

# Summary Report

## Feasibility Study of the Landfill Methane Gas Utilization Project in Semarang, Indonesia

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The Chugoku Electric Power Co., Inc.

### (1) Basic Factors Related to Project Implementation

#### ■ Outline of Project Proposal and Planning Background

This project centers on the Jatibarang landfill waste disposal site, located in Semarang, the capital city of Central Java province in Indonesia. At this site, landfill gas (LFG) that is created by fermenting organic material will be collected and supplied as fuel to gas engine power generation facilities and thereby suppress the release of methane gas (a contributing factor of the greenhouse effect) into the atmosphere. Additionally, this project seeks to substitute the electric power system in order to reduce the amount of CO<sub>2</sub> emitted by thermal power plants.

Semarang is a city with a population of approximately 1.42 million (2005). The city produce some 120,000 tons of solid waste annually with nearly the whole amount being sent to the Jatibarang landfill waste disposal site, the subject of this project, where it is buried as landfill. The Jatibarang site was opened in 1992 and since then has received a total of approximately 1.5 million tons of waste and therefore has already been releasing LFG containing methane gas into the atmosphere from this accumulated waste.

This project involves the installation of a gas venting wells and pipes to collect the LFG, and then burn or destroy the methane gas (main element of LFG) in gas engines and flares. It is believed that stopping the release of methane gas, a major contributor to the greenhouse effect, will bring about a major reduction in overall greenhouse gas (GHG) emissions.



Fig. 1 Location of Semarang  
(Source: <http://www.indonesian-embassy.or.jp/>)

## ■ Host Country Outline

Indonesia declared independence in August 1945 when the Republic of Indonesia was established. The name of Indonesia derives from a combination of the greek words “indos” meaning India and “nesos” meaning island. The country measures 5,110 km from east to west with a surface area of approximately 1.86 million km<sup>2</sup> (roughly five times the size of Japan) and is comprised of approximately 17,500 islands of varying sizes making it the largest archipelago country. Indonesia is located in both the Pacific and Indian Oceans in between the continents of Asia and Australia. It possesses a tropical climate due to its proximity to the equator, and while there is no change in the seasons, there are rainy and dry seasons. The rainy season is from December to March while the dry season is from June to September.

A census of Indonesia carried out in 2000 showed a population of approximately 262.6 million making it the fourth largest country in the world in terms of population. Approximately 60% of the population, some 120 million, is concentrated on the island of Java.

Direct presidential elections were held for the first time in the country’s history on July 5, 2004 and on October 20 of that same year Susilo Bambang Yudhoyono was inaugurated as the sixth president of Indonesia. The Yudhoyono administration built its political policies on the three pillars of peace and security, justice and democracy, and improvement of social welfare, and the administration’s management of the government has received a high degree of approval from the citizenry. In regards to improving the investment climate, the “Presidential Regulation on Public-Private Partnerships for Infrastructure Development” (No. 67, 2005) issued on November 9, 2005, finally incorporated some risk abatement measures including governmental guarantees and preferential treatment so that the previously unclear system related to governmental investment guarantees could be more firmly established, something that was considered a step forward for the promotion of private investment.

The energy policy of Indonesia is determined based on a national philosophy indicated in Article 33 of the constitution of the Republic of Indonesia that states, “all natural resources in the land and the waters of the country are under the jurisdiction of the State and shall be used for the greatest benefit and welfare of the People.” The National Energy Policy 2003-2020 (KEN) established in March 2004 by the Ministry of Energy and Mineral Resources (MEMR) proposed an overriding vision of “Guaranteeing an energy supply to satisfy national interests” with the central tenets of the policy being “Improvement of energy supplying capabilities”, “Optimizing energy production”, and “Energy conservation”. A goal was set in regards to renewable energy sources of “achieving 5% of energy supplied by renewable energy, excluding large-scale hydro power generation, by the year 2020.” This 5% consists of 3% from geothermal power generation, and 2% from small-scale hydropower generation, biomass and similar renewable energy sources.

## ■ Status/Policies Related to CDM/JI: Criteria for Acceptance of Host Country CDM/JI, Establishment of DNA, and Others

Indonesia ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1994 and the Kyoto Protocol in December 2004. A DNA structure was officially launched in October 2005, and from that a CDM system was established in Indonesia. Fig. 2 shows the structure of DNA organization with the roles occupied by the Ministry of the Environment, at the center, and the other nine related ministries that make up the National Committee on CDM.

Evaluations of proposed projects is carried out by the Secretariat and the Technical Team, and when necessary, supporting organizations, consisting of the Expert Group and Stakeholders' Forum, are established to assist evaluation. A Technical Team is a project realization evaluation organization that consults the opinions of the Expert Group and the Stakeholders' Forum, and bases their evaluations on criteria and standards that are divided among four constants (environment, economy, society and technology) of sustainable development. As of January 23, 2007, 11 projects had received approval of the DNA and eight of these had been registered with the CDM Executive Board.

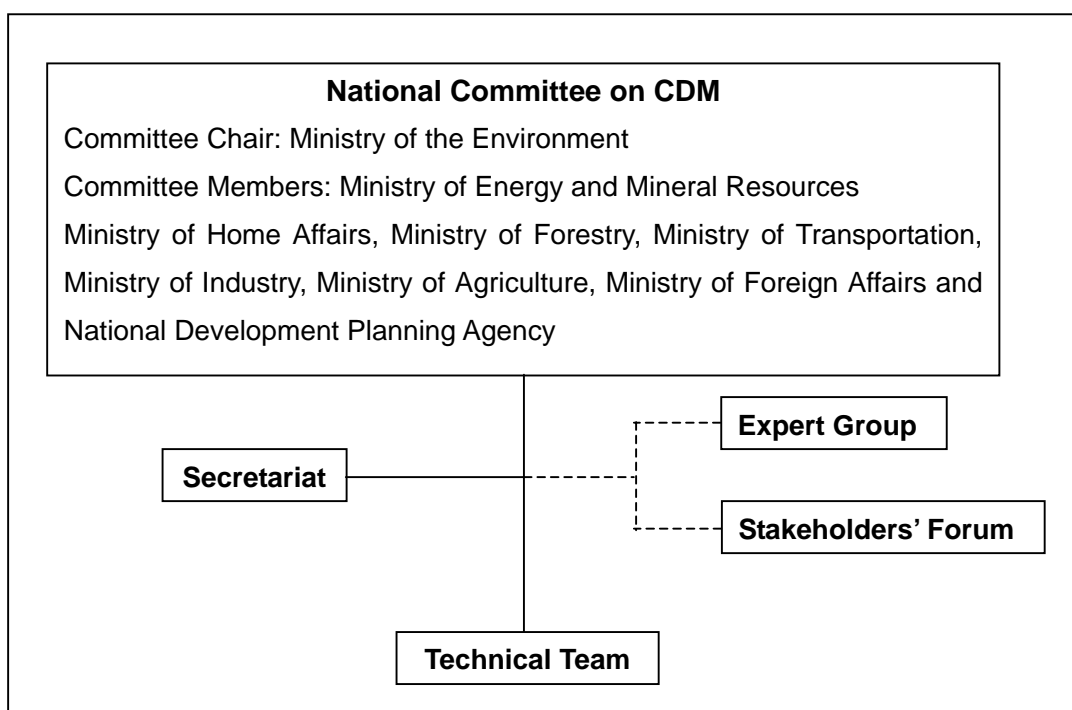


Fig. 2 CDM Project Evaluation System

■ **Proposed Project Aspects that Contribute to the Sustainable Development of the Host Country/Technological Transfer Items**

Given the fact that diffusion of the utilization of biogas as described in the proposed project can result in the use of agricultural waste or wood biomass energy, this could result in raising awareness and increased technical development, as well as promoting the central tenets of the National Energy Policy of “Improvement of energy supplying capabilities”, “Optimizing energy production”, and “Energy conservation”.

Furthermore, promoting utilization of renewable energy sources for all of Indonesia is essential for the efficient use of energy resources and ensuring energy provision capabilities, in addition to the fact that the diffusion of dispersed power source technologies makes possible the diversification of energy resources thereby contributing to the stable energy provision for urban areas.

The installation of a methane gas collection system at the Jatibarang landfill waste disposal site as proposed by this project requires a soil covering for the efficient collection of LFG and this can be expected to be effective in improving the environment in aspects related to sanitation, ecology and

disaster prevention as the soil covering will provide a runoff for rainwater, suppress odors, reduce disease-bearing insects such as flies, prevent animal communities (birds, etc.) from forming and prevent embankments from collapsing. Finally, implementation of this project will contribute to the creation of employment opportunities for the surrounding community.

■ **Study Implementation Structure (In Japan/Host Country/Other Areas)**

The study of this project shall be mainly conducted by The Chugoku Electric Power Co., Inc. with the Semarang Cleaning Department functioning as the local counterpart, and with the collaboration of the Shimizu Corporation and the Indonesian Agency for Assessment and Application of Technology (BPPT). The Shimizu Corporation is currently active in studies and operations for CDM/JI projects that involve the utilization of landfill gasses in Armenia, Ukraine and other countries. For this study, they will supervise tasks such as PDD creation and on-site gas analysis. As collaborating on-site partner, BPPT will be responsible for gathering information necessary for this study, coordination with related agencies and institutions, and similar tasks. Fig. 3 shows the study implementation system.

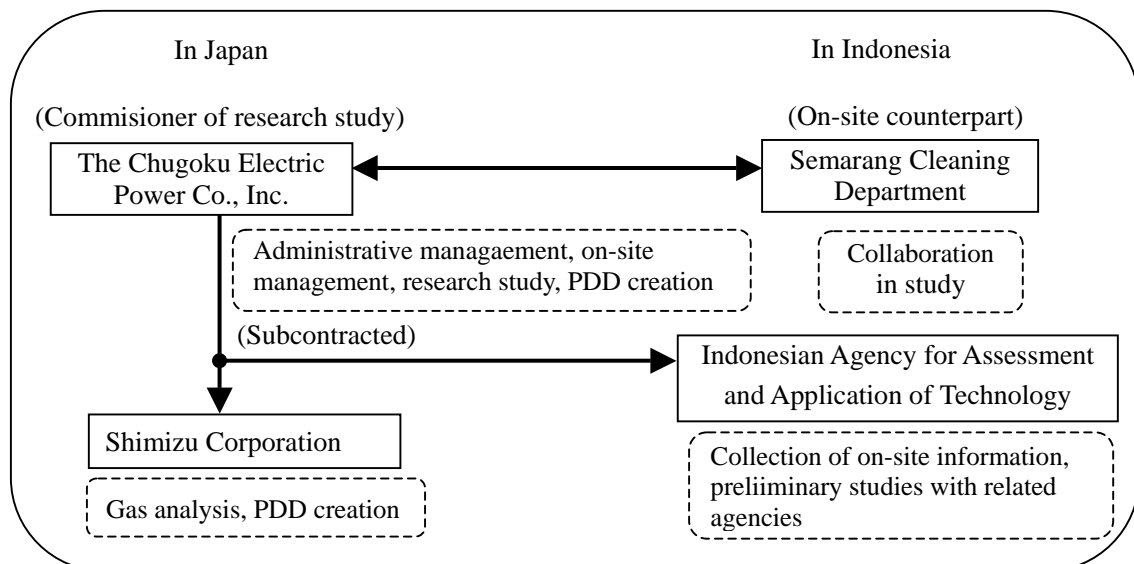


Fig. 3 Study Implementation System

## **(2) Project Outline Draft**

### **■ Basic Project Elements**

#### **(1) Project Site Overview**

This project will be carried out at the Jatibarang landfill waste disposal site located approximately 13 km. to the southwest of downtown Semarang in the Mijen district. This landfill site makes use of the natural valley formation for its layout and began operations in March 1992. The landfill site covers a surface area of 46 ha and 27.6 ha of that are dedicated to buried waste landfill. Landfill waste is buried at approximately 15 m. under the surface and the total amount of landfill waste that is already buried is approximately 1.50 million tons. The site is expected to reach full capacity by the end of 2010 when it will be closed. Operations management of the landfill site (waste collection, transport and landfill) is carried out directly by the municipality.



Photograph of Central Area of Jatibarang Landfill Waste Disposal Site

#### **(2) Project Implementation**

The system to be installed for this project consists of equipment and facilities for gas collection (vertical extraction wells, horizontal piping, blowers and airtight sheets), gas treatment, gas storage, gas engine power generation, power transmission and flares.

According to on-site estimate, the electrical generation facilities can generate 400 kW from two basic facilities. The project plan calls for a portion of the generated output to be consumed internally as the power source of the blower and similar equipment, and the excess capacity will be sold to the power system. After LFG collection begins, the amount of LFG will be ascertained and, based on that amount, the capacity of the power generation facilities can be restudied and determined.

The role of the flare equipment is to destroy the excess LFG not consumed by the power generation

facilities. Additionally, in case the power generation facility cannot be used due to inspection or an emergency shutdown, then the complete amount of LFG produced shall be destroyed by the flare equipments.

Fig. 4 shows an outline of the system for this project.

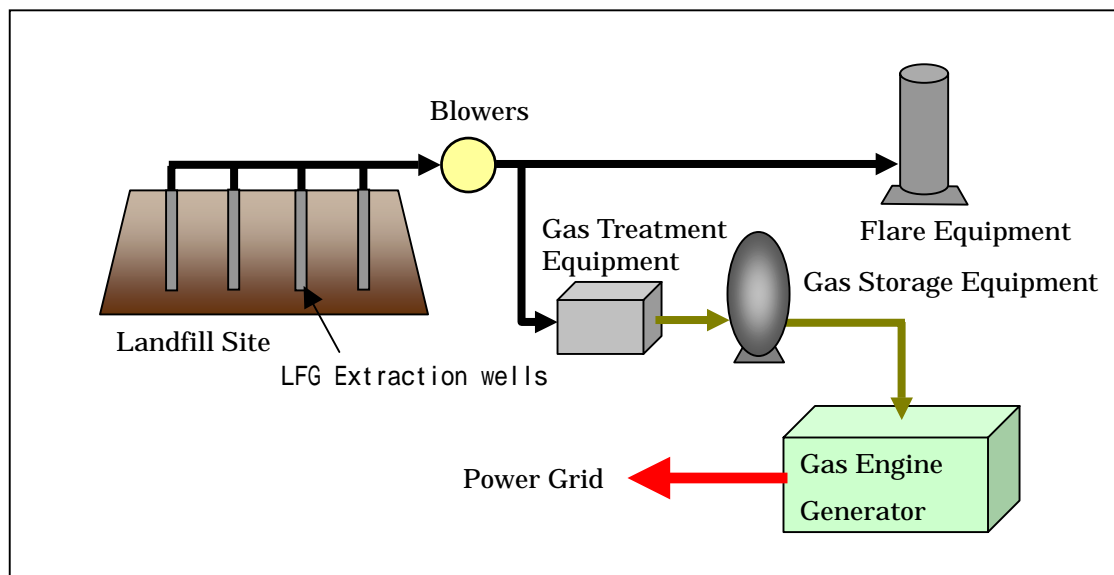


Fig. 4 System Outline

#### ■ Establishment of Project Boundary Baselines/Proof of Additionality

This project adopts the consolidated methodology of ACM0001 (Consolidated baseline methodology for landfill gas project activities and Consolidated monitoring methodology for landfill gas project activities) for baseline and monitoring methodologies.

##### (1) Project Boundaries

Due to the fact that this project involves the supply of energy generated by gas engine power generation facilities to the power system in order to reduce emissions of GHG by the effective substitution of fossil fuel power source and to claim emissions reduction credits, the project boundaries include the collection of LFG at the Jatibarang landfill waste disposal site, the burning of LFG to generate energy, destruction of the LFG using flares and the transmission of the generated electricity to the power system. However, this project does not include new facilities and equipment for collection, transport or landfill of waste and for this reason the effects of the transportation vehicles and similar factors are not included in the project boundaries.

##### (2) Baseline Establishment

Currently, there are no established laws in Indonesia that require landfill waste disposal sites to collect LFG during active operation or after closure, and there are no actual examples of other Indonesian landfill waste disposal sites that utilize LFG. The procedures for the closure of landfill waste disposal sites in Indonesia basically involves only the covering of the waste with soil and no other specialized treatment. For these reasons, the status quo scenario in which LFG is not collected at the Jatibarang landfill waste disposal site but rather is released into the atmosphere has

been established as the baseline.

### (3) Proof of Additionality

The “Proof of Additionality/Tools for Evaluation” approved by the CDM Executive Board has been applied to this study and proof of additionality has been achieved. Since this project presents an IRR with a weak 2% in which no CER income is expected, there is no attractiveness for investment and practicality is low.

## ■ GHG Reduction and Leakage due to Project Implementation

### (1) Amount of GHG Reduction

The estimated reduction of GHG emission is 605,729 tons of CO<sub>2</sub> for the credit period (2008 to 2017) according to the calculations using premised conditions attained from the results of the study carried out according to consolidated methodology ACM0001.

### (2) Leakage

This project presents no leakage if consolidated methodology ACM0001 is followed.

## ■ Monitoring Plan

Due to the fact that consolidated methodology ACM0001 is used as the baseline methodology for this project then the monitoring methodology must be used in conjunction with such baseline methodology. For this reason, consolidated methodology ACM0001 shall be applied for the monitoring methodology of this project. Accordingly, the monitoring items shall be established according to consolidated methodology ACM001.

## ■ Environmental Impact/Other Related Impacts

### (1) Environmental Impact Assessment

While this project involves the use of LFG for gas power generation, the scale of power generation is 0.8 MW making it a small-scale project and for this reason an environmental impact assessment does not need to be applied to this project. However, measures must be applied regarding environmental impact under “Considerations for projects not requiring an environmental impact assessment”.

For this reason, this project is obliged to present an “Environmental Management Plan” (UKL) and “Environmental Monitoring Plan” (UPL) to the Semarang Cleaning Department and attain their approval.

### (2) Environmental Impact

This project is expected to be effective in improving the environment in aspects related to sanitation, ecology and disaster prevention as it will suppress odors, reduce insects such as flies, prevent animal communities (birds, etc.) from forming, prevent embankments from collapsing among other positive effects.

Additionally, while the gas engines introduced by this project produce exhaust gas, technology of developed countries to suppress SO<sub>x</sub> and NO<sub>x</sub> emissions will be adopted in order to reduce the environmental impact on the atmosphere. Soundproof covers and vibration-proofing bases shall be

installed as measures against noise and vibration caused by the engines, blowers and other components.

#### ■ Stakeholders Comments

There are no specific arrangements with stakeholders related to CDM projects in Indonesia. According to the results of information collected for this study, it is assumed that the stakeholders related to this project consist of agencies of the central government, the Semarang municipal authorities, persons residing in proximity to the corresponding landfill waste disposal site and the purchaser of the generated power, the public electric company (PT. PLN). These stakeholders' comments were collected during briefing sessions regarding study results and interviews with concerned agencies.

##### (1) Study Results Briefing Sessions

The results of this study were collected and summarized for presentation at a briefing session attended by 23 persons held on January 17, 2007 in the Semarang Hall City Meeting Hall. Attendees included the Mayor of Semarang, assistant officials supervising economic development, director of the Cleaning Department, head of the Investment Coordination Agency as well as other related city authorities. After the information was presented, the mayor of Semarang commented that, "this project has a very significant meaning for our city and we hope that it can be implemented very soon."

##### (2) Interviews with Concerned Agencies

An explanatory overview of this project was presented to agencies of the central government (Ministries of the Environment, Public Work, Home Affairs, and Energy and Mineral Resources) and the Semarang municipal government (Cleaning, Environment, City Planning , and Investment Coordination Departments). As a result, the host country officials recognized the contributions this project will make for the development of Semarang and towards the resolution of the city's waste problems, and, from their basic standpoint in favor of implementation and agreement, expressed their desire to see the project carried out promptly.



### (3) Towards Operation

#### ■ Project Implementation System

Fig. 5 shows the proposed implementation system for this project.

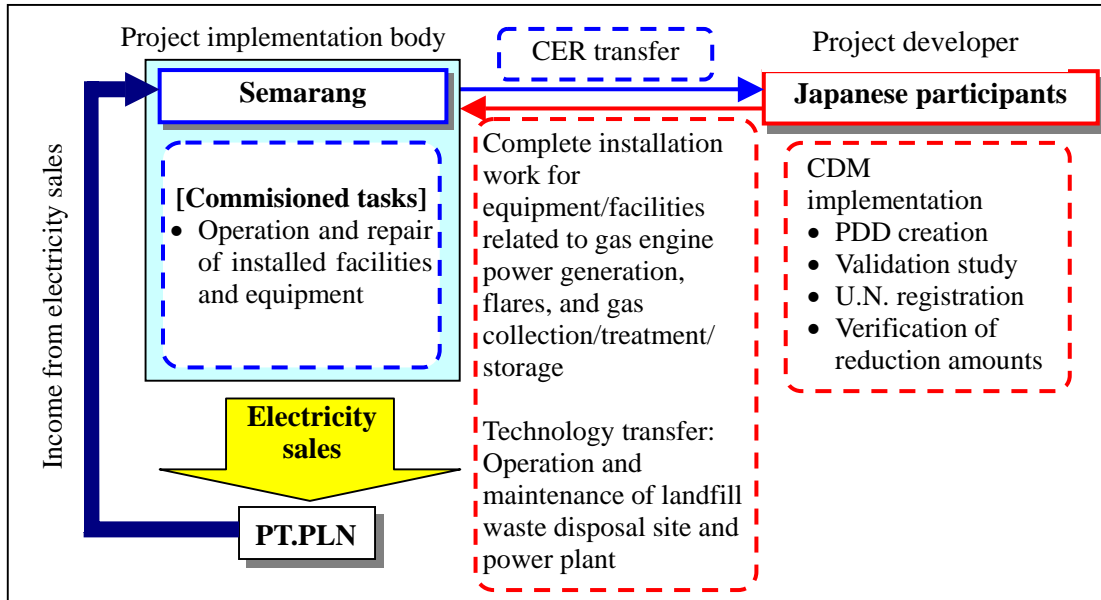


Fig.5 Project Implementation System

The city of Semarang, as proprietor of the corresponding landfill waste disposal site, is slated to be the main institution responsible for project implementation.

This project is to be carried out with capital investment for construction work related to landfill waste disposal site closure and gas engine power generation facilities and, since Semarang is a municipality operating on a budget that is approved by the city council, it is expected that the procurement of these funds will require a great deal of time. For this reason, the plan for this project calls for all initial required investment to be provided by the Japanese participants in order to promptly implement this project. This basically entails factors including system design, equipment/materials provision, construction work contracts and construction supervision. Furthermore, participating Japanese participants shall also take responsibility for CDM implementation-related tasks such as PDD creation, validation study, U.N. registration and verification of reduction amounts.

The city of Semarang will sign a contract for the sale of electricity with PT. RLN, the state-managed electric company, and will manage the electric power enterprise that uses Japanese-constructed power generation facilities. Accordingly, the city of Semarang will provide operations and maintenance management of the gas collection facilities and power generation facilities using capital provided by income received according to the contract for electricity sales. Since the city of Semarang has no experience or technical know-how regarding power generation enterprises, the commissioning of operations and maintenance management of the power plant to the appropriate personnel is being considered. However, given that there are no actual cases in the same region where gas engine power generation using foreign technology has been carried out, this project implies the introduction of new technology. For this reason, technology transfer is

planned that will provide enhanced technical training from the design stage to initial period of facilities/equipment installation. Additionally, advice will be provided, even after operations begin, regarding suitability, and operations and maintenance, with the expectation that this will sustain and improve the operations and maintenance management of small-scale decentralized power generation enterprises.

CERs attained from reduction actions of this project will be transferred, without charge, to Japanese participants.

#### ■ Financial Plan for Project Implementation

Capital funds required for this project consists of capital investment funds and project operating capital. Giving consideration to the scale and implementation schedule of the project, it is considered appropriate that the Japanese participants provide direct capital investment using their own funds.

Additionally, operating capital for this project shall be provided by the city of Semarang using the funds provided by electricity sales.

Due to the presupposed scheme in which the complete amount of CERs produced by this project will be transferred to the Japanese participants basically without cost, direct capital investment is not required for CER acquisition.

#### ■ Cost-Benefit Performance

Table 1 shows the results of the cost-benefits analysis for this project.

Table 1 Years for Return on Investment and Internal Rate of Return (IRR)

Economical Value of CERs		Years for Investment Recovery	IRR (%)
If CERs do not have any economic value	0 USD/ton-CO <sub>2</sub>	Cannot be recovered	1.68
If CERs do have economic value	5 USD/ton-CO <sub>2</sub>	14 years	9.43
	10 USD/ton-CO <sub>2</sub>	4 years	17.57
	15 USD/ton-CO <sub>2</sub>	2 year	25.67

Initial cost for this project, as previously mentioned, is 4,112,000 USD. However, the amount of greenhouse gas reduction will be 605,729 ton-CO<sub>2</sub> within the first 10 years (2008 to 2017) of project implementation (2008 to 2022). For this reason, the cost of greenhouse gas reduction has been estimated at approximately 7 USD/ton-CO<sub>2</sub>.

#### ■ Concrete Measures Towards and Challenges Regarding Initiation of Operations

Paperwork regarding registration of this project with the CDM Executive Board is being prepared with a target date of September 2007, and construction is scheduled to be launched in the second half of 2007 with flare operation due to be initiated in the first half of 2008. After that the emission status of LFG will be assessed in order to plan for the soonest possible introduction of gas engine power generation facilities.

If the investing country from a cost-benefit performance standpoint views the value of this project, it appears to be at a level that will permit the project to proceed as a CDM project. However, the

following risks and challenges in regards to the tangible operation of the project exist, and, with the mutual acknowledgement together with the counterparts, their future resolution in a manner that provides success to both parties.

- Risk of landfill gas emissions amount
- Partner-related risks
- Completion risk of construction works
- Risk of fluctuation in electricity per unit costs based on long-term electricity sales contract
- Risks arising from differences in laws/tax practices between the two countries
- Risks related to the system after the secondary commitment period
- Challenges regarding implementation of a CDM project in Indonesia
- Effect of planned compost project at Jatibarang landfill waste disposal site