882.00
06/04/2009	132,926.00
07/04/2009	128,504.00
08/04/2009	138,708.00
09/04/2009	100,784.00
10/04/2009	14,086.00
11/04/2009	0.00
12/04/2009	0.00
13/04/2009	69,658.00
14/04/2009	139,870.00
15/04/2009	141,484.00
16/04/2009	143,916.00
17/04/2009	141,362.00
18/04/2009	144,504.00
19/04/2009	126,156.00
20/04/2009	141,314.00
21/04/2009	130,936.00
22/04/2009	133,168.00
23/04/2009	130,384.00
24/04/2009	136,688.00
25/04/2009	145,260.00
26/04/2009	105,922.00
27/04/2009	105,820.00
28/04/2009	108,140.00
29/04/2009	141,770.00
30/04/2009	134,012.00

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Información generada por Neón entre 01/05/2009 y 31/05/2009 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/05/2009	126,290.00
02/05/2009	121,468.00
03/05/2009	120,634.00
04/05/2009	138,854.00
05/05/2009	144,170.00
06/05/2009	138,434.00
07/05/2009	134,274.00
08/05/2009	83,334.00
09/05/2009	141,378.00
10/05/2009	131,992.00
11/05/2009	140,050.00
12/05/2009	142,798.00
13/05/2009	140,962.00
14/05/2009	143,110.00
15/05/2009	140,220.00
16/05/2009	142,794.00
17/05/2009	130,484.00
18/05/2009	139,252.00
19/05/2009	140,560.00
20/05/2009	144,074.00
21/05/2009	133,310.00
22/05/2009	143,238.00
23/05/2009	139,822.00
24/05/2009	118,204.00
25/05/2009	92,628.00
26/05/2009	115,898.00
27/05/2009	143,112.00
28/05/2009	142,200.00
29/05/2009	140,666.00
30/05/2009	146,130.00
31/05/2009	129,988.00

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Información generada por Neón entre 01/06/2009 y 30/06/2009 [DD/MM/YYYY]	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/06/2009	140,094.00
02/06/2009	143,518.00
03/06/2009	144,216.00
04/06/2009	136,446.00
05/06/2009	100,402.00
06/06/2009	128,884.00
07/06/2009	128,222.00
08/06/2009	138,668.00
09/06/2009	136,296.00
10/06/2009	132,898.00
11/06/2009	131,074.00
12/06/2009	132,290.00
13/06/2009	130,620.00
14/06/2009	107,366.00
15/06/2009	98,196.00
16/06/2009	142,874.00
17/06/2009	141,510.00
18/06/2009	139,754.00
19/06/2009	141,158.00
20/06/2009	135,468.00
21/06/2009	110,134.00
22/06/2009	113,252.00
23/06/2009	132,492.00
24/06/2009	121,554.00
25/06/2009	76,456.00
26/06/2009	0.00
27/06/2009	61,874.00
28/06/2009	102,450.00
29/06/2009	83,066.00
30/06/2009	124,162.00

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Información generada por Neón entre 01/07/2009 y 31/07/2009 [DD/MM/YYYY]	GENERACION DE MENORES
	(kWh)
	MENOR SANTA ANA
	Central
01/07/2009	133,002.00
02/07/2009	117,336.00
03/07/2009	130,170.00
04/07/2009	123,306.00
05/07/2009	0.00
06/07/2009	0.00
07/07/2009	85,340.00
08/07/2009	49,744.00
09/07/2009	36,060.00
10/07/2009	130,366.00
11/07/2009	126,778.00
12/07/2009	116,782.00
13/07/2009	131,668.00
14/07/2009	136,838.00
15/07/2009	132,388.00
16/07/2009	134,780.00
17/07/2009	132,372.00
18/07/2009	39,236.00
19/07/2009	0.00
20/07/2009	0.00
21/07/2009	0.00
22/07/2009	52,610.00
23/07/2009	113,106.00
24/07/2009	115,648.00
25/07/2009	123,672.00
26/07/2009	105,556.00
27/07/2009	109,630.00
28/07/2009	111,202.00
29/07/2009	110,630.00
30/07/2009	110,132.00
31/07/2009	110,546.00

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