Feasibility Study Report
Palm Oil Mill Effluent (POME) Treatment
Co-benefits CDM Project
(Summary)

February 2009

Tokyo Electric Power Environmental Engineering Co., Inc.

Index

1. An Overview of Project Activity

1.1. An overview of project activity

The study aims at avoidance of methane gas emissions which is now generated by anaerobic treatment process in the palm oil mill, by replacing the current anaerobic open-lagoon system with a new POME treatment technology using a decanter and flocculant material. The organic materials solidified by the new treatment technology are desiccated by drying equipment using the waste heat (excess steam) of boilers in the Mill and then reused for a supplementary fuel of the boilers. The project will be located at the Klang Kelpa Sawit Bukit Pasir Palm Oil Mill, Muar, Johor State, in Peninsular Malaysia ('the Mill').

The Mill has the capacity to handle 50 tonnes per hour of fresh fruit bunch (FFB). This FFB is processed into crude palm oil and a number of other useful by-products. During the processing of the FFB, a significant amount of wastewater is produced, with high content of organic waste materials, known as Palm Oil Mill Effluent (POME). The ratio of POME produced is approximately 0.6 tonnes per tone FFB processed, with a typical COD value of around 78,000 mg / liter. The total amount of organic material contained in the Mill's wastewater is around 145,000 tonnes per annum.

This wastewater is currently treated in a system of anaerobic holding tanks and ponds, with final treatment provided by aerobic pond. The treated wastewater is then released into a nearby river.

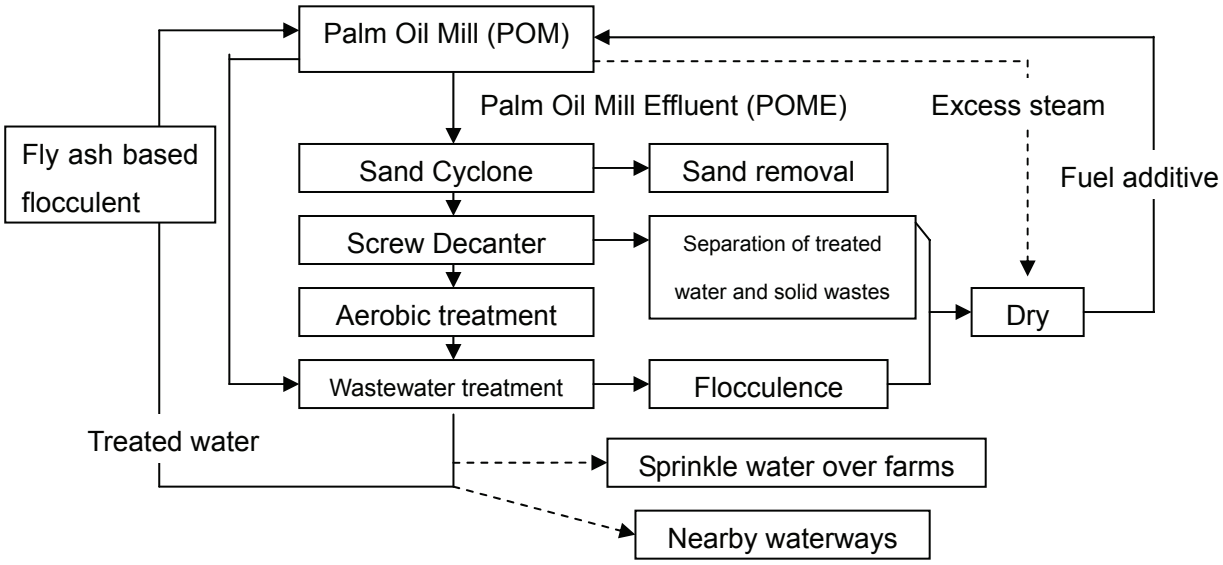
In the project, it is proposed to treat the waster at three phases as follows:
(a) At first in a decanter to remove the larger particles of organic material.
(b) The wastewater stream will then pass through the existing aerobic ponds, but with improvement of the blower system and a longer residence time to promote more complete breakdown of the remaining fine particles of organic material.
(c) The third phase of treatment will be to mix the wastewater with a flocculent material, which will encourage the remaining organic particles to clump together into a solid mass, which can then be easily removed from the wastewater stream.

Recovered organic material " Solid wastes" is applied to boilers of the palm oil mill as fuel after going through the drying process by boiler steam, which can reduce water content of the solid wastes by less than 40% per weight. Thus, efficient & effective use of discharged boiler steam is expected. Also after separation process, almost 100% of the treated water is reused at the mill. The technology also allows extraction of oil, which usually accounts for about 1.0% of POME volume. An additional

centrifugal machine, in case of oil rich, the treatment enabled to recover the oil contained in POME efficiently. Introduction of the high-efficient POME treatment plant replaces the currently practiced open-lagoon anaerobical process where POME is treated. The abandonment of lagoons can avoid emissions of methane gas, one of greenhouse gases. The project thus contributes to the reduction of greenhouse gas emissions. An expected emission reduction average about 35,000 tonnes of CO2-equivalent in a year.

In the baseline, a significant proportion of the reduction in COD of the wastewater is achieved using anaerobic ponds, which results in significant release of methane to the atmosphere. However in the Project, this will be replaced by an approach which minimizes any anaerobic activity. Further, the approach proposed by the Project, in particular the final stage of treatment with flocculent, will allow for a much fuller treatment of the wastewater. The wastewater thus treated would be of sufficient quality for recycling within the Mill, and would of course fully meet the required environmental standards for release into nearby wasterways Finally, the technology is able to efficiently reduce COD, BOD and SS to meet discharge standard. The POME treatment system is shown in the following diagram.

Figure 1-1 POME Treatment System Flowchart



< Equipment Capacity >

(a) Pre-treatment process : Sand Cyclone : 30 ㎥/ h

(b) Separation of treated water and solid waste process : Screw Decanter : 30 ㎥/ h

(c) Aerobic treatment process : 7,300 ㎥/ pond

(d) Drying process : Steam power :1,235 kg / h

(e) Flocculent process : TEE wastewater treatment system : 30 ㎥/ h

Starting date of the Project Activity (Plan) : September 2010

1.2. An overview of physical location in Host country

The project will be located at the the Klang Kelpa Sawit Bukit Pasir Palm Oil Mill, Muar, Johor State, in Peninsular Malaysia

Figure 1-2 Kilang Kelapa Sawit Bukit Pasir SDN.BHD., Palm Oil Mill - 1

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Figure 1-3 Kilang Kelapa Sawit Bukit Pasir SDN.BHD., Palm Oil Mill – 2

The positioning coordinates (decimal) are: 2.0846 N / 102.6972 E

Figure 1-4 An overview of Bakit Pasir Palm Oil Mill

Name of Palm Oil Mill	Kilang Kelapa Sawit Bukit Pasir Palm Oil Mil
Address	P.O.Box 103, 84300 Bukit Pasir, Muar, Malaysia
Operational hours	16 (hour / day), 2 shifts, 300 (day / year)
FFB processing capacity/hour	50 (M / tonnes / hour)
FFB processing capacity/day	800 (M / tonnes / day)
FFB processing capacity/year	240,000 (M / tonnes / year)

1.3 CDM policy and development status in Malaysia

Figure 1-5 CDM policy and development status in Malaysia

Month, Date, Year	CDM policy and development status in Malaysia
July 13, 1994	Malaysia ratified the Climate Change Action Plan as Non-Annex I Parties
Dec. 1997	The Kyoto Protocol was adopted at the 3rd session of the Conference of the Parties (COP3) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Kyoto, Japan
Mar. 12, 1999	Malaysia signed the Kyoto Protocol
Sep. 4, 2002	Malaysia ratified the Kyoto Protocol
Sep. 12, 2002	The national Steering Committee on Climate Change (NSCCC) agreed that Pusat Tenaga Malaysia (PTM) as a secretariat for The Technical Committee on Energy sector
Sep. 15, 2002	The first CDM Project was applies to The Technical Committee on Energy sector
Mar. 2003	Malaysia designated Conservation and Environment Management Division (CEMD) of the Ministry of Natural Resources and Environment (NRE) as designated National Authority (DNA)
Mar. 11, 2003	PMT carried out Capacity Building for CDM Project funded by Danish International Development Agency（DANIDA）
Aug. 2003	The National committee on CDM (NSCCC) approved the criteria of CDM
Feb. 16, 2005	The Kyoto Protocol entered into force
As of Mar. 7, 2008	Malaysia has twenty six CDM projects, which have been already registered by UNFCCC

*Clean Development Mechanism for Energy Sector Web site, CDM in Malaysia, UNFCCC Web site

*http://www.cdm-ji.org/policy/malaysia.html

1.4 Current status of Malaysian palm oil industry

Omitted due to space limitation.

2. Description of Survey on Project Activity

2.1. Survey participants

Figure 2-1 Survey Participants

Name of Party involved, Japan
・Tokyo Electric Power Environmental Engineering Co., Inc. (TEE) - Supervision ・Kansai -Corporation - Technical survey of facility design, and equipment of PMT INDUSTREIS SDN.BHD ・Mitsubishi UFJ Security Co., Ltd. - CDM consultation in Japan
Name of Party involved, Malaysia
・Kilang Kelapa Sawit Bukit Pasir Sdn. .Bhd. - Palm Oil Mill ・PMT Industries Sdh. Bhd. Technical survey of equipment, maintenance and operation ・Mitsubishi UFJ Security, Malaysia Co., Ltd.- CDM consultation in Malaysia

2.2. Description of survey on project activity

The survey includes the following contents.

1. Field survey

(a) Energy balance
  i. Survey on the facilities and the processing capacity of the palm oil mill
  ii. Survey on the processing process of the palm oil mill
(b) Seasonal fluctuation of the amount of biomass
  i. Survey on the biomass energy balance in the palm oil mill
(c) Survey on the excess biomass
(d) Survey on the POME treatment process and the analyzed data of effluent at each point of the process
  i. Survey on the monthly discharge of wastewater from POME treatment process
(e) Check on the review criteria of Peninsular Malaysia for the CDM project materialization, the current approval status, the need for the environmental assessment and the procedures for plant construction

2. Feasibility study on manufacturing the flocculent material with use of incineration ash from biomass boilers

The quantitative analysis of incineration ash from biomass boilers was carried out in order to examine the possibility for recycling of waste materials from the Mill as part of the co-benefits CDM project.

3. Calorimetric and ash analysis, and incineration test of separated solid wastes

In order to confirm the reusability of separated solid wastes as a supplementary fuel, the analysis of carbon content as fuel elemental carbon and ash content as well as the incineration test of the separated solid wastes ware carried out.

4. Methodology survey

From the viewpoint of the small-scale CDM project, the existing applications of AMS-III.I / Version 07 and AMS-III.Y / Version 01 and a new application of AMS-III. New / Version New may be appropriate as methodology.

(a) " Avoidance of methane production in wastewater treatment through replacement of anaerobic systems by aerobic systems " AMS-III.I / Version 07
(b) " Methane avoidance through separation of solids from wastewater or manure treatment systems" AMS-III.Y / Version 01
(c) " Methane avoidance through chemical treatment of industrial wastewater " AMS-III. New / Version New

5. Stakeholders' comments

Listed below are the stakeholders' comments we received:

(a) Conservation and Environment Management Division (CEMD) of the Ministry of Natural Resources and Environment (NRE) as designated National Authority (DNA)
(b) Pusat Tenaga Malaysia (PTM)
(c) Department of Environment, Johor
(d) KILANG KELAPA SAWIT Bukit Pasir Palm Oil Mill, etc.

3. Project Activity Materialization

3.1. Project boundary and baseline scenario

In accordance with paragraph 3 of AMS-III.I, the project boundary for the project activity is defined as follows:

The project boundary is the physical, geographical sites where:

(a) The wastewater treatment would have taken place and the methane emission occurred in absence of the project activity.

(b) The wastewater treatment takes place in the project activity.

(c) The sludge is treated and disposed off in the baseline and project situation.

In accordance with paragraph 12 of AMS-III.Y, the project boundary for the project activity is defined as follows:

The project boundary is the physical, geographical site:

(a) Where the animal waste would have been collected, stored and treated and the methane emission would have occurred in the absence of the proposed project activity.

(b) Where the wastewater treatment would have taken place and the methane emission would have occurred in the absence of the proposed project activity.

(c) Where the treatment of animal waste or wastewater through solids separation takes place.

(d) Where the storage, gainful use, destruction and/or land application of the separated solids takes place.

(e) The itineraries between them, where the transportation of separated solids occur.

In accordance with paragraph 5 of AMS-III. New, the project boundary for the project activity is defined as follows:

The Project Boundary is the physical, geographical sites where:

(a) The wastewater treatment would have taken place and the methane emission occurred in absence of the project activity.

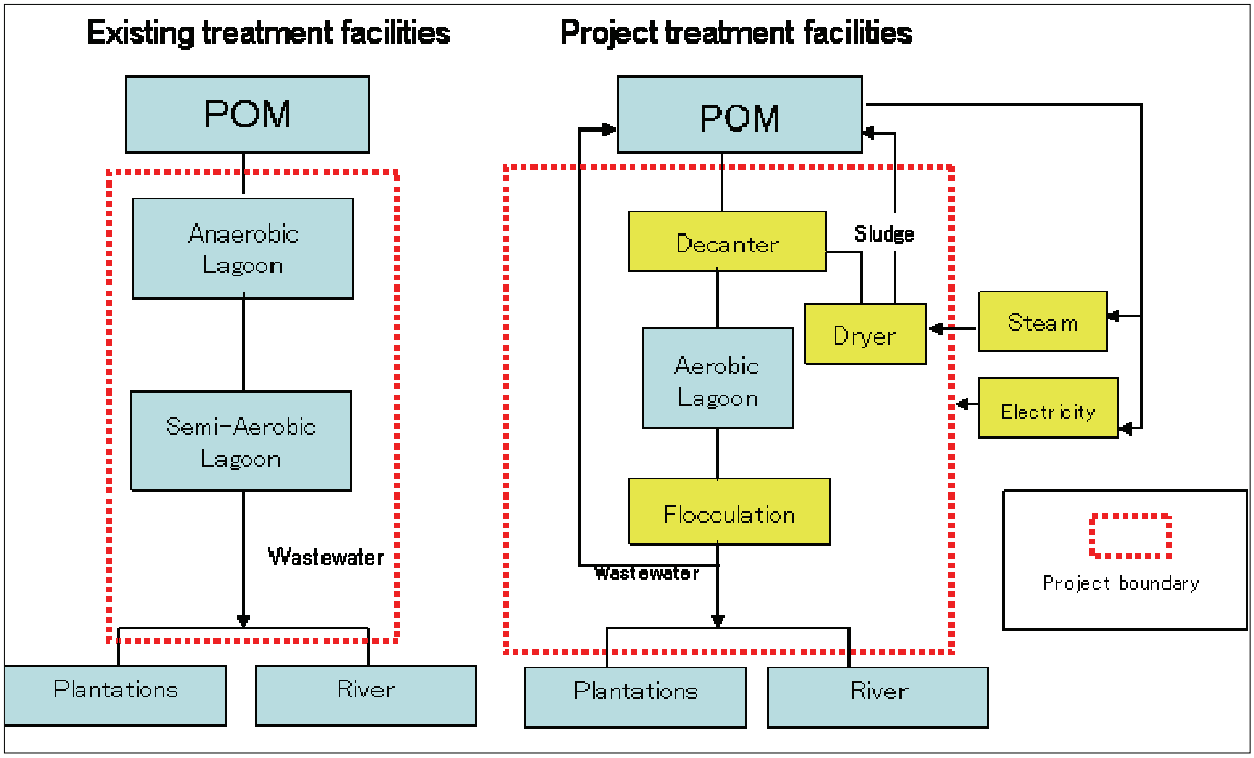
(b) The wastewater treatment takes place in the project activity.

(c) The sludge is treated and disposed of in the baseline situation.

(d) The solid wastes extracted from the flocculation process is treated and disposed of in the project situation.

The illustration below shows a flowchart of the Project and its boundaries

Figure 3-1 A flowchart of the Project and its boundaries



3.1.1. Description of baseline and its development

The baseline scenario is in accordance with paragraph 4 of AMS-III.I:
"The baseline scenario is the situation where, in the absence of the project activity, degradable organic matter is treated in anaerobic systems and methane is emitted to the atmosphere."

The baseline scenario is also in accordance with paragraph 13 of AMS-III.Y:
"The baseline scenario is the situation where the solids separated from manure system or from the wastewater would be treated in the waster treatment or manure management system within the project boundary, without methane recovery, and methane is emitted to the atmosphere."

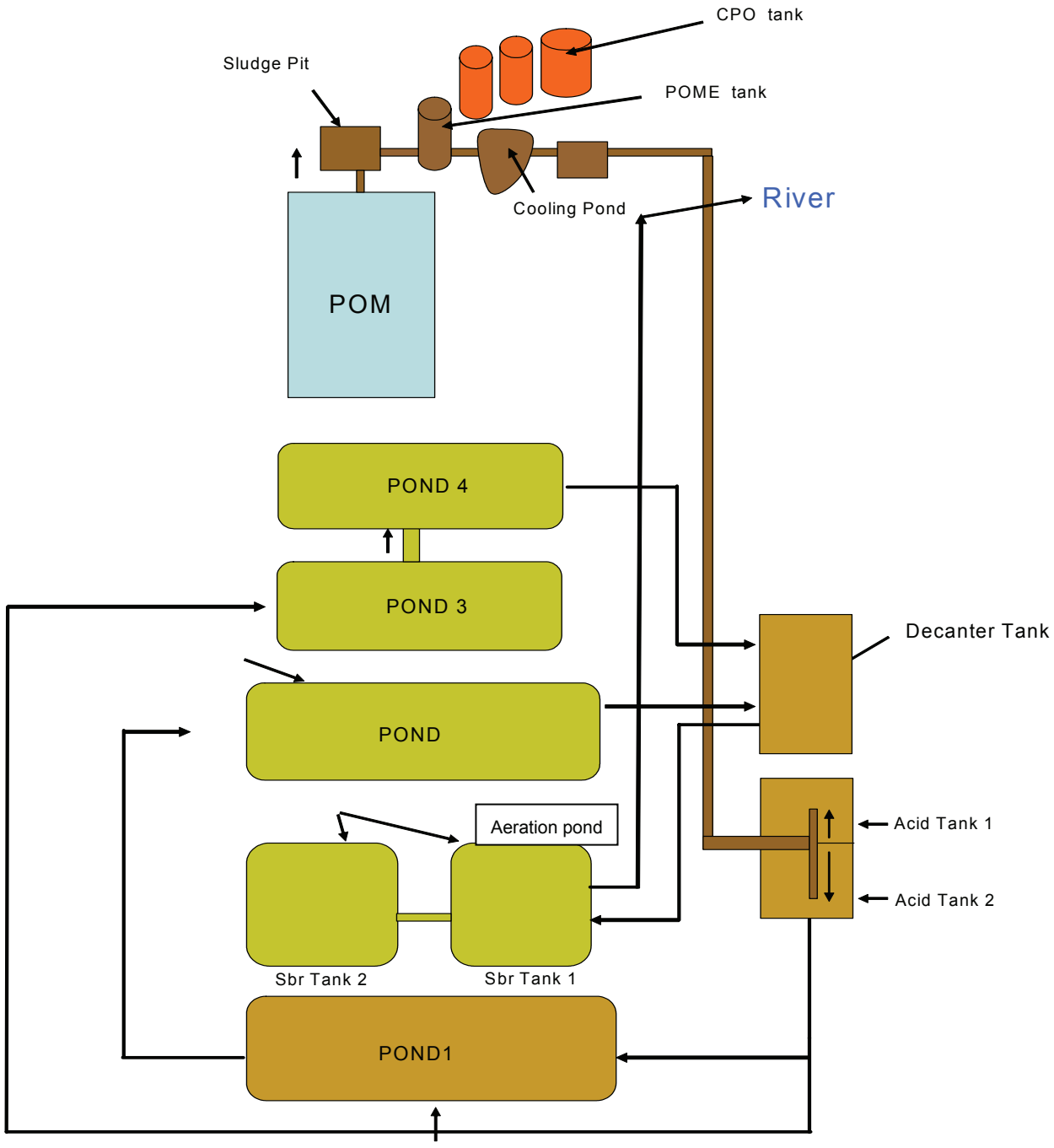
The baseline scenario is also in accordance with paragraph 6 of AMS-III.NEW:
"The baseline scenario is the situation where, in the absence of the project activity, degradable organic matter is treated in anaerobic systems and methane is emitted to the atmosphere."

Currently at the Mill, wastewater is treated in a series of aerobic and anaerobic ponds. Finally, when the wastewater is released into a nearby waterway, it still contains a significant quantity of organic material. Further, sludge is periodically removed from both the aerobic and anaerobic wastewater treatment systems. This sludge is disposed in shallow pits / ponds adjacent to the wastewater treatment system. Please refer to Figure 3-2 for a diagram of the current wastewater treatment system at the Mill. The Department of Environment, Johor (DOE) is considering both strengthening the effluent standard and the enforcement of the regulation of total emission of wastewater in a few years.

Under the CDM methodologies applied by the Project, appropriate baseline calculations are provided to estimate the baseline greenhouse gas emissions associated with:

(a) Methane produced in the anaerobic baseline wastewater treatment systems
(b) Methane produced due to inefficiencies in the baseline aerobic wastewater treatment system
(c) Methane produced during the breakdown of remaining organic material in the wastewater following release to a natural body of water
(d) Methane produced during the treatment and disposal of sludge removed from the wastewater treatment system

Figure 3-2 A flow diagram of the current wastewater treatment system at the Mill



3.2 Monitoring methodology

From the viewpoint of the small-scale CDM project, the existing applications of AMS-III.I / Version 07 and AMS-III.Y / Version 01 and a new application of AMS-III. New / Version New may be appropriate as methodology.

(a) " Avoidance of methane production in wastewater treatment through replacement of anaerobic systems by aerobic systems " AMS-III.I / Version 07.
(b) " Methane avoidance through separation of solids from wastewater or manure treatment systems" AMS-III.Y / Version 01.
(c) " Methane avoidance through chemical treatment of industrial wastewater " AMS-III. New / Version New.

3.2.1 Brief description of the New Methodology

The application of new methodology AMS-III.New in paragraph (c) above is being prepared to file with the United Nations because there is no methodology to avoid methane production in wastewater with flocculent material

(a) This methodology comprises technologies and measures that avoid the production of methane from biogenic organic matter in wastewaters being treated in anaerobic systems. Due to the project activity, the anaerobic systems are replaced by chemical treatment systems based on the use of flocculents.

(b) The flocculent-based wastewater treatment system should be designed so that retention time of the wastewater will be less than one day.

(c) The flocculent used in the project must be identifiable, and its components must be traceable back to their original source.

(d) This methodology may be used in combination with other methodologies (e.g. AMS-III.H, AMS-III.I, AMS-III.Y) to provide a comprehensive solution to wastewater treatment. In such cases, where the baseline emission, project emission or leakage calculations conflict or overlap, then the calculation approach which results in the most conservative estimation of the emission reductions should be selected.

3.2.2 Description of the monitoring plan

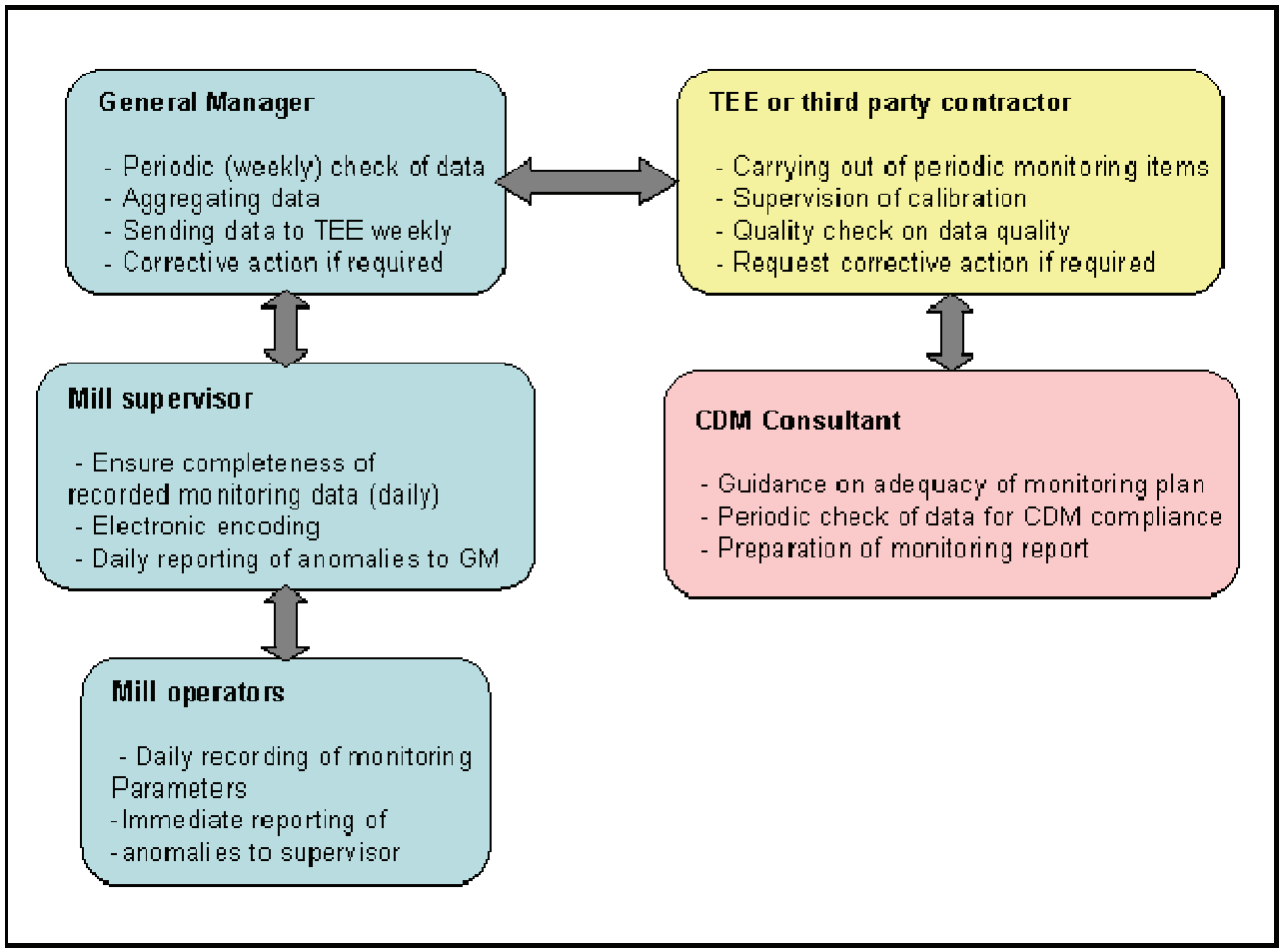
Tokyo Electric Power Environmental Engineering Co., Inc. ('TEE'), the senior partner in the project, has achieved both ISO9001 and ISO14001 certification.

As part of the commercial arrangement between TEE and the Mill, day to day operational functions, including monitoring of the Project's performance will be carried out by the Mill's staff, with appropriate guidance and training to be provided by TEE. Periodic monitoring items, such as sampling of COD levels, or calibration of key instruments, will be carried out either directly by TEE, or by contracting to a third party specialist. Further, TEE will carry out a secondary quality check on all monitored data, with regular updates of the data being supplied to TEE. TEE will form an operational and management team, which will be responsible for carrying out all monitoring functions as prescribed in the Monitoring Plan. This team composes of a general manager, supervisor and operators. The operators, who are under the supervisor, will be assigned for monitoring of the parameters on a timely basis as well as recording and archiving data in an orderly manner. Monitoring reports will be forwarded to and reviewed by the general manager on a weekly basis in order to ensure the Project follows the requirements of the monitoring plan.

Data monitored and required for verification and issuance will be kept for a minimum of two (2) years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later. Data archived will also be verified regularly by the DOE. The performance of the Project will be reviewed and analyzed by the CDM consultant on a regular basis.

The figure 3-3 outlines the management and operational structure that the team will implement to monitor emission reductions and any leakage effects generated by the Project.

Figure 3-3 Management and operational structure for monitoring



3.3 Estimation of GHG emissions and leakage

Baseline : 35,678 tCO_2e

(a) Avoidance of methane through replacement of anaerobic systems by aerobic systems : 31,513 tCO_2e

(b) Sludge is simply removed from the ponds when necessary, and placed in a waste disposal site in the POM's grounds, where it decomposes in anaerobic conditions : 4,058 tCO_2e

(c) Presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea etc.: 107 tCO_2e

▲ Leakage : 640 tCO_2e

the ex-ante estimation of emission reductions : 35,038 tCO_2e

1. Avoidance of methane through replacement of anaerobic systems by aerobic systems (as per AMS-III.I) ($BE_{ww,treatment,y}$) : 31,513 tCO_2e

Calculation for baseline anaerobic ponds is as follows:

$BE_{ww,treatment,y} = Q_{ww,m,y} * COD_{removed,i,m,} * MCF_{anaerobic} * B_{o,ww} * UF_{BL} * GWP_{CH4} * DF$

= 145,302 m^3 * 73.48 kgCOD/m^3 * 0.8 * 0.21 kgCH_4/kgCOD * 0.94 * 21 * 0.89

$BE_{ww,treatment,y}$ = 31,513,000 kgCO_2e

= **31,513** **tCO_2e**

2. In the baseline, sludge is simply removed from the ponds when necessary, and placed in a waste disposal site in the POM's grounds, where it decomposes in anaerobic conditions ($BE_{s,final,y}$) : 4,058 tCO_2e

Baseline emissions from this source are calculated as follows

$BE_{s,final,y} = S_{final,BL,y} * DOC_s * UF_{BL} * MCF_{s,BL,final} * DOC_F * F * 16/12 * GWP_{CH4} * DF$

= 6000 tonnes * 0.257 * 0.94 * 0.4 * 0.5 * 0.5 * 16/12 * 21

$BE_{s,final,y}$ = 4,058,000 kgCO_2e

= **4,058** **tCO_2e**

3. Methane emissions on account of inefficiencies in the baseline wastewater treatment systems and presence of degradable organic carbon in the treated wastewater discharged into river/lake/sea etc. (*BEww,discharge,y*) : 107 tCO_2e

$$BE_{ww,discharge,y} = Q_{ww,y} * GWP\_CH4 * B_{o,ww} * UF_{BL} * COD_{ww,discharge,BL,y} * MCF_{ww,B,L,discharge} * DF$$

$$145{,}302\ m^3 * 21 * 0.21\ kgCH_4/kgCOD * 0.94 * 1.77\ kgCOD/m^3 * 0.1$$

$BE_{ww,discharge,y}$ = 107,000 $kgCO_2e$

= **107** **tCO_2e**

4. ▲ Leakage ($Leakage_{,y}$) : 640 tCO_2e

In the Project, total mass of flocculent expected to be consumed is 162 tonnes per year. Of this flocculent, 50% will consist of fly ash, sourced from the Mill's biomass boiler. The remaining 50% of the flocculent will be a combination of organic and inorganic polymers. The details of the ingredients of these polymers are confidential, but they will be listed for the DOE, along with published references establishing that the default emission factor of 7.9tCO_2e is a conservative estimate of the life cycle emissions associated with the production of these polymers.

Therefore, leakage from this source is calculated as follows:

$$Leakage_{,y} = Q_{floc,mannuf,y} * EF_{floc,manuf,y}$$

$$81t * 7.9\ tCO_2e / t$$

$Leakage_{,y}$ = 639,900 $kgCO_2e$

= **640** **tCO_2e**

The 10-year renewable crediting period option is selected for the Project. Annual estimates, together with total and average estimates for the first crediting period are shown in the figure below. It is estimated that approx. 35,000 tonnes of CERs are expected to be issued from 2011until 2020.

Figure 3-4 the ex-ante estimation of emission reductions (tCO2e)

Calendar Year	Estimation of project activity emissions (tCO2e)	Estimation of baseline emissions (tCO2e)	Estimation of leakage (tCO2e)	Estimation of overall emission reductions (tCO2e)
2011	0	35,678	640	35,038
2012	0	35,678	640	35,038
2013	0	35,678	640	35,038
2014	0	35,678	640	35,038
2015	0	35,678	640	35,038
2016	0	35,678	640	35,038
2017	0	35,678	640	35,038
2018	0	35,678	640	35,038
2019	0	35,678	640	35,038
2020	0	35,678	640	35,038
Total (tCO2e)	0	356,780	6, 400	350,380

3.4 Duration of project activity and credit period

Figure 3-5 Project timetable

Description	2009	2010	2011 - 2018	2019	2020
New methodology submission	Approval ←→				
Making PDD & submission	Approval ←→				
Design of the plant & procurement of the equipment		←→			
Operation of the plant		←	—	→	
Monitoring by DOE		←→			
Issuance of CERs			▼Dec. 2011		
CERs period			← —	— →	Dec.2020

3.5 Environmental impact assessment and other indirect impacts

According to the applicable legislation (Malaysian Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987), new developments which contribute to the improvement of quality of a wastewater source do not have to carry out a full Environmental Impact Assessment.

However, it is required to attach the confirmation document issued by the DOE which explicitly states "the EIA unnecessary" to the PDD documents submitted to the DNA. For the issue of the confirmation document, the applicant should be required to provide the DOE both explanations about the technology and information including the estimated reduction in BOD and COD as well as the estimated final discharge released into nearby waterways.

● Other indirect impacts

(a) Technology transfer

The transfer of the effluent treatment technology accumulated in Japan will be carried out.

(b) Training of Malaysian engineers and employment creation

Through the above mentioned technology transfer, it is expected that the Malaysian engineers can be trained and the employment effect is also expected.

3.6 Stakeholders' comments

Although no formal meeting with stakeholders has been made at the survey stage. Following are the stakeholders' comments.

＜Public agency＞

1. Conservation and Environmental Management Division, Ministry of Natural Resources and Environment of Malaysia (DNA)

(a) Although there have been and are the CDM projects on methane gas collection, it is never heard of a CDM project on the improvement of POME treatment system which is a source of methane gas emission. It marks the first time.

(b) In case that a new methodology is needed for the Project, a prior approval for such new methodology by the United Nations is a prerequisite for the implementation of the Project. Even so, as far as the summary of the technology proposed, there would be no particular reason to be rejected in the review of CDM projects.

2. The Department of Environment, Johor (DOE)

(a) The environmental impact assessment(EIA) for palm oil effluent treatment system is not required. However, it is required to attach the confirmation document issued by the DOE which explicitly states “the EIA unnecessary” to the PDD documents submitted to the DNA.

(b) For the issue of the above mentioned confirmation document, an applicant should be required to provide the DOE both explanations about the technology and information including the estimated reduction in BOD and COD as well as the estimated discharge finally released into a nearby river. Any new construction and expansion of the existing facilities should comply with the water quality standard given in the DOE Ordinance, which stipulates that the levels of BOD and COD should be less than 50ppm and 100ppm, respectively.

(c) The DOE has concerns about the total discharge to rivers and streams, in addition to the BOD, COD and TS regulations to be conformed to. Although it will be long before the restriction on total discharge is enforced, it is probable that the total discharge from palm oil mills would be regulated in later stage.

3. Malaysia Palm Oil Board（MPOB）

(a) Flocculent material from fly ash : The particle size of fly ash from palm EFB is all different due to unstable combustion temperature, therefore it is necessary to even out the size of particles. Also neutralization is needed because the fly ash is alkaline. Even more than the EFB is used for fertilizers, the palm EFB is widely distributed as fuel and the price of FEB has risen from 80RM/t last year to 600RM/t by the fuel price inflation. It becomes more difficult to procure the EFB. (At the beginning of November of 2008)

(b) The MPOB had manufactured a flocculent material by way of trial and gotten a positive result. As the palm EFB contains a 0.5 to 1.0% of oil, the recovered oil will be available for sale and positive economic effects are expected, when the oil could be recovered.

(c) Any polymer material used for the flocculent material can be procured in Malaysia.

4. Pusat Tenaga Malaysia（PTM）

(a) The PTM is as a secretariat for The Technical Committee on Energy sector for CDM project (DNA). The Chubu Electric Power Co., Inc. and the Kansai Electric Power Co., Inc. also had visited to the PTM with regard to other CDM projects, while the Tokyo Electric Power Co., Inc. visited last year. Until this point, the CDM applications in Malaysia principally have involved in biogas electric power generation, biodiesel and biomass electric power generation.

The wastewater treatment technology to recover the organic material in solid wastes using flocculent material will be the first CDM project to reduce CO2 emissions applied to palm oil mills.

(b) At present the Project is timely in the context that the POME is seen as a problem along with the tightening of regulations for discharge in Malaysia. Some questions were posed regarding the calorific value of the separated solid fuel and the CO2 emissions generated by the Project (leakage).

＜Project area＞

5. KILANG KELAPA SAWIT Bukit Pasir Palm Oil Mill（the Mill）

(a) A confirmation that the installation of the facilities in the mill has no particular negative effects, has been received from both the mill manager Mr. LEE and the employees of the mill. On the installation of the facilities, the use of the existing aerobic POME lagoons and the bacteria ponds has been also permitted. Note, however, that any adverse affect on the existing production lines should be avoided while the facilities would be installed and operated.

(b) From the viewpoint of the mill manager Mr. LEE, it is evaluated that the technology of TEE had demonstrated the BOD and COD reduction in the laboratory. However, the actual processing volume is far more than the scale of laboratory and on the practical level approximately 600t/day of POME wastewater is discharged when the FFB treatment volume is 1,000 t/day. The implementation of sufficient demonstration experiment on the site after installing the facilities was requested.

6. YKL ENGINEERING（a nearby palm oil mill）

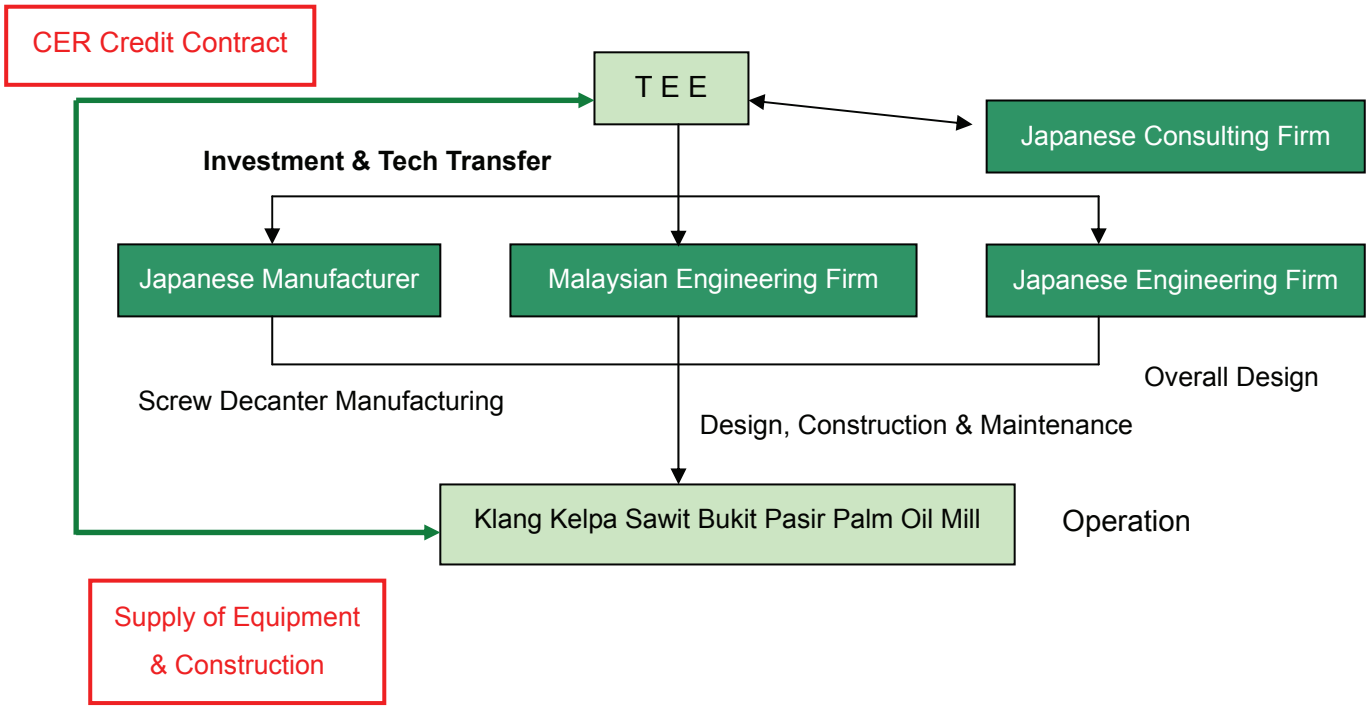
(a) It has been confirmed that the installation of the facilities in the Mill has no particular negative effects. Moreover, in contrast to the conventional methane collection method by covering the POME lagoon, the technology proposed in the Project provides a drastic treatment system which can purify the POME itself, therefore it attracts a great interest. When the facilities of TEE will be installed in the Mill, they have a mind to introduce the facilities together with the effluent treatment technology not only to the parties in palm oil industry in the Johor State but also widely to the internal and external business connections.

7. PMT INDUSTREIS SDN.BHD（Malaysian Engineering Firm）

(a) A confirmation that the installation of the facility in the Mill has no particular negative effects, has been received from the person involved of the company. The company manufactures components and parts for horizontal continuous centrifugal separator (screw decanter) and performs maintenance on the products. It has been confirmed that the company can supply the components and parts used for the treatment system of the TEE and also perform maintenance on them.

3.7 Project implementing participants

Figure 3-6 Project Implementing Participants



3.8 Funding of project activity

The project has received a grant from the Global Environment Centre Foundation of Japan. However, the grant is to cover costs associated with studying the feasibility of the project. No public funding has been used for the actual capital costs of developing the project. Therefore, TEE will be making a initial investment to set up the wastewater treatment facilities, etc.

3.9 Economic evaluation

A provisional IRR is calculated on the assumption that the CERs price** in the primary market for emission trading is 11.4EURO /tCO2. The income (CER credits) is calculated on the assumption that the emission amount of 35,038 tCO2/year which is equivalent to the estimated reduction by means of the Project will be issued and traded from 2011 and that it will be continuously salable in some way from 2013 or later. Consequently, the IRR for 7 years is minus 8.3% and the payout time is 10 years. In comparison with the investment criteria which indicates that the IRR for 7 years not less than 10% is profitable, the Project turns out to be unprofitable (on conditions of preinterest and pretax).

Once the Project will be materialized, the economical efficiency of the Project is expected to be vastly improved, being recognized as a target of investment. Therefore it should be required to scrutinize the precondition for the Project focusing on the cost reduction and examine the possibility of the Project.

The project requires investment of around 110 million Japanese yen. To give a provisional calculation of income and expenditure of the Project, Development and facilities installation cost (initial investment), Annual operating cost and administrative and maintenance cost, Annual operating revenue, the Economic Evaluation (IRR) and the Provisional IRR Calculation are shown in the Figures 3-7, 3-8, 3-9, 3-10 and 3-11 respectively.

** Carbon credits CER price at 11.40EURO/tCO2 (1,400yen at 122.807yen/ one EURO)
*Source of conversion rate : Emission Trading Report（published on 10 of December, 2008 by JBIC (Japan Bank for International Cooperation)

Figure 3-7 Development and facilities installation cost breakdown(initial investment)

	Item	Cost (JPY 000)	Cost (USD)*
1.	Consulting / project development costs	23,000	230,000
2.	Capital investment	96,750	967,500
2.a	*Solid / liquid separation equipment*	*59,355*	*593,550*
2.b	*Flocculent treatment system*	*13,500*	*135,000*
2.c	*Equipment for drying of separated solids*	*10,000*	*100,000*
2.d	*Ancillary equipment*	*8,700*	*87,000*
2.e	*Design and other costs*	*5,195*	*51,950*
	Total	109,750	1,097,500

* Conversion rate of 1 USD = 100 JPY

Further, operating costs are estimated as follows:

Figure 3-8 Annual operating cost and administrative and maintenance cost breakdown

	Item	Cost (JPY 000)	Cost (USD)*
1	Flocculent procurement	4,050	40,500
2.	Maintenance costs	2,880	28,800
3.	Full Overhaul in Year 3**	*3,000*	*30,000*
4.	Management costs	5,000	50,000
5.	Administrative cost	1,182	11,820
6.	Insurance	990	9,900
	Total	14,102	141,020

* Conversion rate of 1 USD = 100 JPY ** Not included in total

Figure 3-9 Annual operating revenue (CERs)

	(JPY 000)	USD	Remarks
CER revenue（2011～2020）	46,601	466,010	

- Carbon credits CER price at 11.40EURO/tCO2 (1,400yen at 122.807yen/ one EURO)
  *Source of conversion rate : Emission Trading Report（published on 10 of December, 2008 by JBIC (Japan Bank for International Cooperation)
- Purchasing cost for CER（including the commissions of both the United Nations and the host country）is calculated on the assumption of 3 Euro / tCO2
- Carbon credits amount : 35,038 tCO2
- Business operational risk : 5% per year

Figure 3-10　Economic Evaluation（IRR）

Year		1	2	3	4	5	6	7	8	9	10
		20010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Intial Investment		109,750									
Revenue	Secondary palm oil sales		0	0	0	0	0	0	0	0	0
(JP 000)	CERs		46,601	46,601	46,601	46,601	46,601	46,601	46,601	46,601	46,601
Expenditure	Cost of CER : 3Euro/ t		12,249	12,249	12,249	12,249	12,249	12,249	12,249	12,249	12,249
(JP 000)	Variable costs	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050
	Fixed costs	15,052	15,052	18,052	13,052	13,052	16,052	13,052	13,052	16,052	13,052
Cash flow	Total	-128,852	15,250	12,250	17,250	17,250	14,250	17,250	17,250	14,250	17,250
	Grand total	-128,852	-113,602	-101,352	-84,102	-66,852	-52,602	-35,352	-18,102	-3,852	13,398
IRR		#NUM!	#NUM!	#NUM!	-38.0%	-23.3%	-15.1%	-8.3%	-3.5%	-0.7%	2.0%
＊ the ex-ante estimation of emission reductions : 35,038tCO2e / y、CERs : 11.40 Euro/tCO_2-、Euro=122.807JPY											

※1）Discount rate : 3%　　※2）No revenue from Secondary palm oil sales

＜Provisional IRR calculation＞

Figure 3-12 shows the provisional IRR calculations on the assumption that the CERs prices are @11.40EURO/tCO2, @13.4EURO /tCO2 and @15.4EURO /tCO2 respectively with conditions of preinterest and pretax

Figure 3-11　Provisional IRR Calculation

Period of CER Trading	With CER trading		
	@11.4EURO /tCO2	@13.4 EURO /tCO2	@15.4 EURO /tCO2
7 Years	▲8.3%	2.9%	12.5%

*Carbon credits CER price at 11.40EURO/tCO2 (1,400yen at 122.807yen/ one EURO)

*Source of conversion rate : Emission Trading Report（published on 10 of December, 2008 by JBIC (Japan Bank for International Cooperation)

3.10　Demonstration of additionality

As a small-scale project, the Project follows the instructions in Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities ('Attachment A'). According to Attachment A:

Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emission.

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher."

In line with this guidance, the Project is subject to the following Barriers:

2. Investment barrier

The project requires investment of around 110 million Japanese yen. Therefore, TEE will be making a initial investment to set up the wastewater treatment facilities, and taking on a commitment to fund ongoing maintenance and operational costs. On the other hand, income from the Project will be zero. Therefore, without income from CERs, it is clear that the project will have no source of income. Unless an outside investor with an interest in procuring CERs, such as TEE, proposed to invest in the project, there is no commercial reason for this Project to be implemented.

3. Technology barrier

The flocculent treatment developed for this project by TEE, with a patent pending, is the first known example of the use of flocculents in treatment of wastewater from palm oil mills in Malaysia. TEE's operations to date have been entirely within the Japanese domestic market, for the most part providing environmental engineering support services for their parent company, Tokyo Electric Power Company. TEE would not therefore have been developing technology for wastewater treatment in an overseas market unless it were for the incentive of the CERs.

4. Prevailing practice barrier

As explained in the technology barrier, this is the first known example of the use of flocculents in treatment of wastewater from palm oil mills in Malaysia. In addition, the use of decanters to separate liquid from solid waste is not a common practice in the palm oil industry, due to the installation and operating costs of a decanter, when compared to the relatively low-cost, low-maintenance approach of using anaerobic ponds

The project activity thus faces serious implementation barriers. The investment, technological and prevailing barriers enumerated above show that, in the absence of regulations preventing the alternatives, the Project is unlikely to be implemented without an additional form of revenue such as that available through the CDM.

3.11 Issues and tasks for project materialization

The following issues should be continuously examined to materialize the CMD project.

1. Economical efficiency of the Project

Both the facilities cost reduction and the administrative and maintenance cost revision are the necessary requirement to enhance the realizability of the Project. It should be required to materialize a reliable and stable effluent treatment process and continuously examine the possibility of adoption of less costly equipments and materials provided by not only the Japanese technologies but also other alternatives with an eye to the local technologies in Malaysia.

2. Consultation with KILANG KELAPA SAWIT Bukit Pasir SDN. BHD. and the local engineering company, and building a cooperative structure for materialization of the Project

After deciding the materialization of the Project as the project contractor of the Japanese side, a consensus building for the implementation of the Project with the local counter party KILANG KELAPA SAWIT Bukit Pasir SDN. BHD. and the engineering company in Malaysia should be required based on the result of the present study on the Project.

In concrete terms, a consensus should be built on the risk hedging method, the terms of CERs sharing (purchase and sales contract), the Project schedule, the division of the roles and the clear

definition of respective responsibilities. In addition, for the materialization of the Project, an agreement should be required regarding the bearing part of the acquired credit risk and benefit which will result from both the operating performance of the Mill and the operation and maintenance management of the facilities.

3. Risk study of the Project IRR

The principal risks of implementing the Project are associated with the following three factors :

(a) Effluent volume and COD concentration
(b) Methane reduction rate (COD elimination rate)
(c) Construction cost recovery

With regard to (b), in particular the decrease both in processing capacity and acquired CERs, which could have come along with an increase in inlet flow into the effluent treatment facilities, etc. could affect the IRR.

4. Co-benefits Effects

The sustainable development benefits of the Project are examined through 4 categories: economic, environmental, social and technical.

Sustainable Development Benefits - economic

The organic material recovered from the decanter, and from the flocculation process, will have a high calorific value, and, after drying, will make a useful supplementary fuel for the Mill's boiler. The organic waste materials from the FFB treatment process are currently consumed in the Mill as fuel for boiler operation, while there is the market for these organic by-products as fuel. Substitution with the material recovered by the Project will enable the Mill to sell more of its waste material to outside users. This represents not only an increase in the Mill's income, but also an increase in the availability of sustainable biomass fuels for other users in the area.

Further, the energy-consuming processes used in the Project will all be supplied by the Mill's existing biomass co-generation system. Additional electricity consumed by the aeration system and the decanter, and steam-drying of the material recovered from the decanter and the flocculation process all fit into this category.

Sustainable Development Benefits – environmental

The Project promotes the environmentally friendly POME treatment by efficiently separating solid wastes of the POME, which is a source of methane gas. In particular, the following effects are expected by the Project.

(a) Sustainable reduction and abandon of methane gas emission, which is one of the greenhouse gases, would be achieved.
(b) The final wastewater would have a sufficient quality for reusing as boiler water in the Mill, by efficiently treating the high organic concentration COD wastewater, which would contribute to the water quality improvement of the nearby waterways and also to the water source saving.
(c) When the POME would be fully recycled in the Mill, the space currently occupied with the aerobic and anaerobic lagoons would be used for a more productive purpose.
(d) The impact of offensive odor on both the surrounding environment and the employees of the Mill would be markedly neutralized.
(e) The waste heat from boilers in the Mill would be used efficiently.
(f) The incineration ash emitted from the palm oil mill would be used efficiently.

Sustainable Development Benefits – social

The use of the technology proposed by the Project indicates that a significant reduction in COD value can be achieved. Once the effectiveness of the Project has been demonstrated, the diffusion of the proposed technology will be expected not only within the Mill but also to the other nearby mills. Through the technology transfer, it is expected that the Malaysian engineers can be trained and then the employment and socioeconomic effects are also expected.

In addition, the Project will enable Malaysian engineers to gain first hand experience of operation of a flocculent-based wastewater treatment system, which should enable the spread of the technology to other applications both within the palm oil sector and in other related wastewater treatment fields.

Sustainable Development Benefits –technical

A contribution to the improvement of the wastewater purification technology in the palm oil industry in Malaysia should be expected.

5. Conclusion

The Project aims at the avoidance of methane gas emissions, which is now generated by anaerobic fermentation process in the palm oil mills in Peninsular Malaysia, by replacing the current inefficient anaerobic open-lagoon system with a new comprehensive POME treatment process using a decanter, aeration and flocculant in which the organic materials in the POME is solidified and separated from the wastewater to be desiccated by a drying equipment using the waste heat (excess steam) of boilers in the Mill and then reused for a supplementary fuel of the boilers. In this study the survey on the materialization of the Project was carried out.

In Peninsular Malaysia, the CDM procedure has already been developed and the 26 projects are now in the implementation phase. In addition some more projects have been approved in this fiscal year. The regulations relating to the environment and the energy have also been developed at each level of the nation, the state and the city.

Two existing applications and a new application on flocculence are appropriate as the methodology for the Project. The appropriate baseline scenario is provided based on the following baseline calculations. The additionality has been demonstrated using barrier analysis and the Project activities should be additional to any certified project activity.

(a) Methane produced in the anaerobic baseline wastewater treatment systems
(b) Methane produced due to inefficiencies in the aerobic baseline wastewater treatment system
(c) Methane produced during the breakdown of remaining organic material in the wastewater following release to a natural body of water
(d) Methane produced during the treatment and disposal of sludge removed from the wastewater treatment system

The property analysis of the POME from the Mill was carried out and the emission reduction (ERy) of greenhouse gas was calculated on the assumption that the inlet COD concentration was 78,000mg/l and the annual inlet effluent was around 145,000Mt. In the result an average of the ERy during the Project period is expected to be 35,038 tCO2e per year. The implementation of the Project allows for the prevention of greenhouse gas emission, the neutralization of offensive odor on the surrounding environment and the water quality improvement of the waterways finally released.

The comments of the stakeholders, which are KILANG KELAPA SAWIT Bukit Pasir Palm Oil Mill (the object mill in the host country), PMT INDUSTREIS SDN.BHD (a engineering company in the host

country), Conservation and Environmental Management Division, Ministry of Natural Resources and Environment as Designated National Authority (DNA), and the Department of Environment, Johor (DOE), were invited and reflected to the Project.

The IRR of the Project was calculated on the assumption that the CER selling price was more than 11.4EURO /tCO2 (approximately 1,400 yen) with conditions of preinterest and pretax. In the result, the IRR for 7 years is minus 8.3%, which indicates that the Project turns out to be unprofitable. The payout time of investment was taken as 10 years. As the issues to be addressed in the future, the IRR improvement by compressing the necessary investment, the efforts for a stable continuing CERs market from 2013 or later, the clarification of the main body who carries out the operation, maintenance and management of the Project and sharing of responsibility of risk and benefit among the participants, all of them should be worked out.

Abbreviations and Acronyms

CDM：Clean Development Mechanism
JI：Joint Implementation
COP：Conference of the Parties
CERs：Certified Emission Reduction
GHG：Greenhouse Gas
IPCC：Intergovernmental Panel on Climate Change
EB : Executive Board
UNFCCC：United Nation Framework Convention on Climate Change
PDD：Project Design Document
PIN：Project Idea Note
MCF :Methane Conversion Factor
DNA：Designated National Authority
DOE：Designated Operational Entity
MNRE : Ministry of National Resources and Environment
CEMD : Conservation and Environmental Management Division
PTM：Pusat Tenaga Malaysia
FRIM : Forest Research Institute of Malaysia
MPOB：Malaysia Palm Oil Board
OE：Operational Entity

CL : Clarification
EIA : Environmental Impact Assessment
CPO：Crude Palm Oil
POM : Palm Oil Mill
POME：Palm Oil Mill Effluent
EFB：Empty Fruit Bunch
FFB：Fresh Fruit Bunch
BOD：Biochemical Oxygen Demand
COD：Chemical Oxygen Demand
IRR：Internal Rate of Return
ppm： parts per million
RM： Ringgit Malaysia