CONTENTS

PROJECT DESIGN DOCUMENT (CDM-SSC-PDD)

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03:	• 28 July 2006	The Board, at its twenty-fifth meeting agreed to the following: To delete the definition of 'Component project activity' from the glossary of terms as well as the occurrences of the term 'component' under the 'Information note on bundling of small scale CDM Project Activities'. • •
04	22 December 2006.	The Board at its twenty eighth meeting agreed to the following: • To revise the Guidelines for completing CDM-SSC-PDD and FCDM- SSC-Subm, F-CDM-Bundle, and the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account the guidelines for completing CDM-PDD, CDMNM. • Glossary of terms has been separated and included into a stand alone document.

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

Title of the project activity: San Ramon Rural Electrification Project.
Version number: 03
Date when the document was completed: 29, March, 2007.

A.2. Description of the small-scale project activity:

The San Ramon Rural Electrification Project was developed as an *"Activity Implemented Jointly"* within the pilot scheme of climate change mitigation projects established in UNFCCC. The parties involved in the activity are the Ministry of Development and Cooperation of the Dutch Government – on behalf of Holland – and Cooperativa Rural de Electricidad Ltd. (CRE) of Santa Cruz – on behalf of Bolivia. As an activity implemented jointly, the San Ramon Rural Electrification Project is under the guarantee of the Memo of Understanding between the Ministry of Development and Cooperation of the Dutch Government and the Ministry of Sustainable Development and Planning, signed in Bolivia on September 23, 1998 (see Annex 2). According to this memo, the governments of Holland and Bolivia acknowledge San Ramon as an activity implemented jointly, accepting the rules established by UNFCCC. After this date, the parties expressed a common interest in turning the project from an activity implemented jointly into a clean development project, which are also climate change mitigation projects between industrialized countries and development countries under the framework of the Kyoto Protocol.

The San Ramon Rural Electrification Project replace diesel powered generators with natural gas fuelled generators. This reduces emissions of greenhouse gases (GHG´s) and improve power generation and distribution in the Chiquitania Norte in Santa Cruz, Bolivia. The total project provides: i) a natural gas fired electric power generation plant with a capacity of approx. 2.9 MW in San Ramón supplying approximately 9000 MWh; and ii) a distribution network that will serve more than 20 towns and villages benefit around 2800 customers. The project will result in increased reliability and decreased electricity cost.

The San Ramon Rural Electrification Project contribute to the sustainable development of the country since it has allowed the cheapest, non-stop throughout-the-day provision of electric power, without great voltage variations and with enough power to take care of the energy needs of the area. The project replaced a fragmented system of low voltage small plants, enabling the existence in the North Chiquitanía of Santa Cruz of a cheaper, highly reliable power source, with the right amount of power to take care of its industrial requirements. Since this area is among the poorest of Santa Cruz and Bolivia, the project has created a significant potential for the economic growth and the social development of the Chiquitanía.

Impact on sustainable development[1]

The San Ramon Rural Electrification Project has allowed the cheapest, non-stop throughout-the-day provision of electric power, without great voltage variations and with enough power to take care of the energy needs of the area. The project replaced a fragmented system of low voltage small plants, enabling the existence in the North Chiquitanía of Santa Cruz of a cheaper, highly reliable power source, with the

[1] Source Annex 5, Socio economic impact assessment.

right amount of power to take care of its industrial requirements. Since this area is among the poorest of Santa Cruz and Bolivia, the project has created a significant potential for the economic growth and the social development of the Chiquitanía.

The economic growth has been fundamentally favored on account of the energy generated by the project, which has brought along productivity improvements mostly in family micro-companies. By having continuous electric power, several homes of the region have optimized the use of the work force during the day and night and between productive and commercial activities in and outside the house. Basically, they have more time on a daily basis to produce and generate income. Also, thanks to the availability of electric power supplied by the project, among other factors, productive establishments have been constituted aimed towards the export of wood and the development of the market of communication technologies, through the provision of "internet cafes", especially. This has resulted in an expansion of the direct and indirect employment in the region as well as the increase of income.

Convergent evidence was found in the sense that for most of the traditionally settled productive establishments in the region, the project has allowed a decrease in costs by enabling the acquisition of higher performance machinery and equipment as well as through the reduction of the cost of electric power[2]. However, it did not result in an expansion of employment and production due mainly to the limitations of the size of the market, the little population density in the localities of the region and the poverty of large segments of the population, which limits significantly their purchase capability.

The San Ramon Rural Electrification Project has favored social development, facilitating an improvement in education, health and potable water services as well as the administrative attention provided by the municipalities. For instance, the attention of childbirths during the night presents fewer risks for the mother and the child; the pumping of potable water has improved considerably; there is a greater degree of automation in the administrative services of municipalities and the children have more available time at nights to take better care of their studies. Altogether, the project has contributed to the improvement of the human resources in the area.

This positive effect, however, has not been uniform. Its magnitude has been conditioned to the investment capability of the administrations or local governments and the degree of poverty prevailing in the communities. Those communities with greater investment capability and less poverty have been able to reap the greater benefits and vice versa. The investment capability depends directly on the number of inhabitants of the community. In general, it could be said that those smaller populations and with high levels of poverty like Yotaú, for instance, improved marginally on a social level thanks to the project; in these cases the potential is there but not the conditions to take advantage of it. On the other hand, the communities with greater population concentration and higher levels of income such as San Julian experienced greater relative progresses in their social development.

The greatest direct benefit of the project in the quality of life in the homes of the region is due to the lighting of the houses and the corresponding potential for the inhabitants to engage in different activities at nights, from the production of goods for domestic consumption to increasing the available study time for the children. In addition, the density of household electric appliances increased in the region. Articles such as ventilators, blenders and irons are more used in the area thanks to the project. To a great extent, however, their diffusion and benefits are restricted by the spending capabilities of the homes that in many

[2] The exception would be the wood-related activities, where there still is a favorable cost-benefit relation to the use of own diesel-fueled generators, due to the current level of electric tariffs.

cases, as referred to above, is seriously limited by the poverty prevailing in the North Chiquitanía of Santa Cruz.

The extension of positive the socioeconomic impact of the San Ramon Rural Electrification Project depends, to a great extent, on the poorest segment of the population of the coverage area being able to access the benefit of having electric power. That would require, among other things, the electric power consumption rates to decrease or converge towards the levels prevailing in the great cities or the national interconnected system.

Extensive information about background, justification and sustainable development contribution of the project can be found in the document attached in Annex 5.

A.3. Project participants:

Table 1 – Project Participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Bolivia	CRE - Cooperativa Rural de Electrificación Limitada	No

(*)In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

Note: When the PDD is filled in support of a proposed new methodology at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.

A.4. Technical description of the small-scale project activity:
A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Host party: Bolivia

A.4.1.2. Region/State/Province etc.:

Region: South America
State: Republic of Bolivia
Province/Department: Santa Cruz

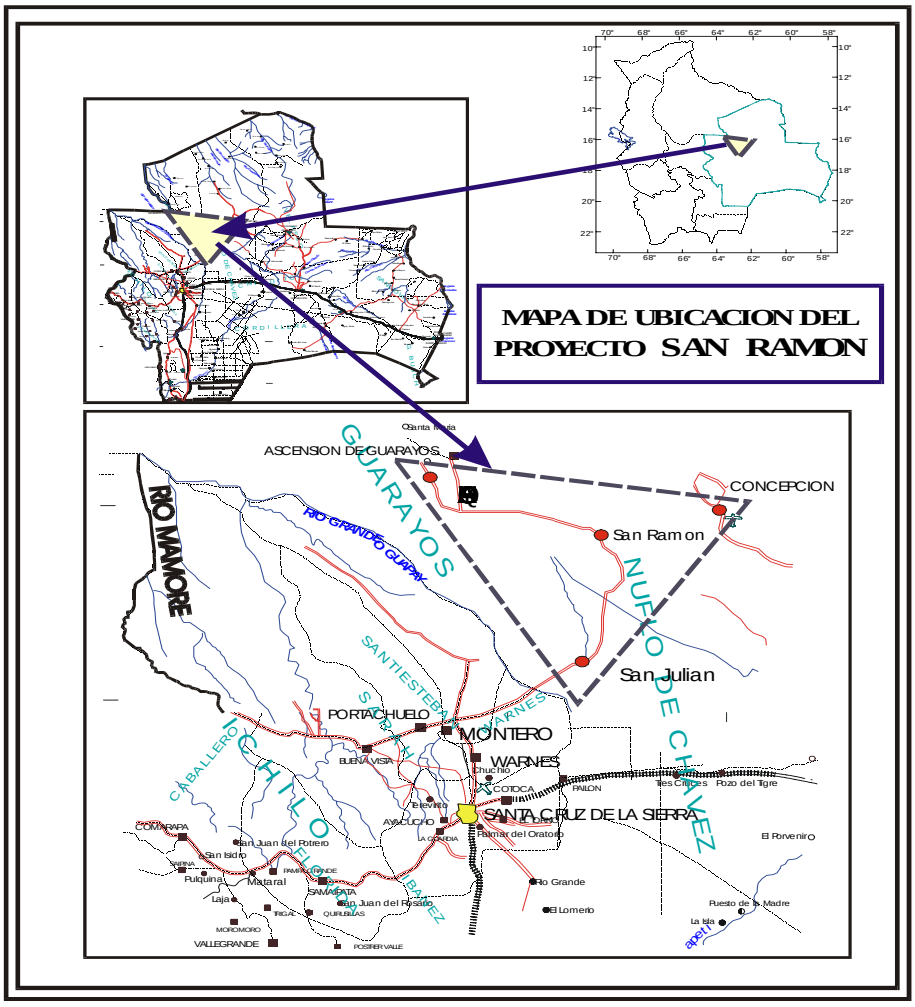
A.4.1.3. City/Town/Community etc:

The coverage area of the San Ramon Rural Electrification Project is the north region of the Department of Santa Cruz, made up by 7 greater localities, San Javier, San Ramon and San Julian in the Ñuflo de Chávez Province and Ascensión de Guarayos, El Puente and Yotaú in the Guarayos Province, and 13 smaller localities, 12 in the Ñuflo de Chávez Province and one in the Guarayos Province.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

Figure 1 shows the geographical location of the project.

Figure 1: Geographical location of the project



The generation plant consists of three 956 kW gas fired units, with total capacity of 2868 kW and a yearly supply of approximately 9000 MWh, coordenates of the plant are 30º 00` 00´´ South and 94º 22` 51´´ West. This plant will dispatch electricity 24 hours per day to the CRE Isolated Electric System[3]. The installation includes a water treatment facility and a transformer substation. The Isolated Electricity System Number 6 will dispatch electricity to the towns of San Ramon, San Javier, Concepción, Ascension de Guarayos, San Julian, El Puente, Yotau, Urubicha and Yaguaru. Also, the electricity system will serve 19 small communities within the project area.

The rural electrification project comprises 4 principal distribution lines:

- San Ramón – San Julián, 35.36 km of medium voltage lines
- San Ramón – San Javier, 42.14 km of medium voltage lines
- San Javier – Concepción, 59.34 km of medium voltage lines
- San Ramón – Ascensión, 116.59 km of medium voltage lines

In total, the distribution network will consist of 253.43 km of medium voltage lines and 130 km of low voltage lines. A schematic chart of the centralised natural gas fired electricity system can be find in Annex 3.

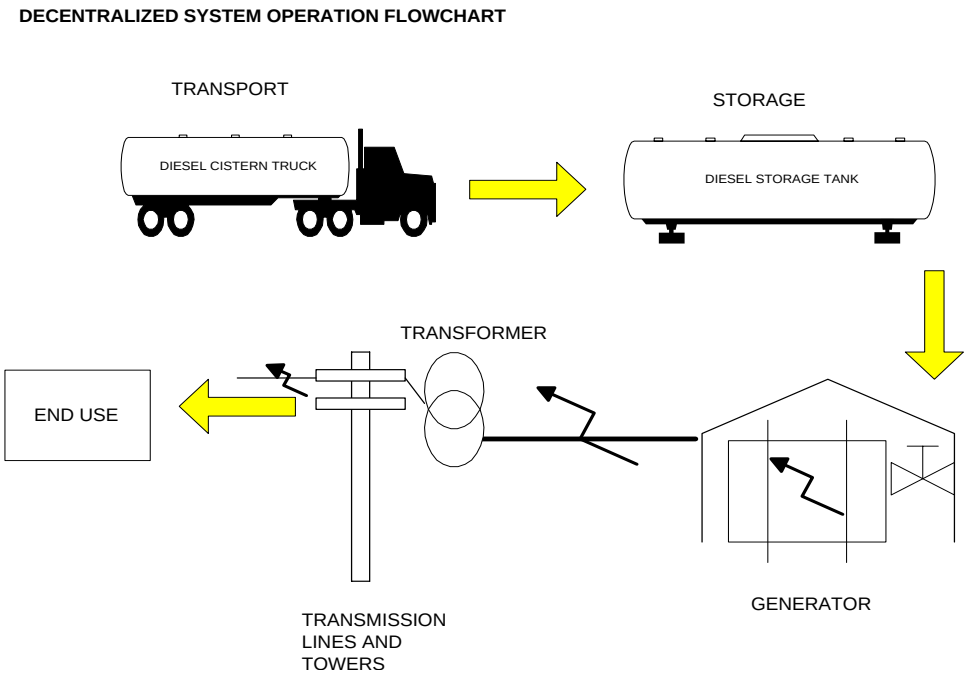
A.4.2. Type and category(ies) and technology of the small-scale project activity:

Version number: 10 AMS III B: Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. Type III – Other Project Activities; Category III. B Switching fossil fuels.

The project activity is a fuel switch program that is based on equipment fuel conversion composed of small generation plants powered by diesel engines. Electricity supply to the towns' urban areas, are carried out using diesel-powered generation plants that are normally located within urban limits. The fuel reaches the project area in cistern trucks and is stored in tanks located near the generating engines. See Figure 1

3 In Bolivia, an isolated electric national system is defined as a system which is not connected to the National Interconnected System, SIN. The SIN is an aggregate system of electricity generation, transmission and distribution. In 1998, the electricity generated in the SIN, represented 90% of the total electric energy produced in the country.

FIGURE 1



In the system that will be replaced by the project, part of the energy generated at the plants is delivered to a primary distribution system through step-up transformers and in some cases the energy is delivered directly to the secondary distribution system. Concerning the physical and operating conditions of the generation units, with few exceptions, the control and protection panels of the generating groups are in poor condition. One of the characteristics of the current system is that most of the diesel-powered generators that are currently operating require repairs or maintenance work. In general, the generators are located in shed-like powerhouses built with wooden beams, and concrete floors.

Under current operating conditions, the electric systems are plagued by typical problems such as supply disruptions fundamentally due to atmospheric discharges and generation failures. Generally, all the electric systems in the area, limit their operation to a few hours during night-time, failing to meet the population's minimum requirements, and the energy demand of non residential users like small farmers, sawmills, hotels and restaurants. Because of this, many of these users must operate their own private diesel fired generator

Annex 3 presents a sets of data that indicate current operating conditions of representative generation units within the project´s boundary. These are all the CRE´s power generators in the Chiquitania Norte area that are being displaced by the San Ramon Project, and a representative number of other generators operating in the area prior to the project activity.

San Ramon Electrification Project expect the use of natural gas substituting diesel fuel in an isolated electricity generation system. Provides a natural gas fired electric power generation plant with a capacity of approx. 2.9 MW, with an average year emission of 1,845.5 ton of CO_2, with a maximum emission rate

of 3569 tons of CO2 emission level bellow the 15 kton (15,000 tons) of CO2 limit of the Version 10 III-B category for small scale projects.

The natural gas fired power generators, technology employed in the project is a proven and commercialized sound technology, manufactured by CATERPILLAR, world leading in mechanical equipment. The main technical characteristics of the natural gas fired power generator are summarised in Table 2. (See also Annex 4).

Table 2. Gas natural power generator

Technical Characteristics	1,275 kv.A/1020 kW
	1,500 rpm/50 Hz
Emission Factor	560.40 kgCO2/MWh

The generation plant's modern technological features are monitored by a single operator through a remote automatic control panel that regulates operating conditions and adjusts the generators' operation as well as their ancillary systems. Moreover, the training undergone by the technicians in charge of operating the thermal plant, allow us to assume a good operational performance of the generators at the San Ramón plant.

The project abatement of GHG emissions is a result of: (i) the approximately 24.5% more carbon content found in diesel oil compared to natural gas; (ii) the greater lower heating value around 11% of a kilogram natural gas compared to diesel; (iii) the efficiency gains of an increased scale of a centralized plant compared to isolated smaller individual units (albeit, it is recognized that there is a slight efficiency penalty of a large plant operating at part load); (iv) the availability of medium speed generator choices for larger centralized plants in contrast to high speed only engine generator choice available for the very small units; and (v) the displacement of emissions caused by the use of wood, liquefied gas and kerosene for cooking and lighting, and diesel engines for water pumping.

A.4.3. Estimated amount of emission reductions over the chosen crediting period:

Table3. Estimated amount of emission reductions over the chosen crediting period

Years	Estimation of annual emissions reductions
	Tonnes of CO2e
2000	807
2001	1886
2002	2199
2003	2486
2004	2773
2005	3040
2006	3304
2007	3569

Total estimated reductions	**20064**
Total number of crediting years	**7**
Annual average of the estimated reductions over the crediting period (tCO2e)	**2866**

Source: Annex 3, Ex- ante estimation of emissions reductions ; Table IV.

A.4.4. Public funding of the small-scale project activity:

Under the MOU with the Ministry of Development and Cooperation of the Dutch Government the project received a financial support of US$ 2,315,000 from the Dutch Joint Implementation Pilot Program. This support was agreed specifically for the San Ramon Project and is not a diversion of the Netherlands official development assistance to Bolivia, resources committed by the Joint Implementation Programme of the Netherlands were additional to those of the Netherlands' existing foreign assistance programs to developing countries.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

According to Appendix C to the simplified modalities and procedures for the small-scale CDM project activities, the project activity is not a debundled component of a large project. San Ramon Rural Electrification Project is a stand alone project. There is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants; and
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline methodology:

B.1. Title and reference of the approved baseline methodology applied to the project activity:

Version 10 of AMS-III.B Switching fossil fuels.

B2. Justification of the choice of the project category:

As presented in Section A.4.3, estimated emission reductions of the project activity will not exceed 2.5 kt CO2e in any year of the crediting period. Table 4, describes the applicability requirements of version 10 AMS-II-B, including "Other Project Activities" sources such as fuel switch from diesel to natural gas. The San Ramon Project attends to all this requirements.

Table 4 - Methodology requirements

Project Type	Type III – Other Project Activities.	
Project Category	III. B. Switching fossil fuels.	Justification for the Project activity
Technology/Measure	This category comprises fossil fuel switching in existing industrial, residential, commercial, and institutional or electricity generation applications. Fuel switching may change efficiency as well. If the project activity primarily aims at reducing emissions through fuel switching, it falls into this category. If fuel switching is part of a project activity focused primarily on energy efficiency, the project activity falls in category II.D or II.E.	San Ramon comprises fuel switching for electricity generation.
Boundary	The project boundary is the physical, geographical site where the fuel combustion affected by the fuel switching measure occurs.	The project boundary is the physical, geographical site where the fuel combustion affected by the fuel switching activities occurs.
Baseline	The emission baseline is the current emissions of the facility expressed as emissions per unit of output (e.g., kg CO2equ/kWh). Emission coefficients for the fuel used by the generating unit before and after the fuel switch are also needed. IPCC default values for emission coefficients may be used.	The emission baseline is based on diesel fuel emissions from electricity generators.
Leakage	No leakage calculation is required.	OK
Monitoring	Monitoring shall involve: (a) Monitoring of the fuel use and output for an appropriate period (e.g., a few years, but records of fuel use may be used) prior to the fuel switch being implemented; (b) Monitoring fuel use and output after the fuel switch has been implemented - e.g. gas use and heat output by a district heating plant, gas use and electricity generated by a generating unit.	Monitoring involves fuel use and output of the project generation unit.

As described in Table 4. the project activity complains with all the requirements of the selected approved methodology.

B.3. Description of the project boundary

The San Ramon project boundary is the physical, geographical site where the fuel combustion affected by the fuel switching activities occurs as stated by Version 10 AMS- III.B. Following the guidelines and rules for small-scale project activities, the emissions related to production, transport and distribution of the fuel used in the diesel plants in the baseline are not included in the project boundary, since these emissions are beyond the physical and geographical site of the project.

B.4. Details of the baseline and its development:

The San Ramon Project activity involves a fuel switch from diesel generators that utilised diesel fuel, to a modern generation plant based on natural gas. Under the business and usual scenario, the diesel fuel power generation system within the project's area will have to keep its operation. The installed capacity of the equipment that is currently operating in the area of the project activity is sufficient to meet the baseline demand during the upcoming years.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

According to *Attachment A* to *Appendix B* of the simplified modalities and procedures for CDM small scale project activities, evidence as to why the proposed project is additional can be shown by conducting an analysis of any of the following: (a) investment barriers, (b) technological barriers, (c) prevailing practice and (d) other barriers. For the San Ramon Project, evidence to why the Project is additional is offered following the category of: **(a) Investment/Financial barrier,** as follows.

The project would not have been undertaken, without being a CDM project. This is because the decentralized, dispersed, diesel-based generation, components and equipment can always be replaced individually without affecting other parts of the system. It takes an additional effort to replace this system as a whole by a centralized natural gas -based generation such as the one involved in the project activity.

The main barrier for the replacement of the dispersed diesel-based generation by the centralized system of the San Ramon project was a high front-end investment requirement that CRE could not afford without the Netherlands government financial support that was linked to the benefits in emissions reductions. Would have been the project financed solely by private investors, high electricity tariffs would have been set up to recover the investment. However, high electricity tariffs would have impeded many customers access to this service, therefore, compromising private investment recovery. A resume of the investment analysis is presented in Annex 3 (*Proyecto San Ramon Metodologia de Evaluacion Economica*) to demonstrate that without the financial support of the Dutch Government the project would have been unable to reach a competitive tariff.

Also, during the period prior to decision making the following events are relevant to demonstrate additionality:

a. The Cooperativa Rural de Electrificacion (CRE) has supplied electricity in the Chiquitania Norte region of Santa Cruz for more than 20 years. The electricity distribution was through at least six isolated mini-grid networks centred in the major towns. During the mid-1990's, CRE recognized that significant rehabilitation of these decentralized networks would be required to continue to provide reliable and cost-effective service to its customers. Pre-feasibility investigations indicated that the best solution would be to abandon the aging diesel powered generation and distribution systems and replace them with a single gas fired generation plant and distribution network.

b. During the pre-feasibility investigations for the project activity, CRE learned that the Compañia Minera del Sur (COMSUR) was to build a natural gas pipeline from Mineros to San Ramon for its Puquio Norte mine located at 11 km from the San Ramon town. Taking advantage of this opportunity, CRE entered into a joint venture agreement with COMSUR to enlarge the pipeline diameter up to 3 inches to deliver natural gas for both the Puquio Norte mine and the thermal power plant which could supply electricity to the Ñuflo Chavez and Guarayos provinces – Chiquitania Norte – of the Santa Cruz department. The

Chiquitania Norte region covers about 11,500 km^2 with a population of about 82,500. The joint venture agreement established that CRE had to finance the USD 800,000 incremental cost required to enlarge the pipeline's diameter.

c. The planned project activity would build on experience in a similar, successful gas substitution project developed in the Los Valles Cruceños region by CRE several years earlier. However, preliminary calculations indicated that the San Ramon project would not be financially viable. If CRE would have to recover the full investment through electricity tariffs, the resulting high electricity prices would have prevented many households and small industrial establishments from connecting to CRE's new centralized system. Recognizing the additional global environmental benefits of its project, CRE decided to look for a co-financing partner.

d. Backed by the Bolivian government, CRE sought financial support for its fuel switch project from the Dutch Government. Contacts initiated in July 1996 led to the commitment of US$ 2,315,000 by the Dutch Joint Implementation Pilot Project Program. On April 29, 2000, the thermal plant located in San Ramon began operations through one of its three power generators.

e. As mentioned before the San Ramon Rural Electrification Project was developed as an *"Activity Implemented Jointly"* within the pilot scheme of climate change mitigation projects established in UNFCCC. The project is under the guarantee of the Memo of Understanding between the Ministry of Development and Cooperation of the Dutch Government and the Ministry of Sustainable Development and Planning, signed in Bolivia on September 23, 1998. According to this memo, the governments of Holland and Bolivia acknowledge San Ramon as an activity implemented jointly, accepting the rules established by UNFCCC. After this date, the parties expressed a common interest in turning the project from an activity implemented jointly into a clean development project, under the framework of the Kyoto Protocol.

f. The MOU between the Dutch and the Bolivian governments signed on 23/09/1998, established the distribution of carbon credits, giving the 50% of them to the Dutch Government, 20% to the Prefectura de Santa Cruz, and 30 % to the CRE. With this distribution it was not attractive for the CRE to cover the costs for the formulation of the PDD and the validation, verification and registration process; to solve this issue, financial support was obtained from the Programa Nacional de Cambios Climaticos, PNCC; the process to obtain this financial support, delay the biding for the validation process.

Based on the arguments explained before, for the final decision making, only the support brought by the Joint Implementation Programme of the Netherlands made possible the implementation of the San Ramon Project. Accordingly, the project complies with the additionality condition of the Meth-Panel recommendations. Also, the latter depends on the fact that resources committed by the Joint Implementation Programme of the Netherlands were additional to those of the Netherlands' existing foreign assistance programs to developing countries.

National policies and circumstances relevant to the baseline of the proposed project activity

The enactment of Bolivian Electricity Law No 1604 dated December 21, 1994, consolidated the reform process in the Bolivian Electricity Sector. Within this new legal framework, the private sector was entrusted with the responsibility of developing and operating the National Interconnected System (SIN)4

[4] The National Interconnected System (SIN) is the system that integrates power generation, transmission and distribution facilities in the departments of La Paz, Cochabamba, Oruro, Chuquisaca and Potosí.

through investments in electric energy generation, transmission and distribution.

The Electricity Law and its regulations define the sectoral regulatory framework, assigning the following functions to the Vice Ministry of Energy and Hydrocarbons: issuance of norms, promotion of investments and facilitating projects; to the Electricity Superintendence the responsibility of becoming the sector's regulatory entity, and, the National Charge Dispatch Committee was entrusted with the responsibility to ensure an efficient, safe and cost effective charge dispatch. In adherence to the current legal framework, the domestic electricity market comprises electric energy distribution, generation and transportation companies which must be desegregated.

Bolivia has been experiencing steady growth in the demand for electricity. Energy demand has grown a rate of 3.1% annually for the past two decades. Despite increasing demand, growth in electricity supply has been limited due to barriers to entry for energy developers.

Consistency of the project activity with the National Development Plan

The project activity is consistent with the following policies expressed in the National Development Plan of the new national Government[5]:

Policy 2: To improve the electricity coverage in the rural and urban areas promoting the massification of the power energy service, developing the rural electrification as a policy of national priority, within the context of the social and productive development to attend the poorest sectors of the population.

Policy 3: Power independence: To promote the change of the power matrix through research and use of the renewable and non renewable resources, promoting the switch of diesel oil generation, in the context of the sustainability, complaining with the environmental law and the international agreements related with the Kyoto Protocol.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emissions for the project scenario are calculated in accordance with the energy available for the system. The Project emissions are calculated based on the natural gas consumption required for energy generation; the formula used is:

PE = GG * EF ng (1)

Where:

PE is the project emissions (tCO2 - year)
GG is the energy gross generation (MWh-year)
EF is the CO2 emission factor for natural gas associated with energy generation (t CO2 / MWh)

[5] Plan Nacional de Desarrollo 2006-2010, Capitulo 3.3.3 Electricidad, pags. 56, 57. http://www.planificacion.gov.bo/BANNER/PARA%20PAG%20WEB/pnd1.html

Baseline emissions

Emissions for the baseline scenario are calculated based on electric energy generation available for the isolated system.

The baseline emissions are calculated based on the diesel fuel consumption required for energy generation; the formula used is:

BE = GG * EF dies (2)

Where:

PE is the project emissions (tCO2 - year)
GG is the energy gross generation (MWh-year)
Ef dies is the CO2 emission factor for diesel fuel associated with energy generation (t CO2 / MWh)

Leakage emissions

According to the methodology, it is not necessary to calculate the project's leakages. Not applicable.

Emission reductions.

The reduction of GHG emissions is calculated by subtracting the emissions for the baseline scenario from the emissions of the project activity scenario. The formula used is :

ER = BE - PE (3)

Where:

ER Emission reductions (tons of CO_2e)

BE Is the baseline emissions (tons of CO_2e)

PE Is the Project activity emissions (tons of CO_2e)

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	EED
Data unit:	MWh-year
Description:	Estimated Electricity Demand
Source of data used:	Project developer

Value applied:	<table><tr><th>Year</th><th>Total energy demand</th></tr><tr><td>2000</td><td>2024</td></tr><tr><td>2001</td><td>4731</td></tr><tr><td>2002</td><td>5517</td></tr><tr><td>2003</td><td>6235</td></tr><tr><td>2004</td><td>6956</td></tr><tr><td>2005</td><td>7625</td></tr><tr><td>2006</td><td>8287</td></tr><tr><td>2007</td><td>8952</td></tr><tr><td>2008</td><td>9626</td></tr><tr><td>2009</td><td>9626</td></tr><tr><td>2010</td><td>9626</td></tr><tr><td>2011</td><td>9626</td></tr><tr><td>2012</td><td>9626</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures actually applied	Shows the total energy demand estimated for the project's lifetime that will be used as the reference for the base line and the project activity scenario.
Any comment:	

Data / Parameter:	EF ng
Data unit:	Tons of CO2/MWh
Description:	CO2 emission factor for natural gas associated with energy generation
Source of data used:	Caterpillar
Value applied:	0,56040 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied	The CO2 emission factor for the project that was calculated based on catalogue information from the manufacturer about the power gas generator. (See Annex 4)
Any comment:	

Data / Parameter:	EF dies

Data unit:	Tons of CO2/MWh
Description:	CO2 emission factor for diesel fuel associated with energy generation
Source of data used:	Fuel consumption of diesel generators; field emission measurements; IPCC 2006, YPFB-Bolivia.
Value applied:	0,95905
Justification of the choice of data or description of measurement methods and procedures actually apllied	To determine the emission factor for the baseline an emission factor calculated based on historical fuel consumption, field emission measurements and the power of the diesel generators operating prior to the project activity, was calculated. (See Annex 3)
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

As part of the feasibility studies and being an energy aisle system[6] prior to the project activity, a comprehensive study of the total energy demand was prepared for the Prefectura de Santa Cruz; the report "*Informe Final, Fase II, Demanda de los Sistemas, Volume III, Tomo 1"*, was the source for the total energy demand for the project activity. (See Annex 3 for the reference study. All the study documentation is available at CRE´s headquartes in Santa Cruz). The emission reductions were calculated base on the total energy demand estimated for the project's lifetime described on Table 5. This total energy demand is the reference for the base line and the project activity scenario.

Table 5.

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Consumption	1840	4381	5108	5773	6441	7060	7673	8289	8913	8913	8913	8913	8913
Distribution Losses	184	350	409	462	515	565	614	663	713	713	713	713	713
Total Energy Demand	2024	4731	5517	6235	6956	7625	8287	8952	9626	9626	9626	9626	9626

Source: CRE

Table 5, shows the electricity consumption estimated for the project's lifetime. It also includes the power distribution losses expected as estimated in the CRE market study which assumes that distribution losses will be around 10% in the year 2000 and 8% in the remaining years According to CRE's technicians interviewed, in 2008 the San Ramon project should reach its full installed capacity. From 2008 to 2012, therefore, it is assumed that the project will yearly generate deliver a constant energy flow of 8913 MWh. In that period, if CRE is able to meet power demand in the area it will be because additional power generation capacity is added to the present San Ramon project.

[6] In Bolivia an aisle system is an electricity system not connected to the national grid.

B.6.4.Summary of the ex-ante estimation of emission reductions

The Table 6 below summarize the results of the ex-ante estimation of emission reductions for all years of the crediting period.

Table 6. Ex-ante estimation of emission reductions

Year	Estimation of Baseline emissions	Estimation of project activity emissions	Estimation of leakage	Estimation of overall emissions reductions
		t CO2e	t CO2e	t CO2e
2000	1941	1134	0	807
2001	4537	2651	0	1886
2002	5291	3092	0	2199
2003	5980	3494	0	2486
2004	6671	3898	0	2773
2005	7313	4273	0	3040
2006	7948	4644	0	3304
2007	8585	5016	0	3569
Total (tonnes of CO2e)	**48266**	**28202**	**0**	**20064**

Source: Annex 3, Ex- ante estimation of emissions reductions ; Table III.

B.7. Application of a monitoring methodology and description of the monitoring plan:

B.7.1. Data and parameters monitored

Project monitoring will be performed with the aim of verifying with an adequate level of precision any emission reductions generated by the fuel switch. Monitoring data and parameters will include:

Data / Parameter:	GG
Data unit:	MWh-year
Description:	Energy gross generation at the San Ramon power plant
Source of data to be used:	Project developer energy balance report: official form ISE 110, submitted to the Electricity Superintendence monthly.
Value of data	Expected annual emissions reductions calculation was based on Estimated Electricity Demand.
Description of measurement methods and procedures to be applied	CRE Ltda. as the project's operations manager is in charge of gathering information and data monitoring. The information gathered will be kept in digital and printed form, and bear the dates and signatures of the persons responsible, so it can be audited whenever this is required.

QA/QC procedures to be applied:	Monitoring energy production is part of CRE´s core business. Administrative procedures will be established at CRE Ltda. so this entity is capable of complying with external audit requirements to verify and certify the project's performance. CRE Ltda. must comply with all auditing requirements, as well as information classification and storage; establish systems to provide certified information for the audit; and, coordinate the material, places and equipment to be audited.
Any comment:	

Data / Parameter:	NG
Data unit:	m3
Description:	Volume of natural gas consumed at the thermal plant
Source of data to be used	Project developer energy balance report: official form ISE 110, submitted to the Electricity Superintendence monthly.
Value of data	Expected annual emissions reductions calculation was based on Electricity generation associated with natural gas consumption.
Description of measurement methods and procedures to be applied	CRE Ltda. as the project's operations manager is in charge of gathering information and data monitoring. The information gathered will be kept in digital and printed form, and bear the dates and signatures of the persons responsible, so it can be audited whenever this is required.
QA/QC procedures to be applied:	Monitoring energy production is part of CRE´s core business. Monitoring the consumption of Natural gas associated to the energy production is also part of CRE´s internal procedures and practices. Data regarding the natural gas consumption will be kept in digital and printed forms for auditing purposes.
Any comment:	

B.7.2. Description of the monitoring plan:

a) Description of the monitoring plan

The Monitoring Plan must be used throughout the project's useful life in order to determine and provide documentation corresponding to the project's GHG emissions as well as its impact on sustainable development. This monitoring plan monitors the requirement set out by the Kyoto Protocol that emissions reductions projects under the Clean Development Mechanism have real, measurable and long-term benefits and that emission reductions are additional to any that would occur in the absence of the certified project activities. Monitoring for the project activity includes the monitoring of energy production and natural gas consumption in the San Ramon thermal plant within the project boundary.

b) Operational and management structure

CRE is a private institution, acknowledged under Bolivian laws, as a power distribution concessionaire in the Department of Santa Cruz. CRE has supplied electric power in the region of the North Chiquitanía of the Department of Santa Cruz for more than 20 years. The operational and management structure that CRE will utilize to monitor the project's GHG emissions reductions will correspond to the structure the company currently uses to monitor generation plants. Also, **CRE** has an Integrated Management System including international certification in environmental management (ISO 14001) and health and occupational safety (OHSA 18001)[7] that supports all the operational activities of the company (See also Annex 4).

c) Data collection and archiving

In accordance with the simplified baseline and monitoring methodologies for small scale CDM projects, the project activity belongs to Version 10 Type IIIB "Switching Fossil Fuels. " The guidelines for monitoring include the following elements:

Fuel Monitoring and Electricity production

The data regarding natural gas consumption and electricity is obtained from the following format:

SUPERINTENDENCIA DE ELECTRICIDAD INFORMACION DEL SECTOR ELECTRICO

SISTEMA DE REGULACIÓN SECTORIAL FORM. ISE 110

GENERACION

EMPRESA: CRE Ltda. - Sistema Las Misiones **RESPONSABLE:**

GESTION:

MES: **FECHA:**

I. ENERGIA GENERADA POR CENTRALES PROPIAS

CENTRAL	TIPO	N° TOTAL DE UNIDADES	N° DE UNIDADES DISPONIBLES	POTENCIA DISPONIBLE (MW)	DEMANDA MAXIMA (MW)	GENERACION BRUTA (MWh)	CONS. PLANTA + PERDIDAS (MWh)	GENERACION DISPONIBLE (MWh)
San Ramón	MG	3,00	3,00	2,87	1,42	572,20	54,04	518,16

III. COMBUSTIBLES Y LUBRICANTES

CENTRAL	COMBUSTIBLES				LUBRICANTES			
	TIPO	CANTIDAD	UNIDAD	COSTO (Bs)	TIPO	CANTIDAD	UNIDAD	COSTO (Bs)
San Ramón	GN	5.647,91	MPC	36.916,46	SAE 40	275,00	Lts.	3.235,47

OBSERVACIONES:

Pérdidas de energía en transformadores de potencia (MWh/mes):

Reporting data

[7] http://www.cre.com.bo/WebCre/cre/2004.htm

The MP includes a set of electronic worksheets (see annex 4), which must be used by the project operators and the persons that handle the project's historical data, so the information is continuously stored and the reductions attributable to the project are calculated on a monthly basis.

B.8. Date of completion of the application of the baseline and monitoring methodology and the name of responsible person(s)/entity(ies):

Date of completion of the application of the methodology to the project activity 27*/02/2007*

Contact information of the persons(s)/entity(ies) responsible for the application of the baseline and monitoring methodology to the project activity : Servicios Ambientales S.A. (SASA) Juan Carlos Enriquez; tel/fax 591-2 2775460-53, La Paz, Bolivia. SASA is not a project participant.

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

C.1.1. Starting date of the small-scale project activity:

April 29, 2000.

C.1.2. Expected operational lifetime of the small-scale project activity:

21 years[89].

C.2. Choice of crediting period and related information:

C.2.1. Renewable crediting period:

Renewable crediting period considering at most seven years per period.

C.2.1.1. Starting date of the first crediting period:

29 de abril 2000.

C.2.1.2. Length of the first crediting period:

7y –0m

C.2.2. Fixed crediting period:

Not applicable

[8] This period is coincident with the use life of the technology for the project activity.

[9] The project conforms to paragraph 4 of COP/MOP1 decision 7/CMP1.

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable

SECTION D.: Environmental impacts:

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Bolivian National Congress approved Law 1333 of the Environment in 1992. In 1995, the General Regulations for Environmental Processes and the Prevention and Control of Contamination of Air, Solid Waste, and Dangerous Materials were approved in order to implement Law 1333. Law 1333 and its regulations are the principal means by which Bolivia can control contamination and protect natural resources. Law 1333 established the Vice Ministry of the Environment, Natural Resources, and Forestry Development (VMARNDF), within the Ministry of Sustainable Development (MDSP), (currently the Ministry of Planning) through as the principal national government environmental regulatory entity. It required the ministries of mining, energy, hydrocarbons, transportation, communication, and industry to coordinate their environmental policies and regulations with VMARNDF.

Law 1551 of Popular Participation and 1654 of Administrative Decentralization changed the structure of public administration in Bolivia in general and, specifically gave the prefectures and the municipal governments central roles in the implementation of environmental laws. The departmental governments have responsibility for enforcing and monitoring compliance with environmental regulations. They are responsible for reviewing the "Ficha Ambiental," environmental impact studies. They issue the Declarations of Environmental Impact and approve Environmental Mitigation Planes. The municipal governments review "Fichas Ambientales," "Manifiestos Ambientales" and classify projects in categories according to their environmental impact. They send reports to the Prefecture recommending whether the project should have a Declaration of Environmental Impact or a Declaration of Adequacies; the Prefectura makes that decision and issues the appropriate documentation.

Once the Licencia Ambiental (LA) has been obtained, the actions of environmental monitoring correspond to the Legal Representative of the Project based on the Plan de Aplicación y Seguimiento Ambiental (PASA) that is part of the Environmental License.

D.2. If environmental impacts are considered significant by the projects participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host party:

The project has a Environmental Licence and follows all the national environmental regulations. For San Ramon it was presented the Environmental Impact Assessment of the projects to the Ministry of Sustainable Development, MSD, which gave the Environmental Licence.

During this impact assessment, as required per national regulations a set of matrixes of impact evaluation was prepared, (See Annex 5). This matrix showed that the highest negative project impacts were associated with, social perturbation, soil compactation and landscape alteration during the construction

phase. Employs generation and improvement of the local productive activities were identified as positive impacts.

On August 2000, the MSD, emitted to CRE the "*Declaratoria de Impacto Ambiental, DIA*" (See Annex 5) recommending that CRE must specified the site of the new power plant prior to the implementation of the plant. CRE has complained with all this recommendations prior to the plant operation.

Also, as stated in the DIA, CRE Ltd., is responsible to implement the monitoring and follow-up of the environmental prevention and mitigation measures. Environmental monitoring reports are available at CRE ´s headquarters in the city of Santa Cruz. The Fiscalización Ambiental, according to Law 1333, is the responsibility of the Prefecture. For the project activity the Prefecture of Santa Cruz has the responsibility for the environmental follow up.

Additionally San Ramon Rural Electrification Project developed an Socio-economic Impact Assessment as part of the social responsibility and commitment of sustainable development in the Activity Implemented Jointly (Socio-economic Impact Assessment Study attached in Annex 5).

SECTION E. Stakeholders' comments:

E.1. Brief description of how comments by local stakeholders have been invited and compiled:

Stakeholders comments were received during surveys and consultations carried out for the Environmental Impact Assessment and the Socio-economic Impact Assessment Study. (See Annex 5).

Socio-economic Impact Assessment

The objective of the *Socio-economic Impact Assessment (See Annex 5)* has been the evaluation of the impact of the San Ramon Rural Electrification Project on the sustainable development of the communities of its coverage area. In order to evaluate this impact three socio-economic agents have been considered: the companies, as producers of goods and services, the public sector, as a supplier of health, education and potable water services and the homes, as suppliers of productive factors and consumers of goods and public services. With the evaluation of the impact of the project on these three types of factors, a systematic estimate has been searched of the impact of the project on the economic growth through the enterprise sector; and in the social development through the quality and amount of public services and the quality of life of families. It is assumed that the economic growth and the social development are enabling factors of the political-institutional development and a harmonious relationship of the society with the environment.

E.2. Summary of the comments received:

Comments were compiled in the environmental impact assessment and the report for the Socio-economic Impact Assessment Study. (See some specific comments received on Annex 5)

Some of the key comments are mentioned below:

- Some people expressed support to the project because of the positive impacts in the municipal development.

- Some authorities expressed that the improvement of electricity service will contribute to the community and the industrial development

- Some people expressed that electricity generation is very important because will allow a less expensive energy.

E.3. Report on how due account was taken of any comments received:

During the implementation of the project CRE, has incorporated all key comments and verified that all of them based on an adequate community perception of the social and economic benefits of the project, as was showed lately in the report for the Socio-economic Impact Assessment Study.

More on this issue, please refer to "Protocolo del Estudio " chapters 5.1.3, 5.1.4 and 5.1.5 . in Annex 5

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization	Cooperativa Rural de Electrificación Limitada
Street/ P.O. Box:	Calle Honduras esq. Av. Busch
Building	CRE
City:	Santa Cruz de la Sierra
Postal fix/ZIP	PO Box 1310
Country:	Bolivia
Telephone:	591 – 3 - 367777
FAX:	591 – 3 – 324936
E-Mail:	cre@cre.com.bo
URL	www.cre.com.bo
Represented by:	Oscar Ciro Pereyra Salvatierra
Title	Gerente Administrativo y Financiero
Salutation	Licenciado
Last Name	Pereyra
Middle Name	Salvatierra
First Name	Oscar Ciro
Department	Gerencia Administrativa y Financiera
Mobile	70956946
Direct Fax:	591-3-382996
Direct Tel:	591-3-338-1079
Personal E-Mail	oscarps@cre.com.bo

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

- Memo of Understanding between the Ministry of Development and Cooperation of the Dutch Government and the Ministry of Sustainable Development of Bolivia.

Memorandum of Understanding
between
THE MINISTER FOR DEVELOPMENT COOPERATION OF THE NETHERLANDS
and
THE MINISTER OF SUSTAINABLE DEVELOPMENT AND PLANNING OF BOLIVIA

1. Aware that the 1992 Declaration of the United Nations Conference on Environment and Development states that "States and people shall cooperate in good faith and in good spirit of partnership" (principle 27);

2. Acknowledging that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions (preamble United Nations Framework Convention on Climate Change);

3. Recognizing that steps required to understand and address climate change will be environmentally, socially and economically most effective if they are based on scientific, technical and economic considerations and continuallly re-evaluated in the light of new findings in these areas (preamble United Nations Framework Convention on Climate Change);

4. Recognizing the spirit of the principles of the United Nations Framework Convention on Climate Change which state inter alia that Parties should take into account that "policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost" and that "efforts to address climate change may be carried out cooperatively by interested Parties" (Article 3, paragraph 3 of the United Nations Framework Convention on Climate Change);

5. Aware that the Annex I Parties of the United Nations Framework Convention on Climate Change have committed themselves to "adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gases sinks and reservoirs" (Article 4.2.a of the United Nations Framework Convention on Climate Change);

6. Aware that "these Parties may implement such policies and measures jointly with other Parties" (Article 4.2.a of the United Nations Framework Convention on Climate Change);

7. Aware that the Conference of the Parties to the United Nations Framework Convention on Climate Change, as its first session in April 1995 in Berlin, has adopted a decision "to establish a pilot phase for activities implemented jointly among Annex I Parties and, on a voluntary basis, with non-Annex I Parties that so request" (Article 1 (a) of the first Conference of the Parties decision on activities implemented jointly under the pilot phase);

8. Aware that "no credits shall accrue to any Party as a result of greenhouse gas emissions reduced or sequestered during the pilot phase from activities implemented jointly" (Article 1 (f) of the first Conference of the Parties decision on activities implemented jointly under the pilot phase),

WHEREAS

9. The Ministry of Sustainable Development and Planning of Bolivia has been appointed as the designated authority for Activities Implemented Jointly and accepted by the United Nations Framework Convention on Climate Change;

10. The Ministry of Social Housing, Spacial Planning and Environment (VROM) of the Netherlands has been appointed as the designated authority for Activities Implemented Jointly and accepted by the United Nations Framework Convention on Climate Change; The Minister for Development Cooperation (Ministry of Foreign Affairs) of the Netherlands is executing the Programme for Activities Implemented Jointly as far as developing countries are concerned,

EXPRESS

11. The need to gain practical experience as well as a better insight in relevant aspects and criteria for activities implemented jointly;

12. Acknowledgment of the importance of facilitating the participation in Activities Implemented Jointly of commercial partners as providers of capital, knowledge and technology;

13. The wish to realise mutually advantageous cooperation through providing a facilitative environment for the implementation of the options to be revealed by AIJ projects,

WHEREAS

14. The Ministry of Sustainable Development and Planning declares that the project, to be carried out by the Cooperativa Rural de Electrificación (CRE) in Santa Cruz, according to the "Project Proposal for the San Ramón Area" (dated.....), is in accordance with the Bolivian legal framework;

15. The implementation of the above mentioned project in the field of rural electrification in the San Ramón area will not change present Netherlands and Bolivian commitments under the United Nations Framework Convention on Climate Change;

16. The Ministry of Sustainable Development and Planning ensures that the project, carried out according to the "Project Proposal for the San Ramón Area" (the Project) is supportive to the national environmental and development goals of Bolivia;

17. The Dutch Minister for Development Cooperation of the Netherlands is willing to provide the financial resources for the Project, being 2,315,000 USD, through a contract with CRE,

18. That the Project will be reported by CRE to both the Bolivian Ministry of Sustainable Development and Planning and the Minister for Development Cooperation of the Netherlands within 12 months after the signing of the contract with CRE;

AGREE

19. To present the Project as an Activities Implemented Jointly project to the Secretariat of the United Nations Framework Convention on Climate Change in Bonn;

20. The Ministry of Sustainable Development and Planning establishes an enabling environment for the project;

21. To have certified the progress and final outcome of the emission reduction project jointly by the Dutch based Joint Implementation Registration Centre (JIRC) and the Bolivian Climate Change National Program (PNCC), taking into account that these certificates only quantify the emission reduction and cannot function as credits;

22. To report on the progress and final outcome of the Project to the Secretariat of the United Nations Framewoek Convention on Climate Change as a contribution to further development and decision making by the Conference of the Parties on the Activities Implemented Jointly cooperation mechanism;

23. To accept a 50% share of the certificates quantifying the amount of greenhouse gas emissions reduced for both CRE and the Minister for Development Cooperation of the Netherlands,

THIS AGREEMENT WAS SIGNED IN 2 ORIGINALS (IN THE ENGLISH AND THE SPANISCH LANGUAGE) IN LA PAZ, BOLIVIA ON ..... 1998 AND WILL BE CONVEYED TO THE UNFCCC SECRETARIAT WITHIN 30 DAYS. IN CASE OF DISCORD ON THE INTERPRETATION OF THE AGREEMENT, THE ENGLISH TEXT WILL BE DECISIVE.

Minister
Ministry of Sustainable Development and Planning

Ambassador
On behalf of the Minister for Development Cooperation of the Netherlands, Ambassador of the Netherlands in Bolivia

Annex 3

BASELINE INFORMATION

	Consumption l/year	Generation kWh/year	Density Kg/l	NCV KJ/Kg	IPCC 2006 EF diesel Kg CO2/KJ	Emissions Kg CO2	EF Kg CO2/MWh	Weighting Factor	Weighted EF
CRE San Ramón	65400	180531	0,8221964	46224	0,0000741	184179	1020,20	0,051007749	52,03833862
CRE San Javier 260	271575	854100	0,8221964	46224	0,0000741	764806	895,45	0,241319876	216,0903947
CRE San Javier 160	63775	131400	0,8221964	46224	0,0000741	179602	1366,84	0,037126135	50,74533709
COPSECO	263895	893520	0,8221964	46224	0,0000741	743177	831,74	0,252457717	209,9794705
CRE Ascensión	237200	688128	0,8221964	46224	0,0000741	667999	970,75	0,194425669	188,7384392
Rest. La Pascana	27375	72270	0,8221964	46224	0,0000741	77093	1066,74	0,020419374	21,78210275
Gasol La Gotera	8030	10950	0,8221964	46224	0,0000741	22614	2065,20	0,003093845	6,389416806
Fábrica Hielo	11856	34800	0,8221964	46224	0,0000741	33389	959,45	0,009832492	9,433739185
Comsur	36500	94900	0,8221964	46224	0,0000741	102791	1083,15	0,02681332	29,04280367
Agrop Sembrador	3500	9125	0,8221964	46224	0,0000741	9857	1080,18	0,002578204	2,784926379
Vicariato Concepción	65000	188500	0,8221964	46224	0,0000741	183052	971,10	0,053259333	51,72006132
Gasolinera Concepción	2000	4653,75	0,8221964	46224	0,0000741	5632	1210,29	0,001314884	1,591386502
Barraca Monte verde	45000	117000	0,8221964	46224	0,0000741	126728	1083,15	0,033057517	35,8061963
Barraca Guanagodo	12480	33600	0,8221964	46224	0,0000741	35146	1046,01	0,009493441	9,930251774
Rancho San Ramón	73000	163408	0,8221964	46224	0,0000741	205582	1258,09	0,046169767	58,08560733
Barraca San Julian	18720	62400	0,8221964	46224	0,0000741	52719	844,86	0,017630676	14,89537766
TOTAL		3539285,75							**959,0538497**

ºAPI	40,6
Density	0,822196397

Characteristics of diesel in Bolivia

PARAMETER	Unit	Value
Density	°API	40,6
Specific gravity		0,8222
Inflammation point	°C	83,3
Punto de Escurrimiento	°C	-1,1
Ashes	% Peso	0,0024
H2O y Sediments	% Vol	Trazas
Centane number		60
Total sulfur	% Peso	0,03
Carbonaceous residue	% Peso	0,09
Calorific Value	BTU/Lb.	19874

Source: YPFB

EX - ANTE ESTIMATION OF EMISSIONS REDUCTIONS

TABLE I. BASELINE EMISSIONS

	2000	2001	2002	2003	2004	2005	2006	2007
Consumption	1840	4381	5108	5773	6441	7060	7673	8289
Distribution Losses	184	350	409	462	515	565	614	663
Total Energy Demand	2024	4731	5517	6235	6956	7625	8287	8952
Emission factor	0,95905	0,95905	0,95905	0,95905	0,95905	0,95905	0,95905	0,95905
Baseline emissions	1941	4537	5291	5980	6671	7313	7948	8585

TABLE II. PROJECT EMISSIONS

	2000	2001	2002	2003	2004	2005	2006	2007
Consumption	1840	4381	5108	5773	6441	7060	7673	8289
Distribution Losses	184	350	409	462	515	565	614	663
Total Energy Demand	2024	4731	5517	6235	6956	7625	8287	8952
Emission factor	0,56040	0,56040	0,56040	0,56040	0,56040	0,56040	0,56040	0,56040
Baseline emissions	1134	2651	3092	3494	3898	4273	4644	5017

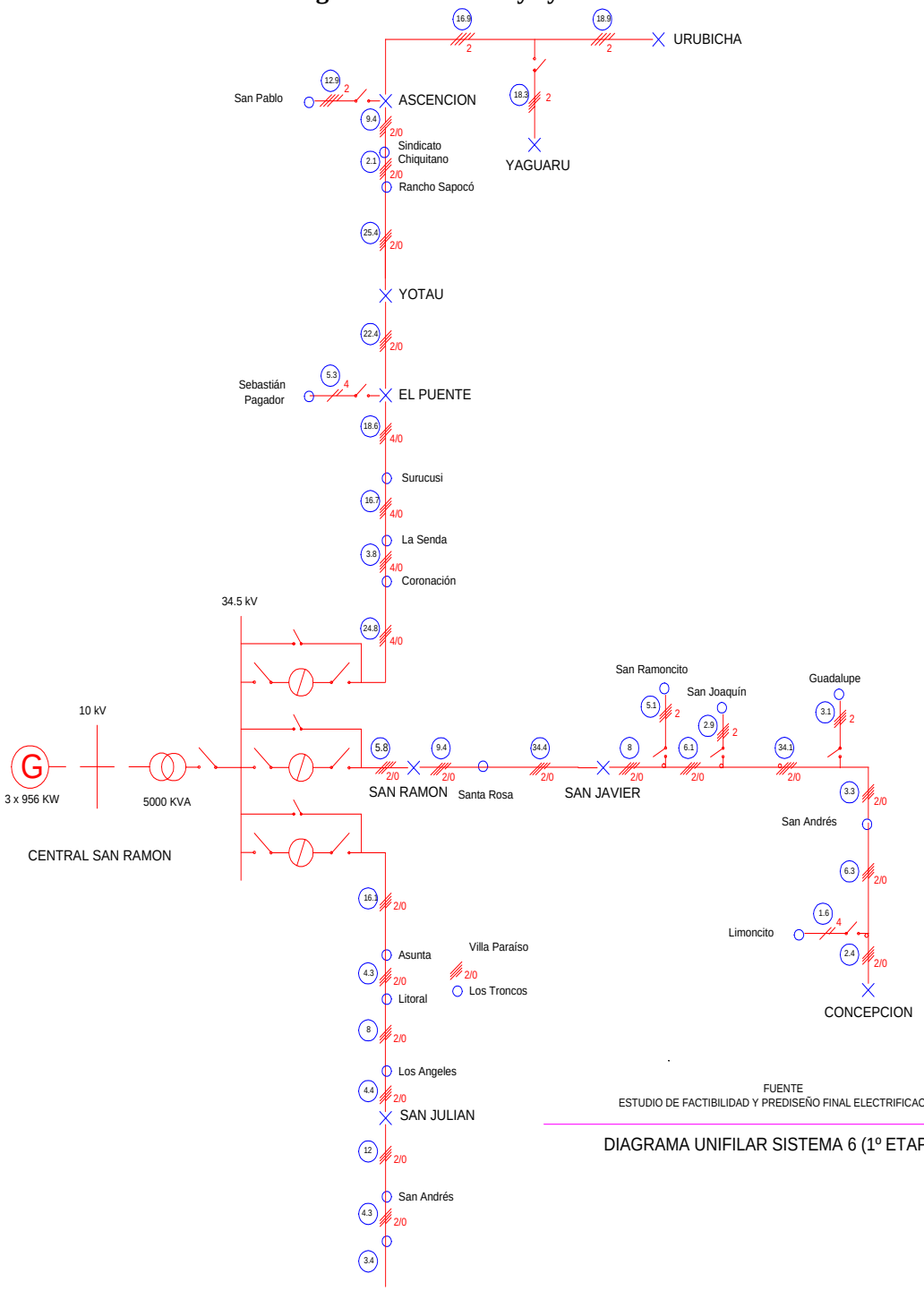
TABLE III. EMISSIONS REDUCTIONS

Year	Estimation of Baseline emissions	Estimation of project activity emissions	Estimation of leakage	Estimation of overall emissions reductions
		t CO2e	t CO2e	t CO2e
2000	1941	1134	0	807
2001	4537	2651	0	1886
2002	5291	3092	0	2199
2003	5980	3494	0	2486
2004	6671	3898	0	2773
2005	7313	4273	0	3040
2006	7948	4644	0	3304
2007	8585	5016	0	3569
Total (tonnes of CO2e)	**48266**	**28202**	**0**	**20064**

TABLE IV.

Years	Estimation of annual emissions reductions
	Tonnes of CO2e
2000	807
2001	1886
2002	2199
2003	2486
2004	2773
2005	3040
2006	3304
2007	3569
Total estimated reductions	**20064**
Total number of crediting years	**7**
Annual average of the estimated reductions over the crediting period (tCO2e)	**2866**

Schematic of the centralized natural gas fired electricity system



FUENTE
ESTUDIO DE FACTIBILIDAD Y PREDISEÑO FINAL ELECTRIFICACION

DIAGRAMA UNIFILAR SISTEMA 6 (1º ETAPA)

Annex 4

MONITORING INFORMATION

Electronic worksheets to calculate GHG emissions

The MP includes a set of electronic worksheets that are part of the plan, which must be used by the project operators and the persons that handle the project's historical data, so the information is continuously stored and the reductions attributable to the project are calculated on a monthly basis.

Data included in electronic worksheets

The information introduced in the worksheets must be obtained from official form ISE 110, prepared by the person responsible for the project activity, and submitted to the Electricity Superintendence every month. The worksheets and information gathered in the field must be stored and classified for external auditing processes.

This Plan does not contain instructions as to how field readings corresponding to energy generated and natural gas consumed should be carried out. These data are gathered under a system established by CRE; the introduction of a parallel field worksheet or any other format would only complicate the procedure already established by CRE.

Use of electronic worksheets

Electronic worksheets must be filled out on a monthly basis by the system's operators, and these have an automatic link so the information is stored on an ongoing basis to obtain the data corresponding to annual reductions.

The tables are divided by colors, which have the following meaning:

Blue	Cells blocked with Project information and data
Yellow	Cells where secondary calculations are performed
Orange	Cells available for introduction of project data.
Green	Cells that present important results, specifically tons of CO2 equivalent.

Two calculation tables were designed, and these are explained below:

Table I. Calculates CO2-e emissions that occurred in the baseline scenario, the data entered correspond to currently available monthly generation, obtained from form ISE 110.

Table I. Calculation of Baseline emissions

Paso 1. Cálculo mensual de emisiones de CO2-e en la Línea Base

Situación Sin Proyecto

Año _____

	Parámetros	Unidades	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Sept.	Octubre	No
2	Generación disponible	MWh	0	0	0	0	0	0	0	0	0	0	
3	Factor de Emisión de CO_2	kg/MWh											
4	Factor de Emisión de CH_4	kg/MWh											
5	Factor de Emisión de N_2O	kg/MWh											
6	Emisión de CO_2	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
7	Emisión de CH_4	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
8	Emisión de N_2O	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	Emisión de CO_2 -e	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Table II. Calculates CO2-e emissions for the project scenario, the data entered are obtained from form ISE 110, which contains in addition to the information corresponding to electric energy generated, information corresponding to monthly natural gas consumption.

Table II. Calculation of emissions for Project scenario

Paso 2. Cálculo mensual de emisiones de CO2-e Las Misiones

Situación Con Proyecto

Año _____

	Parámetros	Unidades	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Sept.	Octubre	Nov.	Dic.
2	Generación disponible	MWh	0	0	0	0	0	0	0	0	0	0	0	
3	Factor de Emisión de CO_2	kg/MWh												
4	Factor de Emisión de CH_4	kg/MWh												
5	Factor de Emisión de N_2O	kg/MWh												
6	Emisión de CO_2	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
7	Emisión de CH_4	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
8	Emisión de N_2O	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
9	Emisión de CO_2 -e	Ton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.

GHG emissions reduction

The reduction of GHG emissions is calculated by subtracting the emissions for the baseline scenario from the emissions of the project activity scenario.

$$REC\left[Ton\,CO_2\right] = LBEmissions - \Pr ojectEmissions$$

CALCULO DEL FACTOR DE EMISION DE GENERADORES A GASNATURAL A PARTIR DE DATOS PROPORCIONADOS POR EL FABRICANTE

MEMORIA DE CALCULO

Los cálculos realizados para estimar el factor de emisión de los generadores a gas natural, se realizan a partir de datos proporcionados por el fabricante (VER CATALOGO CATERPILLAR G3516 ADJUNTO) y siguiendo las guías metodológicas del IPCC.

Los cálculos se resumen en la siguiente tabla:

EQUIPO CAT G3516LE (GAS NATURAL)

EQUIPO	MJ/KWh	TJ/KWh	FACTOR DE EMISION (tC/TJ)*	EMISION DE CARBONO (tC/KWh)	FRACCION DE CARBONO OXIDADO**	EMISION DE CARBONO (tC/KWh)	FACTOR DE EMISION DE CO2 (t CO2/KWh)	FACTOR DE EMISION DE CO2 CALCULADO (Kg CO2/KWh)
A	B	C	D	E	F	G	H	I
		B / 1000		C X D		E X F	(G X 44)/12	H X 1000
32 SCAC	10.08	0.0101	13.65	0.13759	0.99	0.13622	0.49946	499.46
54 SCAC	10.25	0.0103	13.65	0.13991	0.99	0.13851	0.50788	507.88
32 SCAC	11.1	0.0111	13.65	0.15152	0.99	0.15000	0.55000	550.00
54 SCAC	11.31	0.0113	13.65	0.15438	0.99	0.15284	0.56040	560.40

* FUENTE: Reporte de inventariación de emisiones de gases efecto invernadero, Bolivia - 1994. Página E.1

** FUENTE: Reporte de inventariación de emisiones de gases efecto invernadero, Bolivia - 1994. Página E.2

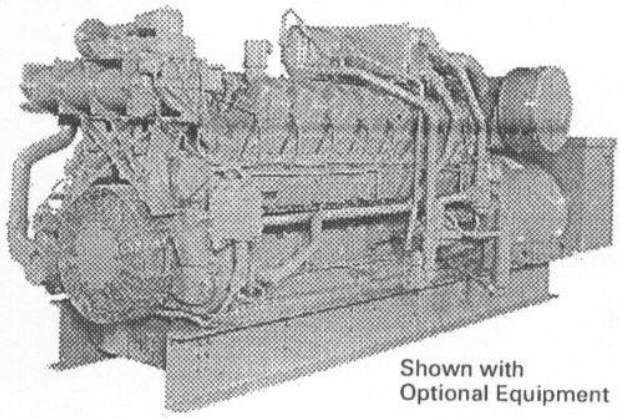
CATERPILLAR

Gas Engine Generator Set

G3516 LE

1500 rpm
50 Hz
1205-1275 kV•A; 965-1020 kW

Continuous Power



Shown with Optional Equipment

CATERPILLAR® ENGINE SPECIFICATIONS

V-16, 4-Stroke-Cycle Spark-Ignited

Bore — mm (in)	170 (6.7)
Stroke — mm (in)	190 (7.5)
Displacement — L (cu in)	69.0 (4210)
Aspiration	Turbocharged-Aftercooled
Compression ratio	8:1, 11:1
Shipping Weight (dry) — kg (lb)	11 813 (26 043) (includes engine, generator, and rails)

FEATURES

- **CATERPILLAR® FACTORY PACKAGE**
  Factory designed, assembled, and tested. Supported by Caterpillar parts and labor warranty through your local Caterpillar dealer.
- **DIESEL STRENGTH BUILT IN**
  Blocks, crankshafts, liners, and connecting rods are common with higher loaded Cat® diesel engines. Robust design provides prolonged life at lower gas engine loads.
- **ELECTRONIC IGNITION SYSTEM WITH DETONATION SENSITIVE TIMING**
  The Caterpillar Electronic Ignition System (EIS) provides optimized spark timing for all operating conditions. Timing is automatically controlled to maintain continuous detonation protection.
- **LOW EXHAUST EMISSIONS**
  2.0 gram/bhp-hr NO_x. Lower emissions are achievable for selected applications; consult your Caterpillar dealer.
- **FUEL FLEXIBILITY**
  Capability to burn a wide range of gaseous fuels, including landfill gas, digester gas, coal seam gas, and propane.
- **GALLERY COOLED PISTONS**
  Oil passageways provide cooler piston temperatures which prevent carbon build-up and increase detonation margin.
- **COOLING WATER TEMPERATURE**
  Choice of cooling water temperature between 99° C and 127° C to match heat recovery requirements.

CATERPILLAR® SR4 GENERATOR

Type	Static regulator, brushless excited
Construction	Single bearing, close coupled
Three phase	Wye connected
Insulation	Class F
Enclosure	Drip proof
Alignment	Caterpillar pilot shaft
Overspeed capability	130%
Waveform	Less than 5% deviation
Voltage regulator	3-phase sensing with Volts-per-Hertz
Voltage regulation	Less than ± 1%
Voltage gain	Adjustable to compensate for engine speed droop and line loss
TIF	Less than 50
THF	Less than 3%

CATERPILLAR ENGINE FACILITIES ISO 9001 CERTIFIED

G3516 LE GAS GENERATOR SET

CATERPILLAR

TECHNICAL DATA

G3516 LE Low Pressure – 1500 rpm		32 SCAC	54 SCAC	32 SCAC	54 SCAC
Electrical Output @ 0.8 PF without Fan	kW	1020	965	1020	965
	kV•A	1275	1205	1275	1205
Engine Speed	rpm	1500	1500	1500	1500
Voltage		400/3300	400/3300	400/3300	400/3300
Compression Ratio		11:1	11:1	8:1	8:1
Min Gas Pressure Required	kPa	10-34	10-34	10-34	10-34
NO_x	g/bhp-hr	2.00	2.00	2.00	2.00
CO g/bhp-hr	g/bhp-hr	1.98	1.95	1.63	1.65
HC (total)	g/bhp-hr	2.78	2.60	2.22	2.22
HC (non-methane)	g/bhp-hr	0.42	0.39	0.33	0.33
Exhaust O_2 (dry)	%	8.1	8.0	7.6	7.8
Fuel Consumption (100% load)	MJ/kW-hr	10.08	10.25	11.10	11.31
Fuel Consumption (75% load)	MJ/kW-hr	10.70	10.80	11.28	11.40
Air Inlet Flow Rate	Nm^3/min	84.8	81.3	87.8	85.1
Exhaust Gas Flow Rate @ stack C	Nm^3/min	211.0	205.0	230.0	224.0
Heat Rejection to Jacket Water (total)	kW	818.0	832.0	1024.0	1025.0
Heat Rejection to Exhaust (to 177° C)	kW	503.0	495.0	594.0	579.0
Heat Rejection to Aftercooler	kW	186.0	137.0	188.0	148.0
Heat Rejection to Atmosphere	kW	100.0	100.0	100.0	100.0
Exhaust Gas Stack Temperature	Deg C	448.0	455.0	483.0	485.0

G3516 LE High Pressure – 1500 rpm		32 SCAC	54 SCAC	32 SCAC	54 SCAC
Electrical Output @ 0.8 PF without Fan	kW	1020	965	1020	965
	kV•A	1275	1205	1275	1205
Engine Speed	rpm	1500	1500	1500	1500
Voltage		400/3300	400/3300	400/3300	400/3300
Compression Ratio		11:1	11:1	8:1	8:1
Min Gas Pressure Required	kPa	207-278	207-278	241-278	241-278
NO_x	g/bhp-hr	2.00	2.00	2.00	2.00
CO g/bhp-hr	g/bhp-hr	1.74	1.78	1.63	1.65
HC (total)	g/bhp-hr	3.66	3.64	2.22	2.22
HC (non-methane)	g/bhp-hr	0.55	0.55	0.33	0.33
Exhaust O_2 (dry)	%	8.5	8.7	7.6	7.8
Fuel Consumption (100% load)	MJ/kW-hr	10.20	10.52	11.10	11.31
Fuel Consumption (75% load)	MJ/kW-hr	10.71	10.98	11.28	11.40
Air Inlet Flow Rate	Nm^3/min	86.9	85.0	87.8	85.1
Exhaust Gas Flow Rate @ stack C	Nm^3/min	220	218	230	224
Heat Rejection to Jacket Water (total)	kW	805	824	1032	1031
Heat Rejection to Exhaust (to 177° C)	kW	536	541	594	579
Heat Rejection to Aftercooler	kW	181	148	180	142
Heat Rejection to Atmosphere	kW	100	100	100	100
Exhaust Gas Stack Temperature	Deg C	459	468	483	485

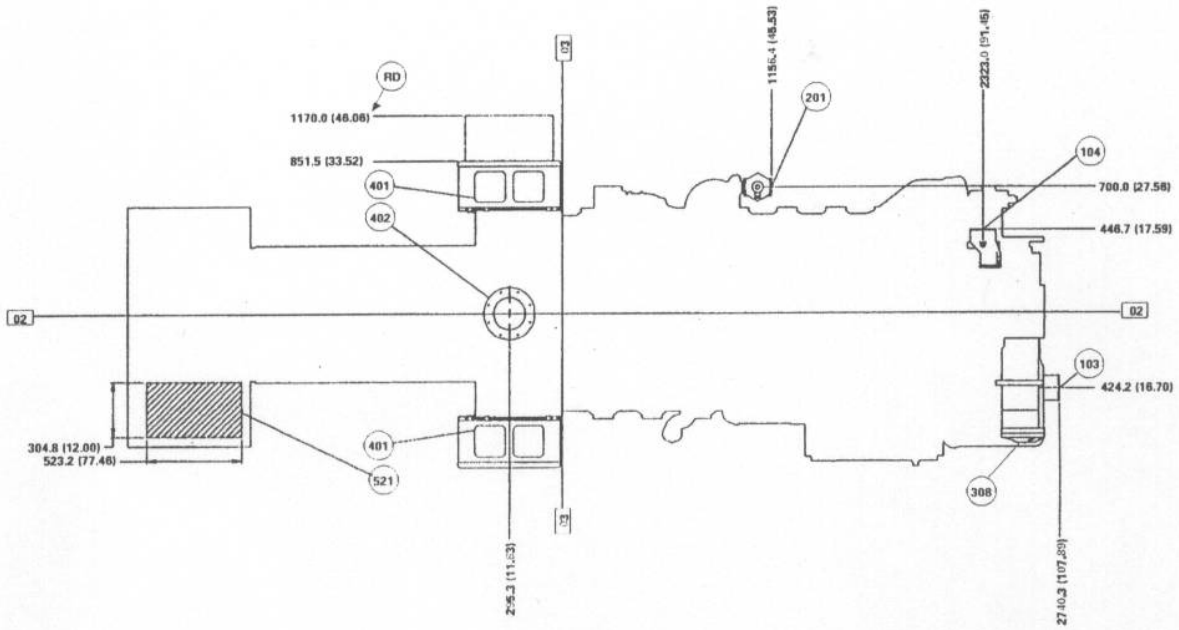
* SCAC refers to Separate Circuit Aftercooling water inlet temperature.

Ratings and data based on specified standard conditions (back page)

CATERPILLAR

G3516 LE GAS GENERATOR SET

GAS GENERATOR SET — TOP VIEW



02	Centerline of Engine	(201)	Fuel Inlet	(521)	Conduit Entrance
03	Rear Face of Cylinder Block	(308)	Oil Filter	(RD)	Removal Distance
(103)	Water Inlet	(401)	Air Inlet		
(104)	Water Outlet	(402)	Exhaust		

See general dimension drawing 114-1975 for additional Electronic Ignition System (EIS) engine detail and NA information.

For magneto ignition system engines see general dimension drawing 7C-5067.

Note: General configuration not to be used for installation.

CONDITIONS AND DEFINITIONS

Ratings are based on SAE J1349 standard conditions of 100 kPa (29.61 in Hg) and 25° C (77° F). These ratings also apply at ISO3046/1, DIN6271 and BS5514 standard conditions of 100 kPa (29.61 in Hg) and 27° C (81° F); and API 7B-11C standard conditions of 99 kPa (29.38 in Hg) and 29° C (85° F) also apply.

Ratings are based on dry natural gas having a low heat value of 35.22 MJ/m³ (905 btu/ft³). Variations in altitude, temperature, and gas composition from standard conditions may require a reduction in engine horsepower.

Turbocharged-aftercooled ratings apply to 1525 m (5000 ft) and 25° C (77° F). **Naturally aspirated** engines apply to 150 m (500 ft) and 29° C (85° F). For applications which exceed these limits consult your Caterpillar dealer.

Continuous – Output available without varying load for an unlimited time. Continuous power in accordance with ISO8528, ISO3046/1, AS2789, DIN6271, and BS5514.

Materials and specifications are subject to change without notice.

The International System of Units (SI) is used in this publication.

LEHX6782
Supersedes LEHX4500

CATERPILLAR

G3516 LE GAS GENERATOR SET

STANDARD EQUIPMENT

- Air cleaners with service indicator
- Breather, crankcase
- Cooler, lubricating oil
- Filters, lubricating oil, RH
- Flywheel housing, SAE No. 00
- Governor (Woodward), magneto engine: 2301 EIS engine: 2301A
- Ignition system
  - Altronic III or Caterpillar EIS
- Instrument panel, RH or LH
  - exhaust temp.
  - intake manifold pressure
  - intake manifold temp.
  - oil pressure
  - oil pressure differential
  - service meter
  - water temp.
- Lifting eyes
- Manifold, exhaust, watercooled
- Paint, Caterpillar yellow
- Protection devices
- Pumps
  - gear driven
  - aftercooler water
  - lubricating oil
  - jacket water
- Rails, mounting, 13 inch
- Regulator, gas pressure
- SAE standard rotation
- Thermostats and housing
- Torsional vibration damper

OPTIONAL EQUIPMENT

- Cooling systems, high temperature
- Custom generator voltages
- Exhaust fittings
- Generator mounted control panel
- Governor (Woodward), magneto engine: 2301A
- Load share governor
- Low BTU arrangements
- Low pressure gas fuel system (10 kPa)
- Muffler
- Power takeoffs
- Prelube pump
- Starting systems
- Tachometer

	**ISO-9001:2000** Esta Norma Internacional pueden utilizarla partes internas y externas, incluyendo organismos de certificación, para evaluar la capacidad de la organización para cumplir los requisitos del cliente, los reglamentarios y los propios de la organización.
	**ISO-14001:2004** Esta Norma permite a una compañía demostrar un sólido desempeño ambiental mediante el control de los impactos de sus actividades, productos y servicios sobre el medio ambiente, acorde con su política y objetivos ambientales.
	ISO-17025:2005 Esta Norma Internacional establece los requisitos generales para la competencia en la realización de ensayos o de calibraciones, incluido el muestreo. Cubre los ensayos y las calibraciones que se realizan utilizando métodos normalizados, métodos no normalizados y métodos desarrollados por el propio laboratorio.Esta Norma Internacional es aplicable a todas las organizaciones que realizan ensayos o calibraciones. Éstas pueden ser, por ejemplo, los laboratorios de primera, segunda y tercera parte, y los laboratorios en los que los ensayos o las calibraciones forman parte de la inspección y la certificación de productos. En CRE, esta Norma Internacional se aplica a su **laboratorio de medidores**.
	**OHSAS-18001:1999** Esta Especificación indica los requisitos para un sistema de gestión de la seguridad y la salud ocupacional, con el objeto de que una organización pueda controlar sus propios riesgos de seguridad y salud ocupacional (SYSO) y mejore su comportamiento.

	**SA-8000:2001** Esta Norma especifica los requisitos de responsabilidad social que permiten a una compañía Desarrollar, mantener y aplicar sus principios y sus procedimientos con el objeto de manejar aquellos asuntos que están bajo su control o influencia. Estos asuntos abarcan aspectos medioambientales, de salud, seguridad y legales aplicables a los trabajadores, proveedores, clientes y todo el entorno social de una compañia

Historial de Certificaciones Obtenidas

Año	Certificado Obtenido
1999	ISO-9001:1994 (primera certificación)
2002	ISO-9001:2000 (segunda certificación) ISO-25 (Laboratorio de Medidores)
2004	ISO-14001:1996 OHSAS-18001:1999
2005	ISO-9001:2000 (tercera certificación) ISO-14001:2004 (actualización de la versión 1996) SA-8000:2001 ISO-17025:1999 (Laboratorio de Medidores, actualización de la ceritifación ISO-25)