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 THIRD ACCREDITATION PERIOD
August 1, 2007 – July 31, 2008

April 13, 2009

Version: 3

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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 third accreditation period, from August 1, 2007 – July 31, 2008.

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 third accreditation period.

1. Description of the Project

2.1 Localization

EAAB provides drinking water to the city of Bogota and eleven (11) neighbor municipalities. The demand for drinking water, which stood at 15 m^3/s during the third accreditation period, is addressed through three water supply systems:

1. Chingaza System – Wiesner Plant (9.8 m^3/s).
2. Bogota River System – Tibitoc Plant (4.8 m^3/s).
3. Tunjuelo System – Dorado Plant (0.4 m^3/s).

The Chingaza System – Wiesner Plant is the most important drinking water supply system of the city. In normal operation conditions water supply systems produce approximately 70% of the drinking water consumed by Bogotá. During the third accreditation period, it produced approximately 65%.

River flows that supply Chingaza System are regulated by the Chuza reservoir and leads them by gravity through tunnel and pipes series to the Wiesner Plant. Additionally, the Chingaza System has the San Rafael reservoir whose function is to provide water to the Wiesner Plant in

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

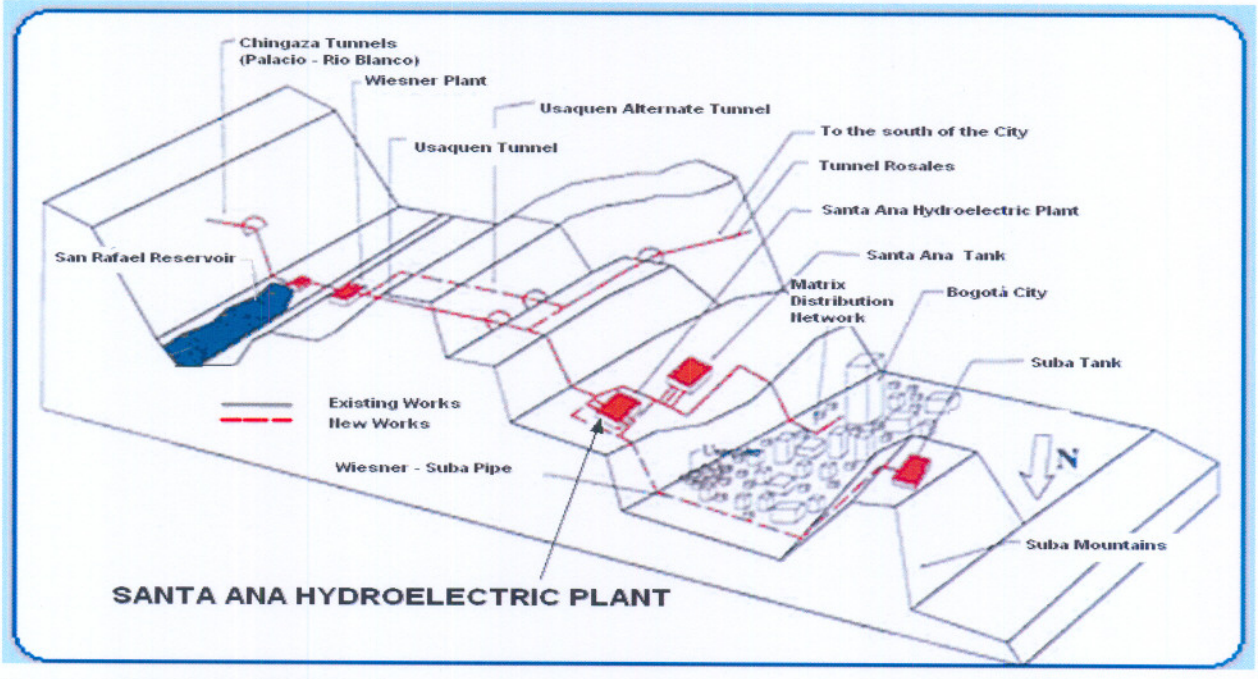
case of supply suspension from Chuza reservoir, especially during the pipeline inspection and maintenance between Chuza reservoir and Wiesner Plant.

As part of the Vulnerability Mitigation Program of the Water Supply Systems, which EAAB is running since the late nineties, the company built at the beginning of this decade Usaquén alternate tunnel, covered in conventional concrete, with 2.5 km in length, which leads the treated water from the Wiesner Plant, in La Calera, to the Santa Ana and Suba tanks, located in north Bogotá, and to the others storage tanks located in center and south of the city through Rosales Tunnel.

Santa Ana and Suba tanks[2], contains the 70% of treated water at the Wiesner Plant, and the Rosales Tunnel diverts the remaining 30% (3.3 m^3/s) to the Chicó, Silencio, Parque Nacional, San Diego, Vitelma, Casablanca and Cazucá tanks, which provide aqueduct service to center, south east and south west of Bogotá.

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 sea level, as well as the water flow delivered to the city through this system, was built between the years 2001 and 2003 the Santa Ana Hydroelectric Plant[3]. Which is located at 110324.65 North and 105849.56 East, at north Bogotá.

FIGURE 1
LOCATION OF THE PROJECT IN THE BOGOTA DRINKING WATER DISTRIBUTION SYSTEM



[2] The storage capacity of Santa Ana Tank is 30,000 m^3 and Suba Tank is 90,000 m^3.
[3] 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.

2.2 Technical Characteristics

The main technical characteristics of the Santa Ana Hydroelectric Plant are: Francis turbine horizontal axis; net design head 105.9 meters[4]; design flow[5] 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 treated flow normally turbined is used by the plant to produce electric energy delivered into the national interconnected grid through local distribution system[6].

2.3 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[7].

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[8], 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[9] Maintenance and Coating Program, seeks to mitigate as much as possible their risk of detachment, coating the tunnels in conventional concrete[10].

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[4] 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.

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

[6] 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.

[7] 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.

[8] 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.

[9] 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

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

In order to make the coating and maintenance of the Chingaza tunnels is needed to make changes in the operation of the water supply systems, in an normal operation stage (see Figure 2) to a stage of operation to consider the implementation of those activities (see Figure 3):

- *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 – Wiesner Plant.

- *Second*, increasing the drinking water supply from the Bogotá River System – Tibitoc Plant to compensate the loss of supply from Chingaza System – Wiesner Plant.

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. It is expected that with this reduction, the flow of water that could pass through the Santa Ana Hydroelectric Plant is below the minimum flow required for operating the plant and, therefore, during the annual activities of maintenance of Chingaza tunnels is not allowed to operate the hydroelectric plant[11].

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[12].

[11] 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.

[12] 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.

FIGURE 2
CONDITIONS NORMAL OPERATION WATER SUPPLY SYSTEMS

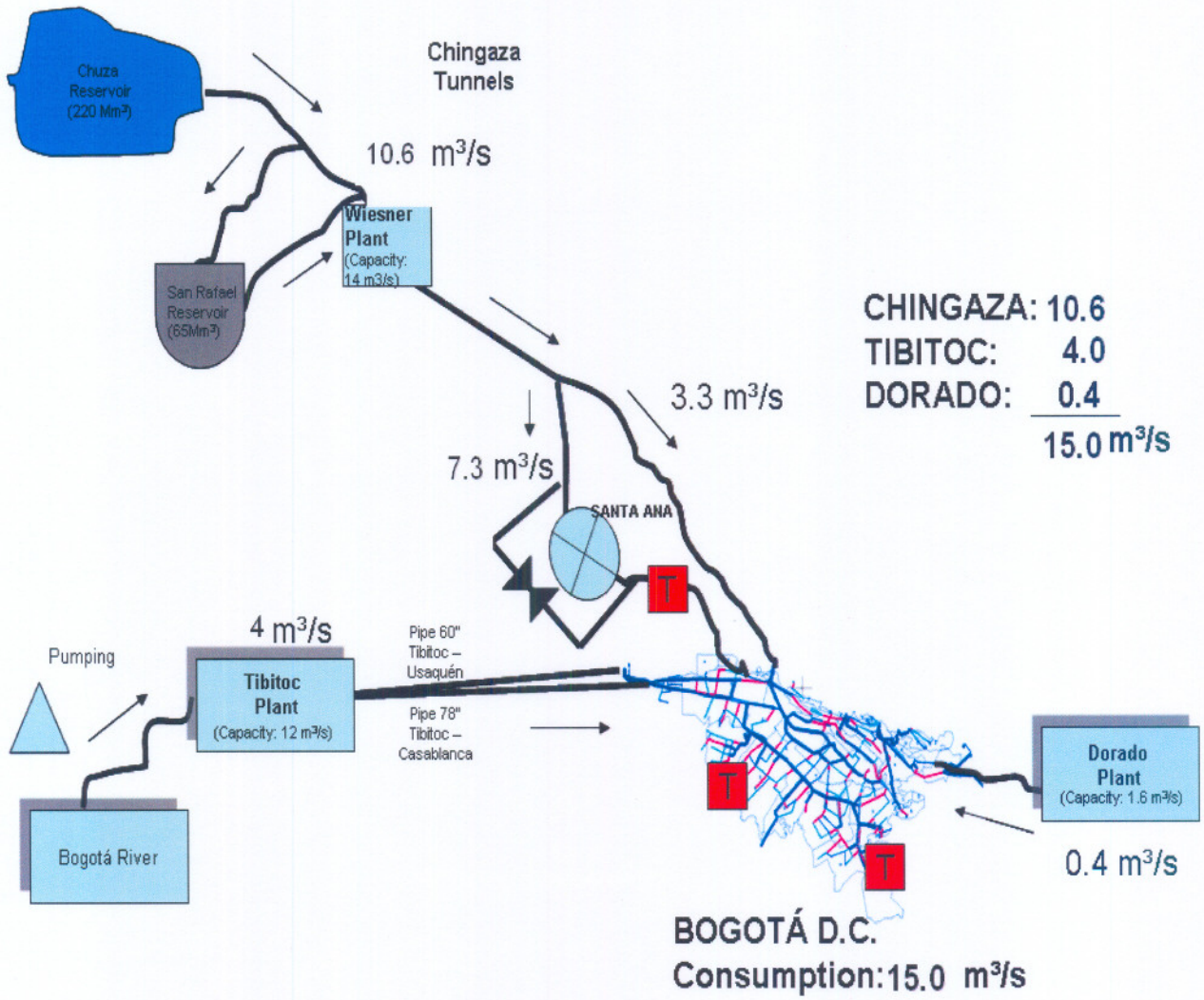
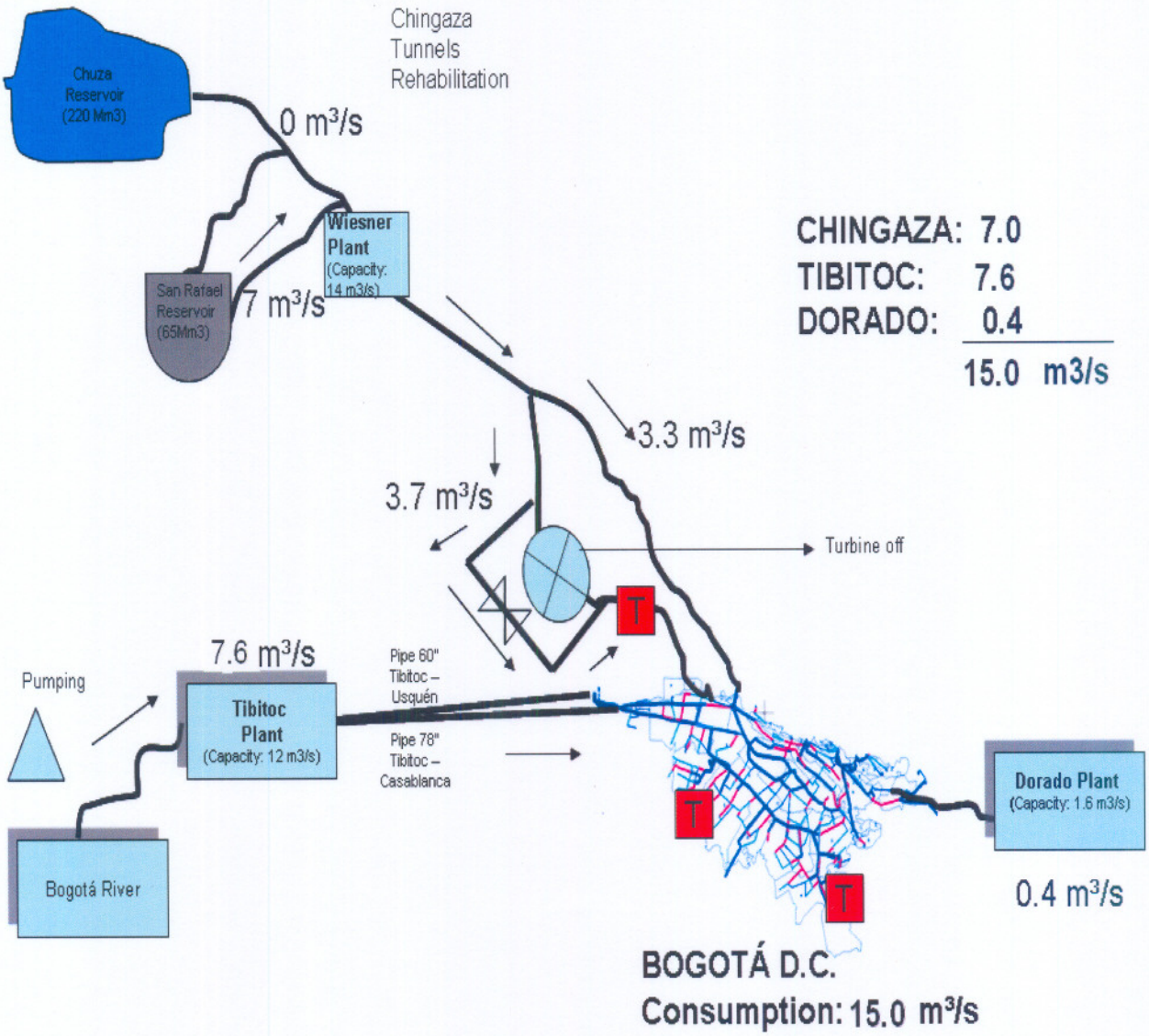


FIGURE 3
CONDITIONS OPERATION WATER SUPPLY SYSTEMS
MAINTENANCE AND COATING CHINGAZA TUNNELS (TIME: 3 MONTHS PER YEAR)

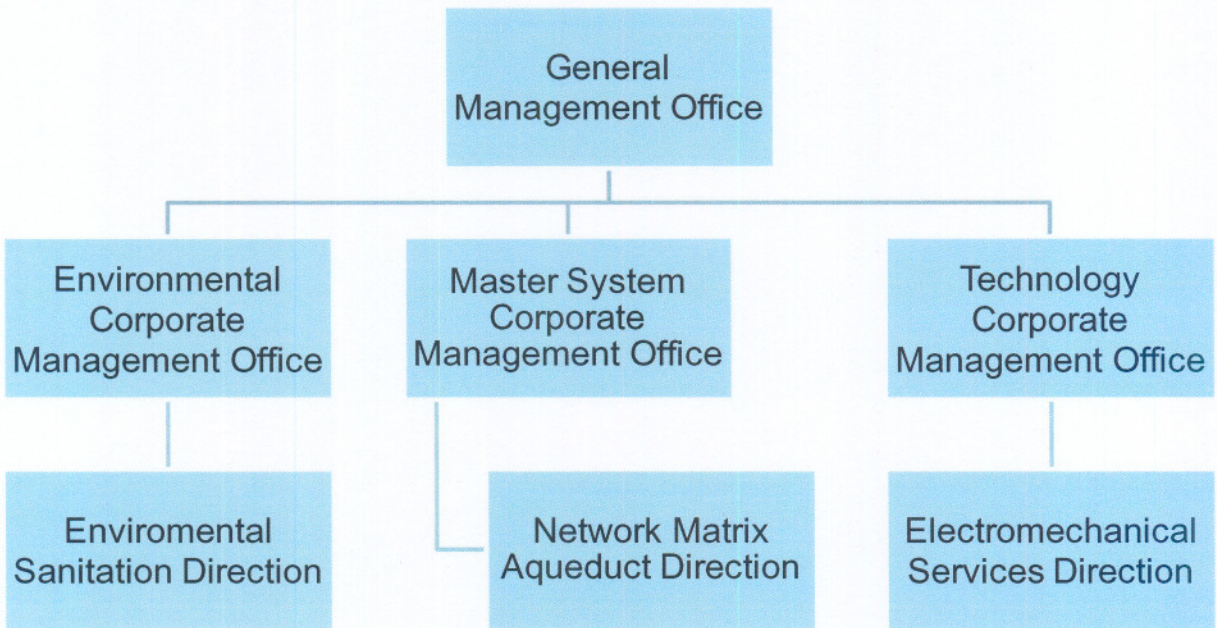


2. Operation of the Project during the Third Accreditation Period

3.1 Operational and Administrative Structure

Figure 4 shows the part of the organizational structure of the EAAB[13] who was responsible for the administration, operation, maintenance and monitoring CDM project Santa Ana Hydroelectric Plant, during the third accreditation period.

FIGURE 4
OPERATIONAL AND ADMINISTRATIVE STRUCTURE
SANTA ANA HYDROELECTRIC PLANT



By being a part of the drinking water system in the city, the plant administration and its general operation are headed by the Master System Corporate Management Office, through the Network Matrix Aqueduct Direction.

[13] 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 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, through the CDM Team Leader from the Environmental Sanitation Direction, which is responsible for preparing the monitoring report with the support of the Electromechanical Services Direction and Network Matrix Aqueduct Direction.

3.2 General Operation

The Table 1 shows the monthly average flow at the entrance of Santa Ana tank, between August 2007 and July 2008, which is the monthly average flow available for generation that period[14].

TABLE 1
MONTHLY AVERAGE FLOW AT THE ENTRANCE TO THE SANTA ANA TANK

PERIOD	AVERAGE FLOW (m^3/s)
Aug-07	7.23
Sep-07	6.93
Oct-07	5.85
Nov-07	5.82
Dec-07	5.82
Jan-08	7.67
Feb-08	7.89
Mar-08	5.29
Apr-08	5.22
May-08	4.99
Jun-08	5.87
Jul-08	4.97

Source: Control Center. Network Matrix Aqueduct Direction.

During the third acreditation period there were not annual coating and maintenance of the Chingaza tunnels[15]. The reasons were: 1) the 60" pipe rehabilitation of the Bogota River System

[14] The average flows showed in Table 1 are based on the monthly water volumes measured at the entrance to the Santa Ana tank.

- Tibitoc Plant, which began in May 2006 and ended in September 2007[16]; 2) schedule coating and maintenance of the tunnels for the second half of 2008.

However, the monthly average flow available for generation was reduced during the third accreditation period due to the reduction in water supply from the Chingaza System - Wiesner Plant.

The reduction in water flow from Chingaza System - Plant Wiesner, occurred for the following reasons:

1. During the second half of 2007, the EAAB had to reduce water production in the System Chingaza from 10.6 m^3/s to 9.8 m^3/s in average, from October of 2007, because there was a water volume reduction in the Chuza reservoir. From the hydrological point of view, this means that the volume of the reservoir was near Chuza reservoir Curve Guide[17], thus taking the necessary precautions to keep the reservoir above the Curve Guide[18].

2. During the first half of 2008, water flow from the plant Wiesner was reduced due to the concretes rehabilitation of the raw water adduction channels, as well as columns and walls of the tank in the Wiesner Plant[19].

In this way, during the third accreditation period, the drop in the treated flow at the Wiesner Plant, allowed the monthly average flow at the entrance to the Santa Ana Tank was reduced to 6.5 m^3/s approximately (about 66% of flow treated), as the EAAB has to ensure 3.3 m^3/s to be sent over the Rosales tunnel to the tanks provide aqueduct service to center, south east and south west of Bogotá.

Additionally, during 9 days in May and 19 days of June 2008, the Santa Ana Hydroelectric Plant could not turbine the available flow for generation due to the scheduled maintenance of plant's electromechanical equipment.

Hence, during the third accreditation period of the project, the power generation of Santa Ana Hydroelectric Plant was reduced by 19% compared to the estimated annual generation.

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[15] By 2008, a total of 32.4 km of tunnels were coating 19.1 km: Siberia (2.6 km) Palacio Rio Blanco (5.1 km) Palace - Rio Blanco (10.5 km) and El Faro (0.97 km).
[16] EAAB: **Construction of the rehabilitation works, geotechnical stabilization and repair of specific problems of the matrix aqueduct pipe 60" Tibitoc - Usaquén**. Contract No. 1-01-25400-796-2005. Contractor: Consorcio Tibitoc SBCC 2005.
[17] The annual storage Guide Curve which guides the operation of the Chuza reservoir, which has a storage capacity of 224 million m^3, it is defined based on the series of hydrologic basins tributary and historical behavior of the flow of water to the reservoir and discharges, the latter related to the water demand of the city. To ensure water supply to the city, the reservoir should always have a greater volume of water defined in the Guide Curve.
[18] EAAB: Specialized Engineering Direction. Document 262001-2008-H057.
[19] EAAB: **Rehabilitation of concrete of adduction channels and the contact camera of the Wiesner Plant of the Water Supply North Division**. Contract No. 1-01-25300-667-2007. Contractor: Consorcio Obras Civiles 2007. Start date: 22-02-2008. Completion date: 20-02-2009.

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 de Energía S.A)*[20], in compliance with the provisions made by resolutions 025 of 1995 and 070 of 1998 of *Comisión de Regulación de Energía y Gas* – CREG[21].

The administration, operation and maintenance of network assets, according to the contract signed between the EAAB and CODENSA[22], 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. 000778-CAM-IM0806 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, Model JemSTAR, which is in the Usaquén Electrical Substation, owned by the EAAB.

The power meter AMETEK 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-IM0806-003274 of June 26, 2008.

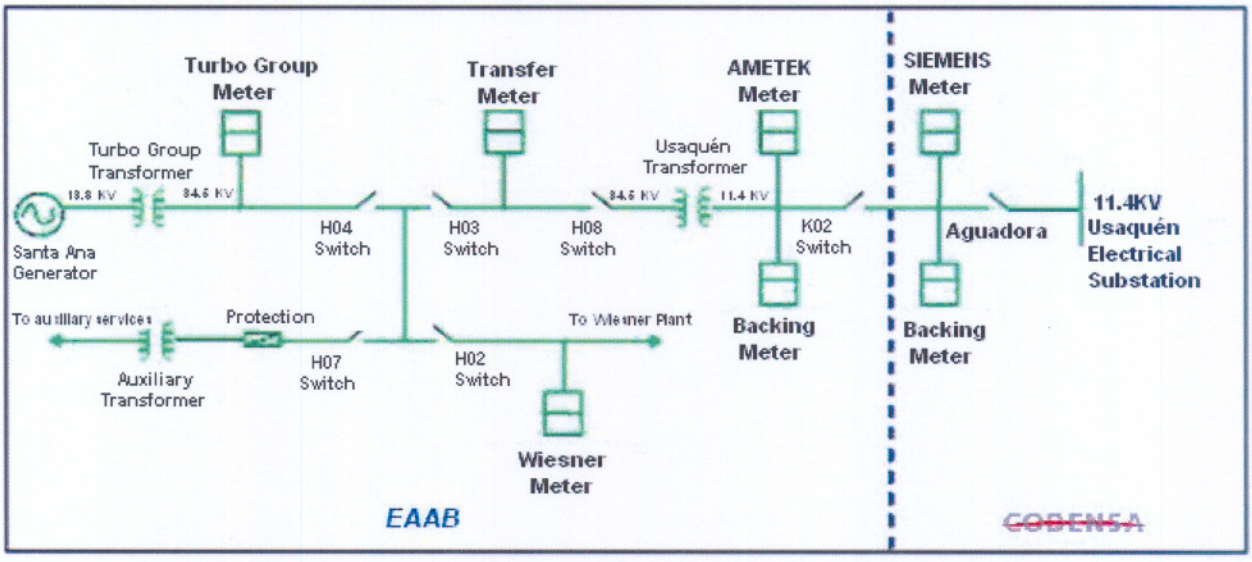
The Single Line Diagram of Santa Ana Hydroelectric Plant (see Figure 5) shows the main line driving the power generated from the plant to the commercial frontier power meter, which is delivered to the interconnected national grid. The two additional lines showed, are output energy lines: one to provide energy to the auxiliary services of the Hydroelectric Plant, and the other one, as an emergency line to supply energy to the Wiesner Plant[23]. In none of the cases, the

[20] EAAB: Contract No. 9-09-25400-566-2004. Duration: 25 years.
[21] The Energy and Gas Regulatory Commission – CREG – is the Colombian authority that regulates the sector of Energy and Gas.
[22] EAAB: Contract No. 1-99-26300-742-2006. Duration: 1 year. Contract No. 1-99-26300-941-2007. Duration: 1 year.
[23] 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".

control system allows importation of energy from another grid that could be counted as energy generated by the Santa Ana Hydroelectric Plant.

FIGURE 5

SINGLE LINE DIAGRAM SANTA ANA HYDROELECTRIC PLANT



3.4 Commercial Operation

The electricity generated by the Santa Ana Hydroelectric Plant is commercialized by EMGESA[24] *(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[25].

As smaller plant began commercial operations on June 10, 2005,[26] after the official registration of the commercial frontier in the ASIC, with an effective capacity of 8 MW under the following characteristics[27]:

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)

[24] Electricity Generating Company.
[25] EAAB: Contract No. 1-99-26300-671-2005. Duration: 3 years and 7 months.
[26] The period from June 10 up to July 31, 2005, corresponds to the period of testing and adjustments.
[27] Communication No. 01916-1 from ISA to EMGESA, dated June 9, 2005.

The registration of the electricity generation makes daily EMGESA, trough CAM[28] (*Compañía Americana de Multiservicios*), with information obtained through the interrogation, automatic and electronic, of the commercial frontier meter[29].

The data is recorded by CAM in the ASIC (Experts Market - XM) [30] 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[31].

Additionally, the ASIC and other market agents checked once this information is available for consultation in the database NEON, administered by XM[32].

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

4.1 Data Monitored

The data monitored during the third 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).

The authority and responsibility roles that were identified for different aspects associated with the monitoring of these data, between August 1, 2007 and July 31, 2008, are presented in Table. 2.

[28] Multi Services American Company.
[29] 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.
[30] 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.
[31] http://sv04.xm.com.co/neonweb/
[32] NEON database is operated and managed by XM, there are stored all transactions of the Wholesale Power Market of Colombia.

TABLE 2

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

Based on the data monitored and application of the emission factor of the national interconnected grid, 0.4392 kg CO_2e per KWh[33], Table 3 presents the monitoring report of CO_2e emissions reduced monthly during the third period of accreditation of the project. The daily monitoring report is on file ***Emissions Reduction of CO2e - Santa Ana (1-08-07 to 31-07-08). xls***.

[33] 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, 2007 – JULY 31, 2008

PERIOD	ELECTRICITY (MW/h)	EMISIONS REDUCED (Ton CO_2e)
Aug-07	4.604	2.022
Sep-07	4.223	1.855
Oct-07	3.439	1.510
Nov-07	3.194	1.403
Dec-07	2.977	1.307
Jan-08	4.784	2.101
Feb-08	4.730	2.077
Mar-08	2.519	1.106
Apr-08	2.727	1.197
May-08	1.757	772
Jun-08	659	290
Jul-08	2.384	1.047
Total	37.996	16.688

4.2 Quality Assurance Procedure

There were two proposals made by Quality Committee (Management Review 08/11/07)[34] to parameterize, by the standard NTC ISO 9001:2000, the power generation activities: the first was to assemble a quality management system itself for power generation and the second was to modify the *Quality Management System for Conduction and Distribution of Drinking Water in Matrix Networks* and broaden its scope to include the power generation activities.

According to the concept given by the Legal Services Direction of the EAAB, the by laws of the Company and the need to unify the Quality Management Systems, was selected the second proposal, agreed as follows:

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

- It should incorporate the documents created to implement the CDM project to the processes and procedures of the *Quality Management System for Conduction and Distribution of Drinking Water in Matrix Networks.*

- It should implement all corporate processes to the activities of power generation.

- By the fact that the Acueduct Network Matrix Direction is a receiving area of services within the Management Model of the Company, responsibilities as a provider will be included in the Quality Plan.

- Given that the Acueduct Network Matrix Direction must modify the Quality Management System because of the new organizational structure approved, there will be included all activities of energy generation.

According to the above, below we will mention the activities undertaken by each process 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:** The Action Plan of the year was done in January 2008 to plan the activities managed by the Acueduct Network Matrix Direction which included the power generation theme. A turn was made power energy planning until 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 aspects of power generation. These documents were in adopted in Quality Committee (Management Review 26/06/08)[35].

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 9001:2000:

[35] Report of the Meeting of Committee on Quality – Management Review – is in the folder EAAB/2541001/080.139/2007 – Management Review 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 "Matrix System Structures Repairing".
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".

Were established the following procedures and instructions:

Procedure: 1SA20150540 "Power Generation".
Procedure: 1AF10100525 "Preventive Maintenance of Santa Ana Hydroelectric Plant".
Instructions: 7SA2015054002 "Load Rejection".

C. Resource Management Processes

1) **Management for Shared Services:** the Acueduct Network Matrix Direction quarterly evaluates the services provided by areas that support the missional process.

2) **Training**: during the defined period were conducted the following training:

TRAINING TITLE	OBJECTIVE	RESPONSIBLE	EXPECTED DATE	PERFORMANCE DATE	TARGET GROUP
Santa Ana Station and Santa Ana Hydroelectric Plant Operation.	Provide concepts for the operation of Santa Ana Station and Santa Ana Hydroelectric Plant.	Electromechanical Services Direction and Aqueduct Network Matrix Direction	07/03/2008	08/03/2008	Hydraulic verifying operators.
Presentation of routines "Santa Ana" and "El Silencio" stations.	To present routines ground to be done by the operators that performs hydraulic verifying in Santa Ana and El Silencio stations.	Quality Engineer	28/03/2008	28/03/2008	Hydraulic verifying operators.
Strategic Plan and Action Plan of Aqueduct Network Matrix Direction	Sensitize the mission, vision, quality policy, quality objectives and actions to be undertaken in 2008 by the Aqueduct Network Matrix Direction.	Director of Aqueduct Network Matrix Direction and Division Chiefs	17/06/2008	17/06/2008	All members of Aqueduct Network Matrix Direction
Operating Outline in Santa Ana station	Submit the operating system of the Santa Ana station.	Chief of Control Center	17-18/09/08	17-18-30/09/08	Control Center Engineers

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

- Request modification, elimination or creation of documents.
- Make adjustments.
- Review by the responsible people.
- Validation.
- Approval by Quality Committee.
- Awareness.

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

5) **Financial and Administrative Management:** in the period were modified and developed the following documents, to include aspects of marketing of power and Certified Emission Reduction:

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

6) **Control of Measurement Equipment**: for this process were the following activities:

- Establishment of Procedures: 1AC1015 "Control of Measuring Equipment Power Generation."
- Inventories, resumes and equipment calibration.

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**: by the 2008 year it was formulated 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**: In that period there were attended the comments received in the internal audit conducted in July 2007. For the 2008 year there were scheduled the following activities:

- The internal audit in September in which there where closed the comments of the previous audit.
- The certification audit in December month, where the scope of the Quality Management System were expanded to Conduction and Distribution of Drinking Water in Matrix Networks.

5) **Improvement Opportunities**: For this period it was documented the following improvement opportunity: "Mainstreaming Activities Power Generation Quality Management System for Conduction and Distribution of Drinking Water in Matrix Networks".

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.

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Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/08/2007	155,724.00
02/08/2007	152,156.00
03/08/2007	154,858.00
04/08/2007	158,888.00
05/08/2007	136,414.00
06/08/2007	151,354.00
07/08/2007	140,502.00
08/08/2007	152,822.00
09/08/2007	155,088.00
10/08/2007	158,322.00
11/08/2007	148,732.00
12/08/2007	135,622.00
13/08/2007	148,736.00
14/08/2007	161,980.00
15/08/2007	147,972.00
16/08/2007	154,354.00
17/08/2007	154,562.00
18/08/2007	188,092.00
19/08/2007	121,018.00
20/08/2007	106,412.00
21/08/2007	156,936.00
22/08/2007	151,146.00
23/08/2007	107,946.00
24/08/2007	159,860.00
25/08/2007	155,584.00
26/08/2007	131,764.00
27/08/2007	133,814.00
28/08/2007	157,398.00
29/08/2007	157,432.00
30/08/2007	153,266.00
31/08/2007	154,738.00

Reporte en formato texto

Paginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

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PBX: 57(4)3172244 - FAX: 57(4)3170989 - Linea de Orientación a Clientes: 57(4)3172929
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Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/09/2007	157,570.00
02/09/2007	141,188.00
03/09/2007	155,400.00
04/09/2007	156,644.00
05/09/2007	156,528.00
06/09/2007	158,174.00
07/09/2007	159,304.00
08/09/2007	164,890.00
09/09/2007	145,956.00
10/09/2007	157,574.00
11/09/2007	159,030.00
12/09/2007	158,100.00
13/09/2007	169,274.00
14/09/2007	179,956.00
15/09/2007	156,606.00
16/09/2007	120,226.00
17/09/2007	137,982.00
18/09/2007	148,098.00
19/09/2007	136,538.00
20/09/2007	118,620.00
21/09/2007	112,414.00
22/09/2007	128,880.00
23/09/2007	114,194.00
24/09/2007	123,270.00
25/09/2007	124,638.00
26/09/2007	124,368.00
27/09/2007	122,410.00
28/09/2007	120,318.00
29/09/2007	117,664.00
30/09/2007	97,106.00

Reporte en formato texto

Paginas de consulta: 1 23 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/10/2007	112,298.00
02/10/2007	122,372.00
03/10/2007	121,310.00
04/10/2007	123,684.00
05/10/2007	120,468.00
06/10/2007	130,938.00
07/10/2007	97,256.00
08/10/2007	110,126.00
09/10/2007	112,798.00
10/10/2007	116,358.00
11/10/2007	112,420.00
12/10/2007	113,040.00
13/10/2007	108,302.00
14/10/2007	83,252.00
15/10/2007	96,538.00
16/10/2007	115,378.00
17/10/2007	117,212.00
18/10/2007	115,340.00
19/10/2007	104,692.00
20/10/2007	104,006.00
21/10/2007	93,230.00
22/10/2007	114,282.00
23/10/2007	114,686.00
24/10/2007	108,464.00
25/10/2007	112,790.00
26/10/2007	113,048.00
27/10/2007	121,054.00
28/10/2007	100,214.00
29/10/2007	111,604.00
30/10/2007	112,400.00
31/10/2007	99,462.00

Reporte en formato texto

Paginas de consulta: 1 2 34 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/11/2007	112,216.00
02/11/2007	109,232.00
03/11/2007	114,090.00
04/11/2007	88,626.00
05/11/2007	98,158.00
06/11/2007	115,184.00
07/11/2007	113,368.00
08/11/2007	116,810.00
09/11/2007	118,122.00
10/11/2007	98,456.00
11/11/2007	51,202.00
12/11/2007	95,830.00
13/11/2007	123,594.00
14/11/2007	112,458.00
15/11/2007	51,134.00
16/11/2007	120,572.00
17/11/2007	119,336.00
18/11/2007	102,528.00
19/11/2007	123,466.00
20/11/2007	67,686.00
21/11/2007	97,372.00
22/11/2007	113,840.00
23/11/2007	114,110.00
24/11/2007	121,296.00
25/11/2007	100,494.00
26/11/2007	118,050.00
27/11/2007	119,990.00
28/11/2007	119,780.00
29/11/2007	119,168.00
30/11/2007	118,088.00

Reporte en formato texto

Paginas de consulta: 1 2 3 45 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/12/2007	125,340.00
02/12/2007	101,292.00
03/12/2007	116,626.00
04/12/2007	118,224.00
05/12/2007	109,316.00
06/12/2007	119,194.00
07/12/2007	121,370.00
08/12/2007	113,960.00
09/12/2007	35,700.00
10/12/2007	15,026.00
11/12/2007	111,544.00
12/12/2007	122,948.00
13/12/2007	102,758.00
14/12/2007	113,596.00
15/12/2007	80,612.00
16/12/2007	78,636.00
17/12/2007	100,728.00
18/12/2007	88,848.00
19/12/2007	48,800.00
20/12/2007	105,724.00
21/12/2007	108,146.00
22/12/2007	86,476.00
23/12/2007	96,210.00
24/12/2007	107,040.00
25/12/2007	68,530.00
26/12/2007	40,562.00
27/12/2007	121,980.00
28/12/2007	119,486.00
29/12/2007	109,682.00
30/12/2007	88,088.00
31/12/2007	100,256.00

Reporte en formato texto

Paginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/01/2008	36,512.00
02/01/2008	80,380.00
03/01/2008	125,712.00
04/01/2008	140,938.00
05/01/2008	139,950.00
06/01/2008	82,584.00
07/01/2008	111,162.00
08/01/2008	181,704.00
09/01/2008	206,924.00
10/01/2008	208,130.00
11/01/2008	207,744.00
12/01/2008	191,108.00
13/01/2008	142,082.00
14/01/2008	155,814.00
15/01/2008	159,548.00
16/01/2008	163,752.00
17/01/2008	162,154.00
18/01/2008	163,174.00
19/01/2008	167,020.00
20/01/2008	144,758.00
21/01/2008	162,996.00
22/01/2008	169,458.00
23/01/2008	171,298.00
24/01/2008	169,488.00
25/01/2008	168,248.00
26/01/2008	153,462.00
27/01/2008	148,686.00
28/01/2008	167,446.00
29/01/2008	166,406.00
30/01/2008	170,054.00
31/01/2008	164,880.00

Reporte en formato texto

Paginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/02/2008	171,010.00
02/02/2008	173,040.00
03/02/2008	155,192.00
04/02/2008	167,776.00
05/02/2008	173,224.00
06/02/2008	169,462.00
07/02/2008	169,768.00
08/02/2008	169,246.00
09/02/2008	152,378.00
10/02/2008	154,552.00
11/02/2008	168,182.00
12/02/2008	168,802.00
13/02/2008	169,904.00
14/02/2008	170,932.00
15/02/2008	171,800.00
16/02/2008	175,148.00
17/02/2008	153,686.00
18/02/2008	142,976.00
19/02/2008	166,440.00
20/02/2008	163,500.00
21/02/2008	159,148.00
22/02/2008	177,612.00
23/02/2008	183,260.00
24/02/2008	173,498.00
25/02/2008	172,378.00
26/02/2008	138,780.00
27/02/2008	151,328.00
28/02/2008	131,828.00
29/02/2008	134,780.00

Reporte en formato texto

Paginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/03/2008	93,142.00
02/03/2008	101,464.00
03/03/2008	101,146.00
04/03/2008	103,948.00
05/03/2008	98,486.00
06/03/2008	96,036.00
07/03/2008	36,084.00
08/03/2008	0.00
09/03/2008	0.00
10/03/2008	0.00
11/03/2008	20,788.00
12/03/2008	63,834.00
13/03/2008	97,430.00
14/03/2008	95,756.00
15/03/2008	98,456.00
16/03/2008	62,450.00
17/03/2008	94,800.00
18/03/2008	104,242.00
19/03/2008	118,236.00
20/03/2008	93,362.00
21/03/2008	62,064.00
22/03/2008	95,458.00
23/03/2008	84,560.00
24/03/2008	102,276.00
25/03/2008	108,782.00
26/03/2008	111,150.00
27/03/2008	86,978.00
28/03/2008	96,940.00
29/03/2008	106,322.00
30/03/2008	89,190.00
31/03/2008	95,586.00

Reporte en formato texto

Páginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/04/2008	95,880.00
02/04/2008	47,342.00
03/04/2008	96,500.00
04/04/2008	77,398.00
05/04/2008	103,992.00
06/04/2008	87,346.00
07/04/2008	86,662.00
08/04/2008	97,166.00
09/04/2008	93,036.00
10/04/2008	86,000.00
11/04/2008	95,726.00
12/04/2008	93,392.00
13/04/2008	86,406.00
14/04/2008	93,438.00
15/04/2008	94,878.00
16/04/2008	80,610.00
17/04/2008	95,330.00
18/04/2008	97,578.00
19/04/2008	106,240.00
20/04/2008	84,422.00
21/04/2008	95,104.00
22/04/2008	95,326.00
23/04/2008	95,724.00
24/04/2008	94,068.00
25/04/2008	95,878.00
26/04/2008	103,452.00
27/04/2008	82,860.00
28/04/2008	72,648.00
29/04/2008	97,354.00
30/04/2008	94,782.00

Reporte en formato texto

Paginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/05/2008	78,100.00
02/05/2008	92,488.00
03/05/2008	94,166.00
04/05/2008	38,152.00
05/05/2008	0.00
06/05/2008	0.00
07/05/2008	0.00
08/05/2008	0.00
09/05/2008	0.00
10/05/2008	0.00
11/05/2008	0.00
12/05/2008	0.00
13/05/2008	0.00
14/05/2008	85,080.00
15/05/2008	100,444.00
16/05/2008	99,462.00
17/05/2008	102,728.00
18/05/2008	64,724.00
19/05/2008	0.00
20/05/2008	39,658.00
21/05/2008	82,396.00
22/05/2008	89,124.00
23/05/2008	90,340.00
24/05/2008	91,070.00
25/05/2008	70,610.00
26/05/2008	70,944.00
27/05/2008	101,068.00
28/05/2008	87,418.00
29/05/2008	92,518.00
30/05/2008	91,368.00
31/05/2008	94,960.00

Reporte en formato texto

Paginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/06/2008	61,372.00
02/06/2008	0.00
03/06/2008	36,852.00
04/06/2008	75,044.00
05/06/2008	0.00
06/06/2008	0.00
07/06/2008	0.00
08/06/2008	0.00
09/06/2008	0.00
10/06/2008	0.00
11/06/2008	0.00
12/06/2008	0.00
13/06/2008	0.00
14/06/2008	0.00
15/06/2008	0.00
16/06/2008	0.00
17/06/2008	0.00
18/06/2008	0.00
19/06/2008	0.00
20/06/2008	0.00
21/06/2008	0.00
22/06/2008	0.00
23/06/2008	36,666.00
24/06/2008	90,728.00
25/06/2008	74,944.00
26/06/2008	66,426.00
27/06/2008	83,630.00
28/06/2008	54,632.00
29/06/2008	40,826.00
30/06/2008	36,210.00

Reporte en formato texto

Páginas de consulta: 1 2 3 4 5 6 7 8 9 10 11 12

Información generada por Neón entre 01/08/2007 y 31/07/2008 [DD/MM/YYYY]

	GENERACION DE MENORES (kWh) MENOR SANTA ANA Central
01/07/2008	46,550.00
02/07/2008	82,396.00
03/07/2008	80,562.00
04/07/2008	80,710.00
05/07/2008	81,986.00
06/07/2008	33,922.00
07/07/2008	49,752.00
08/07/2008	75,056.00
09/07/2008	46,354.00
10/07/2008	81,288.00
11/07/2008	78,698.00
12/07/2008	86,704.00
13/07/2008	71,870.00
14/07/2008	79,810.00
15/07/2008	50,276.00
16/07/2008	83,258.00
17/07/2008	79,972.00
18/07/2008	83,250.00
19/07/2008	90,766.00
20/07/2008	76,006.00
21/07/2008	79,344.00
22/07/2008	83,368.00
23/07/2008	84,146.00
24/07/2008	87,614.00
25/07/2008	79,822.00
26/07/2008	95,960.00
27/07/2008	82,746.00
28/07/2008	85,350.00
29/07/2008	88,762.00
30/07/2008	89,360.00
31/07/2008	88,664.00

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