2004 Feasibility Studies on Projects for CDM and JI

Swine manure to biogas power project in Ratchaburi, Thailand

REPORT

Summary Edition

March, 2004

TAKUMA CO., LTD.

Project Outline & Investigation Purpose:

The purpose of this investigation is to review the business feasibility for CDM Project that a biogas plant for anaerobic treatment of waste liquid or liquor coming out of a large-scale pig farm in the Ratchaburi district, Thailand is set up and clarify various problems for realizing this project.

Thailand ratified the Kyoto Protocol as decided upon by the Cabinet on August 27, 2002. Thailand is the country applicable to "Non Annex I country" that has no duty to reduce global warming gas, and that satisfies the requirements as a CDM applicable nation.

In this large-scale pig farm located in the Ratchaburi district in the suburbs of Bangkok, Thailand, waste liquid generated at present is treated by means of the open lagoon.
By treating this waste liquid with the anaerobic treatment facility (biogas plant), it is possible to suppress the generation of methane gas that is powerful greenhouse effect gas which is considered to have a greenhouse effect approx. 21 times more significant than carbon dioxide (CO_2). Further, the recovered methane gas (biogas) is used for power generation, excess power is sold under the ultra-small scale power generation business company buying-up guarantee system (VSPP), and by substituting such power for grid power supply, the reduction of greenhouse effect gas due to the reduced consumption of fossil fuel can be expected therefrom. This residue is treated into fertilizer for resource recovery.

Thailand and Field Outline:

(1) Geographical Features & Climate

Thailand is located in the central part of Southeast Asia Peninsula – low latitude tropics. Normally, Thailand is high in temperature and high in humidity. The average temperature is stable throughout the year; that is, approx. 28 to 32 deg. C.

(2) Economy

Before Asian economical crisis in 1997, Thailand released the noteworthy record of 20 years or more substantial economic growth. In 1997 and 1998, Thailand showed a minus growth, but from 1999, it turns to a plus growth again.
The table below shows the structure of Thai economy in 2003.

Table 1: Economical Structure in 2003

Department	GDP by Departments (%)	Labor Force by Occupations (%)
Agriculture	10	40
Manufacturer	38	16
Wholesale & retail dealer	14	15
Other service businesses (*)	38	28

(*): These service businesses include the money financing department, education, hotel and restaurant or the like.

Source: Thai Economical Society Development Committee

(3) Present Situation of Pig Raising Industry

The edible pig raising in Thailand has made remarkable progress for the past ten years. A greater part of piggeries were small in scale once, and the edible pigs were brought up for regional consumption by the traditional raising method. From the 1990's on, this raising transferred to commercial raising and the edible pig raising industry introduced a new breed. Further, the fodder quality improvement, etc. is hastened, and the pigshed structure is also being converted to the concrete structure provided with the fodder feeding system in place of the conventional wooden type. However, a greater part of piggeries in Thailand are still small in scale.

The table below shows the number of piggeries and the number of pigs raised according to the classification by the scales in 1997. The small-scale piggeries generally account for approx. 90%, and the large-scale piggeries account for only 2% of the total as given below. In the ratio of the total number of pigs, however, the large-scale piggeries account for 41% of the total.

Table 2: Number of Piggeries and Number of Pigs Raised in 1997

Pig farm Scale	Percentage of Total Piggeries	Ratio of Total Pigs
Small scale pig farm (Total pigs: 50 to 500)	86	20
Medium scale pig farm (Total pigs: 500 to 5,000)	12	39
Large scale pig farm (Total pigs: 5,000 or more)	2	41
Total	100	100

The Ratchaburi district is located in the central part in Thailand, and at present, the number of pigs is the largest here in Thailand. This region accounts for approx. 20% of the number of raising pigs in Thailand in 2003. In view of the number of pig raising piggeries, however, this region accounts only for approx. 3%. In this region, it is found that the average pig raising industry scale is larger than in other areas in Thailand.

Also, to control the quality of effluent water discharged from the livestock farm, the fixed regulations are applied thereto as shown in the table below.

Table 3: Discharge Standard for Pig farm

Analysis Index	Pig farm Effluent Standard	
	Standard A (Large-scale pig farm)	Standard B (Medium-/Small-scale pig farm)
pH	5.5-9	5.5-9
BOD_5, mg/l	≤ 60	≤ 100
COD, mg/l	≤ 300	≤ 400
SS, mg/l	≤ 150	≤ 200
TKN, mg/l	≤ 120	≤ 200

Source: Thai Government Gazette Vol. 118 dated January 23, Special Part-8, Pages 11 to 18
Notification of the Ministry of Science issued, based on Domestic Environmental Quality Promotion/Preservation Law B.E.2535 gazetted in R.E.2544 (2001) – Scheduled to issue after January 24 – 2545 (2002)

For the time being, only the medium-scale and large-scale piggeries must follow these regulatory standards.

As to the small-scale pig farm, the Government has not yet materialized any legal measures for regulating or supervizing this discharge.

(4) Electric Power Situation

The Thai power generation facility capacity reaches approx. 26GW as of 2004. Among the generated energy, the natural gas accounts for approx. 74%, the brown coal (lignite) accounts for approx. 15%, the hydraulic power accounts for approx. 6.6%, and the fuel oil accounts for approx. 1.8%.

On the electric power supply side, the government authorities are playing a major part in both power generation and power transmission/distribution. Approx. 51% of

most power transmission and power generation is occupied by the government enterprise under the control of the Ministry of Energy, and the Electricity Generating Authority of Thailand (EGAT), the largest electric power producer in Thailand, is performing this power generation and power transmission. The electric power is distributed by the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA). The electric power is also distributed directly to some consumers from EGAT. EGAT only generates electric power but purchases it from the private electric power company and neighboring country. Among the private electric power companies, the Small (independent) Power Producer (SPP) and Very Small (independent) Power Producer (VSPP) occupy approx. 11% share. Concerning SPP, the electric power output is limited to 90 MW or less, and the electric power must be sold direct to EGAT. For VSPP, the electric power supplied to the power transmission network must be 1 MW or less, and the electric power is to be sold to PEA or to the consumers directly. The business scheme for s Small (independent) Power Producer (SPP) and Very Small (independent) Power Producer (VSPP) was started according to the Government policy in order to promote the utilization of recyclable energy mainly in Thailand.

Policy & Condition as to Thai CDM:

The political present situation of CDM in Thailand is summarized as described below.

(1) Thailand ratified the Kyoto Protocol as decided upon by the Cabinet on August 27, 2002. Concerning the Kyoto Protocol and CDM, as decided upon, the Ministries of Science, Technology and Environment (MOSTE) were also appointed as the ministry playing a key role in Thailand. With the re-organization of the Government, the Ministries of Natural Resources and Environment (MONRE) are newly responsible therefor at present in place of the ministries described above.

(2) According to the remark of Thai official early September, 2002, the impression that the Thai Government is opposed to the CDM Project was reported to the media.

(3) The Cabinet made another decision on September 14, 2002 to make the Government position clear.
The following comment was made thereon:
"In case where the foreign government desires to support the implementation of a project associated with carbon credit, this project is submitted to the Cabinet, which shall be reviewed case by case. In case where the Cabinet agreed to that project and

approved it, the Thai Government Authorities can promote the implementation of that project."

(4) In September, 2003, the Thai Government decided that the relevant job as to climate fluctuations including CDM would be transferred to the Office of Natural Resources and Environmental Policy and Planning (ONEP) under the control of MONRE from the Office of Permanent Secretary.

Investigating System:

Investigated mainly by: TAKUMA Co., Ltd.

On-site counterpart in investigation: EfE (Energy for Environment Foundation)

"EfE" is a Non Profit Organization set up in May, 2000 mainly in order to promote environmental protection technology and effective utilization of recyclable energy.

Project Outline

Destination for Project: Kanchana Hybrid (Nernthong) Farm (KHF)

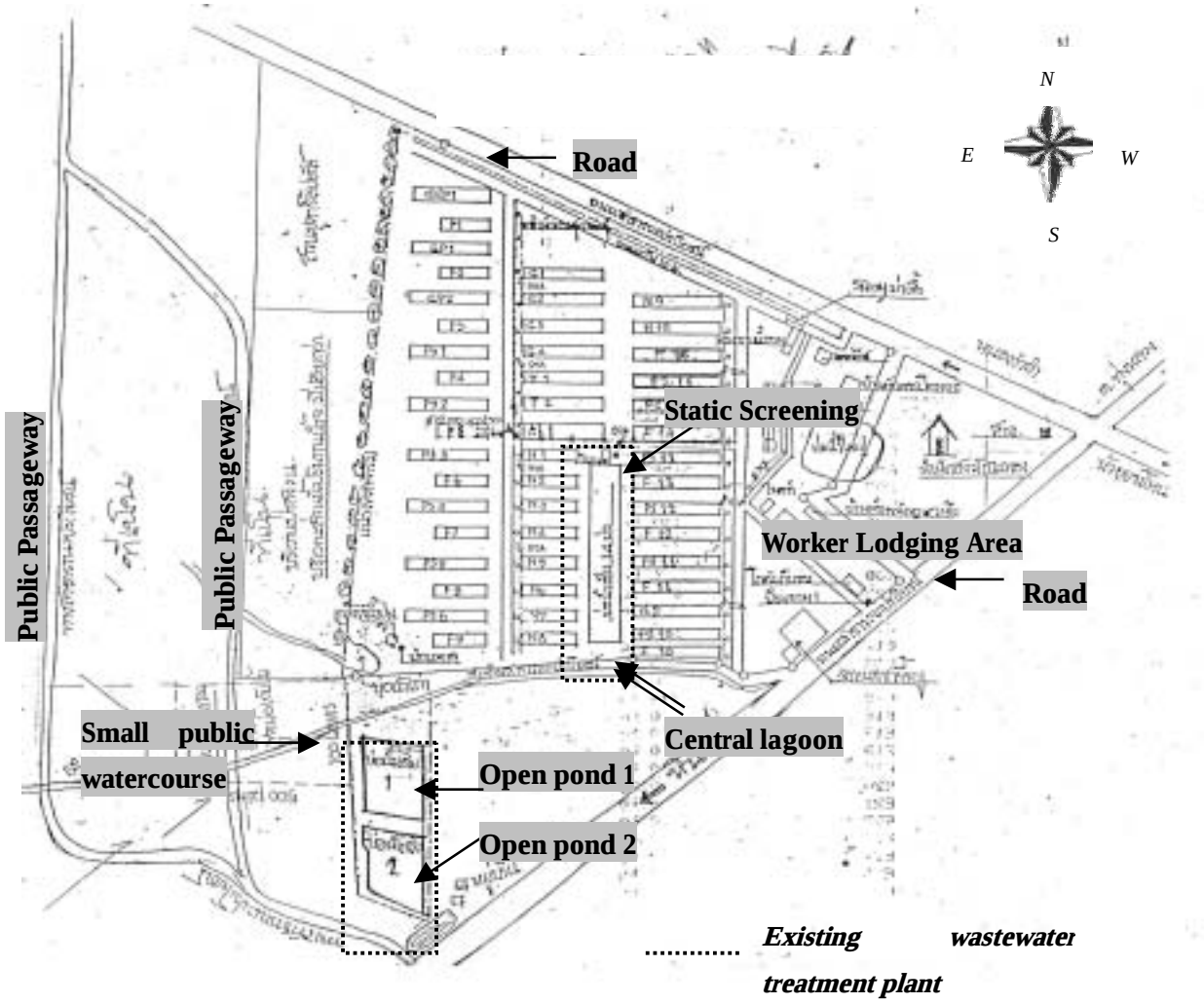

Fig. 1 Site Map

The scheduled site for this project is located in the central part in Thailand, approx. 100 km in the southwest of Bangkok. The site area is as large as approx. 400,000 ㎡, where 49 pigsties are provided. The number of pigs raised there is approx. 46,200, and the average body weight is approx. 45 kg. (Because a part of manure is removed before wastewater treatment, total amount of manure corresponds to 40,765 pig's manure.)

The pig excretions are collected into the excretions receiving tank located in the central part of the site by means of gravity flow together with washing water, which are then charged into the adjacent open lagoon subsequent to solid-liquid separation using the screen.

As shown in the photo below, the open lagoon entrance part is in the anaerobic state due to a high load, and the generation of methane gas is found there. The wastewater (effluent) is then treated through another two lagoons. The volume of wastewater handled per day is approx. 1,050 m^3.

Photo 1: Open Lagoon Entrance Part

In the current project, the hermetically sealed type methane fermentation tank is provided in the pre-stage of open-lagoon treatment, and methane gas being given off into the atmosphere at present is recovered as biogas, which is to be used as fuel for power generation.

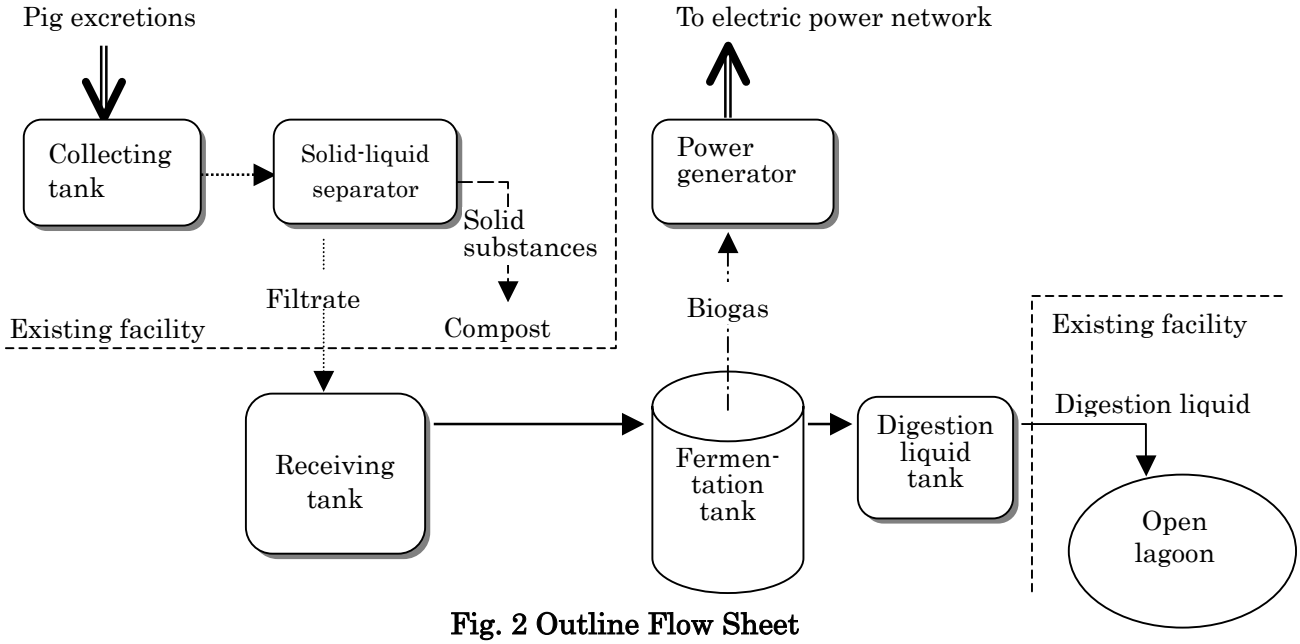

Fig. 2 Outline Flow Sheet

Project Boundary & Baseline scenario Identification

With due consideration given to substitution of grid power due to power generation as well, based on Methodology AM0006 "GHG emission reduction from manure management system", the baseline and monitoring method, etc. were determined.
Based on the treatment using the anaerobic and aerobic open lagoons, which is the current treatment method, the following baseline boundary was determined.

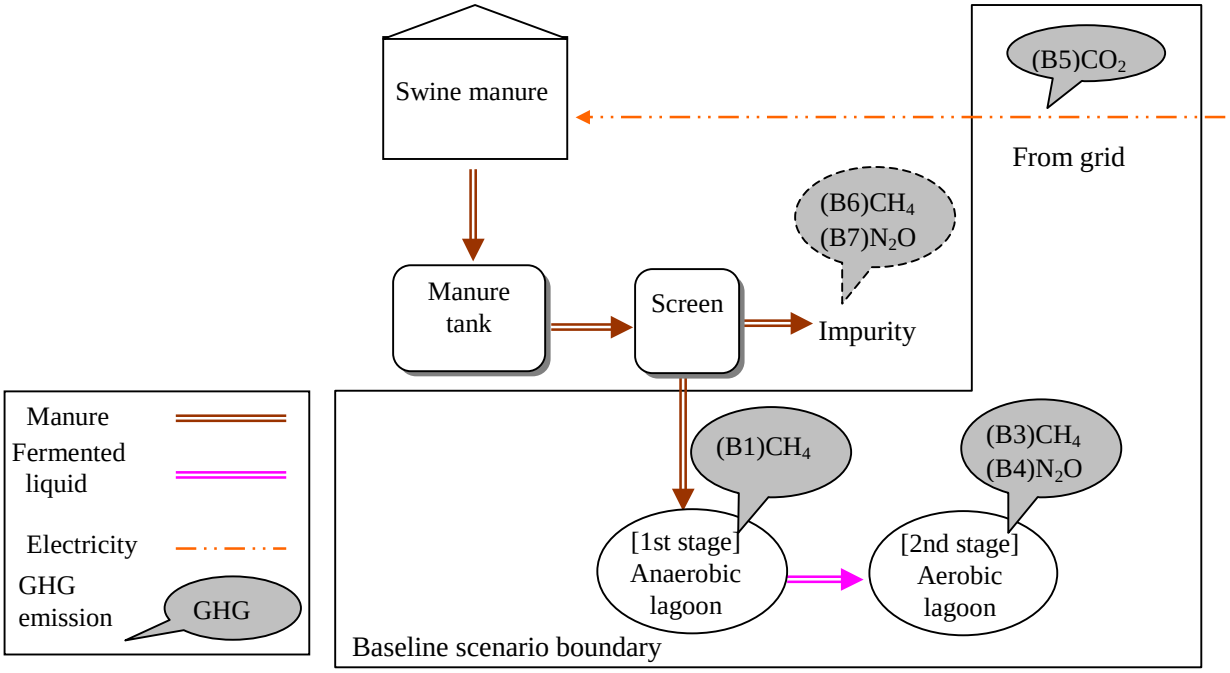

Fig. 3 Baseline Scenario

On the other hand, the project scenario is as shown in Figure-4 below.

(1) Organic substance degradation in the anaerobic lagoon at the 1st stage is displaced to the hermetically sealed methane fermentation tank, and methane gas is recovered as biogas, whereby global warming gas emission to the atmosphere is to be reduced.

(2) The biogas thus recovered is used for power generation fuel.
By selling the generated power to the grid, the fossil fuel used for grid power generation can be substituted, thereby contributing to reducing global warming gas emission. (See Fig. 5)

(3) The fermentation liquid discharged from methane fermentation is treated by the existing aerobic lagoon in the same manner as in the baseline scenario.

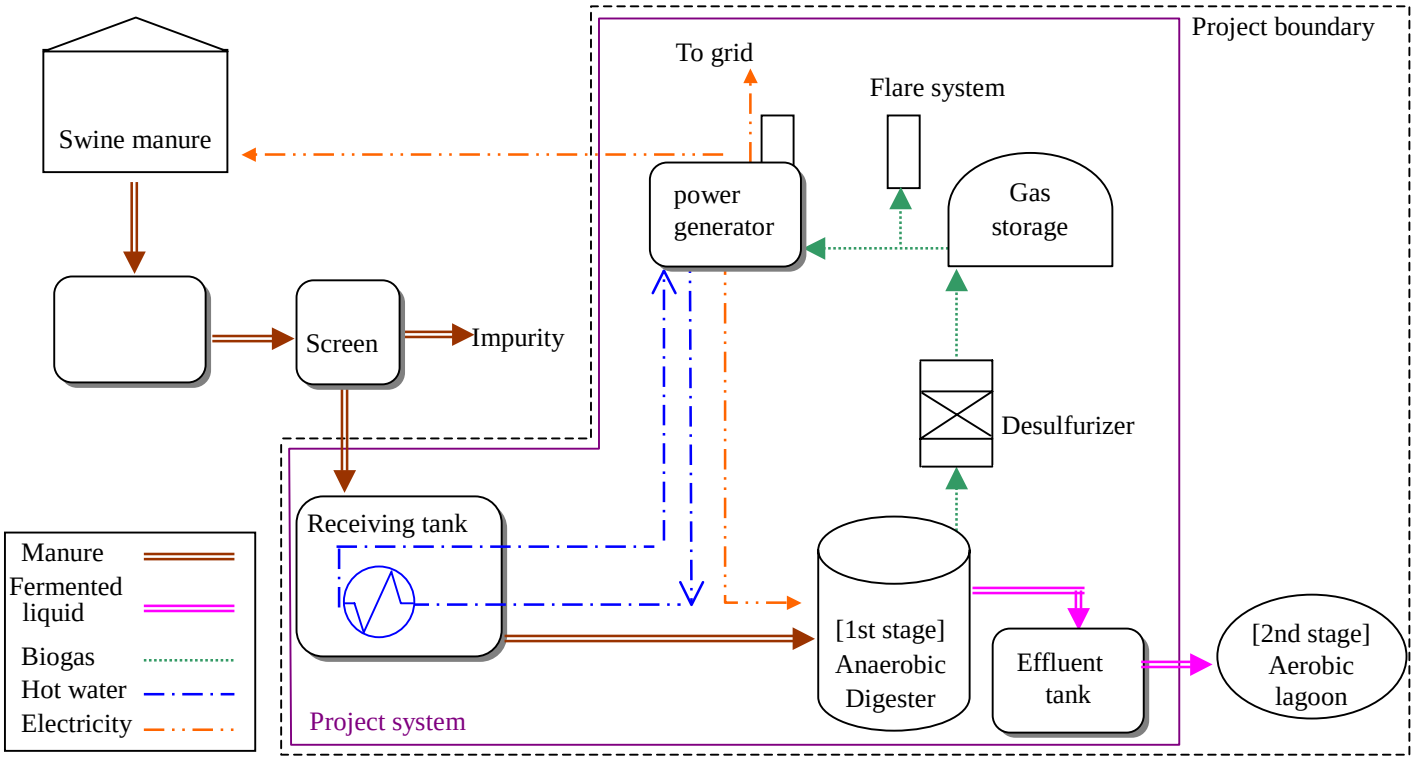

Fig. 4 Project Scenario

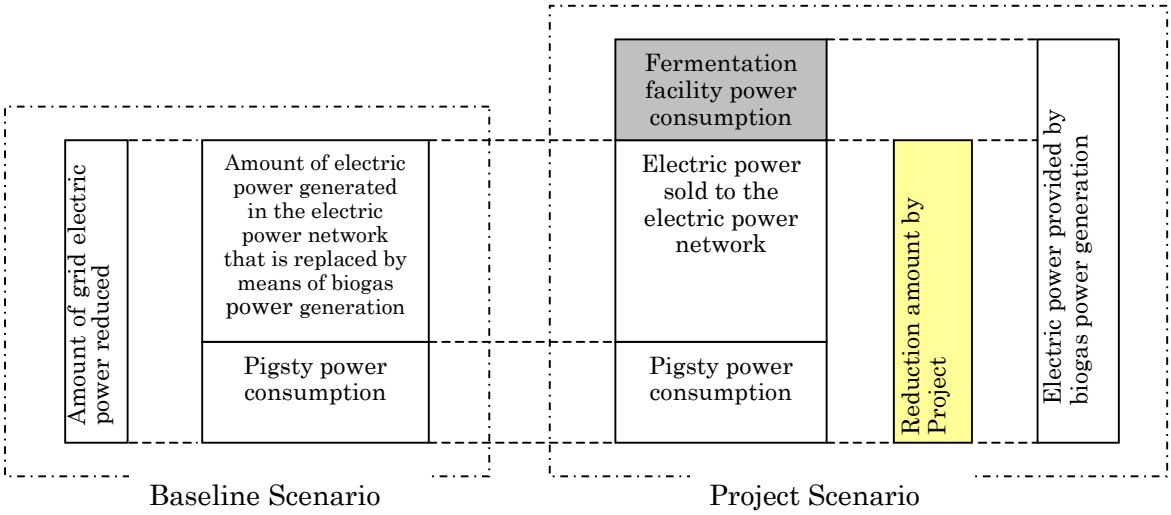

Fig. 5 Amount of Electric Power Reduced by Project

GHG Reduction & Leakage

The emission reduction by the project is estimated 22,000 tonnes in CO_2 equivalent annually. As leakage, there exists global warming gas discharged from foreign matter (composted) that was eliminated through the screen, which can be considered to be equivalent in the baseline and project.

Monitoring Plan:

The monitoring item is shown in Fig. 6.
The amount of electric power sold and biogas amount or the like are continuously measured with a recorder provided. The manure, fermentation liquid VS concentration and exhaust gas component are periodically analyzed. Since the excess gas combustion system is operated intermittently, only the flow rate is recorded with a recorder, and the methane concentration is made equivalent as in the power generator.

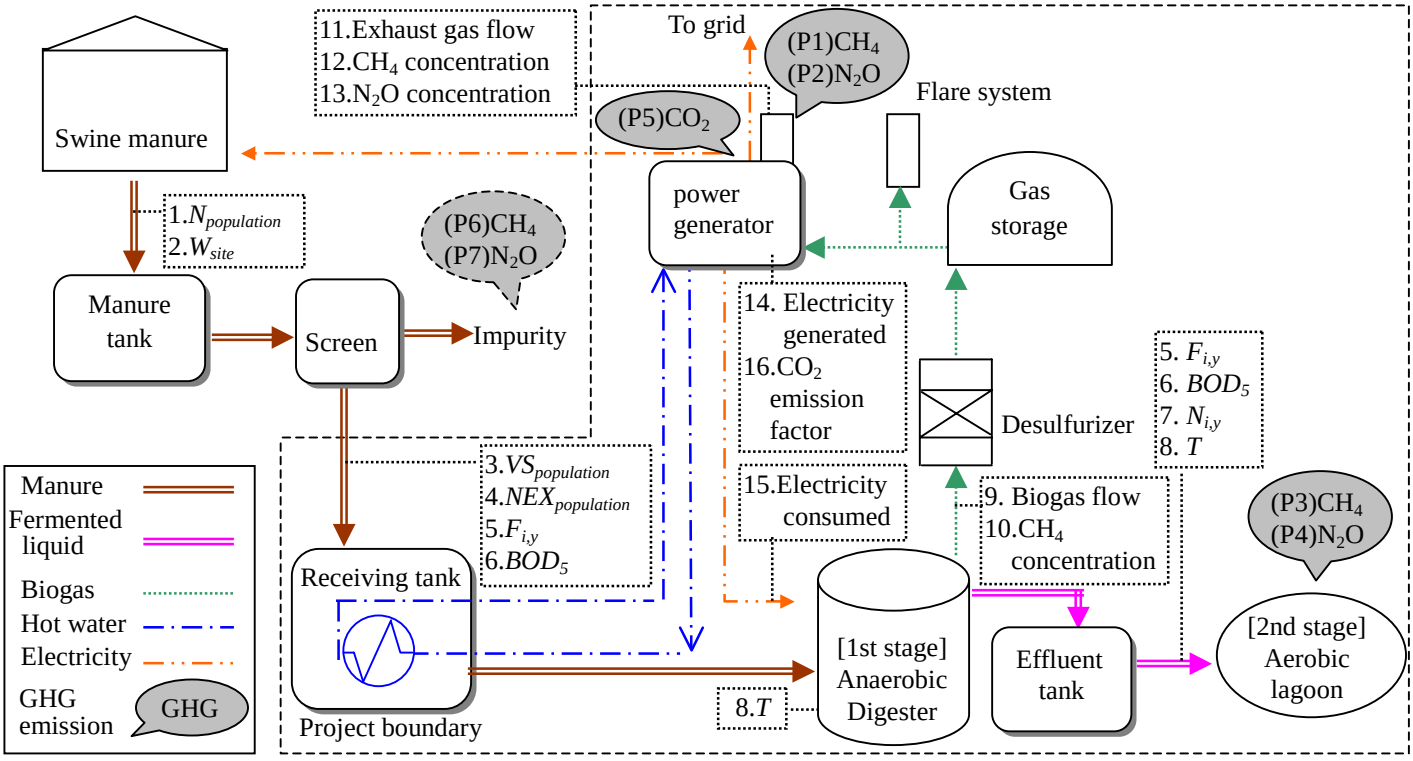

Fig. 6 Monitoring point

Environmental Impacts/ Other Indirect Impacts:

By providing a hermetically sealed methane fermentation tank, biogas is recoverable, and at the same time, it is possible to prevent volatile odor components generated during organic substance degradation from the open lagoon from volatilizing.

Stakeholders' Comments:

The investigation during visit to the field was carried out with the field counterpart "EfE".
The enterpriser (executor) running the field site accepted their cooperation for field survey and data collection regarding the investigation in this Project. After that, we obtained cooperation from EfE in on-site drain sampling and field site data collection or the like.

Project Implementation System:

Engineering and CDM related jobs: Japan-side corporation
Funds raising & business operations related jobs: Thai-side corporation

Financial (Funds) plan for project implementation:
Cost/performance

Because more than 50% of the income of the project is occupied by carbon credit, the economy of the project is depending on the price of carbon credit. In the case of carbon credit = 5 US$, the project is not so profitable, with 3.8% of IRR. If the balance of the price and GHG reduction changed, the economy of the project will become better.

Anticipation & Problem for commercialization:

In implementing this Project, CDM approval by the Thai Government is required.
Prior to field survey, we once visited "ONEP" responsible for relevant jobs as to climate fluctuations including CDM in the Thai Government, but no substantial discussion is executed, and the Thai Government intention is not yet confirmed.