Examination of the situation of collection and effective use of biogas at waste disposal sites in Indonesia: General

(1) Fundamental elements concerning implementation of project

■ Outline of proposed project and background of planning

This project is intended to find the method of collection and effective use of greenhouse gas (biogas) (conversion of gas into electricity by power generating facilities for sale) generated at a land-filled disposal site in use at present, taking, as an example, the Bantar Gebang waste disposal site in city of Bekasi, approx. 40 km southeast of Djakarta. The said disposal site had been in use since 1989 and was to be closed in 2004. However, since there is no alternative disposal site around Djakarta, the present site is to be used continuously for the time being.

Since the disposal site has an aerobic structure primarily for organic waste, generating biogas that contains a large quantity of methane gas as a main ingredient. Because the budget and applicable technology are insufficient, no plan has been made for collection and effective use of generated gas toward the closing of the site.

This project is expected to reduce the consumption of electricity in the existing system by converting the collected biogas into electricity, as well as by reducing the consumption of fossil fuel equivalent to the biogas. Appropriate closing of the disposal site will also lead to prevention of environmental pollution in the vicinity.

■ Outline of the host country

There are many open landfill sites in Indonesia for disposal of organic waste, which is mainly the general household rubbish, and most of the sites are used without any appropriate soil cover because of the shortage of budget. Therefore, people in the vicinity are complaining about the generation of injurious insects, and the appropriate covering method planned in the current project will be significant as a versatile technology in terms of environmental conservation in future as well.

In other words, an appropriate method to cover disposal sites through collection of generated gas and the spread of technology to effectively use the generated gas as a sustainable alternative energy are demanded not only to fight global warming but also to improve the environmental condition of the surrounding area.

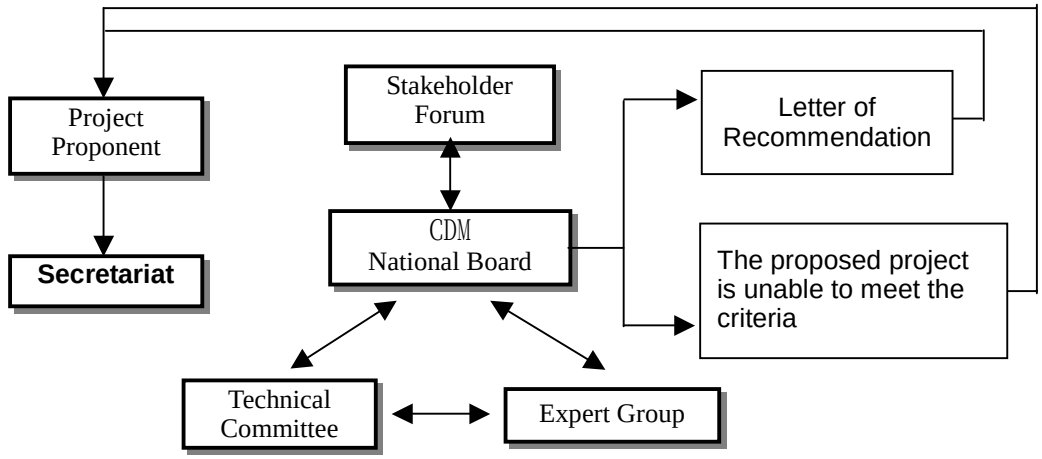
Indonesia is suffering from daily shortage of energy, and the effective use of biogas and other types of recyclable energy (conversion into electricity by gas-powered generating facilities) is expected to be a dual-purpose technology, because it will reduce the consumption of electricity in the existing system for which fossil fuel is used.

CDM/JI acceptance criteria and DNA installation condition, as well as policy about CDM/JI, of the host country

Indonesia ratified the Kyoto Protocol in September 2004, approving it officially in November after the President signed the protocol.

With respect to the DNA organization, the Indonesian Ministry of Environment, which is the competent authorities at present, is taking initiative in coordination and preparation of the basic organization control shown in Fig.1, which will start official activities soon. While listening to the opinions of the Expert Group and stakeholders, the Technical Committee will evaluate the project proposed on the basis of the evaluation criteria for sustainable development, submitting an evaluation report to the CDM National Board. At the same time, the Technical Committee

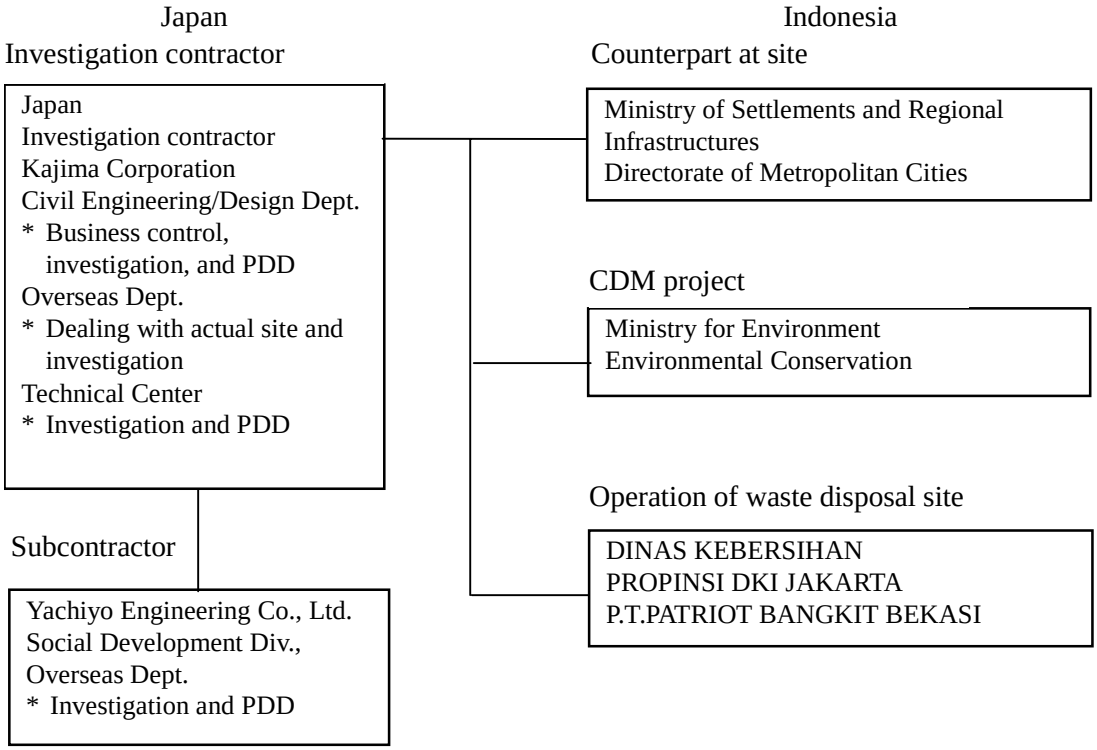
will provide information for capacity building and various other activities for promotion of the CDM project. In response to the request from the CDM National Board, the Expert Group will make an additional evaluation of the project and express their opinion about the evaluation report.



Source: DNA for CDM in Indonesia and its sustainable development criteria; The Ministry of Environment, INDONESIA UNDP's Side Event, 2nd December 2003

Fig.1 Project evaluation organization and evaluation procedure

■ **Investigation implementation system (Japan, Indonesia, and others)**



(2) Project planning

■ Specific details of projects

As shown in the flowchart in Fig.2, this project is intended to collect greenhouse gas (biogas) generated at waste disposal sites and use it effectively (conversion of gas into electricity for sale by power generating facilities).

Collection wells will be installed in landfill sites to collect gas, and send the gas through a pipeline to gas treatment facilities. Gas will be desulphurized and dehumidified by the treatment facilities and then sent to a gas-powered generator to generate electrical energy. A gas holder will be used to regulate the quantity of gas, and the excess gas will be allowed to flare.

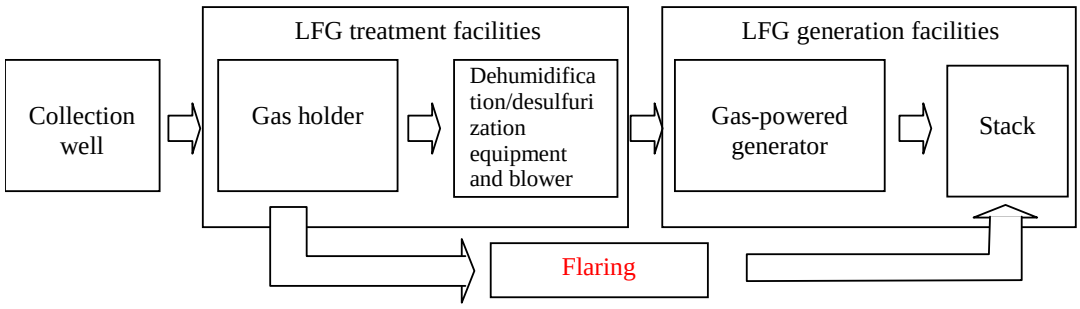


Fig.2 Flowchart of collection and effective use of gas

As shown in the figure at right, porous pipes will be installed perpendicularly in the gas collection well to collect gas at the landfill sites. The gas collection wells will be provided with 120 pipes in Zones IV and V this time.

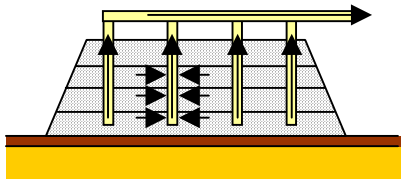


Fig.3 Image of gas collection

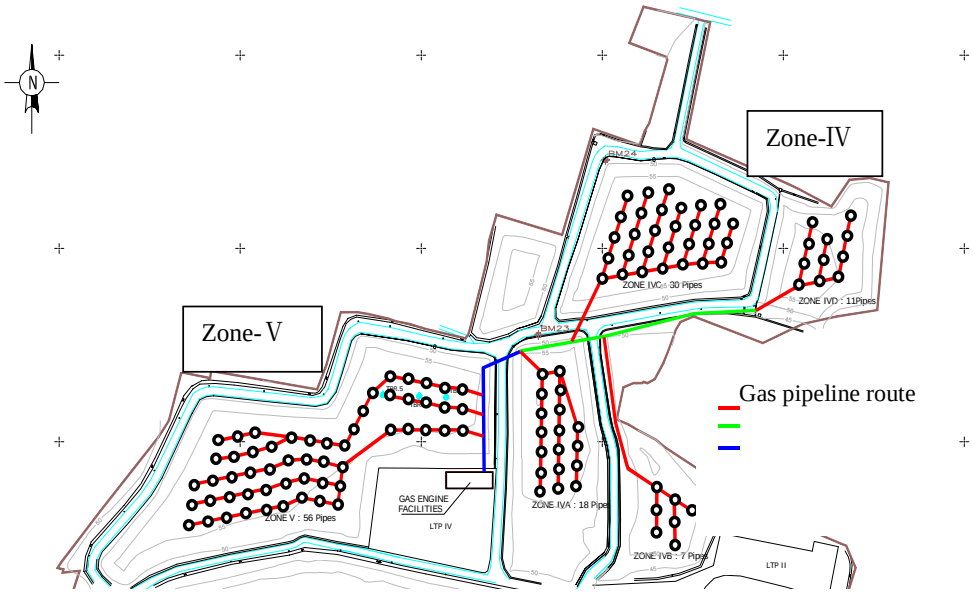
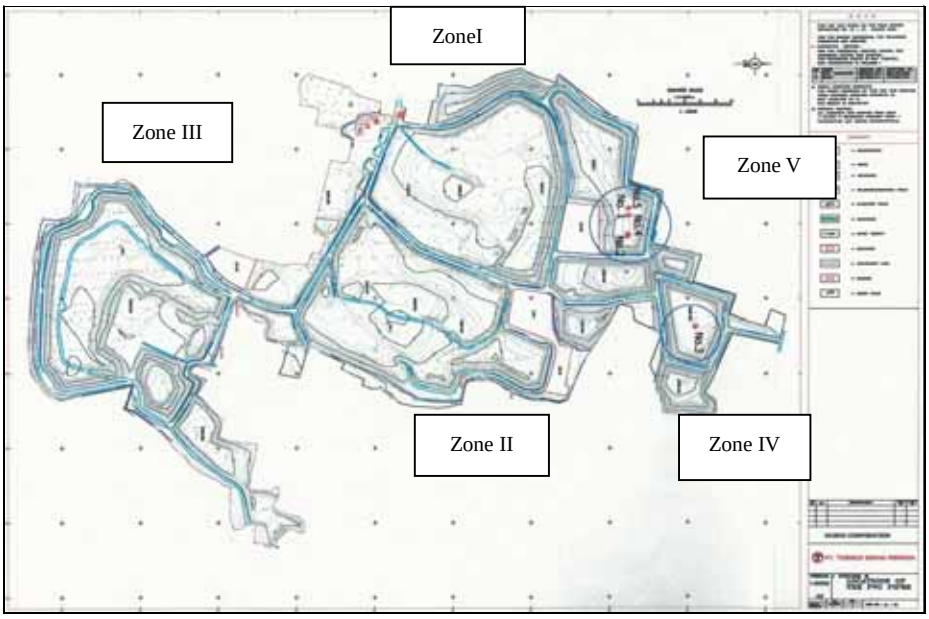


Fig.4 Scheme drawing of gas collection well and pipelines

■ Project boundary, baseline setting, and verification of additionality

1) Project boundary

As shown below, the landfill sites that will be affected by the project, generation facilities, and transmission facilities are set as the system boundary.



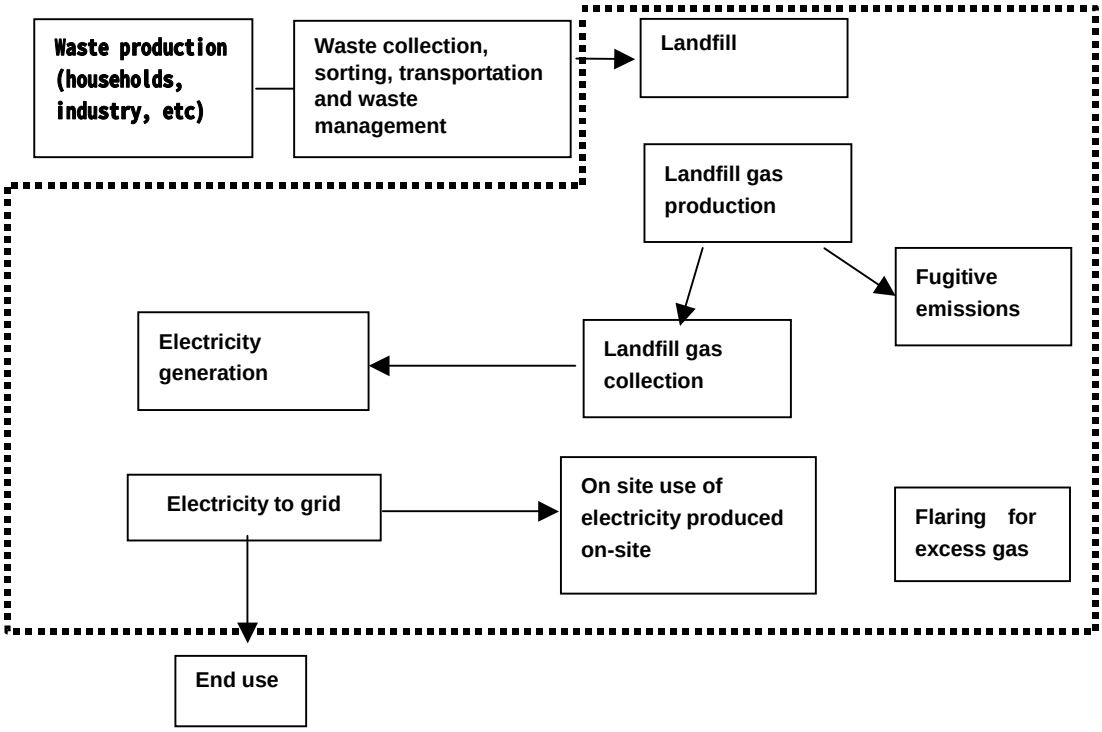


Fig.5 Project boundary and system flowchart

Procurement of generators, etc. planned in the project may be considered as an increase in off-site emission. However, since the influence is very small, leakage is not taken into consideration in this project.

Of all kinds of greenhouse gas (biogas) generated inside the boundary, the gases shown in Table 1 are taken into consideration in the project, and CH_4 (methane gas) at the disposal site and CO_2 (carbon dioxide) generated during power generation in the power system are examined during calculation of the baseline discharge.

Table 1: Subject greenhouse gases in the project boundary

Activities		Source	Gas	Remarks
Baseline	Direct onsite	Landfill gas	CH_4	Considered
			CO_2	Carbon neutral
	Direct offsite	Fuel combustion for grid power	CO_2	Considered
			N_2O	Not considered on conservative side
Project	Direct onsite	Landfill gas	CH_4	Considered
			CO_2	Carbon neutral
		LFG combustion for power	CO_2	Carbon neutral
			N_2O	Negligible
		Battery use for start-up	CO_2	Nominal (ignored)
		Project Operation	CO_2	Electricity by LFG used and carbon neutral

2) Baseline setting

Based on ACM0001 “Consolidated baseline methodology for landfill gas project activities,” an integration methodology, in which the reduction on the fossil fuel consumption by power generation, is used. According to ACM0001, the quantity of CO_2 to be generated by the fossil fuel for power generation (in conformance with the supply power source composition of the project site), which is equivalent to the reduction in power demand from the grid due to power substitution, is taken into consideration as the emission reduction. This methodology has been recognized recently.

3) Verification of additionality

There are many landfill sites of the same type as the Bantar Gebang disposal site in Indonesia, and most of them have an open anaerobic structure. No garbage incineration facilities have been introduced in Indonesia, and there is no plan for introduction at present either. Therefore, biogas generated at these landfill sites has not been collected, and the gas has been released to the atmosphere.

Under the present situation, it is hard to consider that the Indonesian Government will take measures to collect biogas that contains a large quantity of methane gas without the CDM project. Furthermore, the country is still in the process of development, and there are many important public projects that have higher priority. In addition, the profitability of the project is low, and the project will not be materialized economically without any credit. Therefore, the project has sufficient additional.

■ **GHC reduction (CO_2 absorption) and leakage after implementation of project**

With respect to greenhouse gas generation, the baseline generation and the annual generation are estimated by using the formula proposed by the IPPC based on the result of analysis of the ingredients of waste after boring exploration at site, result of gas generation investigation, and the statistic value of annual waste disposal. Table 2 shows the parameters used for the calculation of greenhouse gas generation, while Table 3 shows the annual greenhouse gas generation and CO_2 reduction in the product.

Table 2 Parameters for Gas Volume Estimation

Total Organic Carbon in Waste (TOCO)	80.00	kg/t
Decay Rate (k value)	0.15	/yr
Methane Concentration in Landfill Gas (CH4)	50	%
Methane Gas Potential (Ge)	146.45	m^3/t
Temperature	50	℃
Borehole Diameter	0.07	m
Average Velocity	0.93	m/s
Number of Boreholes	120	-

Table 3 Annual Gas Generation and GHG Reduction

	LFG Emission Vol. (m^3/day)	CH_4 Emission (m^3/day)	CH_4 Capture (m^3/day)	CO_2 Reduction (ton/yr)	CO_2 Emission by Baseline (ton/yr)	CO_2 Emission by Project (ton/yr)
2008	195,765	97,883	28,044	153,538	535,907	382,369
2009	168,497	84,248	26,641	145,861	461,260	315,398
2010	145,026	72,513	25,239	138,184	397,010	258,825
2011	124,825	62,413	23,837	130,508	341,710	211,202
2012	107,438	53,719	22,435	122,831	294,112	171,281
2013	92,473	46,236	21,033	115,154	253,145	137,991
2014	79,592	39,796	19,630	107,477	217,884	110,407
2015	68,506	34,253	18,228	99,800	187,534	87,734
2016	58,963	29,482	16,826	92,123	161,412	69,289
2017	50,750	25,375	15,424	84,446	138,929	54,483

Zones IV and V are used for the estimation shown above, and the greenhouse gas generation and CO_2 reduction in the entire disposal area, which is the boundary of the project, must be reexamined finally based on the future landfill plan for the disposal site.

Meanwhile, this project is intended basically to calculate the final reduction in methane gas contained in the greenhouse gas based on the monitoring result of the quantity of the greenhouse gas collected and made use of when the project is implemented, and calculation of the CO_2 credit based on these estimate values is not intended.

Considering that the influence of the increase in the off-site greenhouse gas emission during material procurement and operation is negligibly small, the leakage is not taken into consideration here.

■ Monitoring plan

In the same way as the baseline, an integration methodology, in which the reduction on the fossil fuel consumption by power generation is taken into consideration, is used as the monitoring method based on ACM0001 “Consolidated baseline methodology for landfill gas project activities.”

Fig.6 shows the monitoring system plan drawing in the project. According to the plan drawing, monitoring is to be conducted consecutively to measure the generated energy and sold energy during greenhouse gas collection, combustion in gas-powered generator, and flaring.

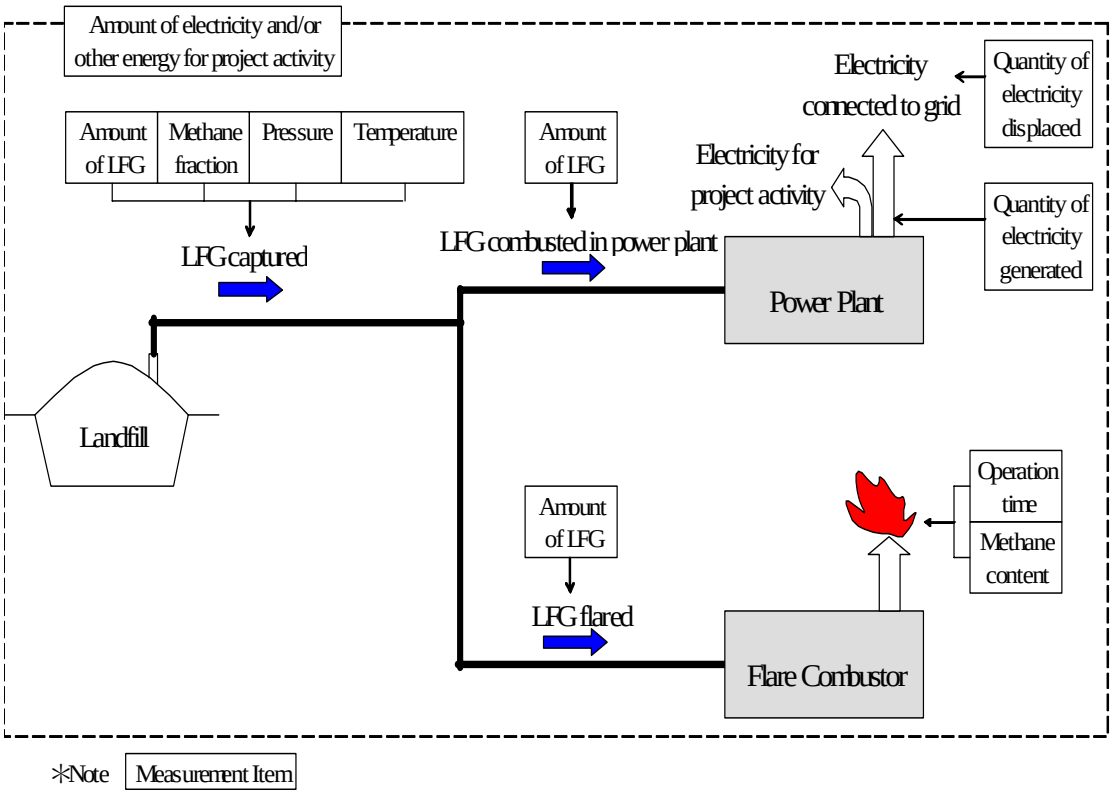


Fig.6 Monitoring system plan drawing

In conformity with the stipulations of ISO9001, monitoring will be conducted for 24 hours for measurement and recording according to the manual.

■ **Environmental impact/other indirect impact (risk investigation result is included in the case of tree planting)**

Appropriate closing of landfill disposal sites that follows the greenhouse gas collection in the project will contribute to the environmental improvement in the surrounding residential area that is annoyed by flies and foul odor, and the project will not generate any negative impact on the surrounding environment. Since the project itself is to be implemented at the disposal site in operation and the scale is small enough to be free from legal control, it seems to unnecessary to conduct environmental impact assessment and the like. (The environmental impact assessment in Indonesia follows the rules of AMDAL, and EIA is unnecessary for generation projects of 10 MW or less.)

At the same time, power generation by the collected gas can secure a steady power source, and electric power selling may generate profits, thereby enhancing the performance of the project and economically contributing to the local community.

There are many landfill sites of the similar type in Indonesia, and the current project will be significant as a versatile technology from the viewpoint of environmental conservation in future. In other words, appropriate closing of disposal sites by collection of generated gas and the spread of alternative energy technology for effective use of generated gas can contribute to the sustainable development of the community in view of reduction in greenhouse gas, as well as prevention of foul odor, control of injurious insects, and other factors of improvement of surrounding environment.

In addition to the environmental sustainability concerning the health and safety of the local inhabitants, technical transfer for sustainable development of Indonesia is included in the sustainable development criteria of Indonesia. Spread of the versatile technology of the project is considered to contribute not only to the improvement of the residential environment of areas around landfill sites but also to the technical transfer to Indonesia.

■ **Stakeholders' comment**

The Ministry of Public works is taking the initiative in organizing the Indonesian counterpart team in this project, and it is clearly shown in an official document that the team will support the materialization of the project and offer appropriate information and guidance. The team includes the Ministry of Environment, DKI Jakarta Cleaning Department, KOTA Bekasi Environment Agency, and other parties concerned, playing a role of being government-related stakeholders. Therefore, the above-mentioned document is regarded as the stakeholders' comment.

Since Bekasi is the seat of disposal sites and there were protest campaigns in the past, any matter concerning those disposal sites is to be discussed by the special committee organized by municipal divisions of Bekasi and a document signed by the mayor is to be used for notification.

Furthermore, interviews were conducted with a person in charge of PLN that would be the buyer of the generated electricity and a person in charge of PBB that were commissioned to control the reclamation of disposal sites, both of which are stakeholders in the private sector.

They made forward-looking comment about the possibility of their cooperation and participation in the project.

Appropriate stakeholders who represent the people living around disposal sites are being selected thought DKI Jakarta Cleaning Department, and KOTA Bekasi Environment Agency, and interviews are to be held late in March. When the project implementation system, which includes local enterprises, is determined, an official protocol for the project will be submitted to the government-related divisions, including Djakarta and Bekasi, through the above-mentioned counterpart team in order to receive a written opinion that includes public comments. In addition, explanatory meeting will be held for the local inhabitants.

(3) Toward commercialization of project

■ **Project implementation system (Japan, Indonesia, and others)**

A special purpose company (SPC) will be established in Indonesia to implement this project. Candidate investing companies for SPC are Kajima Corporation, a Japanese company affiliated with a power company, and Indonesian private companies, but they have not been finalized yet. Detailed economic examinations will be conducted hereafter, and a specific scheme for the business management system will be determined before the end of this year. Fig. 7 shows the organization chart of SPC operations management system.

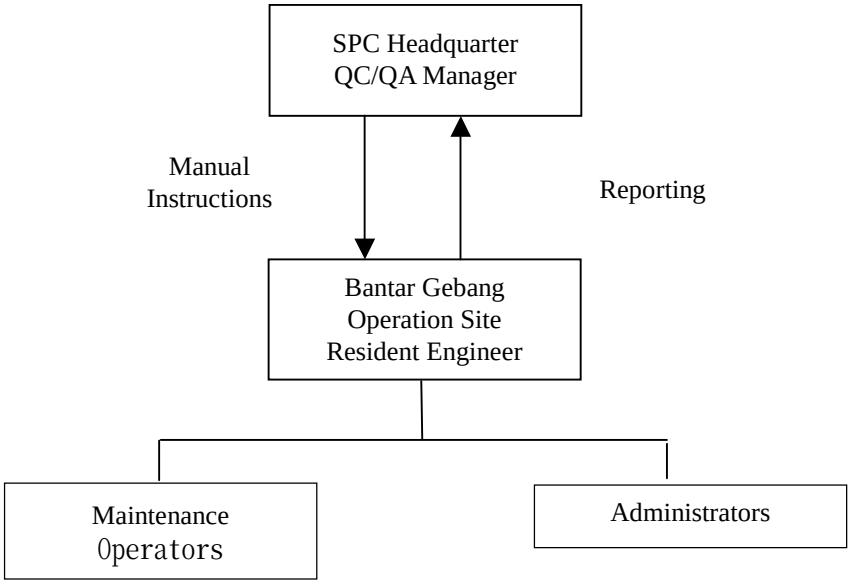


Fig.7 Organization chart of operations management system

■ **Financial plan for implementation of project**

The IRR was calculated on a trial basis based on the reduction in greenhouse gas that was estimated in accordance with the generation of greenhouse gas at site and the result of analysis of the ingredients of waste, result of the estimation of gas generation, selling price of electricity in Indonesia, and approximate estimation of the equipment and construction cost necessary for the project, including gas engines. (Zones IV and V alone are subjected to the trial computation.) According to the result, the project will show a deficit of 13% when the CO_2 credit is not taken into consideration, but the IRR will be 10-19% when the sale of credit is taken into consideration. (The transaction price in the present EU was used for reference, and the fixed contract price was set at US$5, while the market price was set at US$10, and the sensitivity analysis was conducted by changing the balance of sale.)

According to the result, this project will be profitable and attractive to Japanese investors in view of the acquisition of credit. Since the initial investment is approx. US$6,000,000, which is a comparatively small amount, the fund to be invested by the Japanese enterprises will be enough, not requiring any official fund.

The Indonesian enterprises' investment will be held to a minimum that is necessary for the establishment of SPC at site, minimizing the economic load.

■ **Cost effectiveness**

As stated before, this project is profitable even if the fluctuation of the CO_2 credit price is taken into consideration. However, the project will not be very promising when attention is paid only to the cost effectiveness. (Suppose the period of project is 10 years. The profit will be almost zero when the IRR is 10%, while the profit will be approx. US$6,000,000 when the IRR is 19%.) Especially in countries where the inflation rate is high, the project is likely to show a deficit. However, only some areas are subjected to the estimation this time. When the whole area is subjected to the estimation, the rate of return will increase, and the project will be very important because the acquisition of CO_2 credit is necessary and the project will be a sustainable environmental project for Indonesia. The feasibility of the project should not be judged only in terms of cost effectiveness.

■ **Prospect for specific commercialization and problems thereof**

The potential of the project as a CDM project is very high, and the project is promising in terms of profitability as well. However, the following problems must be solved for specific commercialization of the project.

1) The landfill disposal project will be continued at the present location; therefore, it will be necessary to separate the project area from the area where landfill disposal will be continued, and the project plan should be made for respective zones.

2) The landfill disposal project is conducted by the municipal government of Djakarta. However, because the government is planning to establish a private company and commission the company to continue the project, the future operation period, management system, and primary contractor are fluid.

3) The local inhabitants are opposed to the operation of the present disposal sites, and coordination with the local inhabitants is very important for the future operation of the disposal sites.

It is necessary to continue negotiations among the authorities of Djakarta and Bekasi and the local inhabitants, and the negotiation may be very difficult without local companies' backup. Negotiations are continued with Indonesian companies at present, and their support for the negotiation with local inhabitants will be necessary to promote the project when specific conditions are met.

(4) Validation/determination (when the project is implemented)

■ **Outline of validation (determination) or desk review**

The LRQA that is the OE has been asked to do the desk review of PDD for this project. The LRA has already received an indicative letter from the UNFCC and will soon be certified by the DOE. Document review of the present PDD was conducted in accordance with the validation manual of the IETA for the desk review, and a report was made.

■ **Progress of negations with OE**

According to the result of desk review, a lot of matters were pointed out concerning the fact that the project implementation system and project implementation plan had not been finalized. However, these matters can find solutions naturally when the details of the project are determined specifically in the future, and there will be no problem when a specific system is established in the host country. Therefore, these problems cannot be especially serious obstacles.