



VALIDATION REPORT

BERLIN BINARY CYCLE POWER PLANT IN EL SALVADOR

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VALIDATION REPORT

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Client: LaGeo S.A. de C.V.	Client ref.: Ruben Loy

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Summary:

Det Norske Veritas Certification AS (DNV) has performed a validation of the *Berlin Binary Cycle power plant* project in El Salvador on the basis of UNFCCC criteria for the CDM, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to Article 12 of the Kyoto Protocol, the CDM modalities and procedures and the subsequent decisions by the CDM Executive Board. This validation report summarizes the findings of the validation. The validation consisted of the following three phases: i) a desk review of the project design and the baseline and monitoring plan, ii) follow-up interviews with project stakeholders and iii) the resolution of outstanding issues and the issuance of the final validation report and opinion. In summary, it is DNV's opinion that the project, as described in the project design document of 25/10/2007, meets all relevant UNFCCC requirements for the CDM and correctly applies the approved baseline and monitoring methodology ACM0002 Version 6. Hence, DNV requests the registration of the *Berlin Binary Cycle power plant* project as a CDM project.

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**Abbreviations**

CAR	Corrective action request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction
CH ₄	Methane
CL	Clarification request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DNV	Det Norske Veritas Certification AS
DNA	Designated National Authority
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
MARN	Ministerio de Medio Ambiente y Recursos Naturales
MP	Monitoring Plan
MVP	Monitoring and Verification Plan
N ₂ O	Nitrous oxide
NGO	Non-governmental Organisation
ODA	Official Development Assistance
PDD	Project Design Document
PIN	Project Idea Note
UNFCCC	United Nations Framework Convention on Climate Change



1 INTRODUCTION

LaGeo S.A. de C.V. (LaGeo) has commissioned Det Norske Veritas Certification AS (DNV) to validate the *Berlin Binary Cycle power plant* project (hereafter called “the project”) in El Salvador. This report summarises the findings of the validation of the project, performed on the basis of UNFCCC criteria for CDM projects, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The validation team consists of the following personnel:

Mr Sven Starckx	DNV Antwerp, Belgium	Team Leader, GHG auditor
Mr Gustavo Godinez	DNV México, Mexico	CDM validator
Mr Jan Van Evercooren	DNV Antwerp, Belgium	GHG auditor (applicant)
Mr Michael Lehman	DNV Høvik, Norway	Sector expert
Mr Venkata Kakaraparthi	DNV Kolkata, India	Technical reviewer (applicant)
Mr Einar Telnes	DNV Høvik, Norway	Technical reviewer
Mr Miguel Rescalvo	DNV Høvik, Norway	Technical reviewer (final report).

1.1 Validation Objective

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

1.2 Scope

The validation scope is defined as an independent and objective review of the project design document (PDD). The PDD is reviewed against the criteria stated in Article 12 of the Kyoto Protocol, the CDM modalities and procedures as agreed in the Marrakech Accords and the relevant decisions by the CDM Executive Board, including the approved baseline and monitoring methodology ACM0002 Version 6. The validation team has, based on the recommendations in the Validation and Verification Manual /7/ employed a risk-based approach, focusing on the identification of significant risks for project implementation and the generation of CERs.

The validation is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the project design.

1.3 Description of Proposed CDM Project

The project envisages the generation of electricity in a newly built LaGeo power plant using the heat of the waste brine that is produced in the existing LaGeo Berlin Phase I geothermal plant. In the baseline scenario, the Berlin Phase I plant uses the steam from the geothermal brine to generate electricity for power grid supply, while the waste brine at 180 °C is removed for re-injection in downstream injection wells.



In this project activity, the waste brine heat of the Berlin Phase I plant is recovered in the heat exchangers of the project power plant, before it is re-injected at 140 °C. The power plant's installed capacity is 9.2 MW.

The project activity is expected to displace some 63 700 MWh per year of the El Salvador power grid, dominated by carbon intensive generation sources.

The project activity is expected to reduce an estimated 44 141 tCO₂e per year over a 7-year renewable crediting period.

2 METHODOLOGY

The validation consisted of the following three phases:

- I a desk review of the project design documents
- II follow-up interviews with project stakeholders
- III the resolution of outstanding issues and the issuance of the final validation report and opinion.

In order to ensure transparency, a validation protocol was customised for the project, according to the Validation and Verification Manual. The protocol shows in transparent manner criteria (requirements), means of verification and the results from validating the identified criteria. The validation protocol serves the following purposes:

- It organises, details and clarifies the requirements a CDM project is expected to meet;
- It ensures a transparent validation process where the validator will document how a particular requirement has been validated and the result of the validation.

The validation protocol consists of three tables. The different columns in these tables are described in Figure 1.

The completed validation protocol for the *Berlin Binary Cycle power plant* project is enclosed in Appendix A to this report.

Findings established during the validation can either be seen as a non-fulfilment of validation protocol criteria or where a risk to the fulfilment of project objectives is identified. Corrective action requests (CAR) are issued, where:

- i) mistakes have been made with a direct influence on project results;
- ii) validation protocol requirements have not been met; or
- iii) there is a risk that the project would not be accepted as a CDM project or that emission reductions will not be certified.

The term Clarification may be used where additional information is needed to fully clarify an issue.



Validation Protocol Table 1: Mandatory Requirements for CDM Project Activities			
Requirement	Reference	Conclusion	Cross reference
The requirements the project must meet.	Gives reference to the legislation or agreement where the requirement is found.	This is either acceptable based on evidence provided (OK), a Corrective Action Request (CAR) of risk or non-compliance with stated requirements or a request for Clarification (CL) where further clarifications are needed.	Used to refer to the relevant checklist questions in Table 2 to show how the specific requirement is validated. This is to ensure a transparent Validation process.

Validation Protocol Table 2: Requirement Checklist				
Checklist Question	Reference	Means of verification (MoV)	Comment	Draft and/or Final Conclusion
The various requirements in Table 1 are linked to checklist questions the project should meet. The checklist is organised in seven different sections. Each section is then further sub-divided. The lowest level constitutes a checklist question.	Gives reference to documents where the answer to the checklist question or item is found.	Explains how conformance with the checklist question is investigated. Examples of means of verification are document review (DR) or interview (I). N/A means not applicable.	The section is used to elaborate and discuss the checklist question and/or the conformance to the question. It is further used to explain the conclusions reached.	This is either acceptable based on evidence provided (OK), or a Corrective Action Request (CAR) due to non-compliance with the checklist question (See below). A request for Clarification (CL) is used when the validation team has identified a need for further clarification.

Validation Protocol Table 3: Resolution of Corrective Action Requests and Requests for Clarification			
Draft report corrective action requests and requests for clarifications	Ref. to Table 2	Summary of project participants' response	Final conclusion
If the conclusions from the draft Validation are either a Corrective Action Request or a Clarification Request, these should be listed in this section.	Reference to the checklist question number in Table 2 where the Corrective Action Request or Clarification Request is explained.	The responses given by the project participants during the communications with the validation team should be summarised in this section.	This section should summarise the validation team's responses and final conclusions. The conclusions should also be included in Table 2, under "Final Conclusion".

Figure 1 Validation protocol tables

2.1 Review of Documents

LaGeo submitted a first PDD and additional background documents related to the project design and baseline on 20/02/2006. This PDD described the project as a small-scale type AMS-I.D. Following a methodology revision, LaGeo submitted a second PDD on 21/09/2006 describing the project on the basis of methodology ACM0002 Version 6.



Main changes between the ACM0002 based version published for the 30 days stakeholder commenting period and the final version:

- the estimated yearly emission reduction has been recalculated;
- the authority and responsibility for registration, monitoring, measurement and reporting have been adapted;
- the description of how the stakeholders' comments were invited, compiled and accounted for has been elaborated.

2.2 Follow-up Interviews

In the period of 27-28/03/2006, DNV performed interviews with project stakeholders to confirm selected information and to resolve issues identified in the document review. Representatives of LaGeo were interviewed during this visit. The main topics of the interviews are summarised in Table 1.

Table 1 Interview topics

Interviewed organisation	Interview topics
MARN (DNA El Salvador) /M/	DNA approval Sustainable development contribution
LaGeo (Project proponent and developer) /L/	Overview, engineering and construction Environmental requirements Financial requirements Engineering and construction Operation, maintenance, calibration Sustainable development
Energía y Medio Ambiente (Carbon advisor) /E/	Baseline study Emission reduction calculation

2.3 Resolution of Clarification and Corrective Action Requests

The objective of this phase of the validation was to resolve any outstanding issues which needed to be clarified for DNV's positive conclusion on the project design.

The corrective action requests and requests for clarification raised by DNV, presented to the project participants in DNV's draft validation report of 07/04/2006, were mainly resolved during communications between LaGeo and DNV, and in a revised PDD still based on the small-scale methodology AMS I.D.

The PDD of 25/10/2007 as its previous versions already based on the large-scale methodology ACM0002, addresses the *corrective action requests* and *requests for clarification* to DNV's satisfaction and incorporates the requirements of the latest version of the applied methodology.

To guarantee the transparency of the validation process, the concerns raised and responses given are documented in the validation protocol in Appendix A. The comments related to the AMS I.D based PDD are kept in this validation protocol.



2.4 Internal Quality Control

The draft validation report including the initial validation findings underwent a technical review before being submitted to the project participants. The final validation report underwent another technical review before requesting registration of the project activity. The technical review was performed by a technical reviewer qualified in accordance with DNV's qualification scheme for CDM validation and verification.

3 VALIDATION FINDINGS

The findings of the validation are stated in the following sections. The validation criteria (requirements), the means of verification and the results from validating the identified criteria are documented in more detail in the validation protocol in Appendix A. The validation findings below reflect the information provided in the PDD dated 25/10/2007 /1/.

3.1 Participation Requirements

The project is proposed as an unilateral project by LaGeo S.A. de C.V., the sole project participant in the host country El Salvador. The DNA of El Salvador, Ministerio de Medio Ambiente y Recursos Naturales (MARN), approved the project (Letter of Approval /3/) and confirmed it's voluntary participation in the CDM project. The host party El Salvador complies with the participation criteria.

The project contributes to sustainable development by reducing the country's reliance on fossil fuel: This has been confirmed by the DNA of El Salvador (Technical Verdict /4/).

3.2 Project Design

The project envisages the generation of electricity in a newly built LaGeo power plant of the "binary cycle" type, using the heat of the waste brine produced in the existing LaGeo Berlin Phase I geothermal plant. The project power plant, named Berlin Binary Cycle power plant, will deliver electricity to the El Salvador power grid.

In the "binary cycle" geothermal power technology, geothermal heat is used to vaporize a working fluid in a separate closed loop pipework, and the vaporized fluid powers a turbine coupled to an electricity generator. In the Berlin Binary Cycle power plant, the heat used is not that of the brine itself, but that of waste brine that is re-injected in downstream injection wells.

The technology will be implemented by Icelandic Enx, which during 35 years of operation has participated in numerous geothermal projects worldwide and for over 70 years in Iceland.

As per the plant design approx. 300 kg/s of 180 °C hot waste brine are processed in two heat exchanger lines, one of 221 kg/s at 22 bar_a and the other of 79 kg/s at 11 bar_a /5/. In the exchanger lines' evaporator, the waste brine cools down to 140 °C.

The vaporized working fluid isopentane is piped to a turbine as slightly overheated gas at approx. 22 bar_a. In the turbine, the gas pressure drops to approx. 2 bar_a. The isopentane from the turbine is cooled down to saturation in a recuperator before it condenses in a water cooled condenser. The isopentane is piped to a hot well, where make up isopentane can be added to the cycle. The isopentane pressure is raised by a pump and pumped to the other side of the recuperator for preheating on its way back to the evaporators.



The cooling water for the condenser comes from a mechanical draft cooling tower. The installed capacity of the turbine/generator combination is 9.2 MWe, the net output 8.2 MWe. A 10 MVA transformer connects the project plant to the existing LaGeo Berlin electric substation through a 600 m transmission line.

The waste brine temperature of 180 °C fits well in the intermediate temperature range of 100-220 °C allowing “binary cycle” technology, discussed by the World Bank in its survey of geothermal power plant designs (The World Bank Group, *Geothermal Energy: The Technology and the Development Process*, 2006). DNV has furthermore verified the Enx hot brine figures mentioned above in monthly operation reports of the Berlin Phase I geothermal plant.

The Berlin Binary Cycle power plant started construction on 03/05/2005. Its operational lifetime is estimated as 30 years.

The crediting period selected is a renewable crediting period of a first seven years starting on 01/09/2007.

The validation did not reveal any information indicating that the project can be seen as a diversion of ODA funding towards El Salvador.

3.3 Project Baseline

The project applies methodology ACM0002 Version 6, “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” /8/. The methodology is justifiably applicable as it is demonstrated that the project:

1. Applies an electricity capacity addition from geothermal sources (geothermal well waste brine);
2. Does not involve switching from fossil fuels;
3. Connects the plant to a power grid that can be clearly defined and characterized (El Salvador power grid).

According to ACM0002 Version 6, the baseline scenario for project activities that do not modify or retrofit an existing electricity generation facility, is the generation of an equivalent amount of electricity by the operation of grid-connected power plants and by the addition of new generation sources. In the LaGeo case, the Berlin Binary Cycle power plant will displace an equivalent amount of power in the El Salvador power grid. In the absence of the project, the Unidad de Transacciones (UT) would have been required to dispatch an equivalent amount of power in order to balance the demand and losses of the power grid.

LaGeo adequately demonstrates that in El Salvador the above baseline scenario results in the UT dispatching thermal power plants, as these are the last to be dispatched due to the high fuel price compared to renewable energy power plants. In fact, thermal power plants predominate in the El Salvador generation mix since the General Electricity Law of 1996 being in effect. In this respect, LaGeo correctly refers to documentation on national policies and circumstances from the Superintendencia General de Electricidad y Telecomunicaciones (SIGET) and the UT:

- http://www.siget.gob.sv/documentos/electricidad/legislacion/ley_general_de_electricidad_ref42.pdf;
- <http://168.243.84.62/utweb/introduccion.htm>.

The application of the methodology is correct and the selection of the baseline is transparent. Much of the background documentation referred to is available on the Internet, and therefore it is not reproduced in this report.



3.4 Additionality

The additionality of the project has been demonstrated using the four steps of the additionality Tool (Version 3) as required by ACM0002 Version 6.

The starting date of the project activity was 03/05/2005 with the construction start of the project plant. The validation however started afterwards on 21/02/2006 with the publishing of the AMS I.D based PDD. LaGeo has adequately demonstrated that registration as a CDM project was seriously considered earlier than the starting date, by referring to negotiations with the World Bank's Prototype Carbon Fund and the Finnish CDM/JI Pilot Programme:

- the project was presented to the World Bank via contacts as early as 2000, and to Finland as early as 2003; this was evidenced during the follow-up interviews when DNV examined the e-mail correspondence involved;
- the project idea note (PIN) for the World Bank dates from January 2001 (Geotérmica Salvadoreña, S. A. de C. V., *Prototype Carbon Fund. Project Idea Note (PIN): Binary Power Plant Installation at Berlín geothermal field*, January 3rd, 2001), that for Finland from March 2003 (Geotérmica Salvadoreña, S.A. de C.V., *Finnish CDM/JI Pilot Programme. Project Idea Note: El Salvador. Binary Cycle Installation at Berlin Geothermal Field*, March, 2003).

The starting date of the crediting period is after the registration of the project and thus step 0 of the additionality test does not need to be addressed.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulation

Besides the project activity not undertaken as a CDM project, the other identified alternative is the continuation of the current situation of the thermal power plants further dominating the El Salvador generation mix, increasing the utilization and/or the number of these power plants in the power grid (i.e. the baseline scenario).

Both alternatives are in compliance with local regulations.

Step 2: Investment analysis

This step has not been selected.

Step 3: Barrier analysis

LaGeo's background information regarding the barriers the project faces is found to be appropriate.

The technological barriers relate to the project plant being the first in El Salvador of the "binary cycle" type. Furthermore, there is uncertainty on the length of time the plant can operate before silica scaling becomes a problem in the surface pipework and injection wells. This barrier is in line with the findings of the World Bank survey mentioned above.

The project developer claims the existence of a barrier due to the low internal rate of return of the project. This barrier is mentioned in the PDD but it is not elaborated and thus it could not be verified during the validation process.

Shorter front-up times and less technological risks for thermal power plants than for comparable geothermal power plants form a barrier since in El Salvador investment in thermal power is preferred to investment in renewable power; this is evidenced by the fact already mentioned that thermal power plants predominate in the El Salvador generation mix since the General Electricity Law of 1996.



Step 4: Common practice analysis

During the follow-up interviews it was confirmed that there are only two geothermal fields in El Salvador, Berlin and Aguachapan, both exploited by LaGeo. In the Aguachapan field until 2003, the waste brine was transported to the sea via a 5 km pipeline. Now it is sent directly to the injection wells located in the same geothermal field and it is not used for a binary cycle plant. Thus, it can be concluded that the generation of electricity from waste brine is not common practice in the country.

Even when one of the barriers claimed could not be confirmed, the additionality of the project activity has been sufficiently demonstrated through the existence of technological barriers, investment barriers and barriers due to prevailing practice. Furthermore it has been demonstrated that the project envisages a technology that is no common practice in El Salvador. It can be concluded that it is sufficiently established that the project activity is not a likely baseline scenario.

3.5 Monitoring Plan

The correct application and justification of the ACM0002 Version 6 monitoring methodology lies in the fact that monitoring consists of metering the electricity exported to the power grid.

The monitoring plan provides detailed information related to collection and archiving of the relevant data:

1[project emissions]. The project activity does not co-fire fossil fuels nor produces steam with non condensables causing carbon dioxide and methane emissions, and thus no project emissions indicators need to be monitored (in contrast to a “flash” geothermal plant like the Berlin Phase I plant that uses the steam extracted from the geothermal well, the project plant uses the Berlin Phase I waste brine that contains no more non-condensables);

2[leakage]. The project does not use transferred equipment, and no leakage indicators need to be monitored;

3[baseline emissions]. The sole baseline emissions indicator is electricity exported to the power grid. The electricity meter is located in the LaGeo Berlin electric substation. Metering is on an hourly basis. Calibration will take place each two years according to the UT Regulation for the wholesale market.

The sole indicator monitored complies fully with the monitoring methodology of ACM0002 Version 6.

The CDM Projects Manager is responsible for the Monitoring Plan, the calculation of the emissions reductions, and the training of the personnel involved in the monitoring. The Plant Manager of the LaGeo Berlin Phase I power plant is responsible for the verification of the electricity data and the reporting to the CDM Projects Manager. The Operation Manager is responsible for the electricity metering. The Engineering Manager is in charge of the internal audits and the quality control.

3.6 Calculation of GHG Emissions

The project boundaries are appropriately defined, and encompass:

- The plant equipment in the Berlin geothermal field, from heat exchanger over turbine to substation that connects to the power grid;
- The connected El Salvador grid power stations.



The only source accounted for is power grid emission displacement, and the only greenhouse gas is carbon dioxide. The calculation is limited to the baseline emissions as neither project emissions nor leakage need to be calculated:

1[project emissions]. The project activity does not co-fire fossil fuels nor produces steam with non condensables causing carbon dioxide and methane emissions (in contrast to a “flash” geothermal plant like the Berlin Phase I plant that uses the steam extracted from the geothermal well, the project plant uses the Berlin Phase I waste brine that contains no more non-condensables);

2[leakage]. The project does not use any equipment transferred from other locations.

The formulae and factors used for the emission reduction calculation are deemed to be correct and transparent:

3[baseline emissions]. In accordance with ACM0002 Version 6, the yearly emission reduction is calculated by multiplying yearly electricity export to the power grid with the El Salvador power grid emission factor. The latter emission factor equating 0.693 tCO₂/MWh is fixed ex-ante over the crediting period and is calculated as the 50/50 average of an operating margin (data 2003-05, lambda factor 2005) and a build margin emission factor (data 2005). For the operating margin emission factor, the “Simple Adjusted OM” method was chosen since low-cost/must run resources constitute more than 50%, and detailed data are available (from MARN, grid power stations) but not detailed enough to apply the “Dispatch Data Analysis OM” first choice method (from UT, http://216.184.107.60/utweb/comportamiento_horario.htm). For the build margin emission factor, the grid power station sample group consists of the five stations that have been built most recently. Electricity and fuel data covering 2003-04 come from a MARN study, and the data covering 2005 come from the grid power stations. The calculation refers to the combustion emission factors from the U.S. Energy Information Administration (EIA). DNV has verified that the calculation is correct (Spreadsheet /2/).

No assumptions are made and no uncertainties are considered apart from those inherent to ACM0002 Version 6.

LaGeo’s ex-ante estimated emission reduction of 44 141 tCO₂e per year is the result of the ex-ante determined power grid emission factor above and the following forecast output figures, leading to a net electricity generation of 63 700 MWh per year:

- the installed capacity of 9.2 MWe;
- a capacity factor of 79% combining the difference between the gross and the net electric output (1.0 MWe) with an availability of 89%.

3.7 Environmental Impacts

The environmental impacts are sufficiently documented. According to the El Salvador Environmental Law /10/, the project activity does not require an Environmental Impact Assessment. The Working Permit /6/ states that the project activity fulfils the environmental legislation, indicating that it will not create adverse environmental effects. Improvement of the air pollution around the thermal plants of the power grid can indeed be claimed. But given the small amount of electricity displaced by the project activity compared to the total grid electricity, the contribution of the project activity can be considered marginal.



3.8 Comments by Local Stakeholders

The El Salvador Environmental Law does not require direct consultation of the stakeholders. LaGeo however has been in close communication with MARN (permit delivery instance) and the neighbouring communities (in the framework of the firm's fostering of community socio-economic projects).

The following LaGeo activities are to be considered sufficiently adequate consultation of stakeholders:

- The organization of meetings regarding the project plant in neighbouring municipalities; of the 11/08/2005 meetings in Canton "El Zapotillo" and the 17&19/01/2006 meetings in "Berlin" community, the minutes have been transmitted to DNV (date and place, issues treated and participants' names);
- The organization of an exposition regarding the project plant on 26-29/09/2006 in Alegria municipality; the visitors could give comments in writing in a register book available to the public.

Neighbouring communities' comments - positive without any exception - mainly seem to cover the employment opportunities offered by the project (and the parallel socio-economic projects). Due account was given to these comments:

- LaGeo hired the personnel needed in coordination with the municipalities' representatives;
- LaGeo's workers' cooperative society "Los Ausoles" hired the NGO Fundes for the organization of the participation in the "wildlife protection park" of a) local entrepreneurs and b) both municipalities Berlin and Alegria.

4 COMMENTS BY PARTIES, STAKEHOLDERS AND NGOS

The PDD dated 20/02/2006 was made publicly available on DNV's climate change website (www.dnv.com/certification/climatechange) and Parties, stakeholders and NGOs were through the UNFCCC CDM website invited to provide comments during a 30 days period from 22/02/2006 to 23/03/2006.

No comments were received.

The PDD dated 21/09/2006 was made publicly available on DNV's climate change website since it was based on large-scale ACM0002 instead of small-scale AMS I.D. Parties, stakeholders and NGOs were invited to provide comments from 06/10/2006 to 04/11/2006.

No comments were received.



5 VALIDATION OPINION

Det Norske Veritas Certification AS (DNV) has performed a validation of the Berlin Binary Cycle power plant project in El Salvador. The validation was performed on the basis of UNFCCC criteria for the Clean Development Mechanism and host country criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The review of the project design documentation and the subsequent follow-up interviews have provided DNV with sufficient evidence to determine the fulfilment of the stated criteria.

The host country is El Salvador and the project is proposed as a unilateral project. El Salvador fulfils the participation criteria and has approved the project and authorized the project participants. The DNA of El Salvador has confirmed that the project assists in achieving sustainable development.

The project correctly applies the consolidated baseline and monitoring methodology ACM0002 Version 6.

By using renewable energy which will displace power grid electricity, the project activity results in reductions of CO₂ emission that are real, measurable and give long-term benefits to the mitigation of climate change. It is demonstrated that the project is not a likely baseline scenario. Emission reductions attributable to the project are hence additional to any that would occur in the absence of the project activity.

The total emission reductions from the project are estimated to be on the average 44 141 tCO₂e per year over the selected first 7 year crediting period. The emission reduction forecast has been checked making use of the final spreadsheet information involved, and it is deemed likely that the stated amount is achieved given that the underlying assumptions do not change.

Adequate monitoring procedures exist. Actions involved will take place according to the UT Regulation for the wholesale market. Furthermore, LaGeo has a general monitoring and reporting procedure for all its plants. A training procedure also has been developed.

Local stakeholders' comments were invited through different actions and have been verified to be positive.

In summary, it is DNV's opinion that the project, as described in the project design document dated 25/10/2007, meets all relevant UNFCCC requirements for the CDM and correctly applies the consolidated baseline and monitoring methodology ACM0002 Version 6. Hence, DNV requests the registration of the Berlin Binary Cycle power plant project as a CDM project activity.



6 SUSTAINABILITY AND MONITORING PLAN SENSU LATO

In accordance with the particular Belgian tender requirements /9/, the project design document dated 25/10/2007 contains elaborate information on the project's sustainable development impact. The information is located in Ann. 5, "Environmental and socio-economic impacts of the project" and comprises a table with sustainable development criteria and relevant performance indicators. The monitoring plan for the relevant performance indicators is included in Ann. 4, "Monitoring Information".

The project performance has been assessed against all sustainable development criteria of the Belgian tender Table A5. Criteria with score "0" ("no, or negligible impacts") have not been listed except for water and soil condition. Direct impact of the project activity is restricted to global climate change (mitigation through emission reductions) and employment (enhancement by plant construction and operation). The other impact criteria are correctly said to be met by LaGeo socio-economic projects parallel to the project activity e.g. its "wildlife protection park" and "organic coffee plantation".

Of both direct project performances, that regarding employment is only poorly substantiated, and the score is not supported with further information or materials. The other direct project performance regarding global climate change is as a matter of course fully substantiated.

The relevant criteria for the follow-up have been indicated and this is thoroughly justified. The parallel socio-economic projects "wildlife protection park" and "organic coffee plantation" have received appropriate illustration.

The monitoring plan sensu lato provides for the collection and archiving of the relevant performance indicators. It is under the responsibility of the Environmental Manager of the LaGeo Berlin Phase I power plant.



REFERENCES

Documents provided by the project proponent that relate directly to the project:

- /1/ LaGeo, *Berlin Binary Cycle power plant. Version 4*, 25/10/2007
- /2/ LaGeo, *Baseline El Salvador 2005 final version.xls*
- /3/ MARN, *Carta de aprobación del proyecto “Planta de Ciclo Binario Berlín”*, MARN-DGGA-84/2006, 24 de marzo de 2006
- /4/ MARN, *Dictamen tecnico favorable sobre la contribución al desarrollo sostenible del proyecto geotérmico “Planta Ciclo Binario Berlín”*, MARN-DGGA-594/2006, 14 de marzo de 2006
- /5/ Enex/VGK, *Binary Plant Berlin: Heat Balance Report*, 2005
- /6/ MARN, *Montaje Ciclo Binario para Generar 9.5 MW*, Resolución MARN-No-6348-119-2005 (Descripción del Proyecto, DGGA-17/FA-6348, 08/02/05)

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

- /7/ International Emission Trading Association (IETA) & the World Bank’s Prototype Carbon Fund (PCF), *Validation and Verification Manual*, <http://www.vvmanual.info>
- /8/ CDM - Executive Board, *Consolidated baseline methodology for grid-connected electricity generation from renewable sources*, ACM0002 / Version 06, 19 May 2006
- /9/ FPS of Public Health, Food Chain Safety & Environment, *First Belgian Federal JI/CDM Tender - Terms of Reference*, BE/JICDM/051210, December 2005
- /10/ *Ley de Medio Ambiente*, Diario Oficial República de El Salvador, América Central Tomo No. 339, Numero 79, Lunes 4 de Mayo de 1998
- /11/ CDM Executive Board: *Tool for the demonstration and assessment of additionality*. Version 03 of EB29.



Persons interviewed during the validation, or persons who contributed with other information that are not included in the documents listed above:

- /E/ Energía y Medio Ambiente (Carbon advisor):
Alaide González
- /L/ LaGeo (Project proponent and developer):
Ruben Loy (Engineer for management of contract, CDM responsible)
Saul Rolando Molina Padilla (Equipment and Installation Engineer)
Kevin Padilla (Environmental Specialist)
Silvia de Arevalo (Environmental Coordinator)
Jose Luis Henriquez (Coordinator of Surface facilities)
Ricardo Escobar (Engineering Manager)
Sifredo Artola (Production Manager)
Hugo Renato Jacobo (Development Manager - Social Projection Unit -)
- /M/ MARN (DNA El Salvador):
Mauricio Ayala (DNA approval and sustainable development contribution)

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APPENDIX A

CDM VALIDATION PROTOCOL

Table 1 Mandatory Requirements for Clean Development Mechanism (CDM) Project Activities

Requirement	Reference	Conclusion	Cross Reference / Comment
1. The project shall assist Parties included in Annex I in achieving compliance with part of their emission reduction commitment under Art. 3	Kyoto Protocol Art.12.2	N/A	Table 2, Section E.4.1 / Unilateral project.
2. The project shall assist non-Annex I Parties in achieving sustainable development and shall have obtained confirmation by the host country thereof	Kyoto Protocol Art. 12.2, CDM Modalities and Procedures §40a	OK	Table 2, Section A.3 / Technical Verdict /4/.
3. The project shall assist non-Annex I Parties in contributing to the ultimate objective of the UNFCCC	Kyoto Protocol Art.12.2.	OK	Table 2, Section E.4.1
4. The project shall have the written approval of voluntary participation from the designated national authority of each party involved	Kyoto Protocol Art. 12.5a, CDM Modalities and Procedures §40a	OK	- / LoA /3/.
5. The emission reductions shall be real, measurable and give long-term benefits related to the mitigation of climate change	Kyoto Protocol Art. 12.5b	OK	Table 2, Section E
6. Reduction in GHG emissions shall be additional to any that would occur in absence of the project activity, i.e. a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity	Kyoto Protocol Art. 12.5c, CDM Modalities and Procedures §43	OK	Table 2, Section B
7. In case public funding from Parties included in Annex I is used for the project activity, these Parties shall provide an affirmation that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of	Decision 17/CP.7, CDM Modalities and Procedures Appendix B, § 2	N/A	- / The validation did not reveal any information indicating that the project can be seen as a diversion of ODA funding towards El Salvador.

Requirement	Reference	Conclusion	Cross Reference / Comment
these Parties.			
8. Parties participating in the CDM shall designate a national authority for the CDM	CDM Modalities and Procedures §29	OK	- / Ministerio de Medio Ambiente y Recursos Naturales (MARN).
9. The host Party and the participating Annex I Party shall be a Party to the Kyoto Protocol	CDM Modalities §30/31a	OK	- / El Salvador ratified the Kyoto Protocol on 30th November 1998.
10. The participating Annex I Party's assigned amount shall have been calculated and recorded	CDM Modalities and Procedures §31b	N/A	- / Unilateral project.
11. The participating Annex I Party shall have in place a national system for estimating GHG emissions and a national registry in accordance with Kyoto Protocol Article 5 and 7	CDM Modalities and Procedures §31b	N/A	- / Unilateral project.
12. Comments by local stakeholders shall be invited, a summary of these provided and how due account was taken of any comments received	CDM Modalities and Procedures §37b	OK	Table 2, Section G
13. Documentation on the analysis of the environmental impacts of the project activity, including transboundary impacts, shall be submitted, and, if those impacts are considered significant by the project participants or the Host Party, an environmental impact assessment in accordance with procedures as required by the Host Party shall be carried out	CDM Modalities and Procedures §37c	OK	Table 2, Section F
14. Baseline and monitoring methodology shall be previously approved by the CDM Executive Board	CDM Modalities and Procedures §37e	OK	Table 2, Section B.1.1 and D.1.1 / ACM0002 Version 6.
15. Provisions for monitoring, verification and reporting shall be in accordance with the modalities described in the Marrakech Accords and relevant decisions of the COP/MOP	CDM Modalities and Procedures §37f	OK	Table 2, Section D

Requirement	Reference	Conclusion	Cross Reference / Comment
16. Parties, stakeholders and UNFCCC accredited NGOs shall have been invited to comment on the validation requirements for minimum 30 days, and the project design document and comments have been made publicly available	CDM Modalities and Procedures §40	OK	- / A PDD (Version 1. 2/20/2006) was made publicly available on DNV's Climate Change Website (www.dnv.com/certification/climatechange) and Parties, stakeholders and NGOs were invited to provide comments during the 30 days period from 22/02/2006 to 23/03/2006. No comments received. A PDD (Version 3. 21/09/2006) was made publicly available and Parties, stakeholders and NGOs were invited to provide comments during the 30 days period from 06/10/2006 to 04/11/2006. No comments received.
17. A baseline shall be established on a project-specific basis, in a transparent manner and taking into account relevant national and/or sectoral policies and circumstances	CDM Modalities and Procedures §45c,d	OK	Table 2, Section B.2
18. The baseline methodology shall exclude to earn CERs for decreases in activity levels outside the project activity or due to force majeure	CDM Modalities and Procedures §47	OK	Table 2, Section B.2
19. The project design document shall be in conformance with the UNFCCC CDM-PDD format	CDM Modalities and Procedures Appendix B, EB Decision	OK	- / PDD conforms with format of Version 03 - in effect as of: 28 July 2006.

* <http://www.dnv.com/certification/climatechange/Projects/ProjectDetails.asp?ProjectId=339>

Table 2 Requirements Checklist

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
A. General Description of Project Activity <i>The project design is assessed.</i>					
A.1. Project Boundaries <i>Project Boundaries are the limits and borders defining the GHG emission reduction project.</i>					
A.1.1. Are the project's spatial (geographical) boundaries clearly defined?	/1/	DR	Yes. Region with country map, smaller geographic entity indicated but no name on map (city/town/community of Alegría, Berlin-Tecapa volcanic system). Project activity is at well TR-9 of Berlin Phase I (One) plant, and further at Berlin electric substation.		OK
A.1.2. Are the project's system (components and facilities used to mitigate GHGs) boundaries clearly defined?	/1/	DR	Yes. The project boundaries encompass: - the equipment, from heat exchanger over turbine to substation that connects to the power grid (figure "Simplified Binary Cycle diagram") - the connected El Salvador grid power stations (figure "Project electricity system").	CAR-1	OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
A.2. Technology to be employed <i>Validation of project technology focuses on the project engineering, choice of technology and competence/ maintenance needs. The validator should ensure that environmentally safe and sound technology and know-how is used.</i>					
A.2.1. Does the project design engineering reflect current good practices?	/1/ /L/ /5/	DR I	Yes. Additional information is provided: 1. Oferta ENEX ("Binary bottoming plant for Berlin. Documento de Oferta para la Competencia No LaGeo COM 07/2004, ENEX, 2004") 2. Heat Balance Report /5/.		OK
A.2.2. Does the project use state of the art technology or would the technology result in a significantly better performance than any commonly used technologies in the host country?	/1/	DR	Yes (state of the art technology issue). Internet source describes different designs for thermal energy technologies (see "The World Bank Group, Geothermal Energy: The Technology and the Development Process, 2006"). Project's design fits best seen the link between technology and brine temperature ("intermediate temperature" - 100-220 °C - allows binary cycle technology). N/A (better performance issue, no commonly used technologies in the host country for waste brine thermal energy).		OK
A.2.3. Is the project technology likely to be substituted by other or more efficient technologies within the project period?	/1/ /L/	DR I	No. According to ENEX and LaGeo agreements, operational lifetime expectation is 30 years, while length of crediting period is 7 years.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
A.2.4. Does the project require extensive initial training and maintenance efforts in order to work as presumed during the project period?	/1/ /L/	DR I	Yes (training plus maintenance). The issue is not tackled in the PDD. The contract between LaGeo and ENEX includes 3 weeks training in Iceland of LaGeo operators and visits of LaGeo personnel to ENEX facilities (see Oferta ENEX). LaGeo will review the operational and maintenance manuals together with ENEX in order to include maintenance requirements in the preventive routines. Maintenance after the first year of operation will be performed by LaGeo together with ENEX as part of the technology transfer.		OK
A.2.5. Does the project make provisions for meeting training and maintenance needs?	/1/ /L/	DR I	Yes, see A.2.4.		OK
A.3. Contribution to Sustainable Development <i>The project's contribution to sustainable development is assessed.</i>					
A.3.1. Is the project in line with relevant legislation and plans in the host country?	/1/ /M/ /L/ /6/	DR I	Yes. The project was granted the environmental permit by Resolución MARN-No-6348-119-2005 /6/. In addition Alegria municipality approved the Construction Permit (hard copy available).		OK
A.3.2. Is the project in line with host-country specific CDM requirements?	/1/ /3/	DR	Yes. The project has been approved by the DNA of El Salvador. See LoA /3/.		OK
A.3.3. Is the project in line with sustainable development policies of the host country?	/1/ /4/	DR	Yes. This is confirmed by the DNA. See Technical		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
A.3.4. Will the project create other environmental or social benefits than GHG emission reductions?	/1/ /M/ /L/	DR I	Verdict /4/. Yes (environmental benefits). Air quality improvement (EPA criteria pollutants) seems real, but is not local and rather marginal (El Salvador grid power stations). No (direct social benefits). Implementation stage of project will generate employment and will contribute to local economic growth. Benefits announced do not seem to be originated by the project (but by the parallel projects e.g. wildlife park, organic coffee plantation, fostered community projects).	CL 1	OK
B. Project Baseline <i>The validation of the project baseline establishes whether the selected baseline methodology is appropriate and whether the selected baseline represents a likely baseline scenario.</i>					
B.1. Baseline Methodology <i>It is assessed whether the project applies an appropriate baseline methodology.</i>					
B.1.1. Is the baseline methodology previously approved by the CDM Executive Board?	/1/ /8/	DR	Yes. ACM0002 Version 6 /8/.		OK
B.1.2. Is the baseline methodology the one deemed most applicable for this project and is the appropriateness justified?	/1/	DR	Yes. Berlin Binary Cycle plant is a grid-connected renewable power generation project:: - Applies electricity capacity addition from geothermal sources		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
			- Does not involve switching from fossil fuels at the plant site - Connects to power grid that can be clearly defined and characterized - Does not apply landfill gas (condition not identified in PDD).		
B.2. Baseline Determination <i>The choice of baseline will be validated with focus on whether the baseline is a likely scenario, whether the project itself is not a likely baseline scenario, and whether the baseline is complete and transparent.</i>					
B.2.1. Is the application of the methodology and the discussion and determination of the chosen baseline transparent?	/1/	DR	Yes. Baseline is electricity generated by grid-connected power plants (actual, future).		OK
B.2.2. Has the baseline been determined using conservative assumptions where possible?	/1/	DR	Baseline determined with official data (UT, CEL, SIGET).		OK
B.2.3. Has the baseline been established on a project-specific basis?	/1/	DR	Yes.		OK
B.2.4. Does the baseline scenario sufficiently take into account relevant national and/or sectoral policies, macro-economic trends and political aspirations?	/1/	DR	Yes (national). General Electricity Law (1996, about the development of El Salvador wholesale electricity market). El Salvador official historical capacity installed from SIGET. Trends out of actual economic-financial press releases (CDM projects identified in accordance with ACM0002).		OK
B.2.5. Is the baseline determination compatible with the available data?	/1/	DR	Yes, see B.2.4.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
B.2.6. Does the selected baseline represent the most likely scenario among other possible and/or discussed scenarios?	/1/	DR	Yes. The baseline scenario selected is the generation of an equivalent amount of electricity by the power grid generation mix. This has been demonstrated to be the most likely scenario (see B.2.7 below).		OK
B.2.7. Is it demonstrated/justified that the project activity itself is not a likely baseline scenario?	/1/ /L/	DR I	Yes. Additionality Tool version 3 is used, Step 0 is not applicable. Investment analysis has not been selected (Step 2). Step 1. The identified alternatives are the project activity not undertaken as CDM project and the generation of an equivalent amount of electricity by the generation mix existing in El Salvador or by the addition of new generation sources to the power grid. Step 3 - Partly: Investment barriers. Barrier is the larger up-front investments than for thermal power generation (there are no fiscal incentives for renewable energy projects as in other Latin American countries) Step 3 - Partly: Technological barriers. Barriers include - the project plant is the first of the kind in El Salvador - the formation of scales in the surface pipework and injection wells is unknown (as the brine cools and ages it could affect operation of plant and/or downstream re-injection system) - the fluctuating nature of the geothermal	GL-2	OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
			resource, which is not the case with thermal power generation Step 3 - Partly: Barriers due to prevailing practice. Barrier is the fact that the energy will be sold at the Opportunity Market with its unpredictable prices. Step 4. There are no comparable projects in El Salvador.		
B.2.8. Have the major risks to the baseline been identified?	/1/	DR	N/A, see B.2.6.		OK
B.2.9. Is all literature and sources clearly referenced?	/1/	DR	Yes, see B.2.4.		OK
C. Duration of the Project/ Crediting Period <i>It is assessed whether the temporary boundaries of the project are clearly defined.</i>					
C.1.1. Are the project's starting date and operational lifetime clearly defined and reasonable?	/1/ /L/	DR I	Yes. The starting date (construction) is 03/05/2005. The original operational lifetime of 40 years is revised: according to ENEL and LaGeo agreements, the operational lifetime expectation is 30 years.		OK
C.1.2. Is the assumed crediting time clearly defined (renewable crediting period of seven years with two possible renewals or fixed crediting period of 10 years with no renewal)?	/1/	DR	Yes. The starting date (crediting) is 01/09/2007. The length of the (first renewable) crediting period is 7 years.		OK

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
D. Monitoring Plan <i>The monitoring plan review aims to establish whether all relevant project aspects deemed necessary to monitor and report reliable emission reductions are properly addressed ((Blue text contains requirements to be assessed for optional review of monitoring methodology prior to submission and approval by CDM EB).</i>					
D.1. Monitoring Methodology <i>It is assessed whether the project applies an appropriate baseline methodology.</i>					
D.1.1. Is the monitoring methodology previously approved by the CDM Executive Board?	/1/	DR	Yes. ACM0002 Version 6.		OK
D.1.2. Is the monitoring methodology applicable for this project and is the appropriateness justified?	/1/	DR	Yes. Emission reduction calculation based on monitored electricity generated by the plant and fixed grid emission factor.		OK
D.1.3. Does the monitoring methodology reflect good monitoring and reporting practices?	/1/	DR	Yes. Follows ACM0002.		OK
D.1.4. Is the discussion and selection of the monitoring methodology transparent?	/1/	DR	Yes, see D.1.2. Estimation of fixed grid emission factor: - ex-ante fixed OM emission factor; available information not enough for Dispatch Data Analysis OM, so Simple Adjusted OM - ex-ante fixed BM emission factor.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
D.2. Monitoring of Project Emissions <i>It is established whether the monitoring plan provides for reliable and complete project emission data over time.</i>					
D.2.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for estimation or measuring the greenhouse gas emissions within the project boundary during the crediting period?	/1/	DR	N/A. The project activity does not co-fire fossil fuels nor uses steam with non-condensables causing carbon dioxide and methane emissions. The project plant only uses the waste brine of the Berlin Phase I plant, not the steam with non-condensables separated in this plant.		OK
D.2.2. Are the choices of project GHG indicators reasonable?	/1/	DR	N/A, see D.2.1.		OK
D.2.3. Will it be possible to monitor / measure the specified project GHG indicators?	/1/	DR	N/A, see D.2.1.		OK
D.2.4. Will the indicators give opportunity for real measurements of project emissions?	/1/	DR	N/A, see D.2.1.		OK
D.2.5. Will the indicators enable comparison of project data and performance over time?	/1/	DR	N/A, see D.2.1.		OK
D.3. Monitoring of Leakage <i>It is assessed whether the monitoring plan provides for reliable and complete leakage data over time.</i>					
D.3.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for determining leakage?	/1/	DR	N/A (no need to consider according to ACM0002).		OK
D.3.2. Are the choices of leakage indicators reasonable?	/1/	DR	N/A, see D.3.1.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
D.3.3. Will it be possible to monitor / measure the specified leakage indicators?	/1/	DR	N/A, see D.3.1.		OK
D.3.4. Will the indicators give opportunity for real measurements of leakage effects?	/1/	DR	N/A, see D.3.1.		OK
D.4. Monitoring of Baseline Emissions <i>It is established whether the monitoring plan provides for reliable and complete project emission data over time.</i>					
D.4.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for determining baseline emissions during the crediting period?	/1/	DR	Yes. Monitoring shall consist of metering the electricity generated by the plant. All other parameters are available at validation (input data for fixed grid emission factor estimation, see D.1.4).		OK
D.4.2. Is the choice of baseline indicators, in particular for baseline emissions, reasonable?	/1/	DR	Yes. Follows ACM0002.		OK
D.4.3. Will it be possible to monitor / measure the specified baseline indicators?	/1/	DR	Yes. Electricity transformers/meter observe ANSI(/IEEE) norms.		OK
D.4.4. Will the indicators give opportunity for real measurements of baseline emissions?	/1/	DR	Yes. Measuring equipment will be audited by UT.		OK
D.5. Monitoring of Sustainable Development Indicators/ Environmental Impacts <i>It is checked that choices of indicators are reasonable and complete to monitor sustainable performance over time.</i>					
D.5.1. Does the monitoring plan provide the collection and archiving of relevant data concerning environmental, social and economic impacts?	/1/ /L/ /9/	DR I	Yes. Information in accordance with Belgian tender requirements (Terms of Reference	CAR-2	OK

* MoV = Means of Verification, DR= Document Review, I= Interview

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
			/9/). Relevance of the follow-up is correctly said to be connected to activities parallel to the project activity (see A.3.4). Environmental impact (of wildlife park): - m² reforested area - number pro species of flora/fauna already present - number pro species of animals newly accepted - financial contribution. Social impact (of wildlife park): - number of visitors - number of courses/workshops. Social/economic impact (of fostered community projects): - number of projects. Economic impact (of project): - number of temporary jobs (project plant construction) - number of fixed jobs (project plant operation, organic coffee plantation) - financial contribution.		
D.5.2. Is the choice of indicators for sustainability development (social, environmental, economic) reasonable?	/1/	DR	Yes. Though most indicators concern projects parallel to the project activity.		OK
D.5.3. Will it be possible to monitor the specified sustainable development indicators?	/1/	DR	Yes. Environmental Specialist in charge of the monitoring will be trained for the purpose.		OK
D.5.4. Are the sustainable development indicators in line with stated national priorities in the Host Country?	/1/	DR	N/A (no Host Country priorities). PDD defines sustainable development in general way according to "IUCN 1980 World		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
			Conservation Strategy report".		
D.6. Project Management Planning <i>It is checked that project implementation is properly prepared for and that critical arrangements are addressed.</i>					
D.6.1. Is the authority and responsibility of project management clearly described?	/1/ /L/	DR I	Yes. The Plant Manager has the authority and is responsible for the project management.		OK
D.6.2. Is the authority and responsibility for registration, monitoring, measurement and reporting clearly described?	/1/	DR	Yes. CDM Projects Manager is responsible for Monitoring Plan and calculation of emissions reductions. Plant Manager is responsible for verification of electricity data and reporting to CDM Projects Manager. Operation Manager is responsible for electricity measurement. Engineering Manager is in charge of internal audits and quality control.		OK
D.6.3. Are procedures identified for training of monitoring personnel?	/1/ /L/	DR I	No. The issue is not tackled in the PDD. PDD says the personnel carrying out the monitoring function is trained continuously. LaGeo announced a workshop for monitoring personnel in January, 2007.	CL-3	OK
D.6.4. Are procedures identified for emergency preparedness for cases where emergencies can cause unintended emissions?	/1/ /L/	DR I	The development of the Emergency plan is the responsibility of the contractor. This will be handled over to LaGeo according to the contract. Remark: unintended emissions N/A.		OK

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
D.6.5. Are procedures identified for calibration of monitoring equipment?	/1/ /L/	DR I	Calibration of the monitoring equipment will take place each two years according to the UT Regulation for the wholesale market.		OK
D.6.6. Are procedures identified for maintenance of monitoring equipment and installations?	/1/ /L/	DR I	Yes. The development of the manual concerned is the responsibility of the contractor. This will be handled over to LaGeo according to the contract.		OK
D.6.7. Are procedures identified for monitoring, measurements and reporting?	/1/ /L/	DR I	Yes. PDD Ann. 4. Actions involved will take place according to the UT Regulation for the wholesale market. Besides LaGeo has a general procedure for all its plants (relevant features provided to the validator).		OK
D.6.8. Are procedures identified for day-to-day records handling (including what records to keep, storage area of records and how to process performance documentation)	/1/ /L/	DR I	Yes. See D.6.7.		OK
D.6.9. Are procedures identified for dealing with possible monitoring data adjustments and uncertainties?	/1/	DR	Yes. The Monitoring Plan includes the following procedure: "Non conformance treatment and corrective and preventive actions".		OK
D.6.10. Are procedures identified for review of reported results/data?	/1/ /L/	DR I	Yes. See D.6.7.		OK
D.6.11. Are procedures identified for internal audits of GHG project compliance with operational requirements where applicable?	/1/	DR	Yes. The monitoring plan includes the following procedure: "Internal audit procedure".		OK
D.6.12. Are procedures identified for project performance reviews before data is submitted for verification, internally or externally?	/1/ /L/	DR I	Yes. See D.6.7.		OK
D.6.13. Are procedures identified for corrective actions	/1/	DR	Yes, see D.6.9.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
in order to provide for more accurate future monitoring and reporting?					
E. Calculation of GHG Emissions by Source <i>It is assessed whether all material GHG emission sources are addressed and how sensitivities and data uncertainties have been addressed to arrive at conservative estimates of projected emission reductions.</i>					
E.1. Project GHG Emissions <i>The validation of ex-ante estimated project GHG emissions focuses on transparency and completeness of calculations.</i>					
E.1.1. Are all aspects related to direct and indirect GHG emissions captured in the project design?	/1/	DR	The project activity does not co-fire fossil fuels nor uses steam with non-condensables causing carbon dioxide and methane emissions. The project plant only uses the waste brine of the Berlin Phase I plant, not the steam with non-condensables separated in this plant.		OK
E.1.2. Are the GHG calculations documented in a complete and transparent manner?	/1/	DR	N/A, see E.1.1.		OK
E.1.3. Have conservative assumptions been used to calculate project GHG emissions?	/1/	DR	N/A, see E.1.1.		OK
E.1.4. Are uncertainties in the GHG emissions estimates properly addressed in the documentation?	/1/	DR	N/A, see E.1.1.		OK
E.1.5. Have all relevant greenhouse gases and source categories listed in Kyoto Protocol Annex A been evaluated?	/1/	DR	N/A, see E.1.1.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
E.2.Leakage <i>It is assessed whether there leakage effects, i.e. change of emissions which occurs outside the project boundary and which are measurable and attributable to the project, have been properly assessed and estimated ex-ante.</i>					
E.2.1. Are potential leakage effects beyond the chosen project boundaries properly identified?	/1/	DR	N/A (no need to consider, see D.3.1). PDD contains calculation of emissions due to construction (machinery and vehicles' fuel consumption) to assure negligible.		OK
E.2.2. Have these leakage effects been properly accounted for in calculations?	/1/	DR	N/A, see E.2.1.		OK
E.2.3. Does the methodology for calculating leakage comply with existing good practice?	/1/	DR	N/A, see E.2.1.		OK
E.2.4. Are the calculations documented in a complete and transparent manner?	/1/	DR	N/A, see E.2.1.		OK
E.2.5. Have conservative assumptions been used when calculating leakage?	/1/	DR	N/A, see E.2.1.		OK
E.2.6. Are uncertainties in the leakage estimates properly addressed?	/1/	DR	N/A, see E.2.1.		OK
E.3.Baseline Emissions <i>The validation of ex-ante estimated baseline GHG emissions focuses on transparency and completeness of calculations.</i>					
E.3.1. Have the most relevant and likely operational characteristics and baseline indicators been chosen as reference for baseline emissions?	/1/	DR	Yes, see D.4.1.		OK
E.3.2. Are the baseline boundaries clearly defined and do they sufficiently cover sources and sinks for	/1/	DR	Yes, see A.1.2. Table included: "Sources and gases		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
baseline emissions?			included in the project boundary".		
E.3.3. Are the GHG calculations documented in a complete and transparent manner?	/1/ /L/ /2/	DR I	Yes (PDD and Spreadsheet /2/). General: - grid emission factor is average of OM and BM factors - fuels combusted and gross electricity generation from plants/units, net electricity generation from UT - fuels' HHV and corresponding CO ₂ emission factor from EIA OM factor: - El Salvador low-cost must-run plants hydro, geothermal and cogeneration (bagasse) - factor 2003-05, lambda 2005 BM factor: - option 1 (2005) - El Salvador 5 most recent plants generation Emission reduction: - capacity 9.2 MW - capacity factor 0.7904.		OK
E.3.4. Have conservative assumptions been used when calculating baseline emissions?	/1/	DR	N/A (calculations do not contain components possibly subjected to conservative assumptions).		OK
E.3.5. Are uncertainties in the GHG emission estimates properly addressed in the documentation?	/1/ /L/	DR I	Yes. Imports were not included because SIEPAC interchange not clear.		OK
E.3.6. Have the project baseline(s) and the project emissions been determined using the same appropriate methodology and conservative assumptions?	/1/	DR	N/A (zero-emissions project, see D.2.1).		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
E.4.Emission Reductions <i>Validation of ex-ante estimated emission reductions.</i>					
E.4.1. Will the project result in fewer GHG emissions than the baseline scenario?	/1/	DR	Yes. Ex-ante estimation results in 44 141 tCO ₂ e/year.		OK
F. Environmental and Socio-Economic Impacts <i>Documentation on the analysis of the environmental and socio-economic impacts will be assessed.</i>					
F.1.Environmental Impacts <i>Documentation on the analysis of the environmental impacts will be assessed, and if deemed significant, an EIA should be provided to the validator.</i>					
F.1.1. Has an analysis of the environmental impacts of the project activity been sufficiently described?	/1/	DR	Yes. Dust emission and noise nuisance during construction (mitigation through Environmental Management Plan). For the brine temperature risk, see A.3.4.		OK
F.1.2. Are there any Host Party requirements for an Environmental Impact Assessment (EIA), and if yes, is an EIA approved?	/1/ /M/ /10/ /6/ /4/	DR I	LaGeo submitted "Environment form" (Art. 22 of Environmental Law /10/). MARN (in accordance with Art. 18) decided the project does not require EIA (Working Permit /6/). See Technical Verdict /4/.		OK
F.1.3. Will the project create any adverse environmental effects?	/1/ /M/ /4/	DR I	No. See Technical Verdict /4/.		OK
F.1.4. Are transboundary environmental impacts considered in the analysis?	/1/	DR	No, see F.1.3.		OK
F.1.5. Have identified environmental impacts been	/1/	DR	No, see F.1.3.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

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Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
addressed in the project design?					
F.1.6. Does the project comply with environmental legislation in the host country?	/1/ /M/	DR I	Yes, see A.3.1.		OK
F.2.Sustainability <i>Contribution to sustainable development will be evaluated.</i>					
F.2.1. Has the project performance been assessed against all sustainable development criteria?	/1/	DR	Yes. Components of Terms of Reference ref. /9/ not assessed are granted zero score (no impact or not relevant for the project) and not included except environmental components water and soil. Direct impact of the project activity is restricted to global climate change (mitigation through emission reductions) and employment (enhancement by plant construction and operation).		OK
F.2.2. Are the project performance claims sufficiently substantiated, and are the scores supported with further information or materials?	/1/	DR	Yes. Direct project performance regarding employment poorly commented, score not supported.		OK
F.2.3. Have relevant criteria for the follow-up been indicated and is this thoroughly justified?	/1/	DR	Yes. Relevant criteria indicated and justified (see "Operationalising SD at the project level"). The parallel socio-economic projects "wildlife protection park" and "organic coffee plantation" appropriately illustrated in additional annex.		OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Checklist Question	Ref.	MoV*	Comments	Draft Concl	Final Concl
G. Stakeholder Comments <i>The validator should ensure that a stakeholder comments have been invited and that due account has been taken of any comments received.</i>					
G.1.1. Have relevant stakeholders been consulted?	/1/	DR	Yes. MARN, neighbouring municipalities.	CL-4	OK
G.1.2. Have appropriate media been used to invite comments by local stakeholders?	/1/	DR	No. Official consultation of governmental stakeholders: - MARN contacted for Working Permit - constant communication with neighbouring communities.	CL-4	OK
G.1.3. If a stakeholder consultation process is required by regulations/laws in the host country, has the stakeholder consultation process been carried out in accordance with such regulations/laws?	/1/ /4/ /10/	DR	N/A. Stakeholder consultation not required if EIA is not required (Art. 22 of Environmental Law /10/). See Technical Verdict /4/.		OK
G.1.4. Is a summary of the stakeholder comments received provided?	/1/	DR	Yes.	CAR-3	OK
G.1.5. Has due account been taken of any stakeholder comments received?	/1/	DR	Yes. MARN comments resulted in Environmental Management Plan.	CAR-3	OK

* MoV = Means of Verification, DR= Document Review, I= Interview

Table 3 Resolution of Corrective Action and Clarification Requests

Draft report corrective action requests and requests for clarifications	Ref. to Table 2	Summary of project participants' response	Final conclusion
CAR 1: The project plant does not clearly distinguish between the Berlin Phase I and II geothermal power plants.	A.1.2	Bloc diagram included in PDD ("Berlin Binary Cycle Plant boundaries related to the plants in Berlin geothermal field") plus the information that the project plant makes use of waste brine of the Berlin Phase I geothermal plant.	OK, the distinction is clear between power plants included/not included in the project. CAR closed.
CAR 2: Table with "Monitoring indicators" contains no scores/comments and cannot be considered "Monitoring Plan sensu lato".	D.5.1	PDD adapted: 1. additional annex ("Environmental and socio-economic impacts of the project") 2. table with scores/comments and relevant performance indicators idem "Monitoring indicators" ("Operationalising SD at the project level").	OK, PDD brought in line with Terms of Reference /9/. CAR closed.
CAR 3: The summary of the stakeholder comments is not complete (only MARN comments summarized). The account taken of the comments is complete neither (only Environmental Management Plan mentioned). Can PDD Sects. E.1/2 be adapted?	G.1.4 /1.5	PDD Sects. E.1/2 adapted: Neighbouring communities' comments seem only to cover employment opportunities offered by the project (and parallel socio-economic projects). Account was taken by: 1. LaGeo (personnel hiring in coordination with the municipalities' representatives) 2. LaGeo through its "Workers Cooperative Society "Los Ausoles" and hired NGO "Fundes" (organization of participation of local entrepreneurs and Berlin and Alegria municipalities in the "wildlife protection park").	OK, summary/account taken of stakeholders' consultation completed. Documentation provided includes: 1. report to DOE, "Stakeholders' comments.doc" 2. Fundes coordinates, FUNDAPYME tel. 503-22985353 http://elsalvador2.fundes.org/ . CAR closed.
CL 1: It is not clear if the high risk of brine	A.3.4	The risk was relevant for the Aguachapán field (formerly with open	OK, risk of brine temperature not relevant. CL closed.

Draft report corrective action requests and requests for clarifications	Ref. to Table 2	Summary of project participants' response	Final conclusion
temperature for human health and its mitigation is relevant for the Berlin field.		waste brine ditch to the sea, now with injection wells), not for the Berlin field (injection wells).	
CL 2: Investment barrier announced needs further explanation.	B.2.7	IRR of project part included in Project Input Notes to the World Bank and Finnish CDM/JI Pilote Programme (IRR calculation result included in PDD).	OK, the barrier due to the low IRR could not be verified due to the lack of detailed information. But It has been confirmed that the project faces financial/investment barriers due to the obligation of selling the generated electricity at the Opportunity Market as in El Salvador in the long term the price is totally unpredictable. Furthermore, the larger up-front investment for geothermal power than for comparable thermal power forms a barrier since in El Salvador there are no fiscal incentives for renewable power as in other Latin American countries. CL closed.
CL 3: The issue of procedures for training of the monitoring personnel is not tackled in the PDD (PDD says the personnel carrying out the monitoring function is trained continuously). Were procedures presented at the workshop for monitoring personnel in January, 2007? Are announced procedures now being developed?	D.6.3	PDD Ann. 4 adapted: a training procedure is incorporated in the PDD Ann. 4: "Training procedure". The workshop in January, 2007 was the Workshop I foreseen in the procedure. Continuous training means the following: - Workshop I is repeated when new personnel is granted a function in the project's monitoring activities - the CDM Projects Manager will hold as many meetings with the personnel as necessary.	OK, the Monitoring Plan includes the following procedure: "Training procedure". CL closed.
CL 4: The origin, home base and/or association,	G.1.1 /1.2	PDD Sects. E.1/2 adapted: Neighbouring communities more closely	OK, relevance/media of stakeholders' consultation specified. Documentation

Draft report corrective action requests and requests for clarifications	Ref. to Table 2	Summary of project participants' response	Final conclusion
thus the relevance, of the other stakeholders consulted than MARN and neighbouring communities need further specification. The media used for the other stakeholders also need further specification. Can PDD Sect. E.1 be adapted?		identified. Stakeholders consulted include: 1a. participants to <u>meetings on the project plant</u> organized in neighbouring municipalities 1b. visitors to a LaGeo organized <u>exposition</u> . Stakeholders just informed include: 2a. participants to <u>meetings on the "wildlife protection park"</u> organized in neighbouring municipalities 2b. a <u>trade union</u> (through the appropriate legal means) 2c. attendants to a LaGeo organized <u>fair and workshop</u> .	provided includes: 1a. "Stakeholders 1_Aug11, 2005.pdf" (Canton "El Zapotillo", incl. minutes, names of participants) 1b. "Stakeholders 2_Jan17&19, 2006.pdf" ("Berlin" community, incl. minutes, names of participants) 2a. "Stakeholders 3_Jun6&7&8, 2006.pdf" (3 meetings in neighbouring municipalities, incl. minutes, names of participants) 2b. trade union's letter dated 28/12/06 2c. "Summary Berlin 2005_LaGeo Fair Alegria_Sep26-29, 2006.pdf" and "Workshop for Decision Makers_Nov27, 2006.pdf" (LaGeo slide presentations). See also http://www.casapres.gob.sv/vicepresidenta/boletines/2006/11/vbol2701.html . CL closed.

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APPENDIX B

CERTIFICATES OF COMPETENCE



CERTIFICATE OF COMPETENCE

Sven Starckx

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJ1-i1)

<i>GHG Auditor:</i>	Yes		
<i>CDM Validator:</i>	--	<i>JI Validator:</i>	--
<i>CDM Verifier:</i>	--	<i>JI Verifier:</i>	--
<i>Industry Sector Expert for Sectoral Scope(s):</i>	--		

Høvik, 6 November 2006

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director



CERTIFICATE OF COMPETENCE

Gustavo Godinez-Martinez

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJ1-i1)

<i>GHG Auditor:</i>	Yes		
<i>CDM Validator:</i>	Yes	<i>JI Validator:</i>	--
<i>CDM Verifier:</i>	Yes	<i>JI Verifier:</i>	--
<i>Industry Sector Expert for Sectoral Scope(s):</i>	Sectoral scope 4 & 6		

Høvik, 6 November 2006

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director



CERTIFICATE OF COMPETENCE

Jan Van Evercooren

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJ1-i1)

<i>GHG Auditor:</i>	Yes		
<i>CDM Validator:</i>	--	<i>JI Validator:</i>	--
<i>CDM Verifier:</i>	--	<i>JI Verifier:</i>	--
<i>Industry Sector Expert for Sectoral Scope(s):</i>	Sectoral scope 9		

Høvik, 5 February 2007

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director



CERTIFICATE OF COMPETENCE

Michael Lehmann

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJi-i1)

GHG Auditor:	Yes		
CDM Validator:	Yes	JI Validator:	--
CDM Verifier:	Yes	JI Verifier:	--
Industry Sector Expert for Sectoral Scope(s):	Sectoral scope 4 & 5		
Technical Reviewer for (group of) methodologies:			
ACM0001, AM0002, AM0003, AM0010, AM0011, AM0012, AMS-III.G	Yes	AM0027	Yes
ACM0002, AMS-I.A-D, AM0019, AM0026, AM0029, AM0045	Yes	AM0028, AM0034	Yes
ACM0003, ACM0005, AM0033, AM0040	Yes	AM0030	Yes
ACM0004	Yes	AM0031	Yes
ACM0006, AM0007, AM0015, AM0036, AM0042	Yes	AM0032	Yes
ACM0007	Yes	AM0035	Yes
ACM0008	Yes	AM0038	Yes
ACM0009, AM0008, AMS-III.B	Yes	AM0041	Yes
AM0006, AM0016, AMS-III.D, ACM0010	Yes	AM0034	Yes
AM0009, AM0037	Yes	AM0043	
AM0013, AM0022, AM0025, AM00379, AMS-III.H, AMS-III.I	Yes	AM0046	
AM0014	Yes	AM0047	
AM0017	Yes	AMS-II.A-F, AM0044	Yes
AM0018	Yes	AMS-III.A	Yes
AM0020	Yes	AMS-III.E, AMS-III.F	Yes
AM0021	Yes		
AM0023	Yes		
AM0024	Yes		

Høvik, 5 February 2007

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director



CERTIFICATE OF COMPETENCE

Raman Venkata Kakaraparthi

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJi-i1)

GHG Auditor:	Yes		
CDM Validator:	Yes	JI Validator:	--
CDM Verifier:	--	JI Verifier:	--
Industry Sector Expert for Sectoral Scope(s):	Sectoral scope 5		
Technical Reviewer for (group of) methodologies:			
ACM0002, AMS-I.A-D, AM0019, AM0026, AM0029, AM0045	Yes		

Høvik, 22 December 2006

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director



CERTIFICATE OF COMPETENCE

Einar Ternes

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJ1-i1)

GHG Auditor:	Yes		
CDM Validator:	Yes	JI Validator:	--
CDM Verifier:	Yes	JI Verifier:	--
Industry Sector Expert for Sectoral Scope(s):	Sectoral scope 4 & 5		
Technical Reviewer for (group of) methodologies:			
ACM0001, AM0002, AM0003, AM0010, AM0011, AM0012, AMS-III.G	Yes	AM0027	Yes
ACM0002, AMS-I.A-D, AM0019, AM0026, AM0029, AM0045	Yes	AM0028, AM0034	Yes
ACM0003, ACM0005, AM0033, AM0040	Yes	AM0030	Yes
ACM0004	Yes	AM0031	Yes
ACM0006, AM0007, AM0015, AM0036, AM0042	Yes	AM0032	Yes
ACM0007	Yes	AM0035	Yes
ACM0008	Yes	AM0038	Yes
ACM0009, AM0008, AMS-III.B	Yes	AM0041	Yes
AM0006, AM0016, AMS-III.D, ACM0010	Yes	AM0034	Yes
AM0009, AM0037	Yes	AM0043	
AM0013, AM0022, AM0025, AM00379, AMS-III.H, AMS-III.I	Yes	AM0046	
AM0014	Yes	AM0047	
AM0017	Yes	AMS-II.A-F, AM0044	Yes
AM0018	Yes	AMS-III.A	Yes
AM0020	Yes	AMS-III.E, AMS-III.F	Yes
AM0021	Yes		
AM0023	Yes		
AM0024	Yes		

Høvik, 5 February 2007

Einar Ternes
Director, International Climate Change Services

Michael Lehmann
Technical Director



CERTIFICATE OF COMPETENCE

Miguel Rescalvo

Qualification in accordance with DNV's Qualification scheme for CDM/JI (ICP-9-8-i1-CDMJ1-i1)

<i>GHG Auditor:</i>	Yes		
<i>CDM Validator:</i>	Yes	<i>JI Validator:</i>	--
<i>CDM Verifier:</i>	--	<i>JI Verifier:</i>	--
<i>Industry Sector Expert for Sectoral Scope(s):</i>	--		

Høvik, 6 November 2006

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director