CDM/JI Feasibility Studies, 2004

Feasibility Study on the Utilization of Methane Gas from the Landfill Site in Surgut, Russia

Summary Report

(1) General description of project activity

■The project outline and the planning background

The greenhouse effect of methane gas is approximately twenty one times bigger than that of carbon dioxide, thus, preventing methane gas from releasing into the atmosphere is very effective for greenhouse gas (hereinafter referred to as "GHG") emission reductions

This project activity will capture landfill gas (whose main component is methane gas, hereinafter referred to as "LFG") generated from the landfill named "27th km MSW Landfill" owned and operated by a public company CJSC Polygon Ltd. in Surgut, Russia. The LFG captured will be utilized for the fuel of a gas engine co-generation system (hereinafter referred to as "CGS") to restrain the LFG itself from the air diffusion and to reduce GHG emissions effectively.

Moreover, the electricity and thermal energy supplied from the CGS will displace the energies from Polygon's diesel engine generator and boiler which combust fossil fuel, therefore, it will reduce the fuel GHG emissions from them at the same time.

This project is hard to be done by local companies like Polygon because it has some kinds of barriers for the implementation such as economical barriers, technical barriers, etc. But if it is implemented as a Joint Implementation (hereinafter referred to as "JI") project, one of Kyoto Mechanisms, by a collaboration of Japan and Russia, these barriers will be removed and the GHG emission that would be generated without the project activity will be reduced, and then, it will bring profitability as a carbon credit called Emission Reduction Unit (hereinafter referred to as ERU) to both Japan and Russia.

■The outline on the host country

Surgut is located at north latitude of sixty-two degrees, east longitude of seventy-three degrees, approximately six hundred kilometers away from the Ural Mountains. Located on the Ob River, Surgut is a provincial industrial city whose population is approximately three hundred thousand. The major industry is production of petroleum and natural gas. The Surgut Region of Khanti-Mansi autonomous district in Tyumen region has an abundance of fossil fuel deposits, and due to this fact, the population tends to concentrate and increase in this area. The climate in Surgut is continental climate and quite cold all through the year. The annual average temperature is -3.1 degree Celsius and the annual average precipitation is 676mm. Forty years will have passed since the municipality was formed.

Fig.1 Location of Surgut, Russia

■Host country's policy and condition such as the CDM/JI criteria, DNA establishment, etc.

At the initial phase of this FS, Russian authorities' opinions on the ratification of Kyoto Protocol were completely separated and the structural reform for Russian government ministries was very complicated, therefore, the governmental movement for the ratification was not predictable at all. But the condition was changed during the WTO accession negotiation with EU. The priority of WTO accession was the highest for Russian economical development in external economic policies though the ratification was quite suspicious for the Russian national profit. In November 2004, Russia finally ratified Kyoto and the Protocol came into effect in February 16, 2005.

Russia has not developed the requirements for JI implementation such as procedures, organizations, guidelines, etc. because it just ratified Kyoto. It is said that specific assignments were directed to ministries at the cabinet decision of the legislative bill for the Protocol, however, it is quite uncertain on which ministry has what kind of responsibility because of the complicated structural improvement, thus, it is proper to think none of them has not been decided yet officially.

On the other hand, the ministry of the economic development and trade took a positive role on the ratification at the investigation stage, and Mr. Pluznikov, the head of the environmental department of the ministry told us during the first site survey that the ministry would be a responsible authority to implement the Kyoto Mechanism. Therefore, there is no doubt that the ministry will be the important authority for Kyoto.

■FS implementation structure (Japan, the host country, *et al.*)

The FS was implemented under the structure shown as below:

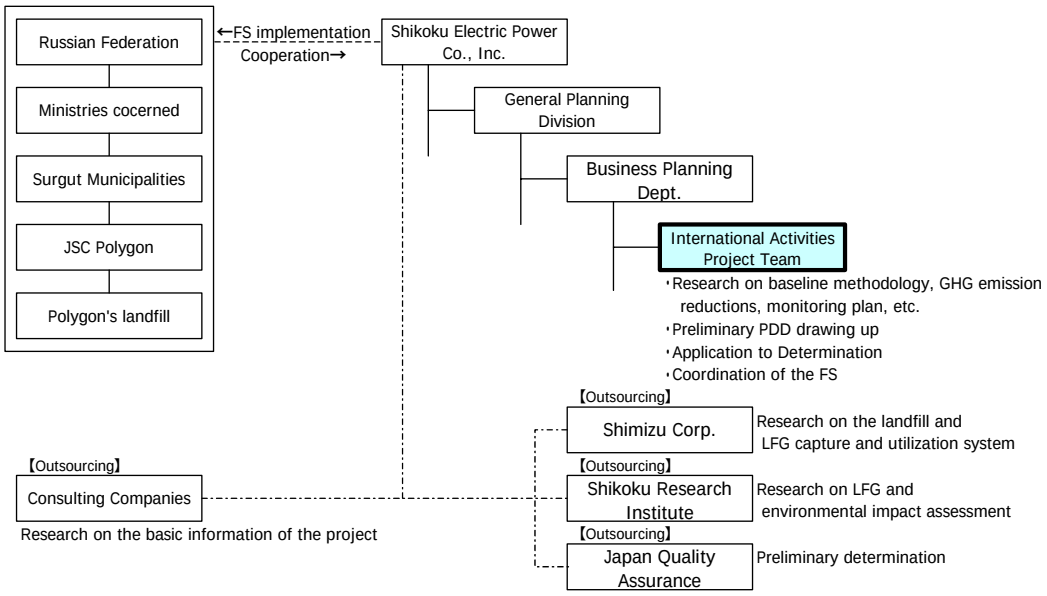

Fig.2 The FS implementation structure

(2) Project planning

■Specifications on the project activity

The amount of municipal solid waste (hereinafter referred to as MSW) generated in Surgut City and the Surgut Region is on the rise as along with the growth in population, and approximately one hundred thousand tons of MSW is now generated from Surgut City alone. However, Surgut City's landfill site is nearing capacity levels and the city's administration is considering whether the municipal landfill site should be continued or closed.

Conversely, JSC Polygon has just constructed the latest landfill site outside the city named "27th km MSW Landfill," which is 27km from the center of Surgut City (inside of Surgut Region.) The purpose of this landfill site revolves around the installation of a cutting-edge wastewater treatment facility and construction of a waste recycling facility that the municipal landfill site lacks. Thus, Polygon's new landfill is more environmental-friendly and is an attempt to minimize harm to the environment.

This project will introduce LFG capture system such as gas pipelines, blowers, LFG treatment equipment, gas holders, etc in order to capture LFG efficiently. The LFG captured will be fed into the CGS and used to produce electricity and thermal energy. The energy generated other than the energy consumed by the LFG capture system and the CGS

themselves will be sold to the landfill. There are a service building, wastewater treatment facility, recycling facility of construction waste, hot houses, lighting system, etc. in the landfill, which means much power demand is in the landfill site. However, this landfill is twenty-seven kilometers far from Surgut City, thus electric power grid and thermal energy network does not exist near the landfill at all. The surplus LFG that cannot be utilized by the CGS will be destroyed by flaring.

Fig.3 outlines the conceptual diagram of the LFG capture and utilization system.

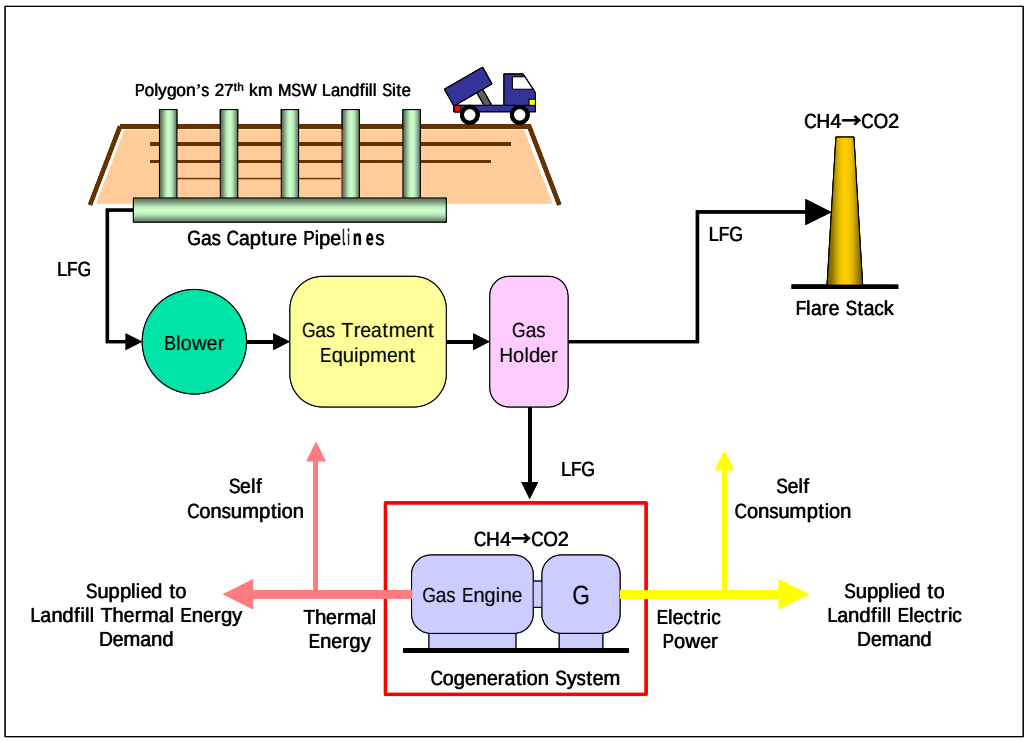

Fig.3 The LFG capture and utilization system schematic

■Project boundary, baseline, and the demonstration and assessment of additionality

(1) Project boundary

The quantity of the LFG/methane gas generation from the landfill and the GHG emission from diesel generators and fossil fuel combustion boilers in the landfill are anthropogenic emissions by sources of GHG under the control of the project participants that are significant and reasonably attributable to the JI project activity.

Therefore, the project boundary includes LFG capture system (LFG capture pipelines, gas blowers, etc.), CGS, flaring facility, electric wire, distribution pipelines for thermal energy, etc. in addition to the diesel generators and the fossil fuel combustion boilers owned in Polygon's landfill.

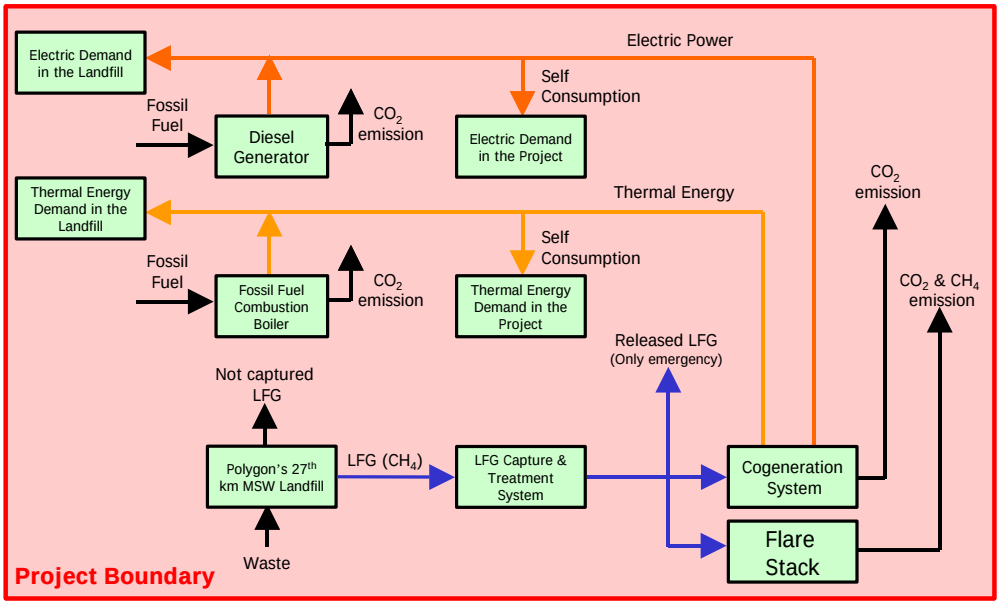

Fig.4 The project boundary

(2) Baseline scenario

Russia and Surgut lacks legislation to enforce the LFG capture on landfills so far and has no plan to introduce the legislation for the moment, and the LFG generated from landfills are not considered as a problem. Because Surgut has an abundance of fossil fuel deposit and the energy supply is sufficient, the awareness on the energy conservation cannot be fostered. Additionally, LFG capture and utilization technology has not been disseminated yet. Thus, there is not any incentive to cost much time, effort, and money to introduce LFG capture and utilization system.

Therefore, it is natural to think that "keeping the status-quo" will continue to release the LFG into the atmosphere, and the scenario that the LFG will not be captured to utilize and the landfill will keep releasing the LFG to the atmosphere is the highly probable baseline scenario. Thus, no GHG emission will be reduced without this project.

(3) The demonstration and assessment of additionality

EB16 Annex1 "Tool for the demonstration and assessment of additionality," (hereinafter referred to as "the Tool") is utilized in order to demonstrate and assess that this project is additional and cannot be a baseline scenario. However, this project is a JI project and it is not necessary to use all of the step-wise approaches required for CDM projects, thus only "Sub-Step 2b - Option III" and "Step 5" provided in the Tool are used in this PDD.

Sub-Step 2b – Option III. Apply benchmark analysis

A special purpose company (SPC) will be established in order to sell the electricity and thermal energy generated by the CGSs to the demand in Polygon's landfill, and a power purchase agreement (PPA) will be concluded between the SPC and the landfill. The SPC can obtain the revenue from the sales of the electricity and thermal energy by the PPA.

Thus, "Sub-step 2b - Option III" in the Tool is available and the Russian government bond rate is used for the benchmark in this analysis, which was between 7.8 ~ 8.0% in September 2004. The revenue from the sale of ERUs is not considered in this analysis according to the Tool.

This project activity will generate the return (the revenue from the sale of electricity and thermal energy) meeting the investment, but the project cash flow estimated shows that the total amount of the cash flow will not turn profitable even after 20 years of the project period – this project is very unattractive without the sale of ERUs. (Please refer to Table 1.)

This demonstrates that the capital investment of this project cannot be collected only through the sale of electricity and thermal energy, thus this project cannot be an attractive baseline for the investors in Surgut, Russia to implement on their own.

Table 1 Project cash flow without the revenue from the sale of ERU

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Income	0	-85	-85	-85	-85	1,464	1,464	1,464	1,464	1,464	2,684
Electricity Sales Income	0	-72	-72	-72	-72	1,167	1,167	1,167	1,167	1,167	2,232
Heat Energy Sales Income	0	-13	-13	-13	-13	297	297	297	297	297	452
Total Expense	7,730	722	722	722	4,572	1,288	1,288	1,288	1,288	5,138	1,891
Capital Investment	7,730	0	0	0	3,850	0	0	0	0	3,850	0
Personnel Cost	0	493	493	493	493	723	723	723	723	723	953
Maintenance Cost	0	200	200	200	200	517	517	517	517	517	870
Overhead Cost	0	29	29	29	29	48	48	48	48	48	67
Income Tax	0	0	0	0	0	0	0	0	0	0	0
Cash flow	-7,730	-807	-807	-807	-4,657	176	176	176	176	-3,674	793

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
2,718	2,753	2,787	2,811	2,835	2,844	2,882	2,906	2,930	2,954	38,083
2,253	2,274	2,294	2,312	2,330	2,333	2,366	2,383	2,401	2,419	31,142
466	479	492	498	505	511	517	523	529	535	6,941
1,906	1,928	1,950	1,963	2,063	5,920	2,202	2,211	2,221	2,306	51,321
0	0	0	0	0	3,850	0	0	0	0	19,280
953	953	953	953	953	953	1,183	1,183	1,183	1,183	16,990
888	905	923	932	942	948	961	970	979	989	13,694
52	53	53	53	46	46	58	58	59	51	953
13	17	21	25	122	123	0	0	0	83	404
812	825	837	848	772	-3,076	680	695	709	648	-13,238

thousand Roubles

Step 5. Impact of CDM registration

Table 2 shows the project cash flow when the revenue from the sale of ERUs is added to the result of the investment analysis studied in "Sub-Step 2b - Option III". Here the table shows the project cash flow in case the cash value of ERU is 6US$/t-$CO_2$.

Table 2 Project cash flow with the revenue from the sale of ERU (ERU: 6US$/t-$CO_2$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Income	0	256	466	733	1,003	3,112	3,375	3,632	3,880	4,120	5,787
ERU Sales Income	0	340	551	817	1,088	1,648	1,911	2,168	2,416	2,656	3,103
Electricity Sales Income	0	-72	-72	-72	-72	1,167	1,167	1,167	1,167	1,167	2,232
Heat Energy Sales Income	0	-13	-13	-13	-13	297	297	297	297	297	452
Total Expense	7,730	722	722	722	4,572	1,448	1,511	1,573	1,632	5,540	2,455
Capital Investment	7,730	0	0	0	3,850	0	0	0	0	3,850	0
Personnel Cost	0	493	493	493	493	723	723	723	723	723	953
Maintenance Cost	0	200	200	200	200	517	517	517	517	517	870
Overhead Cost	0	29	29	29	29	48	48	48	48	48	67
Income Tax	0	0	0	0	0	160	223	285	344	402	565
Cash flow	-7,730	-467	-256	10	-3,569	1,664	1,864	2,059	2,248	-1,420	3,331

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
6,049	6,303	6,547	6,769	6,983	7,171	7,391	7,590	7,787	7,981	96,933
3,331	3,550	3,760	3,958	4,148	4,328	4,508	4,684	4,857	5,027	58,850
2,253	2,274	2,294	2,312	2,330	2,333	2,366	2,383	2,401	2,419	31,142
466	479	492	498	505	511	517	523	529	535	6,941
2,706	2,780	2,852	2,913	3,058	6,959	3,262	3,318	3,372	3,513	63,361
0	0	0	0	0	3,850	0	0	0	0	19,280
953	953	953	953	953	953	1,183	1,183	1,183	1,183	16,990
888	905	923	932	942	948	961	970	979	989	13,694
52	53	53	53	46	46	58	58	59	51	953
813	869	924	975	1,118	1,161	1,061	1,106	1,151	1,289	12,444
3,344	3,522	3,695	3,856	3,925	213	4,128	4,273	4,415	4,468	33,572

thousand Roubles

The investment analysis verifies the attendant benefits derived from the sale of ERUs generated from this project activity. Therefore, implementation as a JI project will alleviate the economic and financial hurdles. The project IRR will be 12.1% when the cash value of ERU is 6US$/t-$CO_2$, which is higher than the Russian government bond rates as a benchmark, which means that this project can be a profitable business for investors if it were registered as a JI activity.

This analysis confirms that this project activity cannot be a baseline scenario and that the project should be a JI project taking into account the cash value of ERUs.

■GHG emission reductions by the project activity and leakage

This project corresponds to the applicability c) of the approved consolidated baseline methodology ACM0001 “Consolidated baseline methodology for landfill gas project activities” (hereinafter referred to as “ACM0001”).

ACM0001 can be applied to the phase of LFG capture, AMS-I.D. “TYPE I RENEWABLE ENERGY PROJECT – I.D. Renewable electricity generation for a grid” and AMS-I.C. “TYPE I RENEWABLE ENERGY PROJECT – I.C. Thermal energy for the user” can be applied to the phase of the displacement for the diesel generator and the boiler.

“First Order Decay Model” shown in “Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual CHAPTER 6 WASTE” was used for the method to estimate the amount of methane gas generation.

On the basis of these methodologies, the amount of GHG emission from the project activity and baseline was estimated respectively and the amount of GHG emission reduction by this project activity. was calculated with these amount.

Table 3 The GHG emission reductions by the project activity（t-CO_2）

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2,101	3,402	5,046	6,715	10,171	11,799	13,383	14,916	16,394	19,152

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
20,561	21,913	23,209	24,434	25,607	26,713	27,830	28,913	29,980	31,031

The total amount of the GHG emission reductions by this project was calculated as 363,270 t-CO_2.

In this project, leakage does not have to be calculated in accordance with the baseline methodologies of ACM0001, AMS-I.C., and AMS-I.D.

■Monitoring plan

The monitoring methodologies of ACM0001, AMS-I.C., and AMS-I.D. can be applied to this project as well as the baseline methodologies.

The amount of GHG emission reduction due to the project activity can be calculated by measuring the quantity of LFG utilized at the CGS and the flare stack, the average methane gas fraction of LFG, and the amount of the electricity and the thermal energy supplied from CGS.

The monitoring plan is shown in the table below.

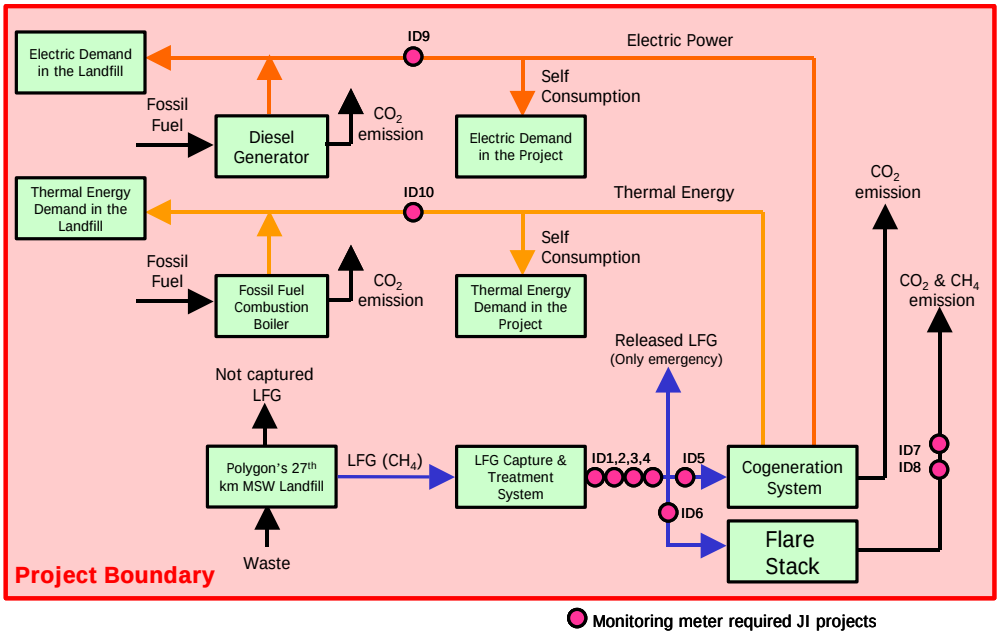

Fig.5 The monitoring plan

Where:

ID1: Flowmeter - Quantity of LFG captured)

ID2: Temperature gauge – Temperature of LFG

ID3: Pressure gauge – Pressure of LFG

ID4: Methane gas analyzer – Average methane fraction of LFG

ID5: Flowmeter – Quantity of LFG used by CGS

ID6: Flowmeter – Quantity of LFG flared

ID7: Thermocouple – Surface temperature of flare

ID8: Methane gas analyzer – Average methane fraction of the exhaust gas of flare

ID9: Voltmeter – Net quantity of electricity displaced

ID10: Calorimeter – Net quantity of thermal energy displaced

In monitoring, the most precise gauges among possible gauges will be used to the extent possible and will be periodically calibrated to maintain the quality assurance.

In terms of the monitoring structure, a monitoring standard, a monitoring policy, monitoring forms, a communication structure, etc. will be prepared by Japanese side and Russian side will implement the monitoring and manage the data. The electric data will be periodically sent to Japanese side through the manager of the monitoring team.

Japanese side will confirm the data and if there is a problem in the data, Japanese side will direct the manner of coping for that as soon as possible, and then the result will be reported by Russian side.

■Environmental impact/ other indirect impacts

This project has no adverse impact on the environment of Surgut. Rather, it provides some favorable benefits by capturing and utilizing LFG that would be released from the landfill, such as the prevention of unpleasant smells, the prevention of fire disasters, the reduction of the quantity of fossil fuel consumed.

The possibility of the pollution due to the exhaust gas and wastewater, ambient noise, and vibration is assumed because the project activity will install mechanical equipment such as blowers, CGS, however, the landfill is located adequate away from residential zones and we think that the project will not give any damage to the environment. In terms of the possibility of these environmental impacts, we have obtained the opinions from the Surgut Municipal Environmental Commission that these factors do not cause any environmental concerns.

Though the competition between the Polygon's landfill and the municipal one can be the other indirect impact, the price competition will lead the waste disposal cost reduction, and the environmental friendly landfill will promote to change the public awareness on the environmental issues, therefore it will bring rather good effects.

■Stakeholders' comments

Russia has recently ratified the Kyoto Protocol, though it has no guidelines, procedures, and structures regarding how comments by local stakeholders are invited and compiled in JI activities.

We collected comments on the project from the important dignitaries concerned during meetings held in two site surveys by asking along prepared questionnaires, and most of these collected comments are generally positive opinions, and the interviewees are commonly supportive to this project. Therefore, we do not think it necessary to take some actions to these comments at present.

These comments are not sufficient to estimate stakeholders' comments, so further more stakeholders' comments required will be collected and treated appropriately in the future in accordance with the decision of the Russian government on the treatment for the stakeholders' comments.

(3) The plan for the project implementation

■Project implementation structure (Japan, the host country, *et al.*)

The implementation structure of this project will be shown as below.

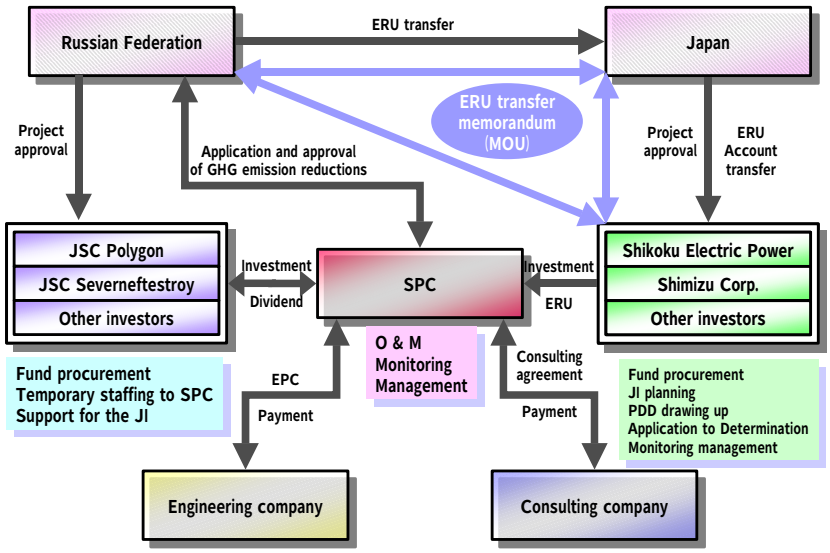

Fig.6 the project implementation structure

■Cash planning for the project implementation

The project will be operated by the investment to a special purpose company (SPC) from Japanese companies and Russian counterpart company concerned this project. The cash required for the project is comparatively small, and the parent company of Polygon Ltd., a construction company named “Severneftestroy” has financial muscle, so finance from banking institution is almost unnecessary.

Therefore, Japanese side will have only to prepare the money for ERU and a part of the investment for SPC will not be a big debt burden.

■Cost effectiveness

The unit price of the carbon credit (ERU) was set as 6US$/t-$CO_2$ in the demonstration of the additionality. Here, the result of the IRR estimations in case the unit price of ERU is variously changed leads the conclusion that more than 5US$/t-$CO_2$ of ERU will make the project attractive taking into account the Russian government bond rate.

Table 4 ERU unit price and IRR

ERU unit price	IRR
2 $/t-CO2	1.6%
3 $/t-CO2	5.0%
4 $/t-CO2	7.7%
5 $/t-CO2	10.0%
6 $/t-CO2	12.1%
7 $/t-CO2	13.9%
8 $/t-CO2	15.7%
9 $/t-CO2	17.3%
10 $/t-CO2	18.9%
11 $/t-CO2	20.3%
12 $/t-CO2	21.7%
13 $/t-CO2	23.0%
14 $/t-CO2	24.3%
15 $/t-CO2	25.6%

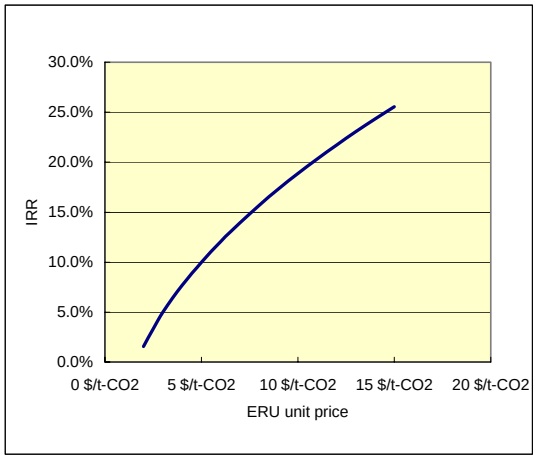

Fig. 7 ERU unit price and IRR

■Prospect and challenging issues for the actual project implementation

The ratification by Russia realized the effect of Kyoto Protocol on February 16 2005, and Russian Federation will have to organize the requirements for JI such as calculation system for the domestic GHG emissions, Registry, Inventory, the establishment of DNA, JI guidelines, etc. We hope these requirements will be organized by Russia as soon as possible.

Speaking from the viewpoint of the economic efficiency, the payback period is estimated about ten years, the quantity of GHG emission reductions will be approximately 300,000 t-CO_2, and the project IRR is estimated about 12% in case ERU unit price is 6US$/ t-$CO_2$,

therefore, the project activity will be economically profitable. On the other hand, it has possibilities of many challenging issues and risks, for instance, particular risks in Russia such as JI project approval risk, ERU transfer risk, market risks, etc. caused by the delay of Russian environmental consideration for JI in addition to general risks for international projects such as force majeure, political risks, etc. Considering the fact, we have to inquire cautiously into this project in detail for the realization in the future.

It is no doubt that JI projects in Russia will be very essential for Japan imposed on the severe duty to reduce GHG emissions, and we public companies will have to promote JI projects in Russia positively. Especially, LFG capturing and utilizing projects are one of the few comparatively easy projects to promote that have already approved by CDM executive board and the consolidated methodology has also already prepared. The realization of this Surgut project will become one of the model projects that will contribute to the sustainable development for Russia. Thus, this project will be crucially important for the promotion of JI projects in Russia.

We are going to make efforts for the success of the project investigating further more in detail with keeping close watch on the movement of Russian government aftertime.

(4) Determination

■The outline of the determination/ the desk review

We outsourced preliminary JI Determination for the draft PDD to Japan Quality Assurance Organization (hereinafter referred to as “JQA”), which required desk review reports excluding site surveys.

The desk reviews were implemented twice. We discussed problems in the PDD in each case and revised it on the basis of the discussion result to improve the PDD determination.

The final desk review report from JQA points out no CAR (Corrective Action Request) but a few CLs (Clarification) as follows:

- ✓ The items concerning the Russian requirements for JI
- ✓ The items concerning the Russian SD (Sustainable Development) policies
- ✓ The items concerning the environmental impact analysis in Russia

These points are attributed to mainly the pending arrangement of the Russian organization for JI, hence, it is important to correspond to the change on the Russian movement and the condition of the Russian organization for JI.

■The interactions with OE

The first desk review reported many CARs. They are classified roughly as follows:

- ✓ The GHG emission from the project boundary and the leakage directly attributed to the project activity in the absence of the project activity are not clearly provided.
- ✓ Relevant indicators such as fuel demand and electricity supply and demand related to the project site required for the choice of the baseline scenario are not clearly provided.
- ✓ The methodology for the electric supply is not clearly indicated.
- ✓ The baseline and monitoring plan do not demonstrate clearly that All the required indicators concerned the measurement and estimation for the anthropogenic GHG emissions will be collected and archived.
- ✓ The PDD does not plan to collect and archive the data concerned the environmental impact.
- ✓ The PDD has defectiveness in the documentary form.

In addition to these CARs, the items that would be CARs because of the unclearness in the description and expression if the investigation will be progressed further more were pointed out as CLs.

For these items pointed out, we responded as follows:

- ✓ Clearly describe the methodologies to apply and the application method in the PDD
- ✓ Clearly describe barriers required for the choice of the baseline scenario in the PDD
- ✓ Describe the monitoring plan in PDD concretely
- ✓ Improve the defectiveness in the documentary form of the PDD
- ✓ Clearly describe how to operate the CGS and the contract conditions between the landfill and SPC in the PDD
- ✓ Submit a supporting document that demonstrates technical evidences and backgrounds of the GHG emission reductions, the power demand, etc.

Consequently, all the CARs and most of the CLs were resolved by these improvements.