CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Utilisation of Biomass at Palm Oil Manufacturing Factories in Sabah, Malaysia

A.2. Description of the project activity:

The project proposes to convert the method for treating palm oil mill effluent (POME) discharged from the Beaufort palm oil factory (Lumadan Mill factory) in Sabah, Malaysia, from the present anaerobic open lagoon method to the closed anaerobic method, with a view to collecting methane gas, using this to generate electricity, and connecting this to the power grid.
As a result, the project will reduce emissions of methane gas discharged from open lagoons, and it will also have a fossil fuels substitution effect in generating electricity for the power grid.

The project crediting period is 16 years, and the aggregate reduction of emissions during this period is estimated as 218,399 ton-CO_2.

The project will contribute to sustainable development in the following ways:
- Effect in terms of improving river environment
- Environmental effect in terms of preventing bad odor from wastewater treatment plants
- Environmental effect in terms of preventing fires at wastewater treatment plants
- Diversification of energy resources
- Effective utilization of energy
- Effect in terms of enhancing human resources through introducing new technologies
- Employment creation effect through project realization (construction and operation)

Moreover, through implementing the project as a CDM undertaking, it is possible that this will provide a spark for dissemination of the technology to the palm industry not only in Malaysia but also in all Indonesia and Thailand.

A.3. Project participants:

○ Hokkaido Electric Power Co., Inc.: a Japanese electric power company seeking to actualise the project. It is scheduled to fund the project and acquire CERs in return.
○ Taisei Construction Co., Ltd.: a Japanese general construction and engineering firm seeking to actualise the project. It is scheduled to fund the project and acquire CERs in return.
○ Sawit Kinabalu Berhad: the company that owns Lumadan Mill factory, which is the target site of the project. In addition to providing the project site, it will fund the project and obtain revenue from the project.
○ Borneo Samudera Sdn. Bhd.: the company in charge of running Lumadan Mill factory, which is the target site of the project. Moreover, this is a group company of Sawit Kinabalu Berhad. Operation and maintenance of the project will be subcontracted to this company.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

Host country:
Malaysia

CER recipient:
JAPAN

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

Sabah State

A.4.1.3. City/Town/Community etc:

Beaufort

Figure 1 Location Map of the Project Site

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Malaysian economy recorded negative actual GDP growth of minus 7.4% in 1998 due to the effects of the 1997~1998 Asian economic crisis; however, it recovered to show positive growth of 5.8% in 1999 and 8.5% in 2000. After this, product exports declined and economic growth again slowed to 0.4% in 2001 as a result of the global economic slowdown; however, thanks to adoption of a new economic package consisting of fiscal policy expansion and promotion of consumption, it again recovered to 4.1% in 2002.

The main industry that supports the economy of Malaysia is the palm oil industry; indeed Malaysia is the world's number one producer in this sector. Palm oil, a vegetable oil made from oil palm, is widely used as the raw material for margarine and as the cooking oil for snack foods, etc.

There are more than 300 palm oil factories throughout Malaysia, and approximately 30% of these are located in Sabah Province. The project site of Lumadan Mill factory is one of these. Lumadan Mill factory is a medium-size plant having FFB treatment capacity of 45 t/h, although it plans to increase its FFB capacity to 90 t/h in future. There are no permanent residents living within 2~3 km of the factory.

The plantation belonging to Lumadan Mill factory has an area of 6,832 ha and accounts for roughly 30% of the factory's FFB harvest. The remaining 70% or so is harvested from the SLDB (Sabah Land Development Board) and individually run farms. In future, there are plans to expand the factory plantation in line with replanting in order to stabilize the FFB harvest, and it is scheduled for the factory plantation to provide around 70% of the requirement by 2014.

Palm oil factories are broadly divided into those using the centrifuge treatment process and those using the decanter treatment process. Lumadan Mill factory adopts the decanter process, and part of this entails removing sludge and spreading it over fields.

POME that is discharged from the factory is generally treated by the open lagoon method, and the factory uses both anaerobic and aerobic lagoons for this purpose. Treated effluent is discharged into the local river. This treatment method was adopted out of consideration to construction cost and maintenance cost, and as can be seen in Figure 2, the open lagoons at Lumadan Mill factory comprise 1 grid open lagoon, 4 anaerobic open lagoons, 3 aerobic open lagoons and 1 stabilization open lagoon. Sludge that accumulates in the open lagoons is removed around once every 4 years.

Currently, out of these open lagoons, methane fermentation is carried out in an anaerobic environment in the grid and anaerobic open lagoons, and methane gas with a global warming potential (GWP) of 21 is discharged into the atmosphere from these. Moreover, Malaysia does not currently have any legislation for controlling methane discharges from open lagoons, and there are no plans to adopt such legislation in the future. Furthermore, Sawit Kinabalu Berhad, the company that owns Lumadan Mill factory, has no plans to change the current treatment processes.

It is under these circumstances that the project proposes to introduce a closed treatment method in place of the current anaerobic open lagoon process, to collect methane gas and use this for generating electricity for sale to SESB (Sabah Electricity Sdn. Bhd.). Incidentally, SESB only manages power transmission and distribution facilities in Sabah Province, and it has no system connections with other provinces or countries.

Moreover, Malaysia has the SREP (Small Renewable Energy Project) for the promotion of renewable energy. This provides for preferential tax measures and power purchase prices and will be applied in the project.

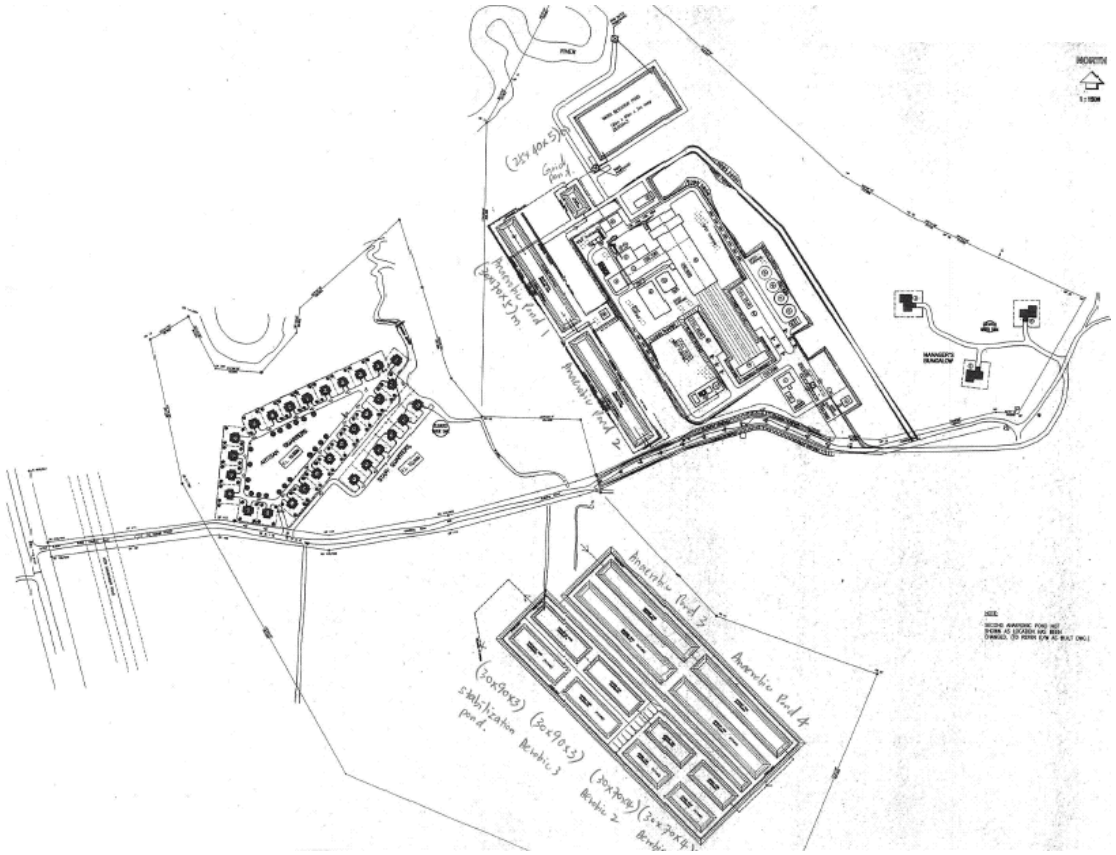

Figure 2 Top View of Lumadan Mill factory

A.4.2. Category(ies) of project activity:

Methane aversion/renewable energy
(Out of the 15 Sectoral Scopes entrusted by the DOE, this corresponds to 1 (Energy industries (renewable - / non-renewable sources), 4 (Manufacturing) and 13 (Waste handling and disposal)).

A.4.3. Technology to be employed by the project activity:

Figure 3 shows the conceptual flow of the new wastewater treatment plant.
In the project, sludge that has conventionally been spread on fields will be reutilised by inserting it into new anaerobic ponds together with POME from the grid pond, and letting it reside in the anaerobic ponds for 10 days. During this retention period, anaerobic fermentation will cause biogas containing methane gas to be generated together with sludge, and this will have the effect of reducing COD/BOD through consuming the organic content of POME.

A cover is placed over the surface of the anaerobic pond to prevent contact with the atmosphere. After biogas generated inside the anaerobic pond has accumulated under the cover, it is removed from the system and sent to the flare stack or generator. Liquid inside the anaerobic pond is recirculated by circulatory pump. At this time, since sludge at the bottom of the tank is stirred up as suspended solids, it comes into contact with the POME and further enhances the anaerobic fermentation effect. Part of the

circulating liquid is removed from the circulating line and conveyed to the adjoining anaerobic pond. After repeating this procedure a number of times, the treated effluent enters the aerobic pond in the next process.

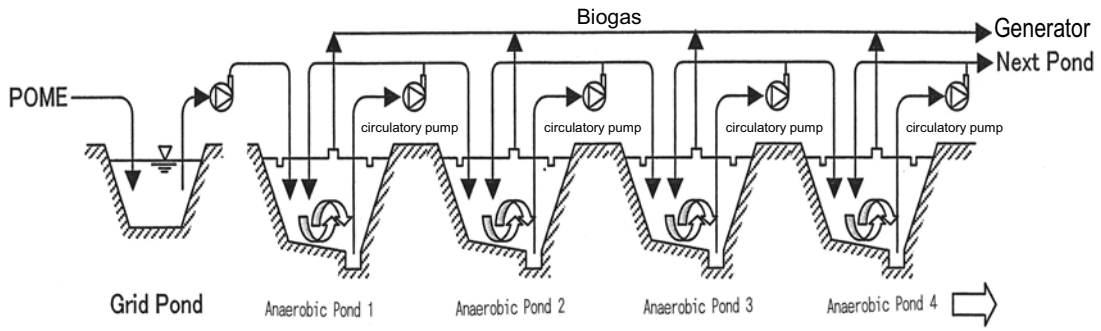

Figure 3 Conceptual Flow of the New Wastewater Treatment Plant

○The overall flow of the new wastewater treatment system is as follows:

① POME discharged from the CPO factory enters the existing grid pond (5,000m^3) together with sludge that was conventionally spread over fields.

② The POME resides in the grid pond for approximately 10 days, during which time acid fermentation takes place. Moreover, the oil content of POME is separated inside the grid pond and returned to the CPO factory.

③ After the oil content is removed in the grid pond, the POME enters the anaerobic ponds, each of which is a concrete container measuring B8 m x L15 m x H5 m and having capacity of 500 m3. There are 10 anaerobic ponds lined up side by side.

④ Biogas that is generated from each anaerobic pond undergoes desulfurization in the desulfurization unit, after which it enters the gas holder. The generated volume of gas is approximately 535 Nm3/h.

⑤ Capacity of the gas holder is 10,00 m^3, and gas discharged from this is usually sent to the gas engine generator.

⑥ Electricity generated in the gas engine generator is transmitted to the nearest grid connection.

⑦ In the event where the gas engine generator is stopped due to maintenance and so on, biogas from the gas holder is sent to the flare stack for combusting.

⑧ The 10 anaerobic ponds are arranged in a straight line and, following completion of anaerobic fermentation treatment for 10 days, the POME next enters the aerobic pond.

⑨ Since the new wastewater treatment system only takes up one-quarter of the existing Anaerobic Pond 1, the remainder of Anaerobic Pond 1 as well as the existing Anaerobic Ponds 2, 3 and 4 can be used as the aerobic pond. Accordingly, the aerobic fermentation treatment time will be more than 6 times longer than in the existing plant.

⑩ POME discharged from the aerobic pond passes through the stabilization pond and is discharged to the adjoining river.

○Features of the new wastewater treatment system are as follows:

① Prevention of atmospheric diffusion of biogas
When anaerobic treatment of POME is carried out, this generates biogas, which is a mixed gas of methane and carbon dioxide. Because the existing plant adopts the open lagoon treatment system, the generated methane gas is discharged directly into the atmosphere. In the anaerobic

fermentation process, however, oxygen is incompatible and causes the fermentation efficiency to decline dramatically. Accordingly, the project proposes to make the anaerobic fermentation process a closed system. The most common approach to conducting anaerobic fermentation in a closed system is to do this inside closed tanks, however, it would be too expensive to install new tanks for this purpose. For this reason, in the project, the existing Anaerobic Pond 1 will be divided into 500 m^3 sections and closed off with covers, so that biogas can be collected without permitting any leakage or infiltration of oxygen.

② Prevention of sludge accumulation
In addition to generation of biogas, the POME anaerobic fermentation process also entails generation of sludge that is composed of fungal forms and non-decomposed organic matter. In the anaerobic fermentation treatment in the existing open lagoons, since the generated sludge has higher specific gravity than liquid, the sludge builds up on the bottom of the anaerobic pond and needs to be periodically removed. However, by stirring up the sludge in the anaerobic pond and subjecting it to anaerobic fermentation along with the POME, it is possible to reduce the generated amount of sludge. Therefore, in the project, the existing Anaerobic Pond 1 will be partitioned and circulatory pumps will be installed in each section in order to stir up the bottom sludge and thus prevent its accumulation and reduce sludge generation. Even so, since sludge will still be generated in line with the POME anaerobic treatment, sludge will be periodically removed from the circulation line in order to maintain the sludge concentration inside the anaerobic pond at a uniform level.

③ Improvement of wastewater treatment performance
By adopting the new wastewater treatment system in the project, it will be possible to carry out anaerobic fermentation treatment, which was previously performed in four anaerobic ponds (Anaerobic Ponds 1~4), in an area less than half of Anaerobic Pond 1. Accordingly, following introduction of the new system, aerobic fermentation, which has so far been conducted in 3 ponds (8,400 m^2 x 2 ponds + 8,100 m^2 x 1 pond = 16,500 m^2), will be implemented in three-quarters of Anaerobic Pond 1 (19,125 m^3) as well as Anaerobic Ponds 2, 3 and 4 (22,500 m^3 x 3 ponds = 76,500 m^3), which means that the aerobic fermentation treatment capacity will be boosted by more than 6 times.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The project site is briefly described as follows.
- The POME currently discharged from Lumadan Mill factory is treated by the open lagoon method. Since this method provides high merits of cost, it is the most widely adopted method in Malaysia.
- In this method, methane fermentation takes place in an anaerobic environment and methane gas is discharged into the atmosphere, thereby having an impact on global warming.
- Malaysia does not have any legislation to control this method, and it has no plans to implement controls in the future.
- Sawit Kinabalu Berhad, the company that owns the factory, plans to continue treating POME using the same approach.

Whereas the targeted palm oil factory currently conducts methane fermentation of wastewater in anaerobic open lagoons and discharges the resulting methane gas into the atmosphere, the project proposes to introduce the closed anaerobic method, with a view to collecting methane gas, using this to generate electricity, and connecting this to the power grid.

The project baseline, according to the economic analysis of the project, is business as usual. Business as usual refers to the case where anaerobic open lagoons are used in the POME treatment process at the palm oil factory and methane gas is discharged from the lagoons into the atmosphere. Concerning the reasoning behind selection of business as usual as the project baseline, see Section B. Application of a baseline methodology.
On the other hand, if the project is implemented, additional GHG emissions reductions will arise for the following reasons:
- Because a closed wastewater treatment system will be adopted and methane gas will be collected, emissions of methane gas into the atmosphere will be reduced.
- Because the collected methane gas will be used as fuel to generate electricity for connection to the power grid, CO_2 emissions will be reduced through the substitution of fossil fuels on the grid.

Furthermore, because CO_2 discharged from power generation utilizing the methane gas is derived from biomass, it is carbon neutral and thus not counted among GHG emissions.

The project crediting period is 16 years, and the reduction of GHG emissions during this period is estimated as approximately 14,000 ton- CO_2 per year.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

The project crediting period is 16 years, and the aggregate reduction of emissions during this period is estimated as 218,399 ton-CO_2.

A.4.5. Public funding of the project activity:

The project is not planned as an ODA undertaking and does not entail any funding obligation on the part of the Government of Japan.

SECTION B. Application of a baseline methodology

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

The following methodology shall be applied to the project:

Revision to approved baseline methodology AM0013: "Forced methane extraction from organic waste-water treatment plants for grid-connected electricity supply and/or heat production"

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

As is indicated below, the baseline methodology AM0013.VERSION02 is applied to the project because the following conditions are satisfied.

Table 1 Applicable Conditions for AM0013. VERSION02 and the Project

No.	Applicable Conditions for AM0013. VERSION02	Applicability of the Project
1	The existing wastewater treatment system is an open lagoon system with an 'active' anaerobic condition, which is characterized as follows: ① The depth of the open lagoon system is at least 1 m; ② The residence time of the sludge in the open lagoons should be at least one year; and ③ The temperature of the sludge in the open lagoons is always higher than 15°C.	In the project, each condition is satisfied as indicated below: ① Depth is 5 m. ② The sludge residence time is around 4 years. ③ The sludge temperature is 25℃ or more.
2	The methodology applies to forced methane gas extraction project cases, as there is a process change from open lagoon to accelerated methane gas generation in a closed tank digester or similar technology.	Since the project entails promoting methane fermentation through switching from present open lagoons to a closed treatment system, it satisfies this condition.
3	The captured methane is used for electricity generation, which avoids emissions due to displaced fossil fuels in the power grid.	Since captured methane is used for power generation in the project, this condition is satisfied.
4	Power generation capacity is 15 MW or less.	Since the power generation capacity in the project is around 1 MW, this condition is satisfied.

B.2. Description of how the methodology is applied in the context of the project activity:

>>The baseline scenario is identified based on AM0013.VERSION02.
In AM0013.VERSION02, the following flowchart is used in order to identify the baseline.

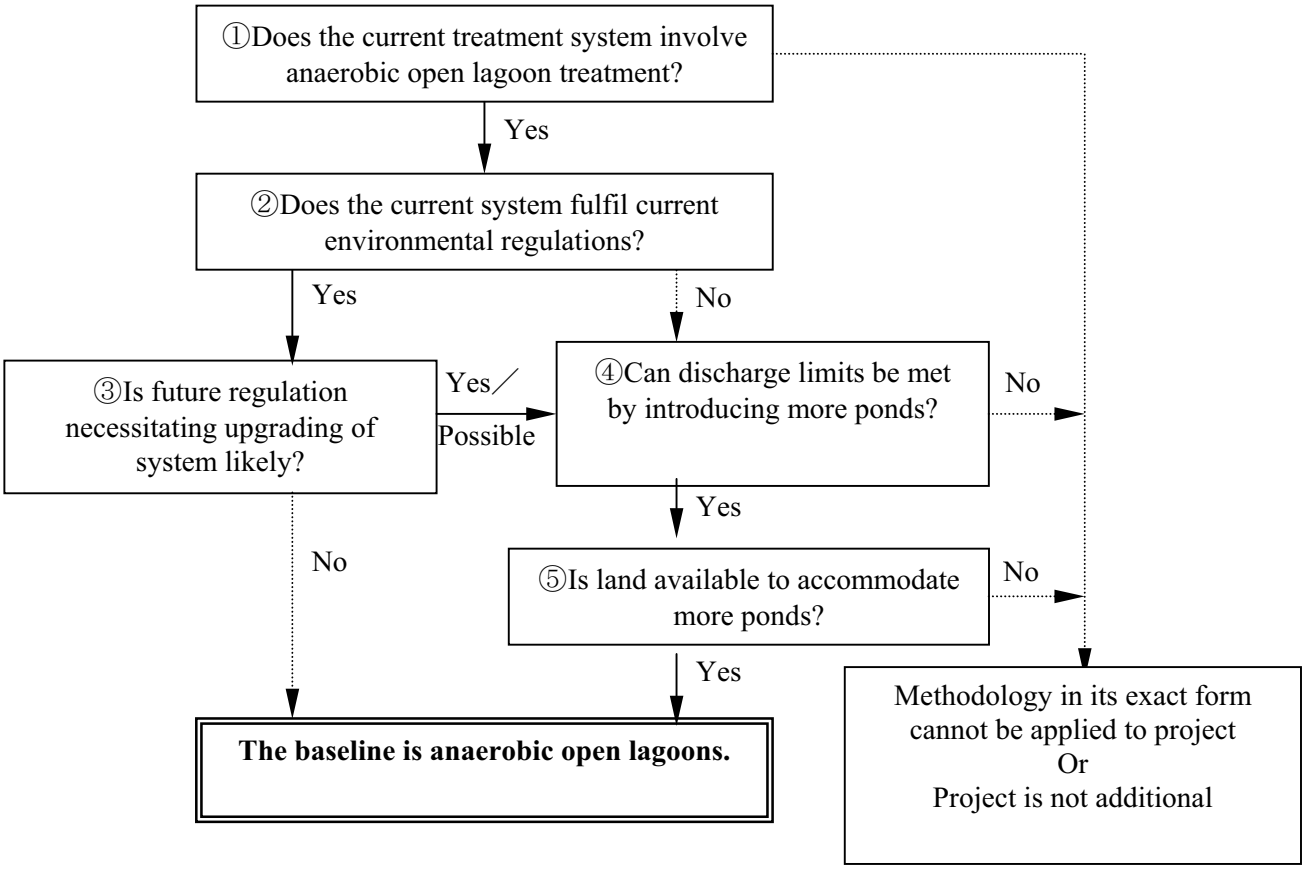

Figure 4 Flowchart for Identifying the Baseline Scenario

The project can be described as follows in terms of the items provided in the above flowchart.

Table 2 Examination Results concerning Baseline Setting

Examination Item	The Project	
① Are anaerobic open lagoons used?	Yes	Anaerobic open lagoons are used.
② Does the current system fulfil current environmental regulations?	Yes	It is managed by the Sabah Department of Environment (DOE) of the Ministry of Natural Resources and Environment and satisfies environmental standards.
③ Is future regulation necessitating upgrading of system likely?	Yes	The DOE has plans to strengthen wastewater standards in future.
④ Can environmental standards be satisfied through increasing the number of open lagoons?	Yes	The environmental standards can be satisfied by increasing the number of open lagoons.
⑤ Is land available to accommodate more ponds?	Yes	Since Sawit Kinabalu Berhad also owns land around the factory, the number of open lagoons can be increased.

In consideration of the above, the project baseline is the business as usual scenario in which the anaerobic open lagoons are used.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

Additionality is demonstrated based on AM0013.VERSION02. This methodology gives two methods, Option A and Option B, for demonstrating additionality, but Option A is used in this PDD.
In AM0013.VERSION02, additionality is demonstrated using the following flowchart.

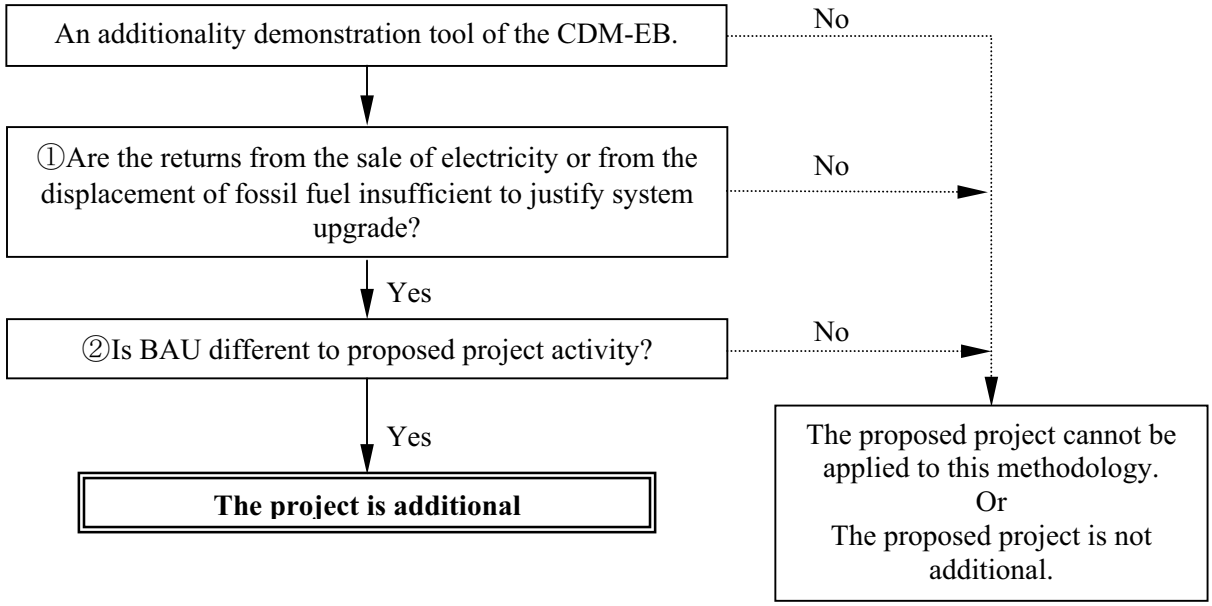

Figure 5 Additionality Demonstration Flowchart

The project can be described as follows in terms of the items provided in the above flowchart.

① Are the returns from the sale of electricity or from the displacement of fossil fuel insufficient to justify system upgrade?
The following three options are given for investment analysis in the CDM-EB's "Tool for the demonstration and assessment of additionality:"
- Option I. Apply simple cost analysis
- Option II. Apply investment comparison analysis
- Option III. Apply benchmark analysis

In the project, since revenue will be obtained through the sale of power in addition to CERs, analysis is carried out using Option 3 (Apply benchmark analysis). For the benchmark, the rate of interest on Malaysian long-term government bonds is adopted for the following reasons:
- When Japanese companies make investment decisions concerning projects in Malaysia, they do not consider the investment to be attractive unless the project returns exceed the rate of interest on

Malaysian long-term government bonds, i.e. they consider it better to purchase bonds rather than invest in the project.
- Interest rate on government bonds is fair and transparent.

Concerning the IRR calculation method, two options, i.e. Project IRR and Equity IRR, are available. Here, since the fund raising method for the project has not yet been decided, the Project IRR was calculated.

In the project, the IRR assuming revenue from only power sales (when there is no revenue from CERs) is 0.3%. However, since the rate of interest on Malaysian long-term government bonds is 4.21% (average for the month of December 2005), the effect based on revenue from power sales alone is not sufficient to upgrade the wastewater treatment system. However, when acquisition of CERs is also taken into account, the IRR increases to 5.1% (assuming CER=10USD/tCO_2) and the project becomes commercially viable.

② Is BAU different to proposed project activity??
There is no evidence to suggest that a similar project has been, is being, or will be implemented in Malaysia (excluding the examination as CDM project) (text of the additionality demonstration tool: "in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.")

In consideration of the above, the project is deemed to be additional.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

Based on AM0013.VERSION02, Table 3 shows the list of greenhouse gases in the project, while Figure 6 shows the conceptual drawing of the baseline and project activity. The red line in the drawing indicates the project boundary.

Table 3 List of Greenhouse Gases

	Source	Greenhouse Gas	
Baseline scenario	Wastewater treatment facilities (open lagoons)	CH_4	Targeted
		CO_2	Not targeted because this is carbon neutral
	Grid power	CO_2	Targeted
		N_2O	Not targeted out of the conservative viewpoint
Project scenario	Wastewater treatment facilities (closed treatment facilities)	CH_4	Targeted
	Wastewater treatment facilities (existing open lagoons)	CH_4	Targeted
		CO_2	Not targeted because this is carbon neutral
	Gas storage tanks	CH_4	Not targeted because generated quantities are negligible. * However, monitoring will be conducted and it will be counted if the generated amount of GHG exceeds 1% of total GHG reductions.
	Fossil fuel consumption at startup time	CO_2／N_2O	

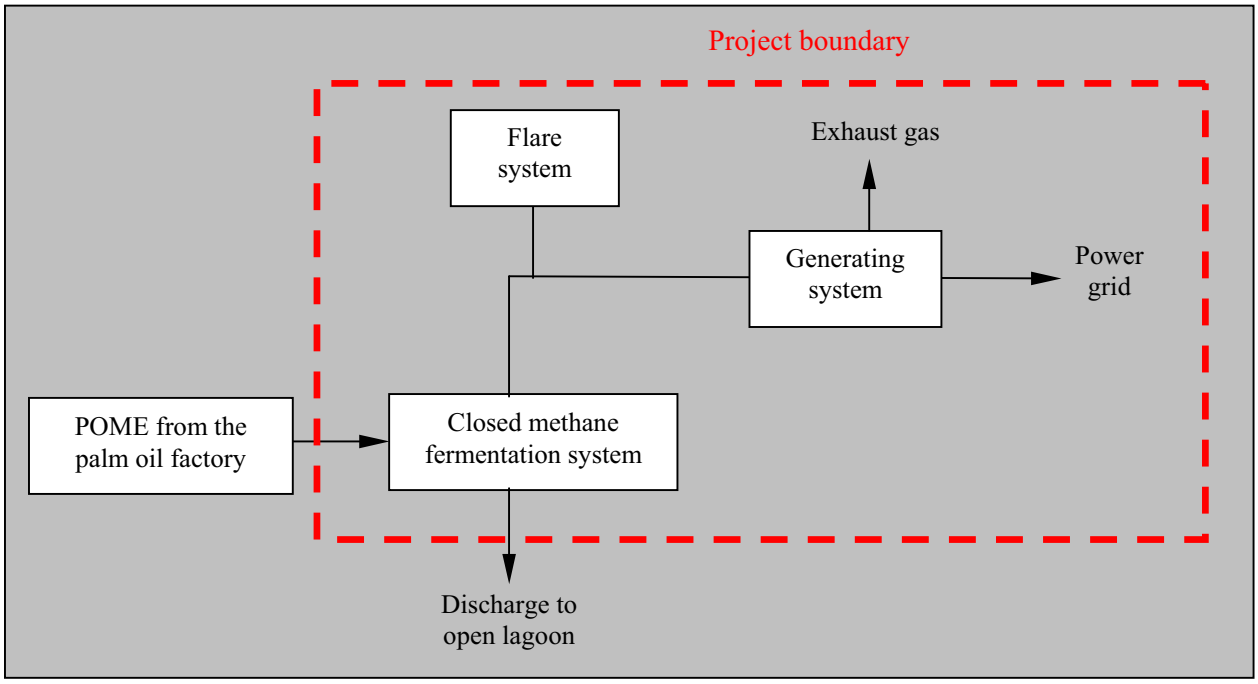

Figure 6 Conceptual Drawing of Project Activity

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

●Date of completion of baseline examination:
March 10, 2006

●Persons determining the baseline
Hokkaido Electric Power Co., Inc.
1-2 Ohdori-Higashi, Chuo-ku, Sapporo, Japan 060-8677

Civil Engineering Department, Civil Engineering Group
Group leader Osamu Yokotsuji
Seiji Toma

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

According to the UNFCCC Clean Development Mechanism Guidelines for Completing the Project Design Document (CDM-PDD): 'The starting date of a CDM project activity is the date at which the implementation or construction or real action of a project activity begins.'

In this project, taking into account time for approval of the new methodology, effective review, detailed design and construction works, the project starting date is October 1, 2007.

C.1.2. Expected operational lifetime of the project activity:

The operational lifetime of the project shall be 16 years in consideration of the service life of the equipment.

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

C.2.1. Renewable crediting period

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

According to the UNFCCC Clean Development Mechanism Guidelines for Completing the Project Design Document (CDM-PDD): "The crediting period for a CDM project activity is the period for which reductions from the baseline are verified and certified by a designated operational entity for the purpose of issuance of certified emission reductions (CERs). Project participants shall choose the starting date of a crediting period to be after the date the first emission reductions are generated by the CDM project activity. A crediting period shall not extend beyond the operational lifetime of the project activity."

GHG emission reductions will be generated with completion of the project construction works and start of project operation. Accordingly, the date of the first emission reductions achieved by the project will be January 1, 2008.

C.2.1.2. Length of the first crediting period:

7 years

~~C.2.2. Fixed crediting period:~~

~~C.2.2.1. Starting date:~~

>>

~~C.2.2.2. Length:~~

>>

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

The following methodology shall be applied to the project:

Revision to approved monitoring methodology AM0013
"Forced methane extraction for grid-connected electricity supply and/or heat production"

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

As is indicated below, the baseline methodology AM0013.VERSION02 is applied to the project because the following conditions are satisfied.

Table 4 Applicable Conditions for AM0013. VERSION02 and the Project

No.	Applicable Conditions for AM0013. VERSION02	Applicability of the Project
1	The existing wastewater treatment system is an open lagoon system with an 'active' anaerobic condition, which is characterized as follows: ① The depth of the open lagoon system is at least 1 m; ② The residence time of the sludge in the open lagoons should be at least one year; and ③ The temperature of the sludge in the open lagoons is always higher than 15°C.	In the project, each condition is satisfied as indicated below: ① Depth is 5 m. ② The sludge residence time is around 4 years. ③ The sludge temperature is 25℃ or more.
2	The methodology applies to forced methane gas extraction project cases, as there is a process change from open lagoon to accelerated methane gas generation in a closed tank digester or similar technology.	Since the project entails promoting methane fermentation through switching from present open lagoons to a closed treatment system, it satisfies this condition.
3	The captured methane is used for electricity generation, which avoids emissions due to displaced fossil fuels in the power grid.	Since captured methane is used for power generation in the project, this condition is satisfied.
4	Power generation capacity is 15 MW or less.	Since the power generation capacity in the project is around 1 MW, this condition is satisfied.

D.2.1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated © or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	COD_{Dout} *COD concentration of effluent at digester outlet*	*Sampling analysis*	*kgCOD/m^3 POME*	*m*	*At least every month*	*100 %*	*Electronic*	*Archive data for at least 2 years after the issue of CERs*
2	$POME_{Dout}$ *Effluent flow rate at Digester outlet*	*Flowmeter*	*m^3POME/ Hr*	*m*	*Measured continuously and recorded once a month*	*100 %*	*Electronic*	*Ditto*
3	BR_{Dout} *Biogas flow rate at Digester outlet*	*Flowmeter*	*m^3/hr*	*m*	*Measured continuously and recorded once a month*	*100%*	*Electronic*	*Ditto*
4	BR_{GEin} *Biogas flow rate at Gas-engine inlet*	*Flowmeter*	*m^3/hr*	*m*	*Measured continuously and recorded once a month*	*100%*	*Electronic*	*Ditto*
5	BR_{fin} *Biogas flow rate at Flare inlet*	*Flowmeter*	*m^3/hr*	*m*	*Measured continuously and recorded once a month*	*100%*	*Electronic*	*Ditto*
6	MC_{BG} *Biogas CH_4 concentration*	*Methane gas analyser*	*%*	*m*	*At least 4 times per year*	*100%*	*Electronic*	*Ditto*
7	*SR Stack gas flow rate*	*Flowmeter*	*m^3/hr*	*m*	*Measured continuously and recorded once a month*	*100%*	*Electronic*	*Ditto*
8	MC_{SG} *Stack gas CH_4 concentration*	*Methane gas analyser*	*%*	*m*	*At least 4 times per year*	*100%*	*Electronic*	*Ditto*
9	*EC Electricity Consumed by Digester Parasitics*	*Watt hour meter*	*MWh*	*m*	*Every month*	*100%*	*Electronic*	*Ditto*

※ Since quantities of CO_2 emissions from the starting power source of the methane fermentation system, CH_4 leakage from the system and CH_4 emissions in exhaust gas are very small, they are considered to be negligible. However, these will be monitored and, if they amount to more than 1% of the annual CER quantity, they will be counted as target gases in the project.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Emissions of GHGs in the project are estimated based on AM0013.VERSION02.

1) Methane gas emissions from the open lagoons:

$PE_{y1} = COD_P \times Bo \times MCF \times GWP_{CH4}$ ..... Formula 1

PE_{y1} : Methane gas emissions from the open lagoons ($kgCO_2/yr$)
COD_P : Chemical oxygen demand (measured value) at the open lagoon inlet (fermentation tank outlet) kgCOD/yr) $= \Sigma$ ($COD_{Dout} \times POME_{Dout}$)
Bo : Maximum methane generation coefficient ($kgCH_4/kgCOD$) $=$ 0.238 $kgCH_4/kgCOD$
MCF : Methane conversion factor （－） $=$0.97
GWP_{CH4} : Global warming potential $=$21

2) CH_4 emissions from the methane fermentation system
In the project, since it is also planned to introduce a flaring system so that CH_4 can be combusted even when the generator is stopped, leakage of CH_4 from the methane fermentation system will be extremely small. However, since it cannot be denied that there will be some leakage from the system itself, it is assumed from a conservative standpoint that there will be emissions equivalent to 5% of the CH_4 ($=PE_{y2}$) that is collected when the project is underway. Moreover, a similar value is also adopted in the PDD for NM0085 “Vinasse Anaerobic Treatment Project - Compañía Licorera de Nicaragua, S. A. (CLNSA).”

$PE_{y2} = BR_{Dout} \times MC \times 0.05 \times GWP_{CH4}$ ..... Formula 2

In addition, concerning quantities of CO_2 emissions from the methane fermentation system starting power source, CH4 leakage from the system and CH_4 emissions in exhaust gas are very small, they are considered to be negligible. However, these will be monitored and, if they amount to more than 1% of the annual CER quantity, they will be counted as target gases in the project.

- CO_2 emissions from the power source at start-up of the methane fermentation system $= EC \times EF_E$
- CH_4 leakage the methane fermentation system $= (BR_{Dout} - BR_{GEin} - BR_{fin}) \times MF \times GWP_{CH4}$
- CH_4 emissions in exhaust gas $= SR \times MC_{SG} \times GWP_{CH4}$

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
10	*COD_{Din} concentration at Digester inlet*	*Water quality analysis*	*kgCOD/m^3 POME*	*m*	*At least every month*	*100%*	*Electronic*	*Archive data for at least 2 years after the issue of CERs*
11	*$POME_{Din}$ Effluent flow rate at Digester inlet*	*Flow meter*	*m^3POME /hr*	*m*	*Measured continuously and recorded once a month*	*100%*	*Electronic*	*Ditto*
12	*EG_y Electricity Supplied to Grid*	*Watt hour meter*	*MWh*	*m*	*Measured continuously and recorded once a month*	*100%*	*Electronic*	*Ditto*
13	*EF_E Emission Factor of Grid in Sabah*	—	*t-CO_2/kWh*	—	*Every year*	*100 %*	*Electronic*	*Collecedt from PMT*
14	*Regulations and Incentives Relevant to Effluent*	—	—	—	*Every year*	*100%*	*Electronic*	*Colleted from DOE*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Emissions of GHGs in the project are estimated based on AM0013.VERSION02.

1) Methane gas emissions from the open lagoons:
   Methane emissions from the open lagoons in an anaerobic environment are calculated using the following formula:

$BE_{OLy} = COD_P \times Bo \times MCF \times GWP_{CH4}$ ..... Formula 3

BE_{OLy} : Methane gas emissions from the open lagoons ($kgCO_2/yr$)
COD_P : Chemical oxygen demand (measured value) at the open lagoon outlet (fermentation tank inlet) $= \Sigma\ (COD_{Din} \times POME_{Din})$
Bo : Maximum methane generation coefficient ($kgCH_4/kgCOD$) $= 0.238\ kgCH_4/kgCOD$
MCF : Methane conversion factor （－） $= 0.97$
GWP_{CH4} : Global warming potential $= 21$

2) CO_2 emissions from fossil fuels equivalent to the sold amount of electricity
CO_2 emissions from fossil fuels equivalent to the sold amount of electricity are calculated based on Option 1 in AM0013.VERSION02 using the mean value across all grid power sources for the discharge coefficient. The following formula is used:

$BE_{Ey} = EG_y \times EF_E$ ..... Formula 4

BE_{Ey} : CO_2 emissions from fossil fuels equivalent to the sold amount of electricity (tCO_2/yr)
EG_y : Sold amount of electricity (MWh/yr) (measured value)
EF_E : Mean CO_2 discharge coefficient across all SESB power sources (tCO_2/MWh) (measured value)

~~**D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).**~~

~~**D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:**~~								
~~ID number *(Please use numbers to ease cross-referencing to table D.3)*~~	~~Data variable~~	~~Source of data~~	~~Data unit~~	~~Measured (m), calculated (c), estimated (e),~~	~~Recording frequency~~	~~Proportion of data to be monitored~~	~~How will the data be archived? (electronic/ paper)~~	~~Comment~~

~~D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):~~

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

There is no leakage resulting from the project activity.

Figure 7 gives an illustrated view of the monitoring plan described above.

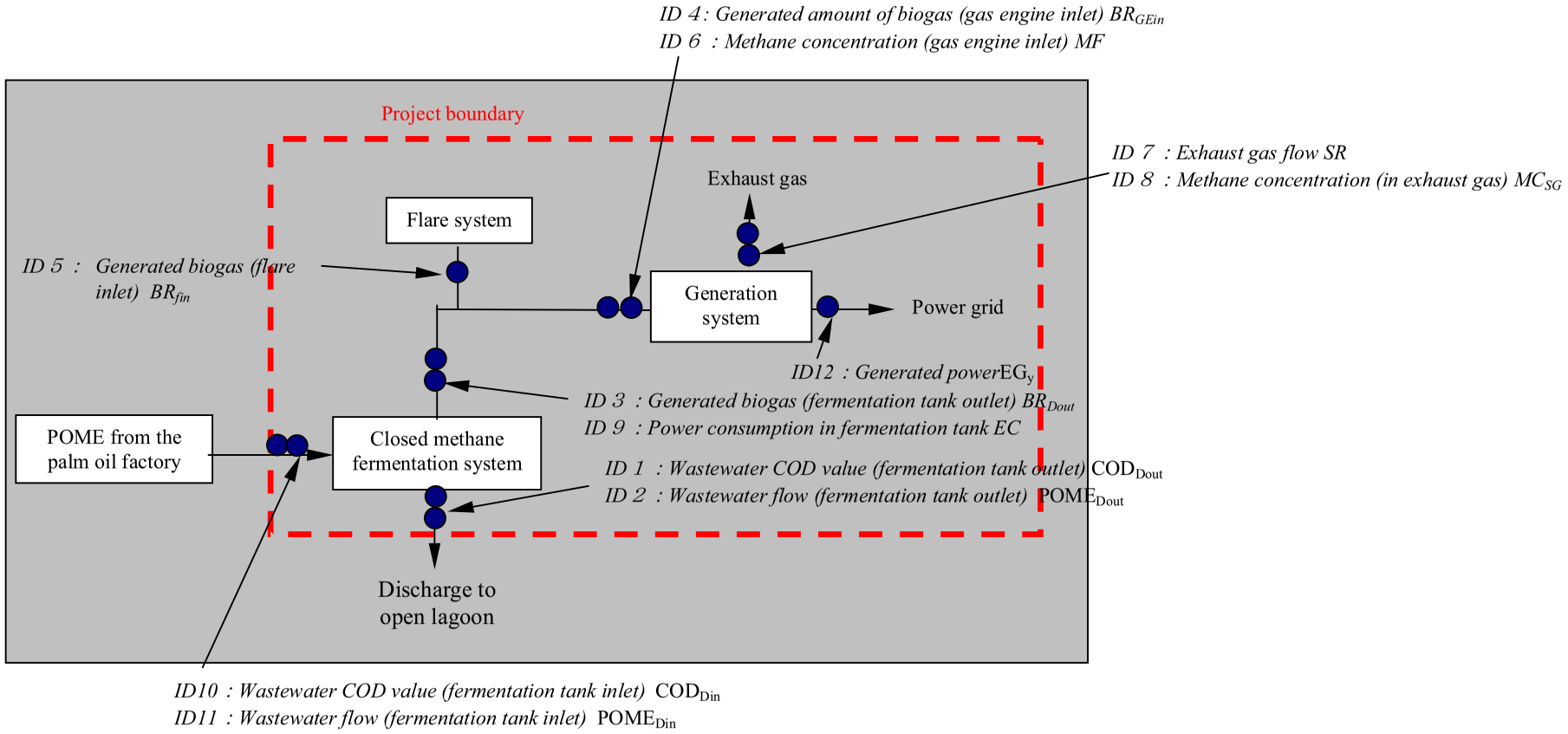

Figure 7 Monitoring Plan Drawing

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The following formulae are used in the project

$ER_y = BE_y - PE_y$ ..... Formula 5
$PE_y = PE_{y1} + PE_{y2}$ ..... Formula 6
$PE_{y1} = COD_P \times Bo \times MCF \times GWP_{CH4}$ ..... Formula 1
$PE_{y2} = BG_{out} \times MF_G \times 0.05 \times GWP_{CH4}$ ..... Formula 2
$BE_y = BE_{OLy} + BE_{Ey}$ ..... Formula 7
$BE_{OLy} = COD_B \times Bo \times MCF \times GWP_{CH4}$ ..... Formula 3
$BE_{Ey} = EG_y \times EF_E$ ..... Formula 4

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Low*	*Sampling analysis will be implemented based on internationally recognised methodology.*
2	*Low*	*Flow meters will be maintained and measurements carried out based on industrial standards.*
3	*Low*	*Flow meters will be maintained and measurements carried out based on industrial standards.*
4	*Low*	*Flow meters will be maintained and measurements carried out based on industrial standards.*
5	*Low*	*Flow meters will be maintained and measurements carried out based on industrial standards.*
6	*Low*	*Sampling analysis will be implemented based on internationally recognised methodology. Implement analysis at least 4 times per year.*
7	*Low*	*Flow meters will be maintained and measurements carried out based on industrial standards.*
8	*Low*	*Sampling analysis will be implemented based on internationally recognised methodology. Implement analysis at least 4 times per year.*
9	*Medium*	*Watt-hour meters will be maintained and measurements carried out based on industrial standards.*
10	*Low*	*Sampling analysis will be implemented based on internationally recognised methodology.*
12	*Low*	*Flow meters will be maintained and measurements carried out based on industrial standards.*
12	*Low*	*Watt-hour meters will be maintained and measurements carried out based on industrial standards. Verify the measured values by using the power purchase receipts from the purchasing company (SESB).*

13	*Low*	*Concerning the grid discharge coefficient, the Malaysia Energy Center (PTM) will provide evidential documents.*
14	*Low*	*Since survey of wastewater regulations is not within the scope of management of the project implementing parties, the DOE will provide evidential documents.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

Project participants on the Malaysia and Japan sides will form a special purpose company (SPC) in order to implement the project.

The SPC will be responsible for managing the project including the initial investment (ordering of construction works). The SPC will consign operation, management and monitoring, etc. to Borneo Samudera Sdn. Bhd.

Quality control and quality assurance activities in the project are summarized as follows.
- Prepare a facilities operating manual.
- Operating personnel will prepare a work daily log to be checked by management.
- Management will periodically implement training and education of operating personnel.
- Management will regularly confirm work conditions.
- In the event of accidents, management will take appropriate stopgap measures, then investigate and deal with the causes.
- Measuring instruments will be periodically inspected.

D.5 Name of person/entity determining the monitoring methodology:

>>
Hokkaido Electric Power Co., Inc.
1-2 Ohdori-Higashi, Chuo-ku, Sapporo, Japan 060-8677

Civil Engineering Department Civil Engineering Group
Group leader Osamu Yokotsuji
Seiji Toma

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Emissions of GHGs in the project are estimated based on AM0013.VERSION02.

1) Methane gas emissions from the open lagoons:
In the project, POME will be discharged to the existing open lagoons after its COD has been largely reduced in the new methane fermentation system. Since the existing open lagoons are in an aerobic environment, the MCF (methane conversion factor) is 0 and there is no discharge of CH_4.

However, in consideration of the unclear separation of the anaerobic and aerobic environments following implementation of the project, the same technique that is used in calculating the baseline shall be used and the same values of Bo and MCF shall be assumed in order to calculate the CH_4 emissions from the conservative viewpoint.

$PE_{y1} = COD_P \times Bo \times MCF \times GWP_{CH4}$ ..... Formula 1

PE_{y1}	:	Methane gas emissions from the open lagoons ($kgCO_2/yr$)
COD_P	:	Chemical oxygen demand (measured value) at the open lagoon inlet (fermentation tank outlet) kgCOD/yr)
Bo	:	Maximum methane generation coefficient ($kgCH_4/kgCOD$) = 0.238 $kgCH_4/kgCOD$
MCF	:	Methane conversion factor （－） =0.97
GWP_{CH4}	:	Global warming potential = 21

For COD_P, values measured following implementation of the project will be used. For the purposes of this PDD, a reference value for COD_P is calculated by the following method.

$COD_P = COD_X \times FFB_y \times PCF \times (1 - RER)$ ..... Formula 8

COD_X	:	COD value per $1m^3$ of POME (=50kgCOD/m^3POME※)
		※ The value used as a substitute for POME as given in the “Industrial Processes & The Environment (Handbook No.3)” (Department of Environment, Ministry of Science, Technology and the Environment, Malaysia)
FFB_y	:	Annual FFB treatment flow (tFFB/yr)
PCF	:	Generated POME per 1t of treated FFB (m^3POME/tFFB)
RER	:	COD removal rate (=0.90※)
		※ In the “UPM-KIT-FELDA International R&D Collaboration: Biogas Bilot Plant“(BIOTECH COMMUNICATIONS Vol.2,July), 0.97 is given as the figure obtained from a demonstration plant, however, 0.9 is adopted in this PDD from the conservative viewpoint.

Concerning FFB, the figures shown in the following table are adopted based on the treatment plan compiled by Borneo Samudera Sdn. Bhd. Concerning 2015 and onwards, it is assumed that the treatment flow in 2014 is continued because as yet there is no concrete treatment plan.

Table 5 Treatment Plan

Year	2008	2009	2010	2011	2012	2013	2014	2015
FFB treatment flow (t)	207,436	254,541	273,541	303,028	322,309	337,901	344,268	344,268
Year	2016	2017	2018	2019	2020	2021	2022	2023
FFB treatment flow (t)	344,268	344,268	344,268	344,268	344,268	344,268	344,268	344,268

PCF is calculated based on the following formula:

PCF＝CFF×2.5 ..... Formula 9

CFF : Quantity of refined CPO per 1t of treated FFB (tCPO/tFFB) (=0.212 tCPO/tFFB※)
※Value based on past data of Borneo Samudera Sdn. Bhd.
PCF : POME discharge per 1t of refined CPO (m^3POME/tCPO) (＝2.5 m^3POME/tCPO※)
※Value based on survey by the PORIM: Palm Oil Research Institute Malaysia)

Concerning Bo, 0.25 $kgCH_4$/kgCOD is given as a default value in the IPCC Guidelines. Moreover, in AM0013.VERSION02, in view of the uncertainty of the said value, 0.21$kgCH_4$/kgCOD is given as the default value. However, neither of these values is calculated for POME specifically, but rather they are intended for wastewater from industry and agriculture in general. On the other hand, in the "Baseline study of methane emission from anaerobic ponds of palm oil mill effluent treatment" (*Science of The Total Environment, In Press, Corrected Proof, Available online 24 August 2005,* Shahrakbah Yacob, Mohd Ali Hassan, Yoshihito Shirai, Minato Wakisaka and Sunderaj Subash), a value of 0.238 $kgCH_4$/kgCOD is given based on the results of study and research of POME in Malaysia. Generally speaking, POME discharged from factories that adopt the same oil refining process in the same country displays the same properties, so the value of 0.238$kgCH_4$/kgCOD is used in the project calculations.

Concerning MCF, no specific default value is given in the IPCC Guidelines, however, a coefficient of 0.9 is given for the Asian region. Moreover, in AM0013.VERSION02, in view of the uncertainty of the said value, 0.738 is given as the default value. However, neither of these values is calculated for POME specifically, but rather they are intended for wastewater from industry and agriculture in general. On the other hand, in the "Baseline study of methane emission from anaerobic ponds of palm oil mill effluent treatment" (*Science of The Total Environment, In Press, Corrected Proof, Available online 24 August 2005,* Shahrakbah Yacob, Mohd Ali Hassan, Yoshihito Shirai, Minato Wakisaka and Sunderaj Subash), a value of 0.97 is given based on the results of study and research of POME in Malaysia. Generally speaking, POME discharged from factories that adopt the same oil refining process in the same country displays the same properties, so the value of 0.97 is used in the project calculations.

Concerning GWP_{CH4}, based on the IPCC Second Assessment Report: Climate Change (1995), 21 is adopted.

2) CH_4 emissions from the methane fermentation system
In the project, since it is also planned to introduce a flaring system so that CH_4 can be combusted even when the generator is stopped, leakage of CH_4 from the methane fermentation system will be extremely small. However, since it cannot be denied that there will be some leakage from the system itself, it is assumed from a conservative standpoint that there will be emissions equivalent to 5% of

the CH_4 (=PE_{y2}) that is collected when the project is underway. Moreover, a similar value is also adopted in the PDD for NM0085 "Vinasse Anaerobic Treatment Project - Compañía Licorera de Nicaragua, S. A. (CLNSA)."

3) CO_2 emissions from the backup power supple used in the methane fermentation system
Since no backup power supply will be installed in the project, there are no such CO_2 emissions.

In addition, concerning quantities of CO_2 emissions from the methane fermentation system starting power source, CH_4 leakage from the system and CH_4 emissions in exhaust gas are very small, they are considered to be negligible. However, these will be monitored and, if they amount to more than 1% of the annual CER quantity, they will be counted as target gases in the project.

To sum up, GHG emissions (= PEy) in the project scenario are as follows:

Table 6 GHG Emissions in the Project Scenario (Unit: tCO_2/yr)

No.	Item	2008	2009	2010	2011	2012	2013	2014	2015
1	Open lagoons	2,665	3,257	3,514	3,893	4,141	4,341	4,423	4,423
2	Methane fermentation system	1,199	1,466	1,581	1,752	1,863	1,954	1,990	1,990
3	Backup power supply	0	0	0	0	0	0	0	0
	Total（=PEy）	3,864	4,723	5,096	5,645	6,004	6,295	6,413	6,413
No.	Item	2016	2017	2018	2019	2020	2021	2022	2023
1	Open lagoons	4,423	4,423	4,423	4,423	4,423	4,423	4,423	4,423
2	Methane fermentation system	1,990	1,990	1,990	1,990	1,990	1,990	1,990	1,990
3	Backup power supply	0	0	0	0	0	0	0	0
	Total（=PEy）	6,413	6,413	6,413	6,413	6,413	6,413	6,413	6,413

E.2. Estimated leakage:

There is no leakage that arises from the project activity.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

In the project, since there is no leakage (L_y=0), emissions resulting from the project activity (ER_{Py}) are the same as in E.1.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Emissions of GHGs in the project are estimated based on AM0013.VERSION02.

1) Methane gas emissions from the open lagoons:
Methane emissions from the open lagoons under an anaerobic environment are calculated using the following formula:

$$BE_{OLy} = COD_P \times Bo \times MCF \times GWP_{CH} \quad \text{..... Formula 3}$$

BE_{OLy} : Methane gas emissions from the open lagoons（$kgCO_2/yr$）
COD_P : Chemical oxygen demand (kgCOD/yr) (measured value) at the open lagoon inlet (before adding sludge)
Bo : Maximum methane generation coefficient ($kgCH_4/kgCOD$)＝0.238 $kgCH_4/kgCOD$
MCF : Methane conversion factor（－）
GWP_{CH4} : Global arming potential = 21

2) CO_2 emissions from fossil fuels equivalent to the sold amount of electricity
CO_2 emissions from fossil fuels equivalent to the sold amount of electricity are calculated based on Option 1 in AM0013.VERSION02 using the mean value across all grid power sources for the discharge coefficient. The following formula is used:

$$BE_{Ey} = EG_y \times EF_E \quad \text{Formula 4}$$

BE_{Ey} : CO_2 emissions from fossil fuels equivalent to the sold amount of electricity (tCO_2/yr)
EG_y : Sold amount of electricity（MWh/yr） （measured value）
EF_E : Mean CO_2 discharge coefficient across all SESB power sources (tCO_2/MWh)

To sum up, GHG emissions (=BEy) in the project scenario are as follows. However, it should be noted that these are just estimate figures and are not actual GHG emissions. Actual GHG emissions are calculated based on measured values.

Table 7 GHG Emissions in the Baseline Scenario (Unit: tCO_2/yr)

No.	Item	2008	2009	2010	2011	2012	2013	2014	2015
1	Open lagoons	10,660	13,029	14,057	15,572	16,563	17,365	17,692	17,692
2	Sold electricity	0	2,609	2,815	3,118	3,317	3,467	3,467	3,467
	Total (＝BEy)	10,660	15,638	16,872	18,691	19,880	20,831	21,159	21,159
No.	Item	2016	2017	2018	2019	2020	2021	2022	2023
1	Open lagoons	17,692	17,692	17,692	17,692	17,692	17,692	17,692	17,692
2	Sold electricity	3,467	3,467	3,467	3,467	3,467	3,467	3,467	3,467
	Total (＝BEy)	21,159	21,159	21,159	21,159	21,159	21,159	21,159	21,159

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

The following table shows the calculation results. However, it should be noted that these are just estimate figures and are not actual GHG emission reductions. Actual GHG emission reductions are calculated based on measured values.

Table 8 GHG Emission Reductions (Unit: CO_2/yr)

Year	2008	2009	2010	2011	2012	2013	2014	2015
Emission reductions	6,796	10,915	11,776	13,046	13,876	14,537	14,745	14,745
Year	2016	2017	2018	2019	2020	2021	2022	2023
Emission reductions	14,745	14,745	14,745	14,745	14,745	14,745	14,745	14,745

E.6. Table providing values obtained when applying formulae above:

GHG emission reductions in the project will be calculated based on measured values, however, reference values calculated under the hypothetical conditions described in E.1~E.4 are given as follows. Incidentally, total GHG emission reductions over the project life of 16 years are calculated as 224,648tCO_2.

Table 9 GHG Emission Reductions tCO_2/y)

Year	2008	2009	2010	2011	2012	2013	2014	2015
GHG emissions in the project scenario	3,864	4,723	5,096	5,645	6,004	6,295	6,413	6,413
GHG emissions in the baseline scenario	10,660	15,638	16,872	18,691	19,880	20,831	21,159	21,159
Emission reductions	6,796	10,915	11,776	13,046	13,876	14,537	14,745	14,745
Year	2016	2017	2018	2019	2020	2021	2022	2023
GHG emissions in the project scenario	6,413	6,413	6,413	6,413	6,413	6,413	6,413	6,413
GHG emissions in the baseline scenario	21,159	21,159	21,159	21,159	21,159	21,159	21,159	21,159
Emission reductions	14,745	14,745	14,745	14,745	14,745	14,745	14,745	14,745

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Upon conducting a hearing with Department of Environment Sabah regarding environmental regulations, we were told that there is no need to implement an Environmental Impact Assessment (EIA). However, concerning air quality, water quality, stack and noise, we found that it is necessary to conduct assessment with respect to environmental regulations. Below are described the contents of the said regulations.

① Air quality regulations

Concerning air regulations affecting the project, the items indicated in Table 10 in the Stack Gas Emission Standards given in ENVIRONMENTAL QUALITY (Clean Air) REGULATIONS 1978 are regulated. Emissions are generated from the gas engine generator and flare stack, however, it is considered that both these satisfy the regulations.

Table 10 Stack Gas Emission Standards

Pollution	STANDARDS	
1.Dark Smoke	Ringelmann Chart No.1	
2.Dust	0.4 mg/Nm^3	
3.Metal and Metallic Compound	Mercury	: 0.01 mg/Nm^3
	Cadmium	: 0.015 mg/Nm^3
	Lead	: 0.025 mg/Nm^3
	Antimony	: 0.025 mg/Nm^3
	Arsenic	: 0.025 mg/Nm^3
	Zinc	: 0.1 mg/Nm^3
	Copper	: 0.1 mg/Nm^3
4.Gases	Acid gases	: 0.2 mg of SO_3/Nm^3 and no persistent mist
	Chorine gas	: 0.2 mg of HCL/Nm^3
	HCL	: 0.2 mg of HCL/Nm^3
	Fluorine, Hydrofluoric acid, inorganic fluorine compound	: 0.10 mg of Hydrofluoric acid/Nm^3
	Hydrogen Sulphide	: 5 ppm (vol%)
	Nox	: 2.0 mg of Nitric oxide/Nm^3

(Source: ENVIRONMENTAL QUALITY (Clean Air) REGULATIONS 1978)

② Water quality regulations

Water quality regulations affecting the project are prescribed in the ENVIRONMENTAL QUALITY ACT, 1974, however, upon conducting a hearing at the Department of Environment Sabah regarding environmental regulations, we found that, in cases such as the project where new wastewater treatment facilities are introduced, it is necessary to satisfy the values that are shown in Table 11. Detailed measures regarding these values will be examined in the future.

Table 11 Parameter Limits of Effluent

Parameter	Standards
1.BOD	20 mg/L
2.Suspended Solids	200 mg/L
3.Oil and Grease	15 mg/L
4.Ammonium-Nitrogen	25 mg/L
5.pH	5.0～9.0
6.Temperature	45 ℃

③ Stack regulations

Stack regulations concerning height and location, etc. are prescribed in the CHIMNEY HEIGHTS Third edition of the 1956 Clean Air Act Memorandum. However, it is expected that the project satisfies all the regulated items contained in this.

④ Noise regulations

Legislation regulating noise in Malaysia is given in the Guidelines For the Siting and Zoning of Industries, Environmental Requirements, Seventh Edition, November 2000, which states that noise must not exceed 65dB over buffer zones of 500 m. In the project, it is planned to take countermeasures that will satisfy this standard.

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

As was mentioned previously, no environmental impact assessment is required for the project, however, simple assessment will be required with respect to some regulations.

SECTION G. Stakeholders' comments

>>

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

The stakeholders' comments were canvassed in hearing studies by the Japanese project implementing parties.

G.2. Summary of the comments received:

>>

① Ministry of Natural Resources and Environment

○Conservation and Environmental Management Division

Dr. Nadzri Yahaya, Deputy Undersecretary
Mr. Chong Poon Chai, Principal Assistant Secretary

- In view of the fact that the project will improve the wastewater environment of the palm industry, which is Malaysia's major industry, and the fact that it is good for energy utilization, we welcome its implementation as a CDM undertaking.

○Department of Environment Sabah

Mr. Ruslan HJ. Mohamad, Principal Assistant Director
Ms. Rosni Ismail, Environmental, Control Officer
Mr. Mohd Suhaimi Azmi, Control Officer

- In view of the fact that the project will improve the wastewater environment of the palm industry, which is Malaysia's major industry, and the fact that it is good for energy utilization, we welcome it.
- Since the scale of power generation is less than 10MW, no EIA is required, although brief reports will be necessary. Report items are air quality, effluent quality, noise and stack height, and these items will need to satisfy environmental standards in Malaysia. The environmental standards for air, effluent and noise are sated in the "Environmental Requirements, A Guide for investors." As for stack height, since Malaysia has no specific standards in place, we want this to be examined and submitted based on standards in Japan.

② Malaysia Energy Centre (PTM), Policy Analysis and Research Management Division
Mr. Azman Zainal Abidin, Deputy Director
Ms. Yuzlina Mohd Yusop, Programme Manager
Ms. Koh Fui Pin, Research Officer

- The proposed project satisfies the established criteria in Malaysia. In view of the fact that the project will improve the wastewater environment of the palm industry, which is Malaysia's major industry, and the fact that it is good for energy utilization, we welcome its implementation as a CDM undertaking.
- Since the proposed project has not yet been implemented in Malaysia, it will likely have a ripple effect on the rest of the country.

③ Energy Commission, Suruhanjaya Tenaga
Ms. Hafiz Binti Yob, Assistant Director

Malaysian Industrial Development Authority
Ms. Nor' Aini Binti Mat Talha, Assistant Director

- Since the proposed project will make use of reusable energy, the SREP system can be applied.
- The proposed project is the first of its kind to be implemented in Malaysia. Since its implementation will create a major ripple effect and promote effective energy utilization, we welcome it.

④ Ministry of Tourism, Culture and Environment
Mr. Datuk Hj Karim Hj Bujang, Assistant Minister

- The proposed project will make a major contribution to environmental improvement, and Sabah Department of Tourism, Culture and Environment will spare no effort in cooperating with it.
- Currently Sabah Province has a environmental conference composed of members from numerous government agencies. Before the proposed project is implemented, it is desirable that it is informed to the said conference and that cooperation be secured from as many related agencies as possible.

⑤ Sabah Electricity Sdn. Bhd.
Mr. Andrew Amaladoss , Manager System Planning

- Since the proposed project will make use of reusable energy, we welcome it.
- I can't think of any major impediments that may affect implementation of the project.

⑥ Sabah Province, Beaufort Town Office
Mr. Wong Foo Tin, Mayo

- In view of the fact that the project will improve the wastewater environment of the palm industry, which is Malaysia's major industry, and the fact that it is good for energy utilization, we welcome its implementation as a CDM undertaking.

⑦ Residents living near the project site

- There are no residents living around the project site (within 2~3 km).

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

According to the comments received, except for items relating to EIA, stakeholders view the project in a positive light and there is no need to adopt any special measures regarding the comments. Moreover, concerning the EIA, necessary reports will be made based on guidance provided by the Ministry of Natural Resources and Environment, Department of Environment Sabah.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant1

Organization:	Hokkaido Electric Power Co., Inc.
Street/P.O.Box:	1-2 Ohdori-Higashi, Chuo-ku, Sapporo, Japan 060-8677
Building:	—
City:	Sapporo
State/Region:	Hokkaido
Postfix/ZIP:	060－8677
Country:	Japan
Telephone:	011－251－1111
FAX:	—
E-Mail:	—
URL:	http://www.hepco.co.jp
Represented by:	Tatsuo Kondoh
Title:	Group Leader
Salutation:	Mr.
Last Name:	Yokotsuji
Middle Name:	—
First Name:	Osamu
Department:	Civil Engineering Department
Mobile:	—
Direct FAX:	011－251－0425
Direct tel:	011－251－4623
Personal E-Mail:	yokotuj@epmail.hepco.co.jp

Project Participant2

Organization:	Taisei Construction Co., Ltd.
Street/P.O.Box:	1-25-1 Nishi Shinjuku, Tokyo, Japan
Building:	Shinjuku Center Building
City:	Shinjuku Ward
State/Region:	Tokyo
Postfix/ZIP:	163－0606
Country:	Japan
Telephone:	03－5381－5175
FAX:	03－3344－9476
E-Mail:	－
URL:	http://www.taisei.co.jp/
Represented by:	Kanji Hayama
Title:	Senior Engineer
Salutation:	Mr.
Last Name:	Takahashi
Middle Name:	－
First Name:	Hideyuki
Department:	Ecology Headquarters
Mobile:	－
Direct FAX:	03－3344－9476
Direct tel:	03－5381－5175
Personal E-Mail:	tkhhdy00@pub.taisei.co.jp

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project is not planned as an ODA undertaking and does not entail any funding obligation on the part of the Government of Japan.

Annex 3

BASELINE INFORMATION

The following table and commentary describe the information to be used for calculating GHG emissions in the project baseline.

Table 1 List of Parameters

No.	Item	Value	Unit	Source
1	Exchange rate (Yen⇔USD)	115.0	Yen/USD	—
2	Exchange rate (Yen⇔RM)	31.0	Yen/RM	—
3	Methane molecular weight	16	g/mol	—
4	Gas capacity per 1mol	22.4	NL/mol	—
5	Lower heating value of methane	8,550	kcal/Nm^3	—
6	Energy conversion factor (electric power⇔calories)	860	kcal/kWh	Science Almanac
7	Methane global warming potential GWP_{CH4}	21.0	—	IPCC Second Assessment Report: Climate Change 1995
8	Chemical oxygen demand COD_B at the open lagoon inlet (fermentation tank inlet)	※See①	kgCOD/yr	※See ①
9	Maximum methane generation coefficient Bo	0.238	$kgCH_4$/kgCOD	※See ②
10	Methane conversion factor MCF	0.97	—	※See ③
11	Generated electric power	980	kW	Assumed value from the project design
12	Power generation efficiency	35	%	Assumed value from the project design
13	Sold electric power EG_y	※See④	MWh/yr	※See ④
14	Mean value across all SESB grid power sources EF_E	0.55	tCO_2/MWh	Value from the PTM hearing

※① COD_P: Chemical oxygen demand COD_B at the open lagoon inlet (fermentation tank inlet) (kgCOD/yr)

Concerning COD_P, values measured after the project has been implemented shall be used. Meanwhile, in this PDD, COD_B is calculated as a reference value using the following method.

$COD_B = COD_X \times FFB_{AVGy} \times PCF$ ..... Formula 1

COD_X : COD value per $1m^3$ of POME (=20kgCOD/m^3POME※)
※Result of water quality analysis at Lumadan Mill factory
FFB_y : Annual FFB treatment flow (tFFB/yr)
PCF : Generated POME per 1t of treated FFB

Concerning FFB_y, the figures shown in the following table are adopted based on the treatment plan compiled by Borneo Samudera Sdn. Bhd. Concerning 2015 and onwards, it is assumed that the treatment flow in 2014 is continued because as yet there is no concrete treatment plan.

Year	2008	2009	2010	2011	2012	2013	2014	2015
FFB treatment flow (t)	207,436	254,541	273,541	303,028	322,309	337,901	344,268	344,268
Year	2016	2017	2018	2019	2020	2021	2022	2023
FFB treatment flow (t)	344,268	344,268	344,268	344,268	344,268	344,268	344,268	344,268

PCF is calculated based on the following formula:

PCF＝CFF×2.5 ..... Formula 2

CFF : Quantity of refined CPO per 1t of treated FFB (tCPO/tFFB) (=0.212 tCPO/tFFB※)
※Value based on past data of Borneo Samudera Sdn. Bhd.
PCF : POME discharge per 1t of refined CPO (m^3POME/tCPO) (＝2.5 m^3POME/tCPO※)
※Value based on survey by the PORIM: Palm Oil Research Institute Malaysia）

※② Bo: Maximum methane generation coefficient ($kgCH_4$/kgCOD)
Concerning Bo, 0.25 $kgCH_4$/kgCOD is given as a default value in the IPCC Guidelines. Moreover, in AM0013.VERSION02, in view of the uncertainty of the said value, 0.21$kgCH_4$/kgCOD is given as the default value. However, neither of these values is calculated for POME specifically, but rather they are intended for wastewater from industry and agriculture in general. On the other hand, in the "Baseline study of methane emission from anaerobic ponds of palm oil mill effluent treatment" (*Science of The Total Environment, In Press, Corrected Proof, Available online 24 August 2005,* Shahrakbah Yacob, Mohd Ali Hassan, Yoshihito Shirai, Minato Wakisaka and Sunderaj Subash), a value of 0.238 $kgCH_4$/kgCOD is given based on the results of study and research of POME in Malaysia. Generally speaking, POME discharged from factories that adopt the same oil refining process in the same country displays the same properties, so the value of 0.238$kgCH_4$/kgCOD is used in the project calculations.

※③ MCF: Methane conversion coefficienct (－)
Concerning MCF, no specific default value is given in the IPCC Guidelines, however, a coefficient of0.9 is given for the Asian region. Moreover, in AM0013.VERSION02, in view of the uncertainty of the said value, 0.738 is given as the default value. However, neither of these values is calculated for POME specifically, but rather they are intended for wastewater from industry and agriculture in general. On the other hand, in the "Baseline study of methane emission from anaerobic ponds of palm oil mill effluent treatment" (*Science of The Total Environment, In Press, Corrected Proof, Available online 24 August 2005,* Shahrakbah Yacob, Mohd Ali Hassan, Yoshihito Shirai, Minato Wakisaka and Sunderaj Subash), a value of 0.97 is given based on the results of study and research of POME in Malaysia. Generally speaking, POME discharged from factories that adopt the same oil refining process in the same country displays the same properties, so the value of 0.97 is used in the project calculations.

※④ EG_y: Amount of sold electricity （MWh/yr）
Values measured after implementation of the project will be used for the EG_y. Meanwhile, in the PDD, values estimated based on the scheduled scale of introduced power generation, i.e. 980 kW, are used (see the following table). Moreover, the number of operating days is set at 335 days in consideration of maintenance stoppages, while the self-consumption rate is set at 20%. Incidentally, it is planned to implement power generation from 2009 onwards.

Year	2008	2009	2010	2011	2012	2013	2014	2015
Sold power (MWh/yr)	0	4,744	5,118	5,670	6,030	6,303	6,303	6,303
Year	2016	2017	2018	2019	2020	2021	2022	2023
Sold power (MWh/yr)	6,303	6,303	6,303	6,303	6,303	6,303	6,303	6,303

Table 2 Electricity Rate and Taxation, etc.

No.	Item	Value	Unit	Source
1	Electricity rate	0.21	RM/kWh	—
2	Price inflation rate	1.8	%	Ministry of Foreign Affairs HP
3	Interest on long-term government bonds in Malaysia	4.21	%	Mean value in December 2005
4	Corporation tax	28	%	Industrial Development Agency of Malaysia
5	Depreciation (plant and equipment)	20	%	Initial year
6	Depreciation (plant and equipment)	14	%	2nd year onwards, fixed instalment method

Table 3 Initial Cost and Running Cost

No.	Item	Value	Unit	Source
1	Methane fermentation tank	68,000	1000 yen	
2	Gas engine	202,000	1000 yen	
3	Flare stack	20,000	1000 yen	
4	Gas holder	32,000	1000 yen	
5	Desulfurization equipment	19,000	1000 yen	
6	Pumps and blowers	12,000	1000 yen	
7	Installation, piping, electric and instrumentation works	48,000	1000 yen	
8	Indirect works, temporary works	24,000	1000 yen	
9	Transmission and linkage works	35,000	1000 yen	
10	Total	460,000	1000 yen	

Table 4 Results of Sensitivity Analysis

Sensitivity analysis shows that, if there are no CERs in the proposed project, the project cannot be the baseline, and it shows the IRR in the case where there are no CERs. The ratio of fluctuation in the cost parameters in the sensitivity analysis will be determined in reference to the rate of inflation in Malaysia, in such a manner that this is covered.

①Variable element: Plant cost and running cost

Rate of variation	−10%	−5%	0%	+5%	+10%
IRR (%)	1.7	1.0	0.3	minus	minus

②Variable element: Electricity rate

Rate of variation	−10%	−5%	0%	+5%	+10%
IRR (%)	minus	minus	0.3	0.9	1.6

③Variable element: Generated amount of biogas

Rate of variation	−10%	−5%	0%	+5%	+10%
IRR (%)	minus	minus	0.3	0.4	0.6

Annex 4

MONITORING PLAN

Based on the monitoring methodology, the monitoring plan for the following items is demonstrated.

○ID1	COD_{Dout}	COD value of wastewater (fermentation tank outlet)
○ID10	COD_{Din}	COD value of wastewater (fermentation tank inlet)

COD will be measured through performing sampling and water quality analysis. COD is sought through making a water sample react with a powerful oxidizing reagent and seeking the non-oxide content. Except for special purpose waters, this is mainly used as an indicator of organic content. In particular, it is used as the environmental standard concerning water pollution in the ocean and in lakes. In the case of river water, BOD is used as the indicator, however, since it takes a few days to measure this, COD is sometimes used instead. BOD and COD are correlated, however, they are not always the same. Generally speaking, potassium permanganate or potassium dichromate are used as the oxidizing agent. The former does not give a very high oxidising factor, however, it is simple and offers high reproducibility. The latter offers a high oxidising factor, however, care is required when using chrome in POME treatment.
Here, COD measurement using potassium dichromate is performed. Incidentally, COD is sometimes referred to as the Chemical oxygen demand.

○ID2	$POME_{Dout}$	Wastewater flow (fermentation tank outlet)
○ID11	$POME_{Din}$	Wastewater flow (fermentation tank inlet)

There are various types of flowmeter, but the target for measurement here is liquid flow. POME at the fermentation tank inlet and outlet contains slurry. Therefore, since there is a risk of blockage in the case of an area-type flowmeter and a volumetric flowmeter, an electromagnetic flowmeter and vortex type flowmeter shall be used.
The electromagnetic flowmeter measures flow rate through utilizing Faraday's Law of Electromagnetic Induction, which states that voltage is generated in proportion to pipe inner diameter x flux density x average flow velocity when dielectric fluid flows in a uniform direction in a magnetic field. Since the electromagnetic flowmeter adopts a through channel structure containing no obstructions in the channel, pressure loss is extremely small.
Concerning the vortex flowmeter, when a column (vortex generating object) is placed in the flow, a regular Karman vortex street is created behind the column, and the vortex flowmeter detects the pressure change resulting from this vortex as a stress change and converts this into the flow rate, which is measured. The vortex flowmeter only has a vortex-generating object in the flow channel and is a simple structure with no moving parts, and it offers excellent reliability and durability.

○ID3	BR_{Dout}	Generated amount of biogas (fermentation tank outlet)
○ID4	BR_{GEin}	Generated amount of biogas (fermentation tank inlet)
○ID5	BR_{fin}	Generated amount of biogas (flare equipment inlet)
○ID7	SR	Exhaust gas flow

There are various types of flow rate, however, the subject targeted here is the volumetric flow rate of gas. The instantaneous volumetric flow rate of gas can be measured using various instruments including a

vortex flowmeter or a supersonic type flowmeter, however, here an instrument fitted with integrating functions that can simultaneously measure pressure and temperature and correct flow into the standard state shall be used.

Various types of flowmeter can be used to measure gas flow rate, for example, an orifice flowmeter, a pitot tube flowmeter, an annubar flowmeter and a vortex flowmeter. When measuring the flow rate of exhaust gas, a pitot tube flowmeter or an annubar flowmeter is used because the gas becomes hot and the flow channel surface area is large. There are various types of flowmeter, however, the subject targeted here is the volumetric flow rate of gas. The instantaneous volumetric flow rate of gas can be measured using various instruments including a vortex flowmeter and a supersonic type flowmeter, however, here an instrument fitted with integrating functions that can simultaneously measure pressure and temperature and correct flow into the standard state shall be used.

○ID6 MC_{BG} Methane concentration (in biogas)
○ID8 MC_{SG} Methane concentration (in exhaust gas)

Methods for measuring the volumetric concentration of methane gas in gas include gas chromatograph analysis, the fixed sensor gas analyzer, the optic sensor gas analyzer, and the hydrogen flame ionization gas analyzer, etc. The performance characteristics required of the gas analyzer to be used here are relatively low price (meaning a widely available type), accuracy, little impact on precision even if there is some variation in concentration, durability, and low-maintenance. Fluctuations in concentration should be in the order of 0~70% and not in the order of ppm. An analyzer that enables simple measurement and requires little maintenance is also required. The optical sensor gas analyzer fulfils these requirements, and an infrared type is most appropriate.

The infrared methane gas analyzer entails simple calibration. This can be performed by preparing a standard methane gas tank of known concentration and a tank of methane gas of zero concentration for zero calibration. In other words, providing that tanks can be carried in, it is possible to calibrate the infrared methane gas analyzer anywhere.

It is desirable that the infrared methane gas analyzer also be able to measure oxygen concentration. Although not directly linked to the monitoring, if there is an abnormal rise in the oxygen concentration of gas, there is risk of explosion; therefore, it is necessary to stop the system.
Concerning checking of methane concentration in biogas, as a rule, the display shall be checked at least once per week for any abnormality and records shall be taken once per month to coincide with checking and recording of the biogas and exhaust gas flow rate.

○ID9 EC Electric power consumption in the fermentation tank
○ID12 EG_y Sold electric power

The wattmeter is used for monitoring required in the JI project and also for power sale and purchase. Accordingly, wattmeters will be installed as required or provided by the electricity grid owner, and these will be calibrated as required.

Electric energy is consecutively measured and automatically summated. Since it is necessary to know the accumulated electric energy rather than the instantaneous electric energy, it is not necessary to take and record frequent visual measurements. As a rule, the display shall be checked at least once per week for

any abnormality, and records shall be taken once per month to coincide with checking and recording of the biogas flow rate.

○ID13 EF_E Grid emission factor

Data shall be received from the Malaysia Energy Center (PTM) once per year.

○ID14 Wastewater regulations

The necessary information shall be received from the Ministry of Natural Resources and Environment, Sabah Department of Environment once per year.

※ Based on the methodology, monitoring data shall be summated as annual data. In cases of monthly data, monthly amounts shall be totaled in order to give the annual data.

- - - - -