



**Project design document form for
CDM project activities
(Version 08.0)**

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	San Jacinto Tizate Geothermal Project
Version number of the PDD	4.0
Completion date of the PDD	20/01/2017
Project participant(s)	1. Polaris Energy Nicaragua S.A. 2. Blues Traveler Environmental Limited ¹ 3. Ecosecurities, Ltd.
Host Party	Nicaragua
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	ACM0002 Version 4.0 "Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources"
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope Number 1: Energy Industries – Renewable Sources
Estimated amount of annual average GHG emission reductions	63,322 tCO ₂ e

¹ Post registration change to Project Participants approved by CDM on 31/01/2009.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Project Activity involves the construction of a Geothermal Power Plant (GPP) in San Jacinto, Nicaragua. The San Jacinto geothermal project is being carried out by Polaris Geothermal Inc. through its Nicaraguan subsidiary, Polaris Energy Nicaragua S.A. (PENSA)². They have signed a power purchase agreement (PPA) with Union Fenosa, the electricity utility in Nicaragua, for 20 years.

The proposed development involves the implementation and construction of a 77 MW geothermal plant³.

The development will be carried out in the following two phases:

1. Phase 1: Installation of two backpressure steam turbo-generators of 5 MW each to test the production capacity of the geothermal field. Both turbo-generators were commissioned in July 2005, operated until July 2012, and decommissioned in Phase 2 of the project activity, in March 20; and,
2. Phase 2: Installation of two 38.5 MW condensing steam power units consisting of single flash steam/brine separation, with steam directed to a conventional condensing steam turbine. The first power unit began commercial operation in January 2012 and the second in February 2013.

At the end of the first crediting period in 2012 the plant had an installed capacity of 48.5 MW and an expected net annual export to the grid of 146,996 MWh. The plant has an installed capacity of 77 MW and the net annual export to the grid is expected to be 583,122,569,864 MWh per year as of February 2013.

Nicaragua made minor investments in the energy sector during the 1980-1994 period. As a result Nicaragua has the lowest per capita electricity generation and consumption rate in Central America. Most of the Nicaraguan power system relies on thermal energy, above 72%. Also, energy demand in Nicaragua grew from 296 MW in 1993 to 381 MW in 1998. This represents a 28.7% overall growth rate over the five year period and an annual average rate of 5.74%. The Nicaraguan government realizes the need of investment in the electricity sector in base load alternative generating capacity, either geothermal or hydro. However, there is still a reliance on expensive and highly pollutant fossil fuel based sources of energy. The government of Nicaragua wants to pursue such an investment through public-private partnerships, where a private company gets the concession to exploit a natural resource. Although the government has released an Indicative Plan for Energy Expansion in Nicaragua where it explicitly says that renewable energy should be promoted, this development is ultimately left to private companies, which are linked to market forces and profitability requirements from shareholders.

Nicaragua is a country endowed with large geothermal potential, due to the presence of volcanoes of the Maribios range along the Pacific coast. Geoscientific investigations were started towards the end of the 1960s, prioritizing the Momotombo and San Jacinto-Tizate geothermal fields. The commercial exploitation of Momotombo started in 1983 with 35 MW capacity installed, and expanded in 1989 to 70 MW. The strategy pursued by the project developer led to depletion of the reservoir and a decline in production to less than 10 MW. This demonstrates that:

² PENSA was previously called San Jacinto Power S.A.

³ Capacity installed according to the nameplate of the turbines.

1. San Jacinto-Tizate area has been known as a potential geothermal area for long, but has not been pursued for financial barriers, that the CDM can help to overcome;
2. Although there is a geothermal plant in Nicaragua, this has not brought great expertise to the country on geothermal development due to bad management. It also provides an example of the risks of geothermal technologies; and
3. Due to failure to develop successful geothermal projects in the country within the last decades, people's perception of geothermal power might be of an unreliable source of electricity, and thus, there is a social risk attached to the project.

By utilizing the existing geothermal resources of San Jacinto-Tizate to generate electricity, the proposed project activity will displace 77MW (569,864 MWh) of electricity produced by a fossil-fuel intensive electricity grid, which has a carbon emission factor (CEF) of 0.754 tCO₂/MWh. Expected emission reductions from the proposed project activity are 63,322 tCO₂ per annum.

Contribution to Sustainable Development

The Government of Nicaragua is committed to the principles of sustainable development and to the implementation of a national sustainable development strategy, which specifically includes the promotion of renewable energies in the country.

The proposed project activity contributes to the sustainable development of Nicaragua, and specifically, to the Department of León, as follows:

- The project contributes to meeting the objectives of the “National Development Plan and Enhanced Strategy for Economic Growth and Poverty Reduction” (in Spanish, “Estrategia Reforzada de Crecimiento Económico y Reducción de la Pobreza y el Plan Nacional de Desarrollo”). By providing clean electricity the project will clearly bring economic and development benefits to a depressed area in the department of León. The implementation of the project activity is expected to improve the situation of local industries in the area, due to an improved electricity supply, contributing at the same time to reducing the costs of electricity generation.
- The proposed project activity increases foreign investment in the country.
- The San Jacinto-Tizate project contributes towards the goals of “National Action Plan to combat Climate Change” (in Spanish, “Plan de Acción Nacional para enfrentar al Cambio Climático”), because the proposed project activity will be generating electricity from an environmentally-friendly technology, using an indigenous and clean source displacing more carbon intensive electricity from the grid.
- Further environmental benefits will be achieved through the reduction of air-based pollutants, such as oxides of nitrogen, sulphur oxides, carbon monoxide and fine particles, being emitted into the atmosphere due to the reduced combustion of fossil fuels.
- A further economic benefit from the project is that using geothermal energy from Nicaragua reduces the dependence on importation of fossil fuels and thus isolates the national economy from fuel price fluctuations. This improves the security and diversity of electricity supply.
- The proposed project activity is an example of successful technology transfer, which will increase the skills and expertise of Nicaraguans, specifically in developing geothermal power projects (see also A. 3).
- The proposed project activity leads to increased employment opportunities for locals and contributes towards employment generation in general. It has been estimated that a total of 500 direct employments and thousands of indirect jobs will be created along the construction of the project. For the maintenance and operational phase of the project, up to 50 professionals will be required, which at least 50% will be locals. Most of the direct jobs created during the construction phase are covered by nationals, especially from the surrounding villages and the city of León.

In absence of the project activity, electricity generation would continue to come from fossil-fuel based plants, and therefore, none of the abovementioned social, environmental and economic benefits would take place. Additionally, geothermal research has identified that there are at least another ten areas of geothermal interest in Nicaragua that could be developed as an energy resource. This implies that the proposed project activity has the potential to contribute to the long-term general economic and social development of Nicaragua by demonstrating the use of a renewable energy alternative technology that could be applied on a larger scale throughout the country.

A.2. Location of project activity**A.2.1. Host Party**

Nicaragua

A.2.2. Region/State/Province etc.

Department of León

A.2.3. City/Town/Community etc.

San Jacinto

A.2.4. Physical/Geographical location

The Project Activity is to be located in the rthwest of Managua, in the Department of León, between the towns of Telica and Malpaisillo, to approximately 120 km from Managua and 20 km from the City of León. Nicaragua is situated in the Central American Isthmus, bordering both the Caribbean Sea and the North Pacific Ocean, between Costa Rica and Honduras. The geographic coordinates are 13 00 N, 85 00 W.

The project site is approximately 2km to the North of Caserío San Jacinto, which is to the north side of the Tizato hill. The project site covers approximately 8km², which is unoccupied except for sparse subsistence farming in some peripheral areas. The area to be occupied for the project has been acquired from the nearby farmers. However, only 25% of the total project site will actually be utilized for equipment and the project developer is happy to permit that the remainder 75% of the land to be used for farming or grazing purposes.

The nearest village is San Jacinto, a small settlement adjacent to the established project base camp. It is isolated from the project site by low hills and no part of the project is visible from the village. Paved road access passes through San Jacinto. A nearby gravel road turns off a short distance north of the base camp, and provides access to the site. The plants will be installed at an altitude of 200 metres above sea level. The wells will be located between 160 and 180 metres above sea level in the San Jacinto area.



Figure 1. Map of Nicaragua showing project location

A.3. Technologies and/or measures

The implementation of the project activity comprises two phases. The second phase is developed in two stages. These are described in Table A.3.1 below.

Table A3.1 Phases of the project activity and technologies to be used

	Phase 1	Phase 2	
		Stage 1 (Fuji Unit 1)	Stage 2 (Fuji Unit 2)
Starting date of commercial operation	01/06/2005	07/01/2012	08/02/2013
Decommission date	08/02/2013	Decommission date is unplanned	Decommission date is unplanned
Installed capacity ⁴	10 MW	38.5 MW	38.5 MW
Plant load factor ⁵	98%	98%	98%
Net capacity factor ⁶	92.84%	92.84%	92.84%
Annual gross energy production ⁷	81,327 MWh	313,112 MWh	313,112 MWh
Annual estimated electricity production ⁸	78,888 MWh	284,932 MWh	284,932 MWh
Production period	From 01/06/2005 to July 2012	From 07/01/2012 to the decommission date	From 08/02/2013 to the decommission date

⁴ Installed capacity as per turbines nameplates.

⁵ Presented in third party engineering report "Value Added Report" dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19.

⁶ Presented in third party engineering report "Value Added Report" dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19.

⁷ As calculated in Table B.3.2.

⁸ As calculated in Table B.3.2.

Number of turbines	2 x 5 MW	1 x 38.5 MW	1 x 38.5 MW
Technology	Back pressure turbines	Condensing turbine (manufacturer Fuji)	Condensing turbine (manufacturer Fuji)

Table A3.2 Project activity at the end of the first crediting period

	As of 31 May 2012
Installed capacity ⁹	48.5 MW
Plant load factor ¹⁰	98%
Net capacity factor ¹¹	92.84%
Annual gross energy production ¹²	159,299.8 MWh
Annual estimated electricity production	146,996 MWh

Phase 1 of the Project

In Phase 1, the project developer installed two 5 MW backpressure steam turbo-generators and the associated equipment, which were commissioned in June 2005. These two 5 MW backpressure turbine generator units produced electricity up to the first quarter of 2012. They remained offline when the Fuji units of Phase 2 entered into commercial operation. The facilities of the backpressure units were subsequently decommissioned in phase 2 (March 2013). Figure 1 below shows a schematic diagram of Phase 1.

Phase 2 of the Project

In Phase 2, the project developer installed two 38.5 MW Fuji single flash condensing turbine and generator units adjacent to the Phase 1 units. The first 38.5 MW Fuji turbine was commissioned in January 2012. The second was commissioned in February 2013. After the first Fuji turbine was installed, the backpressure units were only operated intermittently, until they were taken offline in July 2012. They were subsequently decommissioned on 5 March 2013, when the second Fuji turbine was commissioned.

The selected technology is the development of a geothermal flash steam plant that uses geothermal fluids above 182°C. The high temperature pressurized fluid is passed through a separator which allows a portion of the flow to “flash” off as steam, which is directed to a turbine to generate electricity. Then the electricity produced is supplied to the grid through a 12.9 km transmission line.

The turbines for Phase 2 were fabricated in 2009 by Fuji Electric Company of Japan, which are of geothermal use, characterized by having a very efficient steam rate. In addition, each power unit will require a condenser, which is designed for the San Jacinto environmental conditions.

For Phase 2, A combination of workovers or and re-drills of existing wells and the drilling of new wells will provided the necessary additional production fluid requirement. Also, the electrical

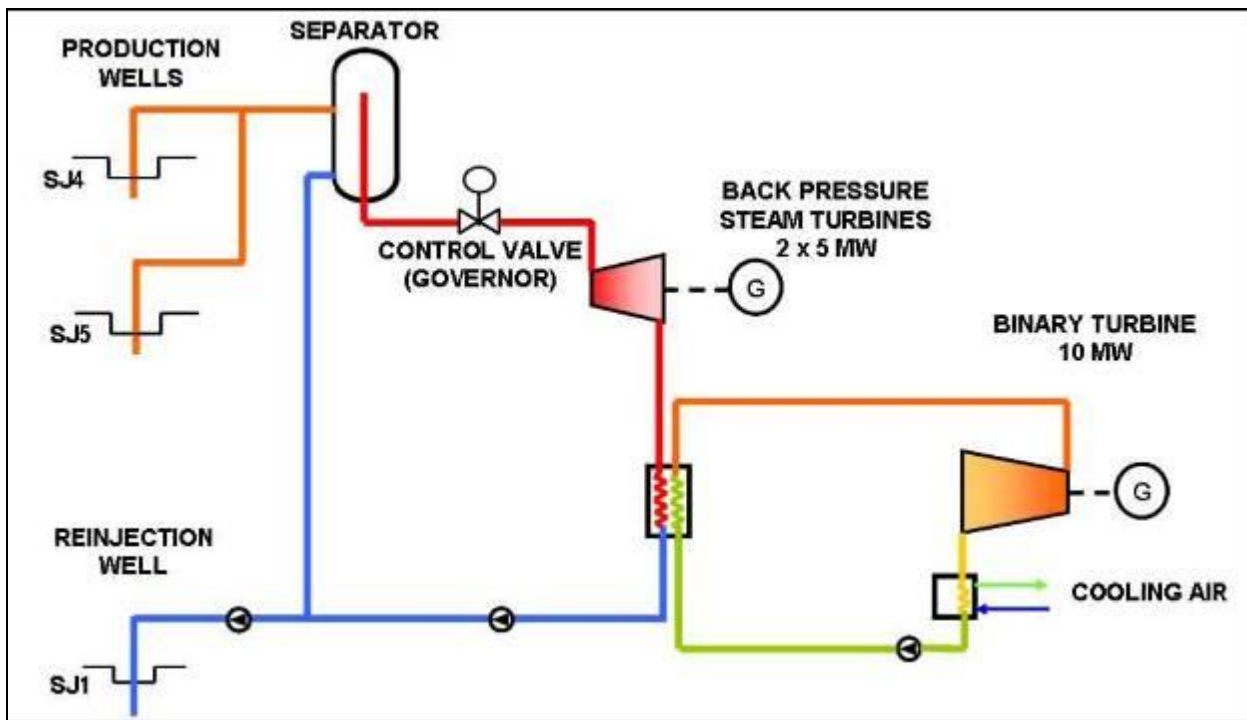
⁹ Installed capacity as per turbines nameplates.

¹⁰ Presented in third party engineering report “Value Added Report” dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19.

¹¹ Presented in third party engineering report “Value Added Report” dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19.

¹² As calculated in Table B.3.2.

transmission system installed for the Phase 1 development was modified by the installation of a second circuit and expansion of the switchyard at the power substation. In addition, the production wells, injection wells and steam-field system servicing the backpressure units were connected to the steam-field system to supply the two 38.5 MW units. It is estimated that up to eight new production wells may be required, and preliminary targets for these have already been identified. Also, the electrical transmission system installed for the Phase I development will be modified by the installation of a second circuit and expansion of the switchyard at the Power Station. It is envisaged that the additional Phase II project units would enter commercial operations at 66MW in the first quarter of 2008. Figure 2 below shows a schematic diagram of one of the 38.5 MW power units built in Phase 2 of the project activity. The second 38.5 MW unit is a parallel unit, identical to the one below. Together these units provide 77 MW of rated power generation.



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Figure 1. Phase I Diagram

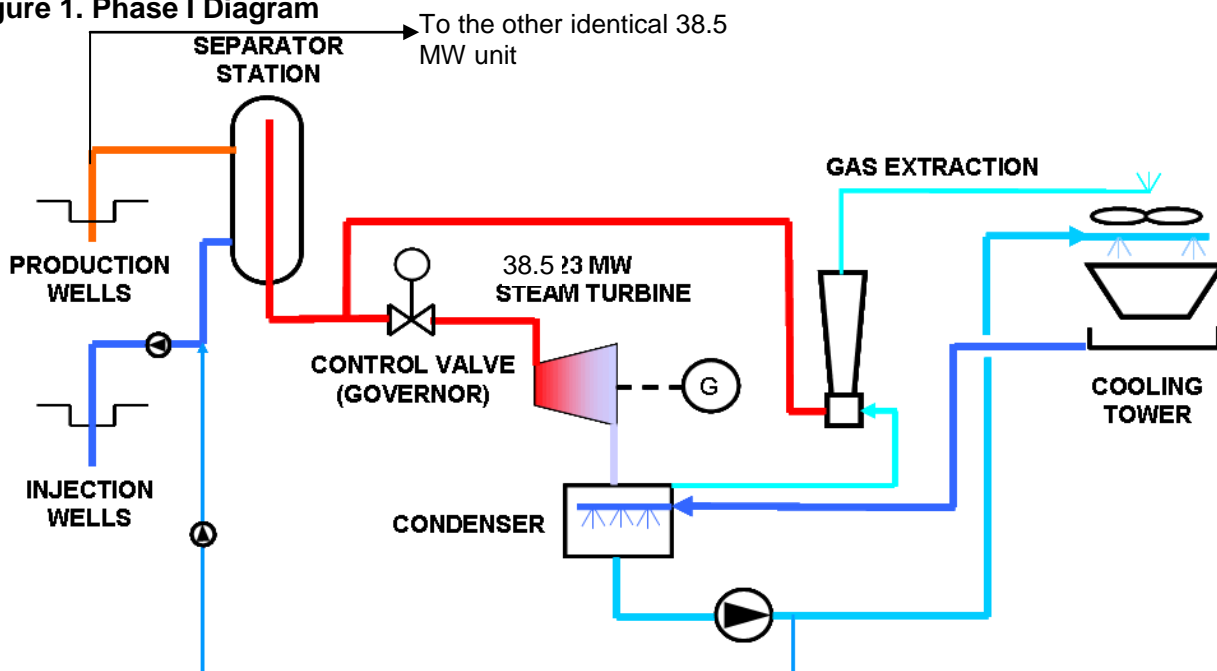


Figure 2. Phase 2 Diagram

Technology Transfer

The technology installed in the project activity has been used in a number of geothermal power projects around the world. Equipment for Phase 1 of the project is supplied by ACEC (of Belgium, now part of Alstom). The same equipment was installed in LaGeo's geothermal power plant at Berlin, Departments of Usulután, in the Republic of El Salvador.

Furthermore, for project management, Polaris Geothermal Inc. has subcontracted a competent team with all the knowledge needed. These include Sinclair Knight Merz Ltd. from New Zealand and LaGeo from El Salvador.

Sinclair Knight Merz (SKM) is a well-known developer of geothermal projects. SKM has international experience in more than 15 countries, having developed over 75% of the geothermal projects outside the USA and all the projects carried out in the Philippines, Indonesia and New Zealand.

LaGeo has vast experience in the development and operation of geothermal plants in El Salvador. LaGeo manages and successfully operates two geothermal plants in El Salvador, Ahuachapán (Ausoles) y Berlín (Tronador). During the first years of operation, LaGeo was the company in charge of the maintenance and operations of the San Jacinto-Tizate plant, then the operation and maintenance was transferred to PENSA. Enel Green Power, from Italy, is one of the main shareholders of LaGeo. A contract has been signed between the project developer and LaGeo for the sale of the two turbo-generator units and associated equipment to be used in Stage 1 of Phase 1. An additional contract to operate and maintain the plant for a period of time has also been signed with LaGeo.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Nicaragua (host)	Private entity: Polaris Energy Nicaragua S.A.	No
UK	Private entity: Blues Traveler Environmental	No
UK	Private entity: Ecosecurities	No

See Annex 1 - Information on participants in the project activity, for contact information of all project participants

A.5. Public funding of project activity

This project will be financed by private sources and as such no public funding will be required to undertake the proposed San Jacinto project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 04)

"Tool for the demonstration and assessment of additionality" (Version 02)

All above methodologies and tools can be found at the UNFCCC website:
<http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

B.2. Applicability of methodology and standardized baseline

The consolidated baseline methodology for grid-connected electricity generation from renewable sources is justified as the proposed project involves an electricity capacity addition of a geothermal source providing power to the grid.

B.3. Project boundary

The project boundary is defined as the notional margin around a project within which the project's impact (in terms of carbon emission reductions) will be assessed. As referred to in ACM0002 the project boundary have to be assessed in terms of the emission sources and spatial extent.

- *Emission sources:* This refers to the geographical site where power expansion facilities could be located. For the San Jacinto project these include the fugitive emissions of methane and carbon dioxide from non-condensable gases contained in the geothermal steam and carbon dioxide emissions from combustion of fossil fuels to operate the geothermal plant. These are included in the project boundary and the calculation of emission reductions.
- *Spatial extent:* The spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the Polaris Energy Nicaragua S.A. Plant is connected to. The Nicaraguan grid is an interconnected grid system. The Nicaragua grid is currently interconnected to Guatemala, El Salvador, Honduras, Costa Rica and Panama. However, for the last three years volumes of electricity imported and exported have been relatively low. Most of the electricity imported for the last three years has come from Costa Rica, and most of the exported electricity has gone to Honduras.

For the baseline determination only CO₂ from electricity displaced due to the Project is accounted for.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO ₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO ₂	Yes	The only baseline emission source according to ACM0002.
		CH ₄	No	Not a baseline emission source according to ACM0002.
		N ₂ O	No	Not a baseline emission source according to ACM0002.
Project scenario	For geothermal project activities, fugitive emissions of methane and carbon dioxide from non-condensable gases contained in geothermal stream.	CO ₂	Yes	Project emission source according to ACM0002.
		CH ₄	Yes	Project emission source according to ACM0002.
		N ₂ O	No	Not a project emission source according to ACM0002.
	For geothermal project activities, carbon dioxide emissions from combustion of fossil fuels required to operate the geothermal power plant.	CO ₂	Yes	Project emission source according to ACM0002.
		CH ₄	No	Not a project emission source according to ACM0002.
		N ₂ O	No	Not a project emission source according to ACM0002.

B.4. Establishment and description of baseline scenario

The project activity is generating electricity from a new geothermal plant, which will be fed into the Nicaragua grid, displacing electricity generated from the Nicaragua source mix. If the project activity was not implemented, the same amount of electricity would be generated from the power plants connected to the grid.

According to ACM0002 Version 04, for project activities that do not modify or retrofit an existing electricity generation facility, the baseline scenario is the following:

Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described below.

The baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.

The baseline emissions are calculated according to the methodology ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 04) and are provided in section B.6.

B.5. Demonstration of additionality

The San Jacinto Geothermal project will result in the reduction of greenhouse gases that would not occur if the project were not implemented. The numerous barriers and risks associated with the implementation of the proposed project activity are identified below clearly demonstrate that this project activity is not the baseline as usual scenario.

The tool used to demonstrate the additionality is the “Tool for the demonstration and assessment of additionality” (Version 02), which is part of the consolidated baseline methodology for grid-connected electricity generation from renewable sources. This tool for assessing additionality

follows a step-based approach. The description below indicates how each step has been applied to demonstrate that the additionality of the San Jacinto project.

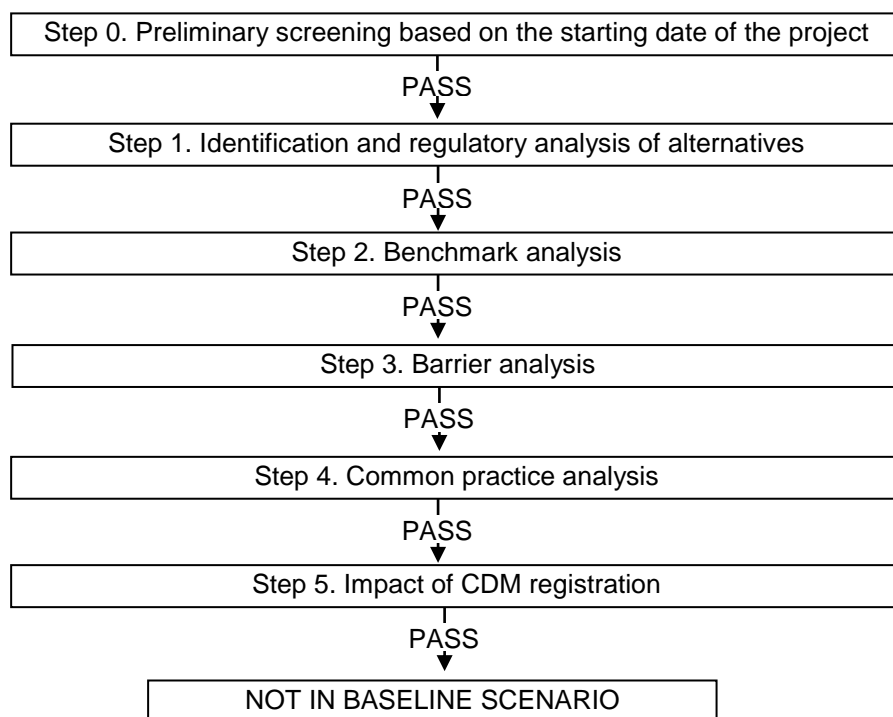


Figure 3. Additionality flowchart

Step 0 – Preliminary screening based on the starting date of the project activity

Construction of the project activity started in April 2004, and the expected start of the crediting period is June 2005. It is intended to submit the proposed project for registration prior to 31 December 2005. Both the equity and debt investors considered the CDM an integral part of their decisions to proceed with the CDM project activity. As for equity holders, Polaris Geothermal Inc. decided to pursue the proposed project activity in Nicaragua, given the incentive to claim carbon credits from the very early stages of the project. As for the debt holders, Standard Bank is the main debt investor of San Jacinto Geothermal Power Plant, and according to the financial director of the bank in London, the CDM revenue was considered as an integral part of the financing of the project and critical in the decision to finance this project. Evidence of such statements is privately available upon request.

Step 1 – Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity

Alternative 1. A 77 MW geothermal plant not undertaken as a CDM project; and

Alternative 2. Continuation of the current situation (i.e., no project activity).

Sub-step 1b. Compliance with applicable laws and regulations

All alternatives are in compliance with all applicable legal and regulatory requirements of Nicaragua. These are Law No. 272 on the electricity industry (in Spanish, “*Ley de la Industria Eléctrica*”), and the “Indicative plan for the generation in the electricity sector in Nicaragua, 2003-2014” (in Spanish, “*Plan indicativo de la generación sector eléctrico de Nicaragua, 2003-2014*”). Specifically, alternative 1 is in compliance with the Law No. 443 on exploration and exploitation of geothermal resources (in Spanish, “*Ley de exploración y explotación de recursos geotérmicos*”).

As set in the above mentioned laws, which regulate the electricity sector in Nicaragua, generation of electricity in Nicaragua is based on a scheme of private competition. In addition, it is said that the State does not have the responsibility of development of electricity generation; the indicative plan is developed to provide useful insight for private investors to orientate their decisions on technologies to implement in the country. The indicative plan for the electricity sector is designed to orientate the private investor towards developing more clean technologies and renewable energy, however, this does not set any target, legal obligation or provide any financial investment for its development. Thus, this decision is left completely up to the private investor.

In conclusion, alternatives 1 and 2 are in compliance with all applicable legal and regulatory requirements in Nicaragua, and this is expected to remain in the future.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

The option chosen to prove additionality is Option III – “Benchmark Analysis”, since the plausible alternatives defined in the previous step do not include investments of comparable scale and/or timing to the project activity. The project developer is a renewable energy investor that could have invested in a different country to install a renewable energy project.

Sub-step 2b. Option III – Apply benchmark analysis

The financial indicator chosen most suitable for the project type and decision context is the Internal Rate of Return (IRR). The most plausible benchmark to compare the project IRR has been derived from government bond rates for the Central American Countries, as substantiated by Standard Bank. A summary table with various government bond rates emitted as November 2004 has been used to calculate the benchmark indicator to be use for comparison. Please find table below.

Table B.5.1 Government bond rates for the Central American countries

Central American Country	Maturity	Indicative Bid Yield	Indicative Offer Yield	Average
Costa Rica	Feb-12	7.92	7.82	7.87
Costa Rica	Jan-13	8.11	7.69	7.90
Costa Rica	Aug-20	8.09	7.76	7.93
El Salvador	Jan-23	6.59	6.44	6.52
El Salvador	Apr-32	8.25	8.07	8.16
El Salvador	Oct-34	7.40	7.29	7.35
Guatemala	Aug-13	7.54	7.43	7.49
Guatemala	Oct-34	7.96	7.90	7.93
Guatemala	Oct-34	7.91	7.84	7.88
			TOTAL AVERAGE:	7.67

Source: Standard Bank, Central America Government Bond Rates (November 4, 2004)

Sub-step 2c. Calculation and comparison of financial indicators

In this case, the IRR has been calculated as a project IRR. The financial model for the additionality analysis of the proposed project activity includes the expected CDM revenues of the project. For the purposes of this analysis, that CDM revenue was discounted to provide estimation of project IRR for alternative 1. As for alternative 2 (i.e., no capacity addition), an estimation of project IRR is not applicable as there is no project activity developed. As no plausible alternative has been identified in the context of the country and the project developer, the project IRR (over 20 years) is compared with average bond rates for the Central American region (over 10 years).

Table B.3.2 Assumptions for calculation of Project IRR

Phase 1 - 2 x 5 MW Back Pressure Units

Parameter	Value	Unit	Comments
Operation starting date	01/06/2005	Date	Construction schedule an Resolution from the Energy National Institute (INE No.0285-2009)
Decommission date of back pressure units	31/03/2013	Date	Common Terms Agreement with the lenders, page 212.
Installed capacity	10	MW	Turbines nameplates
Plant load factor	98	%	Presented in third party engineering report "Value Added Report" dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19
Net capacity factor	92.84	%	Presented in third party engineering report "Value Added Report" dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19
Gross energy production	81,327	MWh	Energy production at generators shaft
Internal consumption (parasitic loads)	3.0	%	Internal consumption for auxiliary services
Net energy supplied to the grid	78,888,005	kWh	Gross energy production - internal consumption as per original PDD
Annual degradation of energy production	0.30	%	Energy production is degraded due to the depletion of the geothermal reservoir as Base Case Model submitted to the banks.

Phase 2 - 2 x 38.5 MW Steam Turbine Units

Parameter	Phase 2.I	Phase 2.II	Total	Unit	Comments
Operation starting date	07/01/2012	08/02/2013	-	Date	Fuji I: Letter to the National Dispatch Center Fuji II: Letter to the National Dispatch Center
Decommission date of Fuji units	-	-	-	Date	Project Participant does not have a decommission plan for these units.
Installed capacity	38.5	38.5	77	MW	Turbine nameplates

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Plant load factor	98	98	98	%	Presented in third party engineering report "Value Added Report" dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19.
Net capacity factor	92.84	92.84	92.84	%	Presented in third party engineering report "Value Added Report" dated 20 November 2009, by Sinclair Knight Merz (SKM). Page 19.
Gross energy production	313,112,184	313,112,184	626,224,368	kWh	Energy production at generators shaft. Calculated as Installed capacity x net capacity factor x 365 days/yr x 24 hrs/day.
Internal consumption (parasitic loads)	9.0	9.0	9.0	%	Internal consumption for auxiliary services, as per Base Case Model submitted to the banks
Net energy supplied to the grid	284,932,087	284,932,087	569,864,175	kWh	Gross energy production minus internal consumption
Annual degradation of energy production	0.08	0.08	0.08	%	Energy production degradation due to the depletion of the geothermal reservoir, as per Base Case Model submitted to the banks.

Income	Value	Unit	Comments
Energy price	0.0595	\$/kWh	Power Purchase Agreement with Empresa Nicaraguense de Electricidad (ENEL). The energy price is adjusted annually.
Component of the energy price relative to the investment (75% energy price)	0.0446	\$/kWh	Power Purchase Agreement with ENEL
Annual price adjustment for the investment component of the energy price	0.0130	%	Power Purchase Agreement with ENEL
Component of the energy price relative to the O&M costs (25% energy price)	0.0149	\$/kWh	Power Purchase Agreement with ENEL

Annual price adjustment for O&M component of the energy price	$[1.00975 + 0.05 * ((\text{IPPn-1}/\text{IPPn-2}) - 1))$	%	The formula is stated in the PPA, where IPPn-1 refers to the final index price for the previously year and IPPn-1 is for two years before. The Producer Price Indexes from the US Bureau of Labor are used for the 2006-2012 period http://data.bls.gov/timeseries/WPU03T15M05?data_tool=XGtable) and then the historical average value is used.
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Capital Expenditures	Value	Unit	Comments
Phase 1 - Investment costs of the back pressure units	59,200	\$ 000	Original approved investment analysis
Phase 2.I - Investment cost for the Fuji	184,675	\$ 000	Amendment No. 2 to the Common Terms Agreement with the lenders, page 10.
Phase 2.II - Investment cost for the Fuji	223,564	\$ 000	Amendment No. 2 to the Common Terms Agreement with the lenders, page 10.
Phase 2.I - Make-up wells in 2015, 2019 and 2023	8,840	\$ 000	Make-up wells are carried out each 7 years as per SKM recommendation, which includes deepening of existent wells, drilling of new wells, chemical cleaning and any action to maintain the steam production level required to achieve the nominal production of the power plant. The investment cost for wells make-up is stated in the Base Case Model submitted to the banks (Phase 2.I & Phase 2.II assumptions sheet).
Phase 2.II - Make-up wells in 2026 and 2029	8,840	\$ 000	As for Phase 2.I above.

Financial Information	Value	Unit	Comments
Analysis term	20	Years	In accordance to the version 5 of the Guidelines on the assessment of Investment Analysis.
Average Cumulative Inflation rate for the 1 st Crediting Period (2005 – 2012)	9.30	%	Central Bank of Nicaragua, http://www.bcn.gob.ni/en/index.php# Statistical Year Book 2012, pg 52. http://www.bcn.gob.ni/publicaciones/periodicidad/anual/anuario_estadistico/anuario_estadistico_2012.pdf
Taxes (Income TAX)	30	%	Fiscal Equity Law (<i>Ley de Equidad Fisca</i>), chapter III, article 21, paragraph 1.
Years of exception	10	Years	Law No. 656, Addition to Law No. 443 (Ley of Geothermal Resources Exploitation), article 68, paragraph 4th.

Depreciation rate	10.0	%	Fiscal Equity Law (<i>Ley de Equidad Fiscal</i>), chapter III, article 57, page 18.
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The resulting project IRR is 4.97 % being lower than the benchmark (7.67%).

Based on the information provided above, it is clearly demonstrated that the proposed project activity is not the business as usual scenario.

Sub-step 2d. Sensitivity Analysis

A detailed sensitivity analysis was undertaken to test the project's feasibility with varying parameters. The variables plant factor (that reflects electricity production), investment costs relative to make-up wells and O&M costs are subjected to a $\pm 10\%$ variation. The initial investment costs for Phases 1 and 2 are not subjected to the sensitivity analysis because these investments have been executed at time of submission of the revised PDD and will not vary.

The sensitivity analysis of the project IRR is used to demonstrate that the financial attractiveness calculation of the proposed project activity is robust to reasonable variations, concluding that under those scenarios, the financial attractiveness of the project activity without CERs continues to be below the identified financial benchmark.

Table B.3.3 Results of the sensitivity analysis

	-10%	Base case	10%
Benchmark	7.67%	7.67%	7.67%
Plant factor	4.07%	4.97%	6.26%
Investment costs	5.06%	4.97%	5.31%
O&M costs	4.80%	4.97%	5.57%
Tariff	6.26%	4.97%	4.07%

The analysis shows that the project has a higher sensitivity to energy production and in all the instances where each of the key parameters was varied by $\pm 10\%$, the benchmark was not crossed, thus the project activity step 2 of the additionality analysis. Detailed calculations are provided on the accompanying investment analysis spreadsheet.

Step 3. Barrier Analysis

Even though the previous step has clearly demonstrated that the proposed project activity is not an economically sound course of action, some barriers have been identified to geothermal project development in developing countries, which can enforce the conclusion of additionality from the previous step. The following barriers have been identified:

- **Resource uncertainty.** Geothermal energy involves relatively high risks compared with most other renewable forms of energy because of the geological uncertainties of the reservoirs which can sustain the long-term fluid and heat flow. While steam is currently monitored as it is released and long term reservoir modeling has been previously undertaken, such assessments are not a conclusive indicator of long term steam availability. Modeling has relied on estimates of the size of the reservoir and the existing knowledge of reservoir fluid temperatures. These evaluations involve assumptions that can have large errors thus increasing the risk of plant size incompatibility. Additionality reservoir pressure may decline resulting in reservoir cooling causing "reservoir failure". This can lead to considerable investment into a geothermal source without necessarily a

corresponding level of return¹³.

- Additional investment requirements. The size and exploitability of a geothermal reservoir can only be determined over a sustained period with several years of production. This may result in the need for additional investment during the San Jacinto's operational stage in the form of drilling new wells to access additional geothermal resources.
- Operational and maintenance requirements. Exact operation and maintenance requirements of the geothermal power station are difficult to determine in the development stages of the project. The extent to which corrosion of moving parts and scale deposition, caused by the presence of silica in water, will be a problem is unknown upfront. This results in the uncertainty of future maintenance requirements¹⁴
- Technological risks. Technology risks have been minimized by adopting a phased deployment of technologies. The Phase 2 turbines are brand new and manufactured by a world renowned manufacturer, and designed specifically for geothermal power production.
- Unskilled labour. Nicaragua has a vast indigenous resource of geothermal energy. However, it has not been fully exploited so far given the lack of experienced staff in the region. As a consequence, San Jacinto is training existing local staff and has hired foreign contractors (i.e., SKM and LaGeo) to undertake specific operation and maintenance activities. Although locals have been employed (especially from the villages nearby and the City of Leon), specialized experience with geothermal energy is still limited.

Step 4. Common Practice Analysis

Sub-step 4a. Analyze other activities similar to the proposed project

Although Nicaragua is a country endowed with large geothermal potential due to the presence of volcanoes of the Marrubios range along the Pacific Coast, it is still very far from exploiting the natural resource extensively and efficiently.

Geoscientific investigations were started towards the end of the 1960s, prioritizing the Momotombo and San Jacinto-Tizate geothermal fields. These studies were accelerated after 1973, when the oil crisis strongly affected Nicaragua's trade balance. Since then, exploitation of the San Jacinto-Tizate geothermal site has been in the list of projects to be developed by the government, however, it was never conducted for lack of investment.

The only similar activity to San Jacinto in Nicaragua is the Momotombo geothermal project. The commercial exploitation of Momotombo started in 1983, when the first geothermal electric unit of 35MW was put in operation. The second unit of 35 MW was installed in 1989. In 1993, the drilling of a number of deep exploratory wells began to further demonstrate the existence of geothermal resources large enough to be exploited commercially to generate additional electricity. Unfortunately, the strategy adopted by the National Electricity Company (ENEL, in Spanish) for the development of Momotombo neglected reinjection and focused exclusively on exploitation of the shallow reservoir. This led to a depletion of the shallow reservoir and a decline in output to a level of about 10 MW in 1999. Privatization took place in 2000, and Ormat, the company that acquired rights to the operation, has been successful in commencing exploitation of the deeper reservoir. By implementing a program for reinjection, they have been able to immediately increase production above 20MW and expected to continue towards a level approaching the installed 75MW.

¹³ World Bank, Geothermal Energy: An Assessment. Available online at <http://www.worldbank.org/html/fpd/energy/geothermal/assessment.htm>

¹⁴ European Commission, Geothermal Energy: Market Barriers. Available online at http://europa.eu.int/comm/energy_transport/atlas/htmlu/geomark.html

Sub-step 4b. Discuss any similar options that are occurring

The existence of the Momotombo project identified above does not preclude that the San Jacinto-Tizate project is financially attractive. The Momotombo project started in 1983 where the conditions of the power sector were entirely different. It was a period where capacity additions were made by the Government itself and not according to private sector rules of economically sound investments. The current investment climate can thus not be compared with the situation in 1983. Also, bad management of the Momotombo project actually entails more barriers than benefits to the San Jacinto-Tizate project, since public opinion might see geothermal projects as unreliable sources of electricity generation and expensive courses of action. Apart from the Momotombo project no other geothermal projects have been developed in Nicaragua, due to the barriers indicated in steps 2 and 3.

In conclusion, there are not similar activities occurring at the time of project activity development, therefore step 4 is passed.

Step 5. Impact of CDM Registration

This section clearly explains how the approval and registration of the project as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the economic and financial hurdles showed in Step 2 and thus enable the project to be undertaken. The benefits and incentives brought about by the CDM to the shareholders of the proposed project activity are as follows:

- The financial benefit from the revenue obtained by selling the CO₂e emissions reductions has been one of the key issues that encourage the project developer (main equity investor) and Standard Bank (main debt investor) to undertake the proposed project activity. As mentioned elsewhere, the proposed project activity was planned to be undertaken for years, but remained unattractive for investors for a long time. Among other factors, the possibility of claiming carbon credits for the project made the project finally attractive to investors. As shown in Step 2, the IRR of the proposed project activity is too low without carbon credits for investors to find the project attractive; however, the impact of the CDM in the IRR of the project is such that the project comes from being unattractive to be attractive for investors. On top of that, from the pre-feasibility study Polaris Geothermal included the revenue of CDM in the projected cash flow of the project, and this was one of the factors evaluated by Standard Bank in their decision to finance the proposed project in Phase 1, and by the consortium of lenders that executed the Lending Agreement in Phase 2..
- Attracting new players who bring the capacity to implement a new technology. In this case, these are Sinclair Knight Merz (New Zealand) and LaGeo (El Salvador with European shareholder). These companies are world leaders in the field of geothermal generation, bringing capacity and technology from Australasia and Europe.
- Reducing inflation/exchange rate risk affecting expected revenues and attractiveness for investors. Price volatility of oil and high inflation rates in developing countries make renewable energy projects less attractive to investors. In this case, the proposed project activity uses an indigenous source of energy. The impact of CDM registration is that the project can go ahead, and these benefits of the project can be passed onto the investors.
- Bringing economic benefits to the host country, helping to isolate the national economy of the fluctuations on price of oil. This will bring prices of electricity down, create a more stable economic environment, and therefore, the proposed project activity will help to create a more attractive environment for foreign investment in Nicaragua.

Therefore, it has been clearly demonstrated how the approval and registration of the project as a CDM activity, and the attendant benefits and incentives derived from the project activity, will

alleviate the economic and financial hurdles showed in Step 2 and thus enable the project to be undertaken. The proposed project activity passes step 5 of the additionality test.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

The following calculations are defined in ACM0002 Version 04.

Emission Reductions

The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plants by renewable electricity. The emission reduction ER_y by the project activity during a given year y is the difference between baseline emissions (BE_y), project emissions (PE_y) and emissions due to leakage (Ly), as follows:

$$ER_y = BE_y - PE_y - Ly$$

where the baseline emissions (BE_y in tCO₂) are the product of the baseline emissions factor (EF_y in tCO₂/MWh) calculated in Step 3, times the electricity supplied by the project activity to the grid (EG_y in MWh) minus the baseline electricity supplied to the grid in the case of modified or retrofit facilities ($EG_{baseline}$ in MWh), as follows:

$$BE_y = (EG_y - EG_{baseline}) \cdot EF_y$$

For most renewable energy project activities, $PE_y = 0$. However, for geothermal project activities, project participants shall account for the following emission sources, where applicable:

Fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam; and
Carbon dioxide emissions resulting from combustion of fossil fuels related to the operation of the geothermal power plant.

The data to be collected are listed in the associated monitoring methodology, ACM0002 (Version 004). Project emissions should be calculated as follows:

a) Fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PES_y):

$$PES_y = (w_{Main,CO_2} + w_{Main,CH_4} \cdot GWP_{CH_4}) \cdot M_{S,y}$$

Where:

PES_y are the project emissions due to release of carbon dioxide and methane from the produced steam during the year y

w_{Main,CO_2} is the average mass fractions of carbon dioxide in the produced steam

w_{Main,CH_4} is the average mass fractions of methane in the produced steam

GWP_{CH_4} is the global warming potential of methane

$M_{S,y}$ is the quantity of steam produced during the year y .

b) Carbon dioxide emissions from fossil fuel combustion ($PEFF_y$)

$$PEFF_y = \sum F_{i,y} \cdot COEF_i$$

where $PEFF_y$ are the project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in tons of CO_2 , $F_{i,y}$ is the fuel consumption of fuel type i during the year y and $COEF_i$ is the CO_2 emission factor coefficient of the fuel type i .

Thus, for geothermal project activities,

$$PE_y = PES_y + PEFF_y$$

B.6.2. Data and parameters fixed ex ante

Data / Parameter	GWP_{CH_4}
Unit	t CO_2 / t CH_4
Description	Global Warming Potential of methane (CH_4)
Source of data	http://www.ipcc.ch/publications_and_data/ar4/wg1/en/tssts-2-5.html
Value(s) applied	21.0
Choice of data or Measurement methods and procedures	IPCC Direct Global Warming Potential as defined in Climate Change 2007: working Group I: The Physical Science basis.
Purpose of data	The value is used for calculating project emissions ($PE_{GP,y}$) from CH_4 mass fraction in geothermal steam sampling
Additional comment	Nil.

Data / Parameter	NCV_{i,y}	
Unit	GJ / ton	
Description	Net calorific value (energy content) of fuel type <i>i</i> in year <i>y</i>	
Source of data	The following data sources may be used if the relevant conditions apply:	
	Data Source	Conditions for using the data source
	Values provided by the fuel supplier of the power plants in invoices	If data is collected from power plant operators (e.g. utilities)
	Regional or national average default values	If values are reliable and documented in regional or national energy statistics / energy balances
	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	
Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.		
Value(s) applied	Heavy Fuel Oil - 39.8 GJ/m ³ Diesel - 41.4 GJ/m ³	
Choice of data or Measurement methods and procedures	IPCC standard for diesel (lower limit of uncertainty at 95%) used as values are not available by fuel supplier and no reliable national default values are available.	
Purpose of data	Calculation of COEF _i .	
Additional comment	Applicable in the following cases: 1) Calculation of the simple OM, the simple adjusted OM, and the average OM in cases where fuel consumption data is available for all power plants / units.	

Data / Parameter	$EF_{CO_2,i,y}$								
Unit	tCO ₂ /TJ								
Description	CO ₂ emission factor of fuel type <i>i</i> in year <i>y</i>								
Source of data	<p>The following data sources may be used if the relevant conditions apply:</p> <table border="1"> <thead> <tr> <th>Data Source</th> <th>Conditions for using the data source</th> </tr> </thead> <tbody> <tr> <td>Values provided by the fuel supplier of the power plants in invoices</td> <td>If data is collected from power plant operators (e.g. utilities)</td> </tr> <tr> <td>Regional or national average default values</td> <td>If values are reliable and documented in regional or national energy statistics / energy balances</td> </tr> <tr> <td>IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td> <td></td> </tr> </tbody> </table> <p>Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.</p>	Data Source	Conditions for using the data source	Values provided by the fuel supplier of the power plants in invoices	If data is collected from power plant operators (e.g. utilities)	Regional or national average default values	If values are reliable and documented in regional or national energy statistics / energy balances	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	
Data Source	Conditions for using the data source								
Values provided by the fuel supplier of the power plants in invoices	If data is collected from power plant operators (e.g. utilities)								
Regional or national average default values	If values are reliable and documented in regional or national energy statistics / energy balances								
IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories									
Value(s) applied	Heavy Fuel Oil - 75.5 tCO ₂ /TJ Diesel - 72.6 tCO ₂ /TJ								
Choice of data or Measurement methods and procedures	IPCC standard for diesel (lower limit of uncertainty at 95%) used as values are not available by fuel supplier and no reliable national default values are available.								
Purpose of data	Calculation of COEF _{<i>i</i>} .								
Additional comment	Used to calculate OM and BM.								

Data / Parameter	OXID _{<i>i</i>,<i>y</i>}
Unit	%
Description	Oxidation factor of the fuel type <i>i</i> in year <i>y</i>
Source of data	Page 1.29 in the 1996 Revised IPCC Guidelines for default values.
Value(s) applied	Heavy Fuel Oil - .99 Diesel - .99
Choice of data or Measurement methods and procedures	IPCC standard as specified in the methodology.
Purpose of data	Calculation of COEF _{<i>i</i>} .

Additional comment	Used to calculate OM and BM.
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Data / Parameter	$F_{i,j,y}$
Unit	gallons
Description	The amount of fuel i consumed by power source j in year y
Source of data	Official publications from the Nicaragua national utility, CNE
Value(s) applied	Values are given in Appendix 4
Choice of data or Measurement methods and procedures	The data is provided by the government owned national utility for the most recent three historical years at the time of the PDD submission (2001 - 2003)
Purpose of data	Calculation of grid emission factor for baseline emissions
Additional comment	Used to calculate OM and BM

Data / Parameter	$GEN_{j,y}$
Unit	MWh
Description	The electricity delivered to the grid by source j
Source of data	Official publications from the Nicaragua national utility, CNE
Value(s) applied	Values are given in Appendix 4
Choice of data or Measurement methods and procedures	The data is provided by the government owned national utility for the most recent three historical years at the time of the PDD submission (2001 - 2003)
Purpose of data	Calculation of grid emission factor for baseline emissions
Additional comment	Used to calculate OM and BM

B.6.3. Ex ante calculation of emission reductions

Estimate of GHG emissions by sources:

For geothermal project activities, project activity emissions are due to the fugitive emissions of CO₂ and methane due to release of non-condensable gases from produced steam and the CO₂ emissions from combustion of fossil fuels related to the operation of the geothermal power plant.

The data to be collected are listed in the monitoring methodology (Section B.7) and are listed as follows:

- Fugitive CO₂ emissions due to release of non-condensable gases from the produced steam (PES_y):

$$PES_y = (w_{Main,CO_2} + w_{Main,CH_4} \cdot GWP_{CH_4}) \cdot M_{S,y}$$

Where PES_y are the project emissions due to release of CO₂ and methane from the produced steam during the year y , w_{Main,CO_2} and w_{Main,CH_4} are the average mass fractions of CO₂ and methane in the produced steam. GWP_{CH_4} is the global warming potential of methane and $M_{S,y}$ is the quantity of steam produced during the year y .

For an *ex-ante* estimation, it is assumed that project emissions due to release of CO₂ and CH₄ are approximately equal to 10% of the baseline emissions, therefore PES_y results:

- PES₂₀₀₅ = 2,478 tCO₂e per year
- PES₂₀₀₆₋₂₀₁₁ = 5,948 tCO₂e per year
- PES₂₀₁₂ = 11,083 tCO₂e per year

Carbon dioxide emissions from fossil fuel combustion (*PEFF_y*):

$$PEFF_y = \sum_i F_{i,y} \cdot COEF_i$$

where *PEFF_y* are the project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in tons of CO₂, *F_{i,y}* is the fuel consumption of fuel type *i* during the year *y* and *COEF_i* is the CO₂ emission factor coefficient of the fuel type *i*.

There are no carbon dioxide emissions from fossil fuel combustion (*PEFF_y*) for the period 1 June 2005 to 24 March 2011, as there is no fossil fuel power generation in the project activity. A back-up diesel generator was purchased in March 2011. This generator is operated only in emergency situations, and for regular testing to ensure that it remains operational. Emissions from this generator will be 0 for *PEFF₂₀₀₅₋₂₀₁₀*, and calculated for *PEFF₂₀₁₁₋₂₀₁₂*.

Estimated leakage:

Not applicable.

The project activity emissions:

Thus for geothermal projects:

$$PE_y = PES_y + PEFF_y$$

PEFF_y (Carbon dioxide emissions from fossil fuel combustion) are expected to be nil, as no attached fossil-fuel based facilities will be required. *PEFF_y* is calculated for the back-up generator in 2011 for the period April to Dec, and in 2012 for the period 1 Jan – 31 May 2012. The generator is operated 14 hours per year, and consumes 6.2 gph.

$$PEFF_y = F_{i,y} \times COEF_i = F_{i,y} \times OXID_{i,y} \times NCV_{iy} \times EF_{CO2,i,y}$$

$$PEFF_{2011} = 6.2 \text{ gph} \times 9/12 \times 14 \text{ hours} \times .99\% \times (43.3 \text{ GJ/m}^3 \times 1,000 \text{ L/m}^3 \times 3.7854 \text{ L/g}) \times .0748 \text{ tCO}_2\text{e/GJ}$$

$$= 0.790 \text{ tCO}_2\text{e}$$

$$PEFF_{2012} = 6.2 \text{ gph} \times 5/12 \times 14 \text{ hours} \times .99\% \times (43.3 \text{ GJ/m}^3 \times 1,000 \text{ L/m}^3 \times 3.7854 \text{ L/g}) \times .0748 \text{ tCO}_2\text{e/GJ}$$

$$= 0.439 \text{ tCO}_2\text{e}$$

PES_y (Fugitive CO₂ emissions due to release of non-condensable gases from the produced steam) have been estimated by the project developer based on the parameters to be monitored as described in Section B.7.

For San Jacinto project, total project emissions (*PE_y*) have been calculated as follows:

$$PE_y = PES_y + PEFF_y$$

$$\begin{aligned}
 PE_{2005} &= 2,478 \text{ tCO}_2\text{e/yr} + 0 \text{ tCO}_2\text{e/yr} = 2,478 \text{ tCO}_2\text{e} \\
 PE_{2006-2010} &= 5,948 \text{ tCO}_2\text{e/yr} + 0 \text{ tCO}_2\text{e/yr} = 5,948 \text{ tCO}_2\text{e per year} \\
 PE_{2011} &= 5,948 \text{ tCO}_2\text{e/yr} + 1 \text{ tCO}_2\text{e/yr} = 5,949 \text{ tCO}_2\text{e} \\
 PE_{2012} &= 11,083 \text{ tCO}_2\text{e/yr} + 1 \text{ tCO}_2\text{e/yr} = 11,084 \text{ tCO}_2\text{e}
 \end{aligned}$$

Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

The baseline emissions reduction (*BE_y*) resulting from the electricity supplied to the grid is calculated as follows, where *EG_y* is the annual electricity generated from the Project.

$$BE_y = EG_y * EF_y$$

For the proposed project activity:

$$BE_{2005} = 32,870 \text{ MWh/year} * 0.754 \text{ tCO}_2\text{e/MWh} = 24,783 \text{ tCO}_2\text{e/year}$$

$$BE_{2006-2011} = 78,888 \text{ MWh/year} * 0.754 \text{ tCO}_2\text{e/MWh} = 59,481 \text{ tCO}_2\text{e/year}$$

$$BE_{2012} = 146,996 \text{ MWh/year} * 0.754 \text{ tCO}_2\text{e/MWh} = 110,835 \text{ tCO}_2\text{e/year}$$

The baseline emissions factor is a weighted average of the *EF_OM_y* and *EF_BM_y*:

$$EF_y = (\omega_{OM} * EF_{OM_y}) + (\omega_{BM} * EF_{BM_y})$$

Where:

EF_OM_y = calculated operating margin value factor (in tCO₂/MWh);

EF_BM_y = calculated build margin value factor (in tCO₂/MWh);

ω_{OM} = weight of the calculated operating margin, in this case ½ is adopted;

ω_{BM} = weight of the calculated build margin, in this case ½ is adopted;

ω_{OM} + *ω_{BM}* = 1.

For the proposed project activity:

$$EF_{1-7} = (0.50 * 0.857 \text{ tCO}_2\text{e/MWh}) + (0.50 * 0.651 \text{ tCO}_2\text{e/MWh}) = 0.754 \text{ tCO}_2\text{e/MWh}$$

The Operating Margin emission factor (*EF_OM_y*) is calculated using the following equation:

$$EF_{OM_y} (\text{tCO}_2 / \text{MWh}) = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}}$$

Where:

F_{i,j,y} is the amount of fuel *i* (in GJ) consumed by power source *j* in year *y*;

j is the set of plants delivering electricity to the grid, not including low-cost or must-run plants and carbon financed plants;

COEF_{i,j,y} is the carbon coefficient of fuel *i* (tCO₂/mass or volume);

GEN_{j,y} is the electricity (MWh) delivered to the grid by source *j*.

The CO₂ emission coefficient *COEF_{i,j,y}* is obtained as

$$COEF_i = NCV_i \times EF_{CO_2i} \times OXID_i$$

Where:

NCV_i is the net calorific value (energy content) per mass of volume of a fuel *i*;

$OXID_i$ is the oxidation factor of the fuel;

EF_{CO_2i} is the CO_2 emission factor per unit of energy of fuel i .

For the proposed project activity:

$$EF_{OM_{1-7}} = 4,807,057 \text{ tCO}_2 / 5,609,419 \text{ MWh} = 0.857 \text{ tCO}_2\text{e/MWh}$$

The Build Margin emission factor (EF_{BM_y}) is the weighted average emission factor of a sample of power plants m . This sample includes either the last five plants built or the most recent plants that combined account for 20% of the total generation, whichever is greater (in MWh). The equation for the build margin emission factor is:

$$EF_{BM_y} (\text{tCO}_2 / \text{MWh}) = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}}$$

where $F_{i,m,y}$, $COEF_{i,m}$ and GEN_m are analogous to the OM calculation above.

For the proposed project activity:

$$EF_{BM_{1-7}} = 896,792 \text{ tCO}_2 / 1,376,891 \text{ MWh} = 0.651 \text{ tCO}_2\text{e/MWh}$$

The emission reductions of the project activity:

Therefore the emission reductions of the San Jacinto geothermal project are:

$$ER_y = BE_y - PE_y$$

For the proposed project activity:

$$ER_{2005} = 24,783 \text{ tCO}_2\text{e/year} - 2,478 \text{ tCO}_2\text{e/year} = 22,305 \text{ tCO}_2\text{e /year}$$

$$ER_{2006-2010} = 59,481 \text{ tCO}_2\text{e/year} - 5,948 \text{ tCO}_2\text{e/year} = 53,533 \text{ tCO}_2\text{e /year}$$

$$ER_{2011} = 59,481 \text{ tCO}_2\text{e/year} - 5,949 \text{ tCO}_2\text{e/year} = 53,532 \text{ tCO}_2\text{e/year}$$

$$ER_{2012} = 110,835 \text{ tCO}_2\text{e/year} - 11,084 \text{ tCO}_2\text{e/year} = 99,751 \text{ tCO}_2\text{e /year}$$

B.6.4. Summary of ex ante estimates of emission reductions

First Crediting Period

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions (t CO ₂ e)
2005	24,783	2,478	0	22,305
2006	59,481	5,948	0	53,533
2007	59,481	5,948	0	53,533
2008	59,481	5,948	0	53,533
2009	59,481	5,948	0	53,533
2010	59,481	5,948	0	53,533
2011	59,481	5,948	0	53,533
2012	59,481	5,949	0	53,532
Total	492,504	49,251	0	443,253
Total number of crediting years	7			
Annual average over the crediting period	70,357	7,035	0	63,322

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$M_{s,y}$
Unit	t
Description	Quantity of steam produced during the year y
Source of data	Direct measurement of steam
Value(s) applied	<p>The ex-ante project emission (PES_y) estimates have been conservatively estimated by the project developer to be 10% of the baseline emissions, and are as follows:</p> <p>$PES_{2005} = 2,478 \text{ tCO}_2\text{e per year}$ $PES_{2006-2011} = 5,948 \text{ tCO}_2\text{e per year}$ $PES_{2012} = 11,083 \text{ tCO}_2\text{e per year}$</p>
Measurement methods and procedures	The steam quantity discharged should be measured with a venture flow meter (or other equipment with a least the same accuracy). Measurement of temperature and pressure upstream of the venture meter is required to define steam properties. The calculation of steam quantities should be conducted on a continuous basis and should be based on international standards. The measurement results should be summarized transparently in regular production reports.
Monitoring frequency	Daily
QA/QC procedures	Quality is assured following plant established procedures, good practices, and training of operations personnel. Calibration, maintenance, and sampling is performed by a certified laboratory to the ASTM E 1675-95a and Norm ASTM E947-83 international standards.
Purpose of data	To calculate PES_y , the project emissions due to release of CO_2 and CH_4 from the produced steam during the year y.
Additional comment	Data stored electronically until at least two years after the end of the crediting period.

Data / Parameter	$\omega_{\text{Main,CO}_2}$
Unit	tCO ₂ / t steam
Description	Mass fraction of CO ₂ in produced steam
Source of data	Direct measurement of CO ₂ in the steam
Value(s) applied	Conservatively estimated to be approximately 0.0030 tCO ₂ /t steam
Measurement methods and procedures	Non-condensable gases sampling should be carried out at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO ₂ and CH ₄ sampling and analysis procedure consists of collecting NCG samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H ₂ S) and carbon dioxide (CO ₂) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH ₄ . All alkanes concentrations are reported in terms of methane.
Monitoring frequency	Every 4 months
QA/QC procedures	Calibration, maintenance, and sampling performed by a certified laboratory to the ASTM E 1675-95a and Norm ASTM E947-83 international standards.
Purpose of data	To calculate PES _y , the project emissions due to release of CO ₂ and CH ₄ from the produced steam during the year y
Additional comment	Data stored electronically until at least two years after the end of the crediting period.

Data / Parameter	$\omega_{\text{Main,CH}_4}$
Unit	tCH ₄ / t steam
Description	Mass fraction of CH ₄ in produced steam
Source of data	Direct measurement of CH ₄ in the steam
Value(s) applied	Conservatively estimated to be approximately 1.0×10^{-6} tCO ₂ /t steam
Measurement methods and procedures	Non-condensable gases sampling should be carried out at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO ₂ and CH ₄ sampling and analysis procedure consists of collecting NCG samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H ₂ S) and carbon dioxide (CO ₂) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH ₄ . All alkanes concentrations are reported in terms of methane.
Monitoring frequency	Every 4 months
QA/QC procedures	Calibration, maintenance, and sampling performed by a certified laboratory to the ASTM E 1675-95a and Norm ASTM E947-83 international standards.
Purpose of data	To calculate PES _y , the project emissions due to release of CO ₂ and CH ₄ from the produced steam during the year y
Additional comment	Data stored electronically until at least two years after the end of the crediting period.

Data / Parameter	EG_y
Unit	MWh
Description	Net electricity supplied to the grid by the project activity in year y
Source of data	Electricity revenue meter
Value(s) applied	From Table A3.1 $EG_{2005} = 32,870$ MWh (10 MW from 01/06/2005 – 31/12/2005) $EG_{2006-2011} = 78,888$ MWh per year (10 MW annually) $EG_{2012} = 146,996$ MWh (48.5MW to 31/05/2012)
Measurement methods and procedures	The revenue meters measure energy automatically and continuously. They are programmed to integrate the instantaneous values every fifteen (15) minutes and accumulative values are automatically saved every fifteen minutes in the massive memory of the principal and back-up meter. Once a month, plant personnel download the data from the electricity meters <i>in situ</i> , and the data is used to prepare the energy bill. The official monthly file is archived together with a scanned copy of the electricity bill for future reference.
Monitoring frequency	Fifteen minutes measurement and monthly recording
QA/QC procedures	Quality is assured following plant established procedures, good practices, and training of operations personnel. Also, there are two electricity meters installed in tandem, in case there is a problem with one. Calibration is performed by the national utility ENATREL. Recorded values are double checked with receipt of sales. On a daily basis (24/7), the Shift Supervisor download all data from the revenue meters for the previous day. This file is then uploaded onto the Grid Operator's Web Page (CNDC web page). See http://www.cndc.org.ni/index2.html . It is user password-protected.
Purpose of data	To calculate the baseline emissions (BE_y)
Additional comment	Data stored electronically until at least two years after the end of the crediting period.

Data / Parameter	$F_{i,y}$
Unit	Volume
Description	Amount of fossil fuel type i used for the operation of the geothermal plant in year y
Source of data	Generator fuel tank
Value(s) applied	Generator consumes 6.2 gph, and is operated approximately 14 hours a year $F_{\text{Diesel}, 2005 - 2010} = 0$ $F_{\text{Diesel}, 2011} = 65.07$ (April - December only) $F_{\text{Diesel}, 2012} = 86.8$
Measurement methods and procedures	Measured from fuel gauge
Monitoring frequency	Monthly
QA/QC procedures	Double checked with fuel purchase records and generator operating time.
Purpose of data	To calculate $PE_{FF,y}$, the project emissions due to the combustion of fossil fuels used to operate the geothermal plant.

Additional comment	Data stored electronically until at least two years after the end of the crediting period. This is a back-up generator only, and was installed on 25 March 2011.
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Data / Parameter	$NCV_{i,y}$
Unit	GJ / ton
Description	Net calorific value (energy content) of fuel type <i>i</i> in year <i>y</i>
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	Diesel Fuel – 43.3 GJ/m ³
Measurement methods and procedures	IPCC default values obtained
Monitoring frequency	Annually. Any future revision of the IPCC Guidelines should be taken into account.
QA/QC procedures	IPCC default values checked annually
Purpose of data	To calculate $PEFF_y$, the project emissions from the combustion of fossil fuels related to the operation of the geothermal power plant.
Additional comment	Plant or country specific values are not available so IPCC default values are utilized. Data stored electronically until at least two years after the end of the crediting period.

Data / Parameter	$EF_{CO_2,i,y}$
Unit	tCO ₂ /TJ
Description	CO ₂ e emission factor of fuel type <i>i</i> in year <i>y</i>
Source of data	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	Diesel Fuel – 74.8 tCO ₂ /TJ
Measurement methods and procedures	IPCC default values obtained
Monitoring frequency	Annually. Any future revision of the IPCC Guidelines should be taken into account.
QA/QC procedures	IPCC default values checked annually
Purpose of data	To calculate $PEFF_y$, the project emissions from the combustion of fossil fuels related to the operation of the geothermal power plant.
Additional comment	Plant or country specific values are not available so IPCC default values are utilized. Data stored electronically until at least two years after the end of the crediting period.

B.7.2. Sampling plan

There is no sampling involved in this project activity.

B.7.3. Other elements of monitoring plan

This plan aims to monitor on a regular basis the GHG emissions of the San Jacinto-Tizate Geothermal Project from non-condensable gases and the from the Nicaraguan electricity grid. There are six main activities are to be performed within the monitoring process:

- 1 Calibration and maintenance of monitoring equipment and instruments;
- 2 Gathering of data from steam wells and power generation;
- 3 Calculation of GHG emission reductions;
- 4 Management and storage of data;
- 5 Supervision of the quality of the monitoring process; and
- 6 Issuance of reports for internal and external verification.

The table in Appendix 5 outlines these steps in detail.

Polaris Geothermal Inc. have created a local firm called Polaris Energy Nicaragua S.A. (the project developer as established on the PDD) to manage San Jacinto-Tizate Geothermal Project. This subsidiary will be the authority of the monitoring process.

San Jacinto Power SA hires a certified laboratory to perform high quality chemical sampling and analyses of water, gases and pollutants on a "Geothermic Laboratory", to perform sampling and chemical analysis activities of non-condensable gases (NCG).

The data required for determining the baseline GHG emissions is summarized in Tables in Section B.7.1 NCG sampling and analytical methods are described in the same tables.

The NCG data, expressed as a weight ration of gas / steam, will be retained in computer files together with other project monitoring data. Using steam flowrate data and gas-in-steam concentrations, the flow of each GHG can be calculated, according to the general formula:

$$\text{GHG FLOW (T/H)} = \text{STEAM FLOW (T/H)} \times \text{GAS-IN-STEAM (T GAS/T STEAM)}$$

NCG emissions all arise from the production well fluids. The well fluids are separated in a separator vessel and the steam is piped to the power station while the separated water (brine) is reinjected. The NCG remains with the steam portion. NCG discharges thus occur from the power plant itself, from the rock muffler at the vent station (where excess steam is vented to atmosphere) and from pipeline drains. The amount of emission can be estimated either from the mass flow coming from the production wells or from the flow to each of the discharge points.

Well mass flow output can be related to well head pressure and this will be checked for each well quarterly, using tracer dilution methods. This analysis also provides information to determine the steam and brine mass fractions. At the same time, the NCG content and composition will be determined. Well output versus well head pressure and NCG content do not change rapidly and quarterly analysis will be adequate for this purpose.

Steam system pressure will be recorded continuously at the power station. By off-line analysis, this can be related back to well head pressure and hence the mass flow production from each well can be determined and hence the NCG production. The results of this analysis will be consolidated and presented in a quarterly report.

The cumulative steam flow into the power station will be directly measured for each unit at the power station. This flow will be recorded regularly and a total quarterly mass flow obtained, from which the NCG discharge from the plant will be able to be determined. In the Stage 1 plant, almost the entire NCG discharge will be from the turbine exhaust silencers, with a small amount from

drains that are downstream of the steam flow measurement point. When Stage 2 is commissioned, the total steam mass flow will still pass through the same flow measurement points, although the NCG will mostly then be discharged from dedicated high level vents. When Phase II is commissioned, additional steam flow measurement instrumentation will be provided for the two Phase II units and the NCG will primarily be discharged with the cooling tower plume.

There is no direct measurement of steam (and hence NCG) discharge from the rock muffler. However, this quantity can be determined from the vent valve position and the steam system pressure. Both parameters will be recorded continuously and periodically analysed off-line to obtain NCG mass flow, which will be determined on a quarterly basis.

The underflow to atmosphere from the pipeline drains, under normal conditions, will be measured during the plant commissioning programme. It will be assumed that this small flow will remain sensibly constant during normal operation and the NCG content will be added to the quarterly measured emissions.

EcoSecurities Ltd is the entity determining the monitoring plan and participating in the project as the Carbon Advisor. The individuals at EcoSecurities that prepared the monitoring methodology are Sonia Medina and Joanna Duthie as listed in Annex 1 of this document.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

EcoSecurities Ltd is the entity determining the application methodology in October 2005 and participating in the project as the Carbon Advisor. The individuals at EcoSecurities who prepared the monitoring methodology were Sonia Medina and Joanna Duthie.

Contact information:

EcoSecurites Ltd.
21 Beaumont Street
Oxford
United Kingdom
Tel: 44 1865 202

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

05/04/2004 (construction date starting)

C.1.2. Expected operational lifetime of project activity

21 years, 0 months

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Renewable. First crediting period.

C.2.2. Start date of crediting period

01/06/2005

C.2.3. Length of crediting period

7 years, 0 months

SECTION D. Environmental impacts**D.1. Analysis of environmental impacts**

Nicaraguan legislation requires San Jacinto Power SA. to obtain an environmental permit from the Ministry of Environment and Natural Resources (MARENA) before construction of the plant can commence. Issuance of the permit is contingent upon, among other criteria, the demonstration through an Environmental Impact Assessment (EIA) that San Jacinto Power SA 's activities will not result in significant environmental impacts.

An EIA was submitted to MARENA in July 2003. A copy is available upon request. The EIA discusses a wide range of potential environmental (soil, air water, fauna, flora and landscape) and socio-economic impacts during the plant's construction and operation phases, and assesses their significance according to a valuation system using a set of 10 criteria. It also discusses a number of corrective measures to certain impacts (including their costs) and an environmental management and monitoring plan. Furthermore, it discusses potential risks to the plant and its surroundings by extreme events (volcanic eruptions, earthquakes, hurricanes, fires and explosions and chemical spills) and presents a contingency plan in case of occurrence of such events.

The EIA concludes that the main environmental impacts of the project are impacts on air quality and noise, which can both be easily controlled and mitigated through chimneys, silencers, forestry sound barriers and the use of ear protection by staff. On the other hand the project will generate significant positive socio-economic impacts in the form of employment and electricity generation, as well as positive environmental impacts in the form of mitigation of climate change.

The EIA's overall conclusion is that environmental impacts are not considered to be significant.

MARENA issued an environmental permit to San Jacinto Power SA. in September 2003. A copy is available upon request.

D.2. Environmental impact assessment

Impacts are not considered to be significant by the project participants or the host party.

SECTION E. Local stakeholder consultation**E.1. Solicitation of comments from local stakeholders**

A public Stakeholder Consultation was organized and conducted by San Jacinto Power SA. on the 21st August 2004 from 9-12 am in Telica, close to San Jacinto. The Consultation, including its announcement, was conducted according to detailed instructions given by the Environmental Impacts and Evaluation Office of the Ministry for Environment and Natural Resources (MARENA) of Nicaragua.

The Consultation was announced in two national newspapers and by loudspeakers in the towns of San Jacinto and Telica. Stakeholders directly invited included representatives from local municipalities and councils and from a number of regional and national governmental and semi-governmental organizations.

87 persons, the majority of which were locals from San Jacinto and Telica, attended the event.

A description of the project was given to the stakeholders, including information on:

- the participants;
- site and size of the project;
- the technology to be used;
- expected negative environmental impacts, including on:
 - air quality resulting from the increased emissions of volcanic gases and from the increased combustion of petrol and diesel from increased project-related traffic and on-site machinery, and how these compare with already occurring natural and anthropogenic emissions in the area;
 - levels of noise produced by the plant and during the construction of the plant;
 - visual impacts;
 - vegetation within the project site.
- how the project intends to minimize and/or undo the above expected environmental impacts, including anticipated costs of measures;
- potential negative environmental impacts, that could occur in case of accidental events, including on:
 - soil erosion and soil quality;
 - ground and surface water quality, including potential for turbidity and sedimentation;
 - vegetation within the project site.
- how the project intends to prevent accidental events and minimize the above environmental impacts should such events nevertheless occur, including anticipated costs of measures;
- expected positive impacts of the projects: employment and electricity generation;
- which expected and potential impacts and which counter measures by the project will be monitored and how they will be monitored, including information on reporting and costs;
- labour needs during the construction process and operational life of the plant;
- details on the construction of the plant, including environmental impacts (see above);
- materials, fuels and chemicals to be used during construction of the plant;
- measures to ensure worker's personal safety during the construction of the plant;
- general operational safety measures to be introduced in the plant, including for the prevention of environmental impacts;
- measures to prevent non-professional persons and animals from entering the dangerous and environmentally sensitive areas within the plant and, should they still manage to gain access to the former, measures to prevent them from being harmed by very hot tubes; and
- measures for collection and disposal of organic and inorganic waste during the construction process and operational life of the plant;

After the presentation stakeholders were asked to provide comments or ask questions regarding the project.

Detailed instructions were given by MARENA on how the event should be organized and how stakeholders should be invited. They can be made available upon request.

A recording was made of the presentation given by the project representative, of questions and comments raised by stakeholders and of answers/replies by the project representative. A transcription of the recording can be made available upon request.

E.2. Summary of comments received

In general the comments made by stakeholders at the consultation expressed their satisfaction and agreement with the project.

Specific comments:

- It is well received that the project seeks to inform the local stakeholders.
- It is thought that the project will contribute to the environmental education of the local population.
- It is thought that the project will bring employment.
- It is thought that the project will bring development.
- It is thought that the project will be able to contain any significant negative impacts on the environment and public health.
- It is thought that the presentation of the project was clear.

Questions and Replies:

Q: What will be the project's impact on San Jacinto's supply of drinking water?

R: In the case of extreme events like very strong rains there exists a risk that runoff will occur, particularly of hydro-carbonic substances (fuels, greases and lubricants) used for and waste produced by the operation of the plant. The project will seek to minimize these risks by building special tanks and containers for hydro-carbonic substances to prevent any spills and by collecting all waste and incinerating it. In addition, the project will carry out some reforestation activities, which will contribute to the prevention of erosion from the project site.

Q: when will the project start and when will the 66 MW be generated?

R: the project will be able to reach a capacity of 20 MW within 20 months, but to install the other 46 MW will take three more years.

Several comments by stakeholders refer to two previous meetings or consultations that the project has had with local stakeholders.

E.3. Report on consideration of comments received

The comments raised and questions asked by stakeholders did not address any issues that had not already been incorporated in the project design. A revision of the project design or any corrective measure were therefore not deemed necessary.

SECTION F. Approval and authorization

The letters of approval from the Parties for the project activity have previously been obtained and are posted on the UNFCCC/CDM website: <http://cdm.unfccc.int/Projects/DB/DNV-CUK1135673240.22/view>.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Polaris Energy Nicaragua S.A.
Street/P.O. Box	Rotonda El Periodista, 150m. al Sur
Building	Ofiplaza El Retiro, Edif. 7, Suite 723
City	Managua
State/Region	
Postcode	
Country	Nicaragua
Telephone	(505) 253 8340
Fax	(505) 278 0543
E-mail	
Website	http://ram-power.com/current-projects/san-jacinto-tizate-i-ii-nicaragua
Contact person	
Title	Vice President and COO of Latin America
Salutation	
Last name	Rodriguez
Middle name	Antonio
First name	José
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	jarodriguez@ram-power.com

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	EcoSecurities Ltd.
Street/P.O. Box	21, Beaumont Street
Building	
City	Oxford
State/Region	
Postcode	
Country	United Kingdom
Telephone	44 1865 202 635
Fax	44 1865 251 438
E-mail	uk@ecosecurities.com
Website	www.ecosecurities.com

Contact person	
Title	President
Salutation	Mr.
Last name	Costa
Middle name	Moura
First name	Pedro
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	pedro@ecosecurities.com

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Blues Traveler Environmental Limited
Street/P.O. Box	Shirley Street & Victoria Avenue
Building	P.O. Box N-272
City	Nassau
State/Region	Bahamas
Postcode	
Country	The Bahamas
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	Director
Salutation	Mr.
Last name	Koltun
Middle name	
First name	Robert
Department	Graham, Thompson & Co.
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

No public funding was available for the project.

Appendix 3. Applicability of methodology and standardized baseline

No further background information on the applicability of the selected methodology is provided.

Appendix 4. Further background information on ex ante calculation of emission reductions

BASELINE INFORMATION

Operating Margin 2001

Plant Name	Technology	Fuel Type	GEN _{i,y} (MWh)	MW	Fuel Consumption Unit	F _{i,j,y} (Fuel Consumption per year)	Year Plant Online	State or Private
Monte Rosa	biomass		-	26	M tons cane		2002	private
Corinto	Internal Combustion	fuel oil	524,675.90	74	gallons	29,766,590	1999	private
Tipitapa	Internal Combustion	fuel oil	416,011.30	52.2	gallons	24,915,740	1999	private
Nicaragua ISA	biomass		46,864.24	39.3	M tons cane		1998	private
Nicaragua ISA	biomass				gallons		1998	
Censa-Amfels	Internal Combustion	fuel oil	250,190.52	63.9	gallons	15,696,520	1997	private
Timal	biomass		955.20	0	M tons cane		1996	private
Las Brisas	gas turbine	diesel	46,600.47	65	gallons	3,648,030	1992	state
Chinandega	gas turbine	diesel	2,551.68	14	gallons	334,960	1990	private
Ormat Momotombo	geothermal		206,078.00	77.5	tons vapor	-	1990	private
Centroamérica	hydro		130,182.80	50	M3		1990	state
Las Canoas	hydro		95.25	0	M3		1990	state
Santa Barbara	hydro		66,525.40	54.4	M3		1990	state
Wabule	hydro		-	0	M3		1990	state
Nicaragua (GEOSA)	Steam	fuel oil	485,377.18	106	gallons	36,752,840	1990	private
Managua (GECSA)	Steam	fuel oil	266,801.75	57.4	gallons	20,388,820	1990	state

Source: CNE, 2001 data

Operating Margin Data: 2002

Plant Name	Technology	Fuel Type	GEN _{j,y} (MWh)	MW	Fuel Consumption Unit	F _{i,j,y} (Fuel Consumption per year)	Year Plant Online	State or Private
Monte Rosa	biomass		47,344.26	26	M tons cane		2002	private
Corinto	Internal Combustion	fuel oil	511,891.04	74	gallons	29,219,090	1999	private
Tipitapa	Internal Combustion	fuel oil	40,996.50	52.2	gallons	24,394,970	1999	private
Nicaragua ISA	biomass		83,341.72	39.3	M tons cane		1998	private
Nicaragua ISA	biomass				gallons		1998	
Censa-Amfels	Internal Combustion	fuel oil	196,343.71	63.9	gallons	12,058,150	1997	private
Timal	biomass		-	0	M tons cane		1996	private
Las Brisas	gas turbine	diesel	12,540.21	65	gallons	938,970	1992	state
Chinandega	gas turbine	diesel	294.81	14	gallons	33,370	1990	private
Ormat Momotombo	geothermal		210,271.99	77.5	tons vapor		1990	private
Centroamérica	hydro		187,035.80	50	M3		1990	state
Las Canoas	hydro		-	0	M3		1990	state
Santa Barbara	hydro		116,299.50	54.4	M3		1990	state
Wabule	hydro		-	0	M3		1990	state
Nicaragua (GEOSA)	Steam	fuel oil	613,944.78	106	gallons	46,280,850	1990	private
Managua (GECSA)	Steam	fuel oil	205,382.72	57.4	gallons	15,979,150	1990	state

Source: CNE, 2002 data

Operating Margin Data: 2003

Plant Name	Technology	Fuel Type	GEN _{j,y} (MWh)	MW	Fuel Consumption Unit	F _{i,j,y} (Fuel Consumption per year)	Year Plant Online	State or Private
Monte Rosa	biomass		36,743.00	26	M tons cane	262,551	2002	private
Corinto	Internal Combustion	fuel oil	533,547.21	74	gallons	30,281,490	1999	private
Tipitapa	Internal Combustion	fuel oil	411,483.90	52.2	gallons	24,672,470	1999	private
Nicaragua ISA	biomass		97,360.00	39.3	M tons cane	269,111	1998	private
Nicaragua ISA	biomass				gallons	132	1998	
Censa-Amfels	Internal Combustion	fuel oil	297,757.54	63.9	gallons	18,148,190	1997	private
Timal	biomass		-	0	M tons cane	0	1996	private
Las Brisas	gas turbine	diesel	20,920.24	65	gallons	1,662,800	1992	state
Chinandega	gas turbine	diesel	730.52	14	gallons	97,690	1990	private
Ormat Momotombo	geothermal		276,700.78	77.5	tons vapor	1,740,610	1990	private
Centroamérica	hydro		171,344.00	50	M3	292,859,150	1990	state
Las Canoas	hydro		-	0	M3	0	1990	state
Santa Barbara	hydro		120,450.00	54.4	M3	251,602,210	1990	state
Wabule	hydro		-	0	M3	0	1990	state
Nicaragua (GEOSA)	Steam	fuel oil	525,863.68	106	gallons	39,498,280	1990	private
Managua (GECSA)	Steam	fuel oil	200,616.27	57.4	gallons	15,747,860	1990	state

Source: CNE, 2003 data

Build Margin Data:

Plant Name	Technology	Fuel Type	GEN_j (MWh)	MW	F_{i,j} (Fuel Consumption)	Year On- Line
Monte Rosa	biomass		36,743	26	0	2002
Corinto	Internal Combustion	fuel oil	533,547	74	30,281,490	1999
Tipitapa	Internal Combustion	fuel oil	411,484	52.2	24,672,470	1999
Nicaragua ISA	biomass		97,360	39.3	0	1998
Censa-Amfels	Internal Combustion	fuel oil	297,758	63.9	18,148,190	1997

Source: CNE, 2003 Data

Appendix 5. Further background information on monitoring plan

Annex 4. Monitoring Procedures								
	Activity		Sub-Activity	Responsible		Periodicity	References	Report
1	Calibration and maintenance of monitoring of equipment and instruments	A	Preparation of sampling equipment and instruments	Certified laboratory	Manager Director	According with standards	The certified laboratory prepares the sampling equipment following the ASTM E 1675-95a; “Standard Practice for Sampling Two-Phase Geothermal Fluid for Purposes of Chemical Analysis”.	SJG-CM-01
		B	Calibrate and maintain laboratory equipment and instruments	Certified laboratory	Manager Director	According with standards	The certified laboratory calibrates and maintains the equipment periodically as per manufacturer protocols.	
		C	Calibration and Maintenance of electricity meter	ENATREL (national electricity utility)	ENATREL	At the start of the project and then accordingly with their operations requirements.	The Grid Operator calibrates and maintains the electricity meter in line with the standards of Norms of Commercial Operation of the National Dispatch Center.	-
2	Gathering of data from steam wells and power generation	A	Sampling steam	Certified laboratory	Project Manager for San Jacinto-Tizate Project	Every four months	ASTM E 1675-95a; “Standard Practice for Sampling Two-Phase Geothermal Fluid for Purposes of Chemical Analysis” and Section B.7 in PDD.	SJG-GD-01
		B	Analyse CO2 content of the steam	Certified laboratory	Project Manager for San Jacinto-Tizate Project	Every four months	Norm ASTM E 1675 and Norm ASTM E947-83 (steam sampling)	

	C	Analyse CH4 content of the steam	Certified laboratory	Project Manager for San Jacinto-Tizate Project	Every four months	Norm ASTM E 1675 and Norm ASTM E947-83 (steam sampling)	SJG-GD-02	
	D	Report the findings of the chemical analysis	Certified laboratory	Project Manager for San Jacinto-Tizate Project	Every four months	Section B.7		
	E	Read electricity generation data from meter	Polaris Energy Nicaragua S.A.	Superintendent	daily	Section B.7		
	F	Measure the steam flow	Polaris Energy Nicaragua S.A.	Superintendent	daily	Section B.7		
	G	Report the data from the readings and measure	Polaris Energy Nicaragua S.A.	Superintendent	daily	Section B.7		
3	Calculation of GHG emission reductions	A	Calculate the project activity emissions from NCG discharged to the atmosphere due to the project activity	Polaris Energy Nicaragua S.A.	Operations Supervisor	At the end of each monitoring period	Section B6.3	-
		B	Calculate the baseline emissions offset from the grid	Polaris Energy Nicaragua S.A.	Operations Supervisor	At the end of each monitoring period	Section B6.3	-
		C	Calculate the emission reductions	Polaris Energy Nicaragua S.A.	Operations Supervisor	At the end of each monitoring period	Section B6.3	-
4	Management and storage of data	A	Archive data from steam generation	Polaris Energy Nicaragua S.A.	Operations Supervisor	Every four months	Section B.7	-
		B	Archive data from power generation	Polaris Energy Nicaragua S.A.	Operations Supervisor	Every four months	Section B.7	-
		C	Manage the data and information	Polaris Energy Nicaragua S.A.	Operations Supervisor	Monthly	Section B.7	-

		D	Storage the data and information	Polaris Energy Nicaragua S.A.	Operations Supervisor	Monthly	The data and information should be stored until two years after the crediting period has finished	-
5	Supervision of the quality of the monitoring process	A	Review all reports are being performed as mentioned in this plan	Polaris Energy Nicaragua S.A.	Operations Manager	Every four months	Section B.7	SJG-SMP-01
		B	Performance evaluation of monitoring personnel	Polaris Energy Nicaragua S.A.	Operations Manager	Annually	Section B.7	
		C	Issue a evaluation report of the monitoring process	Polaris Energy Nicaragua S.A.	Operations Manager	Anually	Section B.7	
		D	Assure the periodical training of personnel mentioned in this plan within Polaris Energy Nicaragua S.A.involved in the monitoring process	Polaris Energy Nicaragua S.A.	Operations Manager	Every six months, or when new Superintendent is hired	Section B.7	SJG-SMP-02
6	Issuance of reports for internal and external verification	A	Produce a Monitoring Management report summarising the reports mentioned above	Polaris Energy Nicaragua S.A.	Operations Manager	At the end of each monitoring period	Section B.7	SJG-MM-01
		B	Produce a report of the GHG emission reductions	Polaris Energy Nicaragua S.A.	Operations Manager	At the end of each monitoring period	Section B.7	SJG-GHG-01

Annex 5. List of Monitoring Reports				
Code	Name	Content	Issuer	Receiver
SJG-CM-01	Instruments and Equipments Calibration and Maintenance Report	List of equipments and instruments used in the sampling and laboratory chemical analysis which have been calibrated and maintained, mentioning the applicable international standards	Certified laboratory	Operations Supervisor
SJG-GD-01	Non Condensable Gases (NCG) Sampling and Data Analysis Report	Description of sampling and data analysis process, including any problem faced and its solution.	Certified laboratory	Operations Supervisor
		Present the result of the analysis in terms of the proportion of NCG found in the samples	Certified laboratory	Operations Supervisor
SJG-GD-02	Power Generation Report	Electricity supplied to the grid (MWh) and daily power output (MW)	Superintendent	Operations Supervisor
SJG-SMP-01	Monitoring Auditing Report	Describe every anomaly found and the way San Jacinto Power SA.. have proceeded to fix them.	Operations Manager	Superintendent, Operations Supervisor
SJG-SMP-02	Trained Monitoring Personnel Report	Description of the training courses delivered to personnel from San Jacinto Power SA. including who attended and briefly describing the content of the course.	Operations Manager	Superintendent, Operations Supervisor
		Letter certifying the sampling and laboratory staff has proper capacity to perform the samplings and analysis (the letter must be issued every year)	Certified laboratory	Superintendent, Operations Supervisor,
SJG-MM-01	Monitoring Management Report	Summarise all other reports	Operations Manager	Superintendent, Operations Supervisor
SJG-GHG-01	GHG Report	Describe the GHG emissions of the project activity as well as the GHG emission reduction from the electricity displaced from the grid	Operations Manager	Superintendent, Operations Supervisor

Appendix 6. Summary of post registration changes

1. 31/01/29 Remove Standard Bank Plc as a Project participant for the Project, and Add Blues Traveler Environmental Limited as a Project Participant for the Project.
2. 10/09/16 PDD Revision 4.0 in accordance with CDM-EB65-A05-STAN CDM Project Standard Version 09.0 Section 13.8.3.5 Changes to the project design of a registered project activity or programme design of a registered programme of activities, Para 289 (a) "Changes in the effective output capacity due to increased installed capacity or units with a technology which is less advanced than that described in the PDD" applies.

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from <i>F-CDM-PDD</i> to <i>CDM-PDD-FORM</i>; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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