VALIDATION REPORT

Chao Khun Agro Biogas Energy Project

REPORT NO. 2005-1475

REVISION NO. 02

DET NORSKE VERITAS

VALIDATION REPORT

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CERTIFICATION AS

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Approved by: Hendrik W.Brinks	Organisational unit: Climate Change Services
Client: EcoSecurities Group plc	Client ref.: Courtney Blodgett

Project Name: Chao Khun Agro Biogas Energy Project
Country: Thailand
Methodology: AM0022
Version: 04
GHG reducing Measure/Technology: Avoided methane emissions from wastewater treatment and displacement of fossil fuels through on-site utilization of biogas.
ER estimate: 48 167 tCO_2e per year over 10 years.
Size
☒ Large Scale
☐ Small Scale
Validation Phases:
☒ Desk Review
☒ Follow up interviews
☒ Resolution of outstanding issues
Validation Status
☐ Corrective Actions Requested
☐ Clarifications Requested
☒ Full Approval and submission for registration
☐ Rejected

In summary, it is DNV's opinion that the Chao Khun Agro Biogas Energy Project in Thailand, as described in the PDD of 19 February 2009, meets relevant UNFCCC requirements for the CDM and relevant host Party criteria and correctly applies the baseline and monitoring methodology AM0022 (version 04). DNV thus requests the registration of the project as a CDM project activity.

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Report title:
Chao Khun Agro Biogas Energy Project

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Michael Lehmann

Key words:
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Abbreviations

ABR	Anaerobic Baffled Reactor
BOD	Biochemical Oxygen Demand
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction
CH_4	Methane
CIGAR	Covered-In-Ground-Anaerobic-Reactor
CL	Clarification request
CKA	Chao Khun Agro
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
DNV	Det Norske Veritas
DNA	Designated National Authority
ENCON	Energy Conservation
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
MP	Monitoring Plan
N_2O	Nitrous oxide
NCV	Net Calorific Value
NGO	Non-governmental Organisation
ODA	Official Development Assistance
PDD	Project Design Document
TBEC	Thai Biogas Energy Company Ltd
UNFCCC	United Nations Framework Convention on Climate Change
WSL	Waste Solutions Ltd

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1. EXECUTIVE SUMMARY – VALIDATION OPINION

Det Norske Veritas Certification AS (DNV) has performed a validation of the "Chao Khun Agro Biogas Energy Project" in Thailand. The validation was performed on the basis of UNFCCC criteria for the Clean Development Mechanism and host Party 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 stated criteria. Following a request for review, the CDM Executive Board requested at its 45th meeting corrections to the PDD and the validation report.

The project participants are Thai Biogas Energy Company (TBEC) and EcoSecurities Group plc. The Parties involved, Thailand as the host Party and the United Kingdom of Great Britain and Northern Ireland as the participating Annex I Party, meet the requirements to participate in the CDM and have approved the project and authorized the project participants. The DNA from Thailand has confirmed that the project assists in achieving sustainable development.

The project correctly applies the approved baseline and monitoring methodology AM0022 "Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector", version 04.

By capturing and utilizing methane that would otherwise have been emitted to the atmosphere and by generating renewable energy from biogas which will displace the fuel oil currently employed to dry the starch product, the project results in reductions of CH_4 and CO_2 emissions that are real, measurable and give long-term benefits to the mitigation of climate change. It is demonstrated that the project faces barriers and is thus 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 ex-ante GHG emission estimations are calculated and documented in a complete and transparent manner. The algorithm and methodologies for accounting GHG emissions are appropriate and the total emission reductions from the project are estimated to be on the average 48 167tCO_2e per year over the 10 years fixed crediting period. The emission reduction forecast has been checked and it is deemed likely that the estimated amount is achieved given that the underlying assumptions do not change.

The monitoring plan is in line with the approved monitoring methodologies AM0022. The plan adequately addresses all necessary information for monitoring and reporting of emission reductions due to the project activity. Responsibilities and authorities for project management, monitoring and reporting and QA/QC procedures have been described in the PDD.

The project is not likely to create any significant adverse environmental effect. There is no requirement for an EIA by the host Party for this project. The project complies with all statutory requirements and environmental legislation of Thailand.

In summary, it is DNV's opinion that the "Chao Khun Agro Biogas Energy Project" as described in the project design document of 19 February 2009, meets all relevant UNFCCC requirements for the CDM and correctly applies the approved methodology AM0022 (version 4). Hence, DNV requests the registration of the "Chao Khun Agro Biogas Energy Project" as a CDM project activity.

2. INTRODUCTION

EcoSecurities Group plc has commissioned Det Norske Veritas Certification AS (DNV) to perform a validation of the "Chao Khun Agro Biogas Energy Project" in Thailand. This report summarises the findings of the validation of the project, performed 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.

2.1. 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).

2.2. 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 AM0022 (version 04). The validation team has, based on the recommendations in the Validation and Verification Manual /4/ 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.

3. 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.

The following sections outline each step in more detail.

3.1. Desk Review of the Project Design Documentation

The following table outlines the documentation reviewed during the validation:

/1/ EcoSecurities Group plc: "*Chao Khun Agro Biogas* Energy Project", version 1 dated 10 October 2005, version 02 dated 31 May 2007, version 03 dated 17 July 2008 and version 4 dated 19 February 2009

/2/ Office of Natural resources & Environmental Planning (DNA of Thailand): *Letter of Approval, 22 February 2008*

/3/ Department for Environment, Food and Rural Affairs (DNA of United Kingdom): *Letter of Approval, 5 August 2008*

/4/ International Emission Trading Association (IETA) & the World Bank's Prototype Carbon Fund (PCF): *Validation and Verification Manual*. http://www.ieta.org/ieta/www/pages/index.php?IdSitePage=200

/5/ CDM Executive Board: "*Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector*" AM0022, version 04

/6/ CDM Executive Board: "*Tool to determine project emissions from flaring gases containing methane*".

/7/ S. Prasertsan, B. Sajjakulnukit: "*Biomass and biogas energy in Thailand: Potential, opportunity and barriers*", dated 13 September 2005, Science Direct, www.sciencedirect.com.

/8/ Parr, J., Smith, M.D. and Shaw, R.J., *"Wastewater Treatment Options"*, Waterlines, the Journal of Appropriate Technologies for Water Supply and Sanitation, April 2000.

/9/ Ajit P. Annachhatre and Prasanna L. Amatya (2000), "UASB Treatment of Tapioca Starch Wastewater", Journal of Environmental Engineering, December 2000, 1149 ~ 1152

/10/ EcoSecurities: *CKA CER calculations 16.07.08.xls*

/11/ Chao Khun Agro Facility Specific Data::

- Starch generation, thermal energy consumption and electricity consumption records for the factory;
- CKA site diagram;
- CKA reducing sugar test result from AOAC International;

- CKA specific electricity and HFO consumption;
- TBEC workbook (recorded COD and wastewater volume);
- Deposition of solid matter results by Waste Solutions Ltd.;

/12/ Equipment lists:

- Boiler specification sheet;
  Project activity equipment list;

/13/ Investment related documents:

- Investment Memorandum;
- Proposal for TBEC from EcoSecurities;
- Invoice from CMV dated December 2005;
- Financial Statement dated 31 December 2006.

/14/ Stakeholders' consultation – minutes of meeting;

/15/ Completion of training acknowledgement letter;

/16/ Seminar Document : The Promotion of Biogas from Wastewater as An Alternative Energy and for Environmental Improvement, published by the Energy Conservation and Renewable Energy Division and Energy Policy and Planning Office (EPPO), 2007

/17/ Advance Energy Plus Co., Ltd. presented the pilot project of CDM development program in "bundle" pattern among medium size starch manufacturers and small size starch manufacturers. http://www.thaitapiocastarch.org/co-operation_detail.asp?id=5

/18/ Legal Due Diligence Report was prepared by Bamrung Suvicha Apisakdi Law Associates Bangkok

The main changes between the version of the PDD published for the 30 days stakeholder commenting period and the final version submitted for registration:

- *Changes related to the CARs and CLs identified in the DNV's draft validation report.*
- *Starting date of the crediting period has been revised to 1 January 2009;*
- *Emission reductions have been revised to include fugitive emissions from organic deposition, organic oxidation and leakage;*
- *CER estimation changed to 48 167 CO_2e per year to take into account of a full ten calendar years.*

3.2. Follow-up Interviews with Project Stakeholders

	Date	Name	Organization	Topic
/16/	2005-10-26	Dr. Natarika V. Cooper (Climate Change	DNA of Thailand	- Host country approval status. - Legal and environmental

		Coordinator)		requirements. - Stakeholder consultation requirement. - Common practice in Thailand. - Sustainable development issues.
/17/	2005-10-25	1) Souheil H. Abboud (Managing Director) 2) Anek Plangsomran (Biogas supervisor) 3) Phunobphon Phuniphad (Project Manager) 4) Sirichai Laojaturapith (Power Plant Supervisor)	Chao Khun Agro Products / Thai Biogas Energy Company Limited.	- Project technology. - Wastewater generation rate. - Legal and environmental issues. - Stakeholder consultation process. - Monitoring plan and project management. - Emission reduction calculations. - Baseline and additionality related issues
/18/	2005-10-25	Mr James Heath	EcoSecurities	- Project technology. - Project participants. - Applicability criteria. - Additionality. - Legal and environmental issues. - Stakeholder consultation process. - Monitoring plan and project management. - Emission reduction calculations.

3.3. Resolution of Outstanding Issues

The objective of this phase of the validation was to resolve any outstanding issues which needed be clarified prior to DNV's positive conclusion on the project design. In order to ensure transparency a validation protocol was customised for the project. 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 two tables. The different columns in these tables are described in the figure below. The completed validation protocol for the Chao Khun Agro Biogas Energy Project is enclosed in Appendix A to this report.

Findings established during the validation can either be seen as a non-fulfilment of CDM 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) CDM and/or methodology specific 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.

A request for clarification (CL) may be used where additional information is needed to fully clarify an issue.

Following a request for review, the PDD and supporting documents, as well as the validation report have been updated to incorporate the substantiation of the technological, financial and social barriers submitted in response to the request for review.

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Validation Protocol Table 1: Mandatory Requirements for CDM Project Activities		
Requirement	***Reference***	***Conclusion***
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.*

Validation Protocol Table 2: Requirement checklist				
Checklist Question	***Reference***	***Means of verification (MoV)***	***Comment***	***Draft and/or Final Conclusion***
The various requirements in Table 2 are linked to checklist questions the project should meet. The checklist is organised in different sections, following the logic of the large-scale PDD template, version 03 - in effect as of: 28 July 2006. Each section is then further sub-divided.	*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 and Clarification Requests			
Draft report clarifications and corrective action requests	***Ref. to checklist question in table 2***	***Summary of project owner response***	***Validation conclusion***
If the conclusions from the draft Validation are either a CAR or a CL, these should be listed in this section.	*Reference to the checklist question number in Table 2 where the CAR or CL 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

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 has undergone 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.

3.4. Validation Team

Role/Qualification	Last Name	First Name	Country
Team leader, CDM validator	Viddal	Mari Grooss	Norway
CDM validator	Lai	Chee Keong	Malaysia
GHG auditor	Wong	Simon Yon Sing	Malaysia
Sector expert	Ramachandran	Ramesh	India
Technical reviewer	Lehmann	Michael	Norway

The qualification of each individual validation team member is detailed in Appendix B to this report.

4. 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 final validation findings relate to the project design as documented and described in the revised PDD dated 19 February 2009 /1/, corrected as per EB 45, paragraph 43 (bc).

4.1. Participation Requirements

The project participants are Thai Biogas Energy Company (TBEC) and EcoSecurities Group plc. The Parties involved, i.e. Thailand as the host Party and the United Kingdom of Great Britain and Northern Ireland as the participating Annex I Party, meet the requirements to participate in the CDM. Written approvals of voluntary participation from the DNA of Thailand /2/ and the DNA of the United Kingdom of Great Britain and Northern Ireland /3/ have been provided. The DNA of Thailand has also provided confirmation that the project contributes to sustainable development /3/.

The validation did not reveal any information that indicates that the project can be seen as a diversion of Official Development Assistance (ODA). It has been confirmed with the DNA of Thailand and the project participants that the project has not received an ODA.

4.2. Project Design

The project activity envisages the implementation of a covered in-ground anaerobic reactor (CIGAR) at Chao Khun Agro starch processing factory, which is high in organic content, through the installation of a Covered-In-Ground Anaerobic Reactor (CIGAR). The CIGAR is a type of anaerobic digester which is designed to capture the methane generated by the anaerobic treatment of wastewater. The captured methane will be combusted to generate thermal energy for the starch drying process. Any unutilized methane will be flared in an open flaring system. The technology is deemed good current practice.

In the absence of the proposed activity, the wastewater will continue to be treated in a series of anaerobic open lagoon system where the methane generated as result of anaerobic degradation of biogenic material escapes into the atmosphere. The factory currently uses fuel oil to meet its thermal energy requirements.

The proposed project results in the reduction of GHG emission by (i) avoiding the release of methane from open lagoons into the atmosphere, and (ii) displacing fuel oil used for thermal energy generation.

The project applies imported technology and the project will result in a technology transfer. This requires transfer of knowledge, primarily via New Zealand based biotechnology expertise by Waste Solutions Ltd. (WSL) and transfer of technology through transfer of components of the Anaerobic Baffled Reactor (ABR) acting as the digester. Additionally, high-tech monitoring and control systems are required.

Major equipments have been sourced from overseas. It was confirmed during follow-up interview that major equipments such as dual fuel burner and gas blowers have been imported from Germany and New Zealand, respectively. A detailed equipment list involved in the project activity has been provided to the validation team /12/.

The project activity started on 28 July 2005, which is the date when the detailed project process design and budget was provided by WSL to the project proponent /13/. This is deemed to be the earliest starting date of implementation, construction and real action. The project selects a fixed crediting period of 10 years starting from 1 January 2009. The project activity is estimated to reduce 48 167 tCO_2e emissions per year over the crediting period. The expected lifetime of the project is 25 years.

4.3. Baseline Determination

The project correctly applies the approved baseline methodology AM0022 "Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector", version 04 /5/. The project fulfils the following conditions under which AM0022 is applicable.

- Project is implemented in an existing lagoon-based industrial wastewater treatment facilities for wastewater with high organic loading;
- The baseline scenario is the continuation of a current lagoon system for managing wastewater. This is demonstrated in the baseline determination;
- The organic wastewater contains mainly polysaccharides and a smaller amount of simple organic compounds (monosaccharide). Polysaccharides are expected to have an emission factor of 0.25 $kgCH_4$/kg COD, due to the presence of materials akin of simple sugars. This value has been further substantiated as being conservative as research conducted on cassava wastewater has demonstrated values of 0.22-0.24 $kgCH_4$/kg COD /11/. The selected value of 0.21 $kgCH_4$/kgCOD for CH_4 emission factor is lower than the lowest range of the results from the research hence, the use of 0.21 $kgCH_4$/kg COD, as CH_4 emission factor is conservative;
- The project activity involves only improvement of existing wastewater treatment facilities and does not involve setting up of a new facility or extending current site capacity;
- The depth of the anaerobic lagoons is greater than 1m (estimated to be between 4-5m);
- The temperature of the wastewater in the anaerobic lagoons is always at least 15 °C (average ambient temperature in Thailand is about 25 – 30°C);
- The biogas recovered from the anaerobic treatment system is used onsite for heat and power generation, and any surplus biogas is flared;
- Heat and electricity needs per unit input of the wastewater treatment facility remain largely unchanged before and after the project. It was demonstrated that the required amount of electricity for wastewater treatment is relatively small, from the use of pumps. Therefore, it can be considered that the energy needs per unit input of the water treatment facility remain largely unchanged before and after the Project; and
- The data requirements as laid out in the related monitoring methodology can be fulfilled.

To demonstrate that the baseline scenario is the continued use of open anaerobic ponds for wastewater treatment, the following six steps were conducted, in accordance with AM0022.

Step 1: Listing a range of potential baseline options

Four alternative scenarios are considered as potential baseline scenarios:

1. Continuation of current practice (BAU, where wastewater is treated in open anaerobic lagoons without methane capture);
2. Direct release of wastewater to an offsite water way;

3. Anaerobic digestion of wastewater streams;
4. Aerobic treatment of wastewater (activated sludge or filter bed type treatment);

Step 2: Select the barriers from the range of potential barriers

The following potential barriers were used in the analysis of the alternative scenarios:

1. Legal barriers
2. Technical barriers
3. Financial barriers
4. Social barriers
5. Business culture and other barriers

The potential barriers that were identified include all barriers that were listed in the baseline determination section of AM0022.

Step 3: Score the barriers

Each of the barriers selected in Step 2 is scored by addressing a range of potential questions.

1. Legal barrier

The Enhancement and Conservation of National Environmental Quality Act 1992 prohibits the direct release of wastewater to an offsite water way. Direct release of starch processing wastewater to water bodies without further treatment will result in violation of the effluent discharge standards set by the laws and regulations of Thailand. Therefore, Alternative 2 was note considered a realistic baseline scenario and excluded from further assessment. This is confirmed by The Office of Natural resources & Environmental Planning (DNA of Thailand). The DNA of Thailand confirmed that the other identified alternatives (1,3 and 4) do not face any legal barriers. It was verified with the local DNA, that there are presently no regulatory or contractual requirements that enforce implementation of a specific wastewater treatment technology, such as anaerobic digester or aerobic treatment system to tapioca starch processing plants for effluent treatment. Current Thai law allows utilization of open lagoon systems for wastewater treatment in the tapioca industry. Furthermore, it was verified on-site that the open lagoon system at the project site is in full compliance with the stipulated environmental legislation prior to implementation of the project activity. The wastewater characteristics of final effluent from the open lagoon system /11/ show that the facility is in compliance with the National Environment Quality Promotion and Conversation Act B.E. 2535 (valid at the time of baseline).

2. Technical barrier

Baseline alternative 1 represents the common handling of wastewater from tapioca starch production in Thailand. Most of the tapioca starch production facilities utilize open lagoon treatment systems. The related technology, skills and labour are readily available in Thailand and there are few risks associated with this technology. This was confirmed by the DNA of Thailand. Therefore, Alternative 1 does not face technical barriers.

Presently, only a few tapioca starch processing facilities have adopted anaerobic digester technology for wastewater treatment in Thailand. Most of other starch producers are using

lagoon treatment system for wastewater treatment. The CIGAR technology which is being proposed for this project is not available indigenously and needs to be imported, as evidenced from the equipment list provided by the technology supplier /12/. Due to this practice, skills and labor to operate and maintain the new wastewater system properly is not adequate and would therefore represent performance and technology risks. The lack of skilled workers in the biogas filed was highlighted in a study conducted by Prasertsan and Sajjakulnukit /7/.

The anaerobic digestion system requires ongoing precise management of a variety of elements in order to avoid disruptions to the anaerobic treatment process. Extracts from the 2 published articles were provided to DNV /7//8/. The study done by Parr and Smith /8/ clearly shows that anaerobic processes require precise management for the inflow or composition of the incoming wastewater. Reduced performance of the reactor affects the quality of the biogas generated. As the quality of biogas feed is crucial to the smooth operation of the biogas boiler, which in turn is important for the uninterrupted combustion of heat for starch drying process, the interconnection of the systems involved requires constant and ongoing precise management of a variety of elements, water flows, pH etc and therefore is challenging. Therefore, alternative 3 is deemed to face technical barriers.

Furthermore, in response to questions raised by the Executive Board 45 meeting during the review of the project, DNV would like to reiterate that the implementation of anaerobic digester technology in tapioca starch processing facilities is not a common practice due to number of barriers which also make the project activity unviable without CDM benefits. A report from 2007 by the Energy Conservation and Renewable Energy Division and Energy Policy and Planning Office of Thailand (EPPO report) /16/ was reviewed by DNV to verify that open ponds are prevailing practice for the treatment of wastewater at tapioca starch plants in Thailand. The EPPO report confirms that most manufacturers prefer to retain wastewater from cassava starch plant in open ponds. The EPPO report also confirms that during 2003 to 2005, the Ministry of Energy started a pilot demonstration of the biogas system in starch industry with 4 different technologies at 9 factories. The participating manufacturers receive financial support from the Energy Conservation (ENCON) Promotion Fund through four agencies that include: Department of Alternative Energy Development and Efficiency (DEDE), Department of Industrial Works (DIW), King Mongkut's University of Technology Thonburi (KMUTT), and Biogas Advisory Union Foundation (BAU). DNV is of the opinion that the existence of such support scheme demonstrates that these projects faced significant barriers and would have not been developed in the absence of external support.

In addition to the projects receiving financial support under the ENCON scheme, the project proponents have stated in their response that there are 17 similar projects that have applied for CDM financing, suggesting that CDM incentives are necessary for these projects to take place. DNV was able to cross check this by reviewing a published article from the Thai Tapioca Starch Association (TTSA) /17/.

DNV was also provided with a letter from Dr. Saroch Boonyakitsombut, a faculty member of Department of Environmental Engineering, King Mongkut’s University of Technology Thonburi (KMUTT) stating that until CDM became reality the open lagoon system was the most cost effective form of wastewater treatment from starch plants over aerobic and anaerobic systems in Thailand.

No similar projects have been identified by DNV outside of the CDM or ENCON scheme. Therefore, it can be confirmed with reasonable level of assurance that CDM incentives have been a major deciding factor for tapioca plant owners to invest in anaerobic digester and

biogas utilization technology. The few tapioca starch processing facilities that have adopted anaerobic digester technology in Thailand either received financial support under the ENCON scheme or were developed considering CDM.

Similar technical barriers are also applied to an aerobic wastewater treatment system. As mentioned above, most of the starch producers are using lagoon based wastewater treatment systems in Thailand. Aerobic treatment systems are not representing common practice in the starch produce industry in Thailand and starch producers can have difficulties in operating and maintaining the system properly due to the lack of experiences and knowledge. Also considering the high organic load of the starch wastewater, there is a perceived performance uncertainty in applying this technology in starch industry. However, equipment and experienced operators of aerobic systems are likely to be available in Thailand. It is DNV's opinion that aerobic systems (alternative 4) will thus face more technical barriers than the open lagoon system (alternative 1) but less prominent as compared to the anaerobic digester system (alternative 3). Therefore, alternative 4 is also deemed to face technical barriers.

3. Financial barrier

It was verified on-site that the existing open lagoon system does not require additional investments. In addition, its operational costs are minimal due to its low power consumption and operational controls. In contrast, aerobic and anaerobic treatment systems require a constant supply of electricity to ensure proper operations. This would be in addition to the capital investment required for the installation of these systems at the project site. As such, aerobic and anaerobic treatment systems faces greater financial barriers compared to the existing system.

It was claimed that the project developers saw themselves facing a difficulty to obtain funding from the local financial institutions. DNV was able to verify that this is especially true for biogas projects in Thailand and this was highlighted in a joint study conducted by the Thailand Research Fund and Department of Alternative Energy that bio-energy projects face more difficulty in getting finance. DNV was also able to verify in the study that without the subsidy from the Energy Conservation (ENCON) Fund, it is almost impossible to produce a bankable document for the loan proposal. It must be noted that the project did not receive subsidy from the ENCON Fund /7/.

The project is being funded by Thai Biogas Energy Company Ltd (TBEC), a company specifically created to help facilities in Thailand to develop clean technology biogas projects through CDM process. It has also been confirmed by DNV that the profitability of each of the projects being developed by TBEC relies on income from the CDM. It was demonstrated in the Investment Memorandum that the project developers considered the potential benefits from carbon credits before deciding to invest in the project activity /13/. In this Investment Memorandum it is clear that the financial rate of return is only sufficiently attractive if income from the CDM is included. This memorandum is specific evidence to support the barrier due to lack of financing in the absence of CDM.

Furthermore, in response to questions raised by the Executive Board 45 during the review of the project, further evidence has been provided by the project participant. The investors in TBEC commissioned a Legal Due Diligence Report on Chao Khun Agro (CKA) /18/, the host company, while they were considering whether to go ahead with the investment. The Legal Due Diligence Report was prepared by Bamrung Suvicha Apisakdi Law Associates Bangkok, Thailand in March 2004; it includes an assessment of the CKA's audited accounts. DNV was

able to verify that this Legal Due Diligence Report concludes that the auditor of Chao Khun Agro's (CKA) most recent accounts 'had significant concerns over the financial prospects of the Company''. This demonstrates that there was significant risk associated with investing in the project activity which would make equity participation difficult to find locally and internationally. Due to poor financial state of the host company (Chao Khun Agro) it was not possible for CKA to make additional investments in the proposed project activity since it could put their core business at risk and it was not easy to find investors willing to invest in the business.

In addition, the technology implemented under the project activity was imported to Thailand. The equipment imported was paid in US dollars and would have been paid from income from the first years of operation. However, without income from CDM (in dollars), evidenced through the Investment Memorandum, the only income from the project would have been in the local currency (Baht). This would mean that there would be a significant exchange rate risk, which exacerbates the low rate of return and makes the project even more unattractive for investors. This risk was easily mitigated by carbon credit sales that would be paid in US dollars.

Furthermore, in the absence of CDM the only revenue for TBEC was related to the production and utilisation of biogas. It is exposed to the same risks associated with any company developing this kind of project in Thailand. Hence, it is in our opinion that some barriers to the project could be 'generic' to the sector, but are nevertheless real and significant.

In comparison to the baseline case, where the current waste water treatment process requires minimal operational costs, and is able to meet effluent discharge standards, there is no real motivation for the project host other than CDM incentives to invest in a the more expensive, more complicated bio digester.

4. Social Barrier

Novel or new technology is likely to face social barriers to its implementation. The open lagoon system is a well understood and accepted technology in Thailand and as a result, does not face significant social barriers. It has been confirmed with the DNA of Thailand that the open lagoon system is the common practice and thus local communities do not have knowledge of or experience with anaerobic or aerobic treatment technology.

To decrease such risks, public engagement with regard to the project activity has been carried out. It is the opinion of DNV that these barriers are deemed minor but reasonable in the local situation. The two alternatives (anaerobic and aerobic systems) that faced these barriers had other barriers that were much more important and DNV assessed that it was sufficiently demonstrated through those that the project activity faces barriers and concluded on the social barriers to be minor. In response to question raised by EB 45 during the review of the project, even if social barrier is questioned, it is in DNV's opinion that this should not question the overall additionality of the proposed project since it also faces technological and financial barriers.

5. Business culture and other barrier

The primary concern for the management of the facility is for the wastewater discharge to comply with legal requirements at the lowest cost. Energy production is capital intensive and requires greater management resources. It is thus not a priority as fossil fuel sources can be

easily purchased. This indicates that the anaerobic and aerobic systems face barriers due to prevailing business culture. The business-as-usual scenario does not face such barriers.

Step 4: Compare with the most plausible baseline option

Based on the above arguments and the summary table on the barrier analysis presented in section B.4 of the PDD, the continuation of the current system of open anaerobic ponds (Alternative 1) does not have any barriers while the anaerobic digestion system (Alternative 3) and aerobic treatment system (Alternative 4), face technical, financial and business culture barriers, which prevent the implementation of these alternatives. Therefore, Alternative 1, continuation of the current situation, is considered to be the most plausible baseline scenario.

Step 5: Investment Analysis

It was proven in Step 1 to Step 4 that there is only one plausible baseline option. As such, an investment analysis is not necessary as per the methodology.

Step 6: Conclusion

In summary, DNV has confirmed that the existing open anaerobic pond system is the most likely baseline scenario due to the following reasons:

1. It complies with legal requirements;
2. It has the lowest technological risk among all the possible options.
3. It does not require any additional capital investment, and requires minimal maintenance;
4. It is a well understood wastewater treatment system.

The system boundaries can be presented in tabular format:

	GHGs involved	*Description*
Baseline emissions	*CH_4* *CO_2*	*Methane capture from open anaerobic lagoons* *Displacement of fuel oil boilers for on-site heat generation*
Project emissions	*CH_4* *CO_2*	*Fugitive methane emissions from the existing lagoon-based water treatment system, from possible methane emissions from the new anaerobic waste water treatment facility.* *Fugitive methane Emissions from leakage due to piping.* *Fugitive CO_2 emissions from flare and dual fuel burner.*
Leakage	*Zero*	*No leakage effects need to be considered under methodology under AM0022.*

4.4. Additionality

In accordance with AM0022 (version 04) /5/, the project is considered as additional if it can be demonstrated that the baseline is different from the proposed project activity not undertaken as a CDM project. From Section 4.3, the baseline was determined to be the continued use of existing open anaerobic ponds for wastewater treatment without methane capture. This is different from the proposed activity, which will utilize an anaerobic treatment facility and the extraction of biogas for thermal energy generation.

A draft PDD for the project was received on 28 September 2005 and was used as basis for preparing the follow-up interviews and site visit carried out by DNV on 25-26 October 2005. The original PDD suitable for publishing for comments by Parties, stakeholders and NGOs was submitted for validation on 29 October 2005 (please refer to section 4.9 of the validation report). A validation agreement was signed between DNV and EcoSecurities on 19 September 2005, which was based on a proposal for validation services prepared by DNV on 12 September 2005. It was demonstrated that the project developers considered the benefits from carbon credits before operation of the project activity through a contract between the developers and EcoSecurities dated 9 December 2004 /13/. The project activity starting date is defined as 28 July 2005 /13/. AM0022 was approved on 13 May 2005. The reason for the significant delay in requesting registration for the project was the delay in obtaining the approval by the Thai DNA. The project only received LoA in 22 February 2008, several years after the project participant first requested approval.

Based on the justification listed in section 4.3, it is thus concluded that the project is additional.

4.5. Monitoring

The project correctly applies the approved monitoring methodology AM0022 “Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector” version 04 /5/.

4.5.1. Parameters determined ex-ante

The following data and parameters are available during the validation:

1. Biogas generation potential, EF_{CH4} (0.21 kg CH_4 / kg COD);
2. Methane global warming potential, GWP_{CH4} (21);
3. Amount of organic material degraded aerobically in the lagoon system, $M_{lagoon\_aerobic}$ (254 kgCOD / hectare / day);
4. Total organic material removal ratio of the lagoon, R_{lagoon} (96%);
5. Organic material deposition ratio of the lagoon, $R_{deposition}$ (1.78%);
6. Reduction factor for SO_4^{2-} oxidative substance, Rso_4^{2-} (651 kg_{COD}/tSO_4^{2})
7. Net calorific value of fuel oil, NCV (39.996 x 10^{-6} TJ/dm^3);
8. Carbon emission factor for fuel oil, EF (77.367 tCO_2/TJ, calculated as per IPCC 2006);
9. Total lagoon surface area (2.09 hectare);
10. Flare efficiency for open flare (50%).

The total lagoon surface area was obtained from the mill’s drawing plans /11/. R_{lagoon} was determined in accordance with AM0022 prior to the start of the project activity through on-site biochemical testing in the lagoon system. Existing studies on tapioca starch wastewater treatment in open anaerobic lagoons have also indicated that the biogas generation potential

for tapioca starch wastewater is greater than the default IPCC value used in this PDD. Hence, the applied values are considered conservative.
A series of pre-project experiment performed by WSL in 3 May 2006 showed that approximately 1.78% of chemical oxygen demand is lost through sedimentation /11/. The experiments were performed before the CIGAR commissioned on 16 December 2006, which was evidenced with TBEC's annual financial report /13/.
The 2006 IPCC default values that are applied to the other *ex-ante* parameters are applicable to the project activity.

4.5.2. Parameters monitored ex-post

The baseline and project emission parameters that are monitored ex-post are indicated in Section B.7.1 of the PDD. The list of parameters to be monitored is in line with the requirements of AM0022 and the "*tool to determine project emissions from flaring gases containing methane*" /6/.
Baseline emissions from the following sources will be monitored:

1. Daily wastewater flows entering system boundary (measured with cumulative flow meter);
2. Daily wastewater flow leaving project treatment facility (measured with cumulative flow meter);
3. Wastewater organic material concentration entering the project boundary (sampled and analyze daily);
4. Wastewater organic material concentration leaving the treatment facility (sampled and analyze daily);
5. Volume of biogas sent to facility heaters (measured (Nm^3) continuously by a flow meter);
6. Volume of biogas sent to flare (measured (Nm^3) continuously by a flow meter);
7. Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility (measured and calculated);
8. Biogas methane concentration (measured continuously);
9. Biogas calorific value (annually).

Project emissions from the following sources will be monitored as part of the monitoring plan:

1. Amount of chemical oxidising agents entering the digester (sampled daily, analyzed weekly);
2. Amount of chemical oxidising agents out of the digester (sampled daily, analyzed weekly);
3. Heating system combustion efficiency (annually);
4. Flow of wastewater bypassing the new wastewater treatment facility (measured with a flow meter)
5. Biogas leakage from pipeline (daily checks);
6. Organic material removed from wastewater facility (calculated).

As required by the "*Tool to determine project emissions from flaring gases containing methane*" /6/, the measurement of "Other Flare Operating Parameters" is included in the

monitoring plan. A UV sensor is employed to detect flame. This will be monitored to enable the use of a 50% efficiency default for open flares.

The GHG indicators, monitoring methods, and equipments are deemed appropriate and in accordance with AM0022.

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4.5.3. Management system and quality assurance

The monitoring plan has specified the roles and responsibilities of project management in Section B.7.2 and Annex 4 of the PDD. The validation team was able to verify that the project has made necessary provision for meeting training and maintenance needs. A detailed training course to the staff has been provided on 14 November 2006, and a letter to acknowledge the completion of training was made available on 5 November 2007 /15/.

TBEC is an ISO 9001 certified company. The existing procedures have been revised or independent procedures have been established to include the proposed project activity. These procedures will be checked during the first verification period.

All monitoring data will be kept for at least two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

4.6. Estimate of GHG Emissions

The formulas and factors used in the project's emissions calculations are in accordance to the approved baseline methodology AM0022, version 04 /5/.

In the baseline scenario, methane is emitted from the factory's open anaerobic ponds; CO_2 is emitted from the combustion of fuel oil for thermal energy generation. All relevant baseline emissions are accounted for by these two sources. The baseline emissions calculations are documented in a transparent manner and are in accordance to AM0022.

The following emission sources were included in the baseline emissions calculations:

(i) Emission from anaerobic lagoons- The calculations for baseline methane emissions from the open anaerobic lagoons were based on the calculated baseline data in the section on project emissions. All emission factors for surface aerobic losses of organic material, aerobic degradation, deposition or removal as well as chemical oxidation are determined in the same way as described for project emissions calculations (described below). Based on this scenario, the calculated baseline emission is 61 589 tCO_{2e} per year.

(ii) Displacement of fuel oil- The amount of heavy fuel oil displaced by the project activity is estimated using three years of historical data (2001-2003), as required by AM0022. During follow-up interviews, a 3 year historical fuel records was provided to the validation team /11/. A default 2006 IPCC value for NCV is applied in the absence of a site-specific value. This is 0.0404 TJ/t divided by the density (0.99 kg/l from Engineer's Edge, reference in PDD) from which gives 39.9 x 10^{-6} TJ/dm^3. Based on this scenario, the calculated baseline emission is 7899 tCO_{2e} per year.

Total estimated project emissions as per AM0022 are the sum of a) fugitive methane emissions from the existing lagoon based wastewater treatment system, b) possible methane emissions from the new anaerobic wastewater treatment facility, c) from incomplete biogas combustion d) and biogas leaks.

Fugitive methane emissions from the existing lagoon system are based on the anaerobic microbacterial activity, aerobic surface oxidation, chemical oxidation and organic material

lost through deposition. Surface aerobic losses of organic material in pond-based systems equal to the default factor 254 kg COD per hectare of pond surface area and per day and is assumed to be lost through aerobic processes. Wastewater analysis carried out by the host shows that there exists small amount of SO_4^{2-} in the wastewater /11/. The amount of SO_4^{2-} in the wastewater is approximately 116 mg/l /11/. The losses of chemical oxidation demand through chemical oxidation have been accounted in the emission reductions calculation. A series of biochemical test has been carried out on May 2006, which is prior to the start of commissioned on December 2006 /13/ and it was found that the organic material removal ratio, $R_{removal}$ of the lagoon is 96% and the $R_{deposition}$ deposition ratio is 1.78% /11/. The results were provided for review and were found appropriate and in line with the stipulated methodology requirements (project specific and pre-project analysis). Details of the calculations have been addressed in the PDD and presented in a transparent manner.

CO_2 emissions from the combustion of biogas are considered to be carbon neutral and are not included in the project emission calculations. Leaks in the biogas system are expected to be negligible in this project. The technology provider, WSL, has estimated based on their experience that the physical leakage from CIGAR system is less than 1% for systems with size similar to the project activity. To ensure conservativeness, physical leakage factor of 1% of total biogas production is used for the project activity. In any event, the actual of biogas captured are monitored for subsequent verification of emission reductions.

In addition to it, leaks from the biogas pipeline delivery system are estimated to be zero in the project emissions estimates. However, leakage from biogas pipeline will be monitored in accordance with AM0022 which will enable subsequent verification of emission reductions. Calculated project emissions based on this scenario are 20 304tCO_{2e} per year.

As per AM00022, leakage resulting from the project activity is considered to be negligible.

In addition to calculating the emission reduction (ER), AM0022 also requires the project proponent to include verification that the emissions of CH_4 from the lagoons in the baseline situation are not higher than the total emissions of biogas from the digester and lagoons in the project situation. Therefore, emissions reduced from conservative clause were calculated to have an average of 1 017 tCO_2e per year. The project is estimated to result in 48 167 tCO_2e emission reductions per year over its crediting period.

Values and assumptions used in calculating the estimated emission reductions were obtained from the factory's operational records, on site measurements, data from technology providers, 2006 IPCC reference documents and conservative estimations. Aside from the issues raised above, the values and assumptions made in the emission calculations were found to be conservative.

4.7. Environmental Impacts

The DNA of Thailand has confirmed that an Environmental Impact Assessment (EIA) is not required for the emission reductions project activity. An EIA has not been performed and an EIA is not required by Thai law of this project. During site interviews, it was confirmed there are no legal requirements to conduct an EIA in developing the project activity.

The project activity is expected to have positive environmental impacts as a result of reduced methane and odour from the anaerobic ponds, and a reduction in fossil fuel consumption. It is not expected to have significant negative impact on the environment and there are no

significant transboundary effects due to the project. The project is expected to improve the treated wastewater quality and reduce odour to surrounding area.

4.8. Comments by Local Stakeholders

The local stakeholder consultation meeting was held on 8 October 2005 at the Saraburi Inn in Saraburi. Local stakeholders were invited to the meeting through direct invitations, adverts in a newspaper, and through word of mouth. Among those who were consulted were government officials, local officials, NGOs and members of academia. The comments were related to carbon credits, the technology involved in the project activity and the possibility of introducing CIGAR into other industry. No negative comments were received during the stakeholder consultation meeting. The local stakeholder consultation process is deemed appropriate and in line with the national requirements.

4.9. Comments by Parties, Stakeholders and NGOs

The PDD versions 1 and 2 dated 10 October 2005 and 31 May 2007, respectively, were made publicly available on DNV's climate change website[1]. The reason the PDD was published twice is due to the revision of the methodology. The PDD applied AM0022 version 02 initially and later version 04 was applied. Parties, stakeholders and NGOs were through the CDM website invited to provide comments during a 30 days period first from 29 October 2005 to 28 November 2005 for version 1 of the PDD. The revised PDD version 2 was subsequently web-hosted from 2 June 2007 to 1 July 2007. No comments were received during either of the 30 days commenting periods.

[1] http://cdm.unfccc.int/Projects/Validation/DB/BUXKLPCSLMR8WGDLXOGYU2UMAP5H8A/view.html
http://cdm.unfccc.int/Projects/Validation/DB/JT8AV69A87I6I3O8UUUQ73J3FXLNXT/view.html

APPENDIX A

CDM VALIDATION PROTOCOL

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

Requirement	Reference	Conclusion
About Parties		
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	OK
The project shall assist non-Annex I Parties in contributing to the ultimate objective of the UNFCCC.	Kyoto Protocol Art.12.2.	OK
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	~~CAR 1~~ OK
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	~~CAR 1~~ OK
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 these Parties.	Decision 17/CP.7, CDM Modalities and Procedures Appendix B, § 2	OK
Parties participating in the CDM shall designate a national authority for the CDM.	CDM Modalities and Procedures §29	OK
The host Party and the participating Annex I Party shall be a Party to the Kyoto Protocol.	CDM Modalities §30/31a	OK.
The participating Annex I Party's assigned amount shall have been calculated and recorded.	CDM Modalities and Procedures §31b	OK.
The participating Annex I Party shall have in place a national system for estimating	CDM Modalities and Procedures §31b	OK

Requirement	Reference	Conclusion
GHG emissions and a national registry in accordance with Kyoto Protocol Article 5 and 7.		
About additionality		
Reduction in GHG emissions shall be additional to any that would occur in the 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.
About forecast emission reductions and environmental impacts		
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
For large-scale projects only		
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
About stakeholder involvement		
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
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
Other		
The baseline and monitoring methodology shall be previously approved by the CDM Executive Board.	CDM Modalities and Procedures §37e	OK.

Requirement	Reference	Conclusion
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
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
The project design document shall be in conformance with the UNFCCC CDM-PDD format.	CDM Modalities and Procedures Appendix B, EB Decision	OK
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 Requirements Checklist

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
***A.* General Description of Project Activity** *The project design is assessed.*					
A.1. Project Boundaries *Project Boundaries are the limits and borders defining the GHG emission reduction project.*					
A.1.1. Are the project's spatial boundaries (geographical) clearly defined?	/1/	DR	Yes. The project is located at a starch processing factory owned by Chao Khun Agro Products in Songkorn, Kaengkoi, Saraburi Province in Thailand. The GPS coordinates for the project location are: 14°35'59.28"N 101°00'41.30"E.		OK
A.1.2. Are the project's system boundaries (components and facilities used to mitigate GHGs) clearly defined?	/1/	DR I	The project's system boundaries include the Covered-In-Ground Anaerobic Reactor (CIGAR), the open lagoons, the flaring system and the Weishaupt dual fuel burner.		OK
A.2. Participation Requirements *Referring to Part A, Annex 1 and 2 of the PDD as well as the CDM glossary with respect to the terms Party, Letter of Approval, Authorization and Project Participant.*					
A.2.1. Which Parties and project participants are participating in the project?	/1/	DR	Thailand and United Kingdom (UK) are the participating Non-Annex 1 and Annex 1 parties respectively. Thai Biogas Energy Company (TBEC) of Thailand and EcoSecurities Group plc of United Kingdom are the project participants.		OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
A.2.2. Have all involved Parties provided a valid and complete letter of approval and have all private/public project participants been authorized by an involved Party?	/1/ /2/ /3/	DR I	Letters of Approvals from DNA of Thailand and United Kingdom are still pending.	~~CAR 1~~	OK
A.2.3. Do all participating Parties fulfil the participation requirements as follows: - Ratification of the Kyoto Protocol - Voluntary participation - Designated a National Authority	/1/	DR I	**Thailand (Non-Annex 1 Party):** - Ratified the Kyoto Protocol on 28 August 2002. - Letter of Approval from the DNA of Thailand is pending. - The Office of Natural resources & Environmental Planning is the DNA of Thailand. **United Kingdom (Annex 1 Party):** - Ratified the Kyoto Protocol on 31 May 2002. - Letter of Approval from the DNA of United Kingdom is pending. - Department for Environment, Food and Rural Affairs is the DNA of United Kingdom.	~~CAR 1~~	OK
A.2.4. Potential public funding for the project from Parties in Annex I shall not be a diversion of official development assistance.	/1/ /2/	DR I	The project does not involve any public funding from an Annex I Party, and the validation did not reveal any information that indicates that the project can be seen as a diversion of official development assistance (ODA) funding towards Thailand.		OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
A.3. Technology to be employed *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.*					
A.3.1. Does the project design engineering reflect current good practices?	/1/ /9/	DR	The project design engineering reflects good practices as it captures methane emissions from the anaerobic ponds and utilises it to generate thermal energy. This is superior to the current practice of allowing methane emissions from the open lagoons to escape into the atmosphere. The description of the project activity lacks clarity with respect to: a) Configuration/flow regime/type of existing lagoon systems b) Discharge Standards (Land or Waterway) It has to be clarified with analytical data (inlet/outlet) whether the existing lagoon systems are able to meet the discharge standards. (This has been addressed in PDD version 3 dated 17 July 2008.)	~~CL 1~~	OK
A.3.2. Does the project use state of the art technology or would the technology result in a significantly	/1/	DR	The technologies employed include a CIGAR (a type of anaerobic digester), a biogas piping		OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
better performance than any commonly used technologies in the host country?			system, a dual fuel burner for the boiler and the flaring system. This is technologically superior to the current practice of lagoon-based organic wastewater treatment with full methane release to the atmosphere		
A.3.3. Does the project make provisions for meeting training and maintenance needs?	/1/ /9/	DR I	Yes, the project has made necessary provision for meeting training and maintenance needs. Knowledge was provided via New Zealand based company (Waste Solutions Ltd). Site interview established there is an ongoing communication between Waste Solutions and TBEC biogas supervisors and engineers. Waste Solutions specialist visits monthly and there is practical learning and exchange of knowledge opportunities. A detailed training course to the staff has been provided on 14 November 2006.		OK
A.4. Contribution to Sustainable Development *The project's contribution to sustainable development is assessed.*					
A.4.1. Has the host country confirmed that the project assists it in achieving sustainable development?	/1/	DR I	The project is expected to be in line with host-country specific CDM requirements. Host country approval pending.	~~CAR 1~~	OK
A.4.2. Will the project create other environmental or social benefits than GHG emission reductions?	/1/	DR	The project creates environmental benefits by capturing and combusting methane that would otherwise be emitted into the atmosphere. Methane emissions result in		OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			decreased air quality and odour problems to the surrounding area. It will also reduce the factory's fossil fuel consumption. Social benefits resulting from the project include increased employment opportunities and the improvement of local manpower skills.		
B. **Project Baseline** *The validation of the project baseline establishes whether the selected baseline methodology is appropriate and whether the selected baseline represents a likely baseline scenario.*					
B.1. Baseline Methodology *It is assessed whether the project applies an appropriate baseline methodology.*					
B.1.1. Does the project apply an approved methodology and the correct version thereof?	/1/ /5/	DR	The project applies the approved baseline methodology AM0022 "Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector", version 4 of EB28.		OK
B.1.2. Are the applicability criteria in the baseline methodology all fulfilled?	/1/ /5/	DR I	The project fulfils the following conditions under which AM0022 is applicable. - Project is implemented in an existing lagoon-based industrial wastewater treatment facilities for wastewater with high organic loading; - The baseline scenario is the continuation of a current lagoon system for managing wastewater. This is demonstrated in the baseline determination;	~~CL 2~~	OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			- The depth of the anaerobic lagoons is greater than 1m (estimated to be more than 4-5m); - The temperature of the wastewater in the anaerobic lagoons is always at least 15 °C (average ambient temperature in Thailand is about 25 – 30°C); - The biogas recovered from the anaerobic treatment system is used onsite for heat and power generation, and any surplus biogas is flared; - The data requirements as laid out in the related Monitoring Methodology can be fulfilled. Further evidence and justification regarding the following applicability conditions need to be provided. - The organic wastewater contains simple organic compounds (monosaccharides). If the methodology is used for wastewater containing materials not akin to simple sugars as is the case with the project activity wastewater CH_4 emission factor different from 0.21 kg CH_4/kg COD has to be estimated and applied, - The project activity involves only improvement of existing wastewater treatment facilities and does not involve setting up of a new facility or extending		

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			current site capacity, and - Heat and Electricity needs per unit input of the wastewater treatment facility remain largely unchanged before and after the project. (This has been addressed in PDD version 3 dated 17 July 2008.)		
B.2. Baseline Scenario Determination *The choice of the baseline scenario will be validated with focus on whether the baseline is a likely scenario, and whether the methodology to define the baseline scenario has been followed in a complete and transparent manner.*					
B.2.1. What is the baseline scenario?	/1/ /5/	DR	The baseline was determined in accordance to AM0022: ***Baseline scenario for wastewater treatment:*** Treatment of wastewater by open anaerobic pond system without methane gas capture. ***Baseline scenario for thermal generation:*** Generation of thermal energy through the combustion of fuel oil.		OK
B.2.2. What other alternative scenarios have been considered and why is the selected scenario the most likely one?	/1/	DR I	The baseline scenario was determined in accordance to AM0022: **Step 1:** Four alternative baseline scenarios were assessed in the PDD: 1. Continuation of current practice (BAU, where wastewater is treated in open	~~CL 3~~ ~~CL 4~~	OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			anaerobic lagoons without methane capture); 2. Direct release of wastewater to an offsite water way; 3. Anaerobic digestion of wastewater streams 4. Aerobic treatment of wastewater (activated sludge or filter bed type treatment); **Step 2:** The following barriers can be demonstrated to be significant: - Legal barriers - Technical barriers - Financial barriers - Social barriers - Business culture and other barriers **Step 3:** Score the Barriers**.** <u>Legal barriers:</u> The Enhancement and Conservation of National Environmental Quality Act 1992 prohibits the direct release of wastewater to an offsite water way. As this is an absolute barrier to the direct release of wastewater into waterways, this alternative is not discussed further. The DNA of Thailand confirms that the other identified alternatives do not face any legal barriers.		

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			Technical barriers: Open lagoon treatment systems require minimum maintenance and operational control. It is a low tech wastewater treatment option which faces minimal technical barriers. The anaerobic digestion system was indicated to face technical barriers due to the lack of available equipment and skilled labourers in Thailand. This was confirmed by the DNA of Thailand. The anaerobic digestion system also requires ongoing precise management of a variety of elements in order to avoid disruptions to the anaerobic treatment process. Uncertainties such as chemical shock, shortage of skilled operators and engineers to built and operate such biogas plants were reported to be the barriers faced by the project. Evidence should be provided to substantiate these arguments and the difficulties faced by the project. Aerobic wastewater treatment systems require more technical input compared to the open lagoon system. Aerobic systems will thus face more technical barriers than the open lagoon system. However, equipment and experienced operators of aerobic systems are likely to be available in Thailand.		

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			Financial barriers: The open lagoon system is financially attractive as it requires minimal maintenance and capital costs. Operating costs are minor as it requires minimal energy inputs and operational controls. It was reported in the PDD that the aerobic and anaerobic digestion systems faces commercial risks, and that local financing is difficult to obtain. Transparent and documented evidence to support these statements should be provided. Furthermore, it was indicated that relative risk and reward involving parties was considered in discussing financial analysis. An analysis of the financial risks faced by both treatment systems has to be substantiated with financial indicators. Social barrier: Novel or new technology is likely to face social barriers to its implementation. The open lagoon system is a well understood and accepted technology in Thailand and as a result, does not face significant social barriers. It has been confirmed with the DNA of Thailand that the open lagoon system is the common practice and thus local community does not have knowledge of or		

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			experience with anaerobic or aerobic treatment technology. To decrease such risks, public engagement with regard to the project activity has been carried out. Thus, social issues are therefore considered a minor barrier to the latter two scenarios and no barrier to BAU. <u>Business culture and other barriers:</u> The primary concern for the management of the factory is for the wastewater discharge to comply with legal requirements at the lowest cost. Energy production is capital intensive and requires greater management resources. It is thus not a priority as fossil fuel sources can be easily purchased. This indicates that the anaerobic and aerobic systems face barriers due to prevailing business culture. The business-as-usual scenario does not face such barriers. **Step 4:** The existing anaerobic pond system faces the least number of barriers among the potential baseline options. Therefore, it is the most likely baseline. **Step 5:** There is only one plausible baseline option. As such, an investment analysis is not necessary. **Step 6:** It can thus be concluded that the existing open anaerobic pond system is the		

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			most likely baseline because: - It complies with legal requirements; - It has the lowest technological risk among all the possible options. - It does not require any additional capital investment, and requires minimal maintenance; - It is a well understood wastewater treatment system. It is a common practice in the industry for treating wastewater. The baseline was correctly determined according to the requirements stated in AM0022. (This has been addressed in PDD version 3 dated 17 July 2008.)		
B.2.3. Has the baseline scenario been determined according to the methodology?	/1/ /5/	DR	Yes. The baseline discussion and determination was conducted in accordance to the 'Baseline Determination' section of AM0022.		OK
B.2.4. Has the baseline scenario been determined using conservative assumptions where possible?	/1/	DR	Yes. Assumptions regarding the barriers faced by the alternative scenarios are acceptable.		OK
B.2.5. Does the baseline scenario sufficiently take into account relevant national and/or sectoral policies, macro-economic trends and political aspirations?	/1/	DR I	The baseline scenario is the current prevailing practices for wastewater treatment in Thailand and it is in compliance with relevant environmental regulations		OK

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B.2.6. Is the baseline scenario determination compatible with the available data and are all literature and sources clearly referenced?	/1/	DR	It was reported in the PDD that the aerobic and anaerobic digestion systems faces commercial risks, and that local financing is difficult to obtain. Transparent and documented evidence to support these statements should be provided. Furthermore, it was indicated that relative risk and reward involving parties was considered in discussing financial analysis. An analysis of the financial risks faced by both treatment systems has to be substantiated with financial indicators. (This has been addressed in PDD version 3 dated 17 July 2008.)	~~CL 4~~	OK
B.2.7. Have the major risks to the baseline been identified?	/1/	DR	The baseline is not expected to have any major risks.		OK
B.3. Additionality Determination *The assessment of additionality will be validated with focus on whether the project itself is not a likely baseline scenario.*					
B.3.1. Is the project additionality assessed according to the methodology?	/1/	DR	As the baseline determination has demonstrated that the baseline is different from the proposed project activity not undertaken as a CDM project activity, it can be concluded that the project is additional. It remains to be demonstrated that the anaerobic and aerobic digestion systems are	~~CL 4~~	OK

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			economically unattractive and faces significant commercial risks. Supporting documents should also be provided to prove that local financing for such projects are difficult to obtain. Furthermore, it was indicated that relative risk and reward involving parties was considered in discussing financial analysis. An analysis of the financial risks faced by both treatment systems has to be substantiated with financial indicators. (This has been addressed in PDD version 3 dated 17 July 2008.)		
B.3.2. Are all assumptions stated in a transparent and conservative manner?	/1/	DR	Yes. Assumptions made in the baseline determination were clearly stated in the PDD.		OK
B.3.3. Is sufficient evidence provided to support the relevance of the arguments made?	/1/	DR	Transparent and documented evidence to support the commercial risks and economic attractiveness of the anaerobic and anaerobic systems were not clearly referenced. Supporting documents should also be provided to prove that local financing for such projects are difficult to obtain. (This has been addressed in PDD version 3 dated 17 July 2008.)	~~CL 4~~	OK
B.3.4. If the starting date of the project activity is before the date of validation, has sufficient evidence	/1/	DR	The project activity started on 27 December		OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
been provided that the incentive from the CDM was seriously considered in the decision to proceed with the project activity?	/9/	I	2005, which is before the validation date. It was demonstrated that the project developers considered the benefits from carbon credits before operation of the project activity through a contract between the developers and EcoSecurities dated 9 December 2004. The validation team was able to verify that a proposal was prepared between the two parties on 9 December 2004.		
***C.* Calculation of GHG Emissions by Source** *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.*					
C.1. Calculation of GHG Emission Reductions – Project emissions *It is assessed whether the project emissions are stated according to the methodology and whether the argumentation for the choice of default factors and values – where applicable – is justified.*					
C.1.1. Are the calculations documented according to the approved methodology and in a complete and transparent manner?	/1/ /5/	DR	The project emissions calculations are documented in a transparent manner and are in accordance to AM0022 and the "*tool to determine project emissions from flaring gases containing methane*". The project emissions directly attributable are the emissions from the followings: (i) the lagoons receiving effluent discharge	~~CL 5~~	OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			from the digester, and (ii) fugitive emissions from the incomplete combustion of methane in the open flare. Further clarifications and justifications are required with respect to: - Basis for considering leakages as nil from anaerobic reactors, and - Basis for determination of biogas line leaks (This has been addressed in PDD version 3 dated 17 July 2008.)		
C.1.2 Have conservative assumptions been used when calculating the project emissions?	/1/	DR I	The assumptions made in the calculation of project emissions are clearly stated. The organic removal ratio used in the calculations was determined by carrying out a series of biochemical tests prior to project implementation, as per AM0022. The organic deposition rate under the project scenario was assumed to be zero. It was assumed that all solid material that could sediment would have been largely degraded in the digester. Chemical oxidation rate is assumed to be zero as it was claimed by the project proponent that there are no oxidative materials used in the production process. Further clarifications and justifications are	~~CL 5~~	OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			required with respect to: - Basis for considering organic deposition rate as nil, - Basis for considering chemical oxidation rate as nil. (This has been addressed in PDD version 3 dated 17 July 2008.)		
C.1.3 Are uncertainties in the project emission estimates properly addressed?	/1/	DR I	Uncertainties with regards to the quantity of wastewater treated and quantity of biogas captured were identified. Both parameters will be monitored ex post to ensure an accurate estimation of project emissions.		OK
C.2. Calculation of GHG Emission Reductions – Baseline emissions *It is assessed whether the baseline emissions are stated according to the methodology and whether the argumentation for the choice of default factors and values – where applicable – is justified.*					
C.2.1. Are the calculations documented according to the approved methodology and in a complete and transparent manner?	/1/	DR	The baseline emissions calculations are documented in a transparent manner and are in accordance to AM0022. The following emission sources were included in the baseline emissions calculations: (i) the treatment of wastewater in open anaerobic lagoons, and (ii) the combustion of fuel oil for thermal		OK

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			energy generation.		
C.2.2. Have conservative assumptions been used when calculating the baseline emissions?	/1/ /5/ /9/	DR	The calculation for amount of fuel oil displaced by the use of biogas for the generation of thermal energy (F) was not clearly shown in the PDD. It was assumed in the PDD that the quantity of biogas will replace 37% of the fuel used on site through biogas. It would be beneficial to demonstrate how this assumption was derived at when calculating the biogas displacement capacity. The amount of fossil fuel displaced by the project activity should be estimated using three years of historical data, as required by AM0022. During follow-up interviews, the historical fuel and starch production data were provided to the validation team. The organic deposition rate was assumed to be zero. It was assumed that all solid material that could sediment would have been largely degraded in the digester. Chemical oxidation rate is assumed to be zero as it was claimed that there are no oxidative materials used in the production process. Further clarifications and justifications are required with respect to:	~~CL 5~~ ~~CL 6~~ ~~CL 7~~	OK

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			- Basis for considering organic deposition rate as nil, - Basis for considering chemical oxidation rate as nil. (This has been addressed in PDD version 3 dated 17 July 2008.)		
C.2.3. Are uncertainties in the baseline emission estimates properly addressed?	/1/	DR	Uncertainties with regards to the quantity and COD concentration of the wastewater were identified. The baseline emissions calculation uses appropriate values for these parameters.		OK
C.3. Calculation of GHG Emission Reductions – Leakage *It is assessed whether leakage emissions are stated according to the methodology and whether the argumentation for the choice of default factors and values – where applicable – is justified.*					
C.3.1. Are the leakage calculations documented according to the approved methodology and in a complete and transparent manner?	/1/ /5/	DR	In accordance to AM0022, leakage resulting from the project activity is considered to be negligible.		OK
C.4. Emission Reductions *The emission reductions shall be real, measurable and give long-term benefits related to the mitigation of climate change.*					
C.4.1. Are the emission reductions real, measurable and give long-term benefits related to the mitigation of climate change.	/1/ /5/	DR	The project will result in fewer GHG emissions than the baseline scenario. In addition to calculating the emission reduction		OK

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			(ER), the AM0022 methodology also requires the project proponent to include verification that the emissions of CH_4 from the lagoons in the baseline situation are not higher than the total emissions of biogas from the digester and lagoons in the project situation. Therefore, emissions reduced from conservative clause were calculated to have an average of 1 017 tCO_2e per year. The project is estimated to result in 48 167 tCO_2e emission reductions per year over its crediting period.		
***D.* Monitoring Plan** *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).*					
D.1. Monitoring Methodology *It is assessed whether the project applies an appropriate baseline methodology.*					
D.1.1. Is the monitoring plan documented according to the approved methodology and in a complete and transparent manner?	/1/ /5/	DR	Yes. The project applies the approved monitoring methodology AM0022 version 4 of EB28 "Avoided Wastewater On-site Energy Emissions in the Industrial Sector".		OK
D.1.2. Will all monitored data required for verification and issuance be kept for two years after the end	/1/	DR I	All monitoring data will be kept for at least two years after the end of the crediting period		OK

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of the crediting period or the last issuance of CERs, for this project activity, whichever occurs later?			or the last issuance of CERs for this project activity, whichever occurs later.		
D.2. Monitoring of Project Emissions *It is established whether the monitoring plan provides for reliable and complete project emission data over time.*					
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	Yes. The following monitoring data will be collected for the estimation of project emissions: - Volume of biogas sent to facility heaters (Nm^3, V_{heat}); - Volume of biogas sent to flare (Nm^3, V_{flare}); - Biogas methane concentration (% of Nm^3/Nm^3, C_{CH4}); - Heating system combustion efficiency (%, f_{heat}); - Daily wastewater flows entering system boundary (m^3, ww_{input}); - Wastewater organic material concentration entering the project boundary (kg COD/m^3, COD_{input}); - Flare operation; No physical leakage of methane from the digester is expected as the system is maintained under sub-atmospheric pressure. However, leakage from the biogas piping system will be monitored ex-post.		OK

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D.2.2. Are the choices of project GHG indicators reasonable and conservative?	/1/ /6/	DR	The choices of project GHG indicators are in line with the requirements of AM0022 and the "*tool to determine project emissions from flaring gases containing methane*".		OK
D.2.3. Is the measurement *method* clearly stated for each GHG value to be monitored and deemed appropriate?	/1/ /6/	DR	Measurement methods are specified in the monitoring plan, B.7 in the PDD. COD of effluent will be measured by an accredited laboratory. From the "Tool to determine project emissions from flaring gases containing methane", 50% was selected as the combustion efficiency of the open flare. The monitoring of biogas losses through the piping system is included in the monitoring plan. Biogas leaks in the piping system are monitored using a gas detector and the testing is done on daily basis.		OK
D.2.4. Is the measurement *equipment* described and deemed appropriate?	/1/	DR	Measurement equipments are listed in the monitoring plan and are deemed appropriate.		OK
D.2.5. Is the measurement *accuracy* addressed and deemed appropriate? Are procedures in place on how to deal with erroneous measurements?	/1/	DR I	Procedures to deal with erroneous measurements have been in placed. The procedures are covered under the ISO procedures QP-CKA-NC-01 (non-conformity).		OK
D.2.6. Is the measurement *interval* identified and deemed appropriate?	/1/	DR	Measurement intervals for the monitoring parameters are in accordance with the		OK

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			methodology. In accordance to the requirements of AM0022, the boiler will be maintained annually. This has been reflected in the PDD.		
D.2.7. Is the *registration*, *monitoring*, *measurement* and *reporting* procedure defined?	/1/	DR I	Procedures for registration, monitoring, measurement and reporting have been established. A daily summary of SCADA report and the reading from the plc recorder will be compiled by the shift manager. The CDM data sheet is then cross-checked with another internal summary report at HQ. These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		OK
D.2.8. Are procedures identified for *maintenance* of monitoring equipment and installations? Are the calibration intervals being observed?	/1/	DR I	Procedures for maintenance and calibration have been covered in ISO: Maintenance-QP-CKA-MT-01 and ISO: Calibration-QP-CKA-CE-01 respectively. The gas analyzer is calibrated on-site with standardized sample gas. Two gas analyzers are available, if one of them fails, the other will act as a backup. When both analyzers undergo maintenance simultaneously, a portable gas analyzer will be used. The calibration certificate of this device is available.		OK

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			These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		
D.2.9. 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/	DR I	Procedures for handling day-to-day records are listed in ISO QP-CKA-DC-01 and responsibilities have been assigned to staff members.		OK
D.3. Monitoring of Baseline Emissions *It is established whether the monitoring plan provides for reliable and complete baseline emission data over time.*					
D.3.1. 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 I	Yes. The following monitoring data will be collected for the estimation of baseline emissions: - Daily wastewater flows entering system boundary (m^3, ww_{input}); - Wastewater organic material concentration entering the project boundary (kg COD/m^3, COD_{input}); - Volume of biogas sent to facility heaters (Nm^3, V_{heat}); and - Biogas methane concentration (% of Nm^3/Nm^3, C_{CH4}).		OK
D.3.2. Are the choices of baseline GHG indicators	/1/	DR	The choices of project GHG indicators are in		OK

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reasonable and conservative?	/5/		line with the requirements of AM0022		
D.3.3. Is the measurement *method* clearly stated for each baseline indicator to be monitored and also deemed appropriate?	/1/	DR	Measurement methods are specified in the monitoring plan, B.7 in the PDD. COD will be measured by an accredited laboratory, while the quantity of wastewater treated will be measured with flow meters.		OK
D.3.4. Is the measurement *equipment* described and deemed appropriate?	/1/	DR	Measurement equipments are listed in the monitoring plan and are deemed appropriate		OK
D.3.5. Is the measurement *accuracy* addressed and deemed appropriate? Are procedures in place on how to deal with erroneous measurements?	/1/	DR I	Procedures to deal with erroneous measurements have been in placed. The procedures are covered under the ISO procedures QP-CKA-NC-01 (non-conformity). These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		OK
D.3.6. Is the measurement *interval* for baseline data identified and deemed appropriate?	/1/	DR	Measurement intervals addressed in the monitoring plan are in accordance with the methodology. The wastewater flows entering and leaving the treatment facility will be monitored continuously with flow meters. This is in accordance with the AM0022 methodology		OK

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			and has been reflected in the PDD.		
D.3.7. Are the *registration, monitoring, measurement* and *reporting* procedures defined?	/1/	DR I	Procedures for registration, monitoring, measurement and reporting have been established. A daily summary of SCADA report and the reading from the plc recorder will be compiled by the shift manager. The CDM data sheet is then cross-checked with another internal summary report at HQ. These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		OK
D.3.8. Are procedures identified for *maintenance* of monitoring equipment and installations? Are the calibration intervals being observed?	/1/	DR I	Procedures for maintenance and calibration have been covered in ISO: Maintenance-QP-CKA-MT-01 and ISO: Calibration-QP-CKA-CE-01 respectively. The gas analyzer is calibrated on-site with standardized sample gas. Two gas analyzers are available, if one of them fails, the other will act as a backup. When both analyzers undergo maintenance simultaneously, a portable gas analyzer will be used. The calibration certificate of this device is available. These procedures should be established and implemented before the commencement of		OK

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			the crediting period to enable subsequent verification of emission reductions.		
D.3.9. 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/	DR I	Procedures for handling day-to-day records are listed in ISO QP-CKA-DC-01 and responsibilities have been assigned to staff members. These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		OK
D.4. Monitoring of Leakage *It is assessed whether the monitoring plan provides for reliable and complete leakage data over time.*					
D.4.1. Does the monitoring plan provide for the collection and archiving of all relevant data necessary for determining leakage?	/1/ /5/	DR	No sustainable development indicators are included in the monitoring plan. This is not required by AM0022 nor by Thai requirements. There is no requirement to monitor any sustainable development in Thai law.		OK
D.5. Monitoring of Sustainable Development Indicators/ Environmental Impacts *It is assessed whether choices of indicators are reasonable and complete to monitor sustainable performance over time.*					
D.5.1. Is the monitoring of sustainable development indicators/ environmental impacts warranted by legislation in the host country?	/1/	DR	There is no requirement to monitor the sustainable development indicators in		OK

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			Thailand at present.		
D.6. Project Management Planning *It is checked that project implementation is properly prepared for and that critical arrangements are addressed.*					
D.6.1. Is the authority and responsibility of overall project management clearly described?	/1/	DR	Yes, the authority and responsibility of project management is described in Section B.7.2 of the PDD. It was verified during site interviews the existence of key TBEC personnel at Chao Khun Agro site, e.g. Biogas Supervisor, Electrical Supervisor and Project Manager. Their responsibility includes day-to-day operations, trouble-shooting, maintenance and close liaison with Waste Solutions specialist and other equipment vendors. Their primary role is consistent input of GHG related project parameters into database and ensuring data is protected and meets the project objective of generating verifiable CERs.		OK
D.6.2. Are procedures identified for training of monitoring personnel?	/1/	DR	The company is an ISO 9001 certified company. Internal training has been conducted on 14 November 2006 and documents to substantiate this have been provided to the validation team.		
D.6.3. Are procedures identified for emergency preparedness for cases where emergencies can cause unintended emissions?	/1/	DR I	Emergency procedures especially in case of fire have been implemented. It is unclear if emergencies that can affect the emission reductions are likely to occur. If yes,		OK

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			emergency preparedness procedures should at the latest is implemented prior to commencement of the project. These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		
D.6.4. Are procedures identified for review of reported results/data?	/1/	DR I	The company is an ISO 9001 certified company. Procedures for internal review of monitoring data are detailed in ISO procedures. It remains to be demonstrated if procedures for project management covering authority & responsibility, measurement, monitoring, reporting, calibration, maintenance, performance reviews, internal audits are linked to existing ISO 9001 system. These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.	~~CL 8~~	OK
D.6.5. Are procedures identified for corrective actions in order to provide for more accurate future monitoring and reporting?	/1/	DR I	The company is an ISO 9001 certified company. Procedures for corrective actions are detailed in ISO procedures. It remains to be demonstrated if procedures	~~CL 8~~	OK

CHECKLIST QUESTION * MoV = Means of Verification, DR= Document Review, I= Interview	Ref.	MoV*	COMMENTS	Draft Concl.	Final Concl.
			for project management covering authority & responsibility, measurement, monitoring, reporting, calibration, maintenance, performance reviews, internal audits are linked to existing ISO 9001 system These procedures should be established and implemented before the commencement of the crediting period to enable subsequent verification of emission reductions.		
E. **Duration of the Project/ Crediting Period** *It is assessed whether the temporary boundaries of the project are clearly defined.*					
E.1.1. Are the project's starting date and operational lifetime clearly defined and evidenced?	/1/	DR	The starting date of the project activity was 27 December 2005, and the project is estimated to have an operational lifetime of 25 years. Evidence that the project starting date is the earliest date of implementation, construction or real action is needed. (This has been addressed in PDD version 3 dated 17 July 2008.)	~~CL 9~~	OK
E.1.2. Is the start of the crediting period clearly defined and reasonable?	/1/	DR I	A fixed crediting period of 10 (ten) years starting in 1 April 2008 has been selected. The project proponent has agreed to revise		OK

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			the crediting period to 1 January 2009 in PDD version 3 dated 17 July 2008.		
***F.* Environmental Impacts** *Documentation on the analysis of the environmental impacts will be assessed, and if deemed significant, an EIA should be provided to the validator.*					
F.1.1. Has an analysis of the environmental impacts of the project activity been sufficiently described?	/1/	DR	Yes. The project is expected to have minimal environmental impact. Sludge generation, handling and disposal issues should be elaborated in the environmental impacts of the project activity. (This has been addressed in PDD version 3 dated 17 July 2008.)	~~CL 10~~	OK
F.1.2. Are there any Host Party requirements for an Environmental Impact Assessment (EIA), and if yes, is an EIA approved?	/1/	DR I	An EIA has not been performed and an EIA is not required by Thai law of this project. During site interviews, it was confirmed there are no legal requirements to conduct and EIA in developing the project activity.		OK
F.1.3. Will the project create any adverse environmental effects?	/1/	DR	The project is expected to have positive environmental impacts as a result of reduced methane and odours emissions from the anaerobic ponds, and a reduction in fossil fuel consumption. The construction of the CIGAR will require the development of previously unused land. This is not expected to result in significant environmental impacts.		OK

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F.1.4. Are transboundary environmental impacts considered in the analysis?	/1/	DR	There are no adverse transboundary environmental impacts.		OK
F.1.5. Have identified environmental impacts been addressed in the project design?	/1/	DR	The project's negative environmental impacts will not be significant.		OK
F.1.6. Does the project comply with environmental legislation in the host country?	/1/	DR I	The factory complies with the relevant effluent discharge standards.		
***G.* Stakeholder Comments** *The validator should ensure that stakeholder comments have been invited with appropriate media and that due account has been taken of any comments received.*					
G.1.1. Have relevant stakeholders been consulted?	/1/ /9/	DR	Government officials, local officials, NGOs and members of academia were consulted.		OK
G.1.2. Have appropriate media been used to invite comments by local stakeholders?	/1/ /9/	DR I	Yes. The local stakeholder consultation meeting was held on 8 October 2005 at the Saraburi Inn in Saraburi. Local stakeholders were invited to the meeting through direct invitations, adverts in a newspaper, and through word of mouth.		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/	DR	Yes.		OK
G.1.4. Is a summary of the stakeholder comments	/1/	DR	Yes, the stakeholders		

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received provided?			meeting minutes were presented to the validation team. Comments received were incorporated in the meeting minutes.		
G.1.5. Has due account been taken of any stakeholder comments received?	/1/	DR	The comments were related to carbon credits, the technology involved in the project activity and the possibility of introducing CIGAR into other industry. No negative comments were received during the stakeholder consultation meeting.		

Table 3 Resolution of Corrective Action and Clarification Requests

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
CAR 1 The Letters of Approvals from the DNA of Thailand and United Kingdom are pending.	Table 1 A.2.2. A.2.3 A.4.1	LoA by Thai DNA granted on 22 Feb 2008. LoA by the United Kingdom granted on 5 August 2008.	LoAs by the DNA of Thailand and the DNA of the United Kingdom have been received.
CL 1 The description of the project activity lacks clarity with respect to: a) Configuration/flow regime/type of existing lagoon systems b) Discharge Standards (Land or Waterway) It has to be clarified with analytical data (inlet/outlet) whether the existing lagoon systems are able to meet the discharge standards.	A.3.1.	a) Further description was added to the PDD and the site layout was provided b) Please see Thailand env laws (Chapter IV, part 5: Water Pollution), included and Discharge standard law. The projects were and still are in compliance with the National Environment Quality Promotion and Conservation Act B.E. 2535 which states that industrial food wastewater can be discharged at up to 400 mg/l COD. A footnote has been added to the PDD. Compliance with existing standards is verified annually by local authorities. Certification is included. A footnote has been added to the PDD. Historical COD info was provided to the validator to demonstrate that, prior to project implementation, the discharge was lower than 400 mg/l, in compliance with regulation.	a) Description of the existing lagoon systems were added to the revised PDD. DNV was able to confirm the site layout through follow-up interviews. b) The discharge standards stipulated by the Department of Environmental Quality Promotion (DEQP) were provided to DNV. It has been verified through the discharge standard compliance certificate that the existing lagoon systems are able to meet the discharge standard. CL is closed.

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
CL 2 Further evidence and justification regarding the following applicability conditions need to be provided. - The organic wastewater contains simple organic compounds (monosaccharides). If the methodology is used for wastewater containing materials not akin to simple sugars as is the case with the project activity wastewater CH_4 emission factor different from 0.21 kg CH_4/kg COD has to be estimated and applied, - The project activity involves only improvement of existing wastewater treatment facilities and does not involve setting up of a new facllity or extending current site capacity, and - Heat and Electricity needs per unit input of the wastewater treatment facility remain largely unchanged before and after the project. -	B.1.2.	-The Reducing Sugar biochemical test from AOAC International was used to test for monosaccharides. The test results of influent of 0.04 g of reducing sugar /100ML, demonstrate the presence of monosaccharides. Although cassava wastewater also mainly contains polysaccharides, which have an emission factor of 0.25 kgCH4/kg COD, due to the wastewater being akin to simple sugars (as stated on page 3 of AM0022) and in order to be conservative, 0.21 kgCH4/kg COD will be used. This value is derived from a very conservative interpretation of the IPCC default value of 0.25 kg CH_4/kg COD, from the Good Practice Guidance and Uncertainty Management in National GHG Inventories, page 5.16, as stated in AM0022. This value has been further substantiated as being conservative as research[2] conducted on cassava wastewater has demonstrated values of 0.22-0.24 kgCH_4/kg COD. - The meth states: It is not applicable for	- The Reducing Sugar biochemical test conducted in 2007 demonstrates the presence of monosaccharides in the organic wastewater. - It has been confirmed during follow-up interviews that the project activity was implemented to improve the existing wastewater treatment facilities and does not involve the extending of current site capacity. - The required amount of electricity for wastewater treatment is relatively small, Therefore, it can be considered that the energy needs per unit input of the water treatment facility remain largely unchanged before and after the Project. CL is closed.

[2] Ajit P. Annachhatre and Prasanna L. Amatya (2000), "UASB Treatment of Tapioca Starch Wastewater", Journal of Environmental Engineering, December 2000, 1149 ~ 1152

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
		new facilities to be built or new build to extend current site capacity. As the project is not a new build, this applicability criteria is met. - Historical and 2007 data for electricity consumption, HFO use and starch production (ww volume is based on starch production and, as starch production records were kept more accurately than ww volume, starch production was use). This information was provided to the validator. This information demonstrated that the heat and electricity needs for the wastewater treatment increased only slightly, from the use of pumps.	
CL 3 It was argued in the PDD that the anaerobic digestion system requires ongoing precise management on a variety of elements in order to avoid disruptions to the anaerobic treatment process. Uncertainties such as chemical shock, shortage of skilled operators and engineers to built and operate such biogas plants were reported to be the barriers faced by the project. Evidence should be provided to substantiate these arguments and the	B.2.1.	Documents were provided as evidence. "Wastewater treatment options" by Parr and Smith includes discussion on chemical shock. "Biomass and biogas energy in Thailand" demonstrates proof about the shortage of human resources. Furthermore, please refer to Annex 6 for proof of the training conducted by Waste Solutions to train the staff to work on the ABR.	Extracts from the 2 published articles were provided to DNV. The study done by Parr and Smith clearly shows that anaerobic processes require precise management for the inflow or composition of the incoming wastewater. In addition to it, the project is taken up in a location where availability of skilled manpower is a barrier for the project. Due to need for higher technical skills, new employees received training

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
difficulties faced by the project.			from suppliers. Evidence for this has been assessed and confirmed by DNV. CL is closed.
CL 4 It was reported in the PDD that aerobic and anaerobic digestion systems face commercial risks, and that local financing is difficult to obtain. Transparent and documented evidence to support these statements should be provided. Furthermore, it was indicated that relative risk and reward involving parties was considered in discussing financial analysis. An analysis of the financial risks faced by both treatment systems has to be substantiated with financial indicators.	B.2.1. B.2.6. B.3.1. B.3.3.	"Biomass and biogas energy in Thailand: potential, opportunity and barriers" by Prasertsan and Sajjakulnukit provides evidence about the financial barriers to biomass projects in Thailand. Note that the project activity did NOT receive a subsidy from the ECON fund. Also, please see attached proof of consideration of carbon credits in the confidential PEMF Investment Memorandum. The significant value of carbon credits is mentioned throughout the memorandum; revenue from carbon credits was essential in approving investment in the project activity. The project activity was not able to get funding from any Thai sources; it is only able to proceed due to being financed exclusively by equity from	The project proponent convened a board meeting on 16 October 2003 regarding the potential investments in a biogas system. The Investment Memorandum was submitted to DNV as soft copy for review. It was demonstrated in the Investment Memorandum that the project developers considered the benefits from carbon credits before operation of the project activity. It was argued in the confidential document that the decision to proceed with the project activity was encouraged by potential CDM incentives. Furthermore, it was explained in a joint study conducted by the Thailand Research Fund and Department of Alternative Energy that bio-energy project face more difficulty in getting finance. Without the subsidy from the ENCON Fund, it is almost impossible

[3] Proof of this was provided to the validator.
[4] Proof of this was provided to the validator.

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
		foreign investors specializing in high-risk projects. For example, Al Tayyar Energy is a private equity investor with several years experience working on high-risk energy investments in developing countries. Local investors are unwilling to take on the risks of such a novel project [3] with an unproven technology. In order to be incentivized to invest in the project with a technology unknown in Thailand, the foreign investors looked towards the added benefits from CDM[4]. The benefits from the CDM were an integral part of the investors' decision to proceed; benefits from CDM were considered with the other benefits from the project from the very start. Had carbon credits not been one of the benefits associated with the project, the investors would have been in a similar situation as local investors; they would have lacked the encouragement to invest. In addition to the risk from the project activity, there was the very significant risk associated with the operation of the	to produce a bankable document for the loan proposal. It must be noted that the project did not receive subsidy from the ENCON Fund. CL is closed.

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
		factory which produces the wastewater in the project activity. One example of this is, in 2005, there was a prolonged droughts that crushed cassava crop output (Partos 2005), harming the Thai cassava industry. Further demonstrated this risk is the fact that a number of cassava producers went bankrupt in 2006.	
CL 5 Further clarifications and justifications are required with respect to: - Basis for considering leakages as nil from anaerobic reactors, - Basis for determination of biogas line leaks, - Organic deposition rate, and - Chemical oxidation rates.	C.1.1. C.1.2. C.2.1.	- The ABR is covered by a high quality 1 mm High Density Polyethylene (HDPE) membrane which floats on the surface of the lagoon and leaks are not expected. However, leaks will be monitored on-site annually, in accordance with the methodology. To be conservative, a 1% leakage default value was used in ex-ante ER calculations. - There will be limited leakage as the pipelines are less than 2km and made of high quality material. In addition, the pipelines will be monitored by a gas detector to ensure that there is no leakage. - Testing was completed at the project site prior to the start of the project	- Leaks in the biogas system include leaks from any anaerobic digester are expected to be zero in this project. Because the CIGAR is being operated effectively under sub atmospheric pressures, air will be sucked in as opposed to biogas leaking out. The technology provider, WSL, has estimated based on their experience that the physical leakage from CIGAR system is less than 1% for systems with size similar to the project activity. To ensure conservativeness in emissions reductions estimations, physical leakage factor of 1% of total biogas production is used for the project activity. The monitoring of biogas leaks will enable subsequent verification of emission

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
		activity in order to determine the deposition rate. A conservative rate of 1.78% was determined. - The presence of sulphates exist in the wastewater. Sulphate levels are monitored and they are included in the PDD and calculator.	reductions. The monitoring of biogas leaks will enable subsequent verification of emission reductions. - Leaks from the biogas pipeline delivery system are estimated to be zero in the project emissions estimates. The monitoring of biogas leaks will enable subsequent verification of emission reductions. - The letter from the biotechnologist representing the technology supplier shows that the organic deposition rate is 1.78%. - The waste water entering the project activity boundary contains small traces of sulphates. The emission reduction calculation has been revised. CL is closed.
CL 6 The calculation for amount of fuel oil displaced by the use of biogas for the generation of thermal energy (F) was not clearly shown in the PDD.	C.2.2.	The PDD for adjusted for clarification. The calculation was completed as according to the meth.	The revised calculation was reflected in the revised PDD. CL is closed.

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
CL 7 It was assumed in the PDD that the quantity of biogas will replace 37% of the fuel used on site through biogas. It would be beneficial to demonstrate how this assumption was derived at when calculating the biogas displacement capacity.	C.2.2.	This was calculated based on historical fuel oil usage. However, these percentages are just an estimate; related parameters will be monitored.	The monitoring of the volume of biogas sent to facility heaters will enable subsequent verification of emission reductions. CL is closed.
CL 8 It remains to be demonstrated if procedures for project management covering authority & responsibility, measurement, monitoring, reporting, calibration, maintenance, performance reviews, internal audits are linked to existing ISO 9001 system	D.6.4. D.6.5.	Included in the existing ISO 9001 system is the scope of production and supply of biogas and electricity and heat. The monitoring of these parameters is covered by ISO procedures.	The existing procedures have been revised or independent procedures have been established to include the proposed project activity. These procedures will be checked during the first verification period. CL is closed.
CL 9 The project activity started on 27 December 2005, which is before the validation date. Evidence that the project starting date is the earliest date of implementation, construction or real action is needed.	E.1.1.	28 July 2005 is 6 weeks before the date of the invoice for milestone 2 from the technology provider. As stated in the invoice, the final budget was provided and the decision to proceed with the project was made.	The project activity started on 28 July 2005, which is the date when the detailed project process design and budget was provided by WSL to the project proponent. This date is earlier than the signing of construction as it is the design state. Also the financial agreement was not signed until after this date as the final budget was not known. This is deemed to be the earliest starting date of implementation, construction

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Validation team conclusion
			and real action. CL is closed.
CL 10 The description of environmental impacts in the PDD excludes the sludge generation and handling and disposal issues.	F.1.1.	There is a minimal amount of sludge produced and all sludge produced is extracted and pumped back into the lagoon in order to maintain the bacteria levels in the system. If sludge is applied to land, it will be applied in a thin layer – less than 0.1m – in a manner that ensures minimal methane emissions.	The environmental impacts of the proposed project are low as the project as the sludge will be re-used in the lagoon and periodically pumped out of the digester for land application as fertilizer. CL is closed.

APPENDIX B

CERTIFICATES OF COMPETENCE

CERTIFICATE OF COMPETENCE

Ramesh Ramachandran

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, 13		
Technical Reviewer for (group of) methodologies:			
ACM002, AMS-I.A-D, AM0019, AM0026, AM0029, AM0045	Yes		

Høvik, 22 December 2006

Einar Telnes
Director, International Climate Change Servicer

Michael Lehmann
Technical Director

CERTIFICATE OF COMPETENCE

Mari Grooss Viddal

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):	--		
Technical Reviewer for (group of) methodologies:			
ACM0001, AM0002, AM0003, AM0010, AM0011, AM0012, AMS-III.G	Yes		
ACM002, AMS-I.A-D, AM0019, AM0026, AM0029, AM0045	Yes		

Høvik, 26 September 2007

Michael Lehmann
Technical Director, International Climate Change Services

CERTIFICATE OF COMPETENCE

Chee Keong Lai

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):	--		

Høvik, 30 October 2007

Michael Lehmann
Technical Director, International Climate Change Services

CERTIFICATE OF COMPETENCE

Yon Sing (Simon) Wong

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

GHG Auditor:	Yes		
CDM Validator:	--	***JI Validator:***	Yes
CDM Verifier:	--	***JI Verifier:***	--
Industry Sector Expert for Sectoral Scope(s):	--		

Høvik, 30 November 2007

Michael Lehmann
Technical Director, International Climate Change Service

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:***	Yes
CDM Verifier:	Yes	***JI Verifier:***	Yes
Industry Sector Expert for Sectoral Scope(s):	Sectoral scope 1, 2, 3		
Technical Reviewer for (group of) methodologies:			
ACM0001, AM0002, AM0003, AM0010, AM0011, AM0012, AMS-III.G	Yes	*AM0027*	Yes
ACM002, AMS-I.A-D, AM0019, AM0026, AM0029, AM0045	Yes	*AM0030*	Yes
ACM003, ACM0005, AM0033, AM0040	Yes	*AM0031*	Yes
ACM0004, ACM0012	Yes	*AM0032*	Yes
ACM0006, AM0007, AM0015, AM0036, AM0042	Yes	*AM0035*	Yes
ACM0007	Yes	*AM0038*	Yes
ACM0008	Yes	*AM0041*	Yes
ACM0009, AM0008, AMS-III.B	Yes	*AM0034*	Yes
AM0006, AM0016, AMS-III.D, ACM0010	Yes	*AM0043*	
AM0009, AM0037	Yes	*AM0046*	
AM0013, AM0022, AM0025, AM0039, AMS-III.H, AMS-III.I	Yes	*AM0047*	
AM0014	Yes	*AMS-II.A-F, AM0044*	Yes
AM0017	Yes	*AMS-III.A*	Yes
AM0018	Yes	*AMS-III.E, AMS-III.F*	Yes
AM0020	Yes		
AM0021, AM0028, AM0034, AM0051	Yes		
AM0023	Yes		
AM0024	Yes		

Høvik, 5 February 2007

Einar Telnes
Director, International Climate Change Services

Michael Lehmann
Technical Director