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IMPLEMENTATION COMPLETION REPORT
(38300)

ON A

LOAN

IN THE AMOUNT OF US$75 MILLION EQUIVALENT

TO THE

REPUBLIC OF KOREA

FOR A

WASTE DISPOSAL PROJECT

June 27, 2002

Urban Development Sector Unit
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective April 30, 2002)

Currency Unit	=	Won
1000 won	=	US$ 0.80
US$ 1.00	=	1,250

FISCAL YEAR

January 1 December 31

ABBREVIATIONS AND ACRONYMS

BOD	Biochemical Oxygen Demand
CAS	Country Assistance Strategy
EIA	Environmental Impact Assessment
EMC	Environmental Management Corporation
FRR	Financial Rate of Return
GOK	Government of Korea
KRSC	Kunsan Resident Support Committee
KTP	Kunsan Specified Waste Treatment Plant
MOE	Ministry of Environment
PCG	Pusan City Government
PEIC	Pusan Environmental Installation Corporation
PSD	Pusan Sewerage Division
PSM	Pusan Sewerage Management Office
SMP	Sewerage and Drainage Master Plan
SS	Suspended Solids
SSA	PSM Sewerage Special Account
STP	Sewage Treatment Plant
SWA	KTP Account
SWI	Specificed Waste Incinerator
WTP	Wastewater Treatment Plant

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REPUBLIC OF KOREA
WASTE DISPOSAL PROJECT

CONTENTS

Project ID: PO35079	*Project Name:* WASTE DISPOSAL PROJECT
Team Leader: Ming Zhang	*TL Unit:* EASUR
/CR Type: Core ICR	*Report Date: June 28, 2002*

1. Project Data

Name: WASTE DISPOSAL PROJECT
L/C/TF Number: 3 8300
Country/Department: REPUBLIC OF KOREA
Region: East Asia and Pacific Region
Sector/subsector: WS - Sewerage

KEY DATES

			Original	Revised/Actual
PCD.	12/03/1 993	*Effective:*		10/27/1995
Appraisal:	09/2 1 /1 994	*MTR.*		
Approval:	12/20/ 1994	*Closing:*	06/30/2000	12/31/200 1

Borrower/Implementing Agency. Republic of Korea/MIN. OF CONSTRUCTION
Other Partners.

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2. Principal Performance Ratings

(HS=Highly Satisfactory, S=Satisfactoty, U=Unsatisfactory, HL=Highly Likely, L=Likely, UN=Unlikely, HUN=Highly Unlikely, HU=Highly Unsatisfactory, H=High, SU=Substantial, M=Modest, N=Negligible)

Outcome: S
Sustainability: L
Institutional Development Impact: SU
Bunk Performance: S
Borrower Performance: S

	QAG (if available)	ICR
Quality at Entry:		S

Project at Risk at Any Time: No

3. Assessment of Development Objective and Design, and of Quality at Entry

3. I Original Objective.

Background. In the early 1990s, Korea's industrialization, improved living standards and rapid urban

population growth had resulted in the generation of large quantities of various kinds of waste. Wastewater was projected to grow from 11 million m3/d in 1990 to 19 million m3/d in 2001; solid waste from 145,000 t/d to 250,000 t/d; and specified waste (defined as toxic work-site waste such as acids and alkalis, oils, organic solvents, asbestos, pesticides, polychlorinated bi-phenl, and sludge containing heavy metals) from 3,000 t/d to 12,500 t/d. Korea's waste treatment facilities could not keep up with the rising levels of waste. The Government recognized these environmental deficiencies and had created institutions and regulations to control waste disposal, and had defined national level plans to prevent contamination and preserve the environment. It then requested Bank financing and expertise to implement a project for wastewater treatment and disposal of specified waste.

The key **objective** of the project was to support the Government of Korea in addressing environmental, institutional and technological concerns regarding wastewater and specified waste disposal. Specifically, the project would reduce the health hazards caused by air, soil and water contamination by specified [hazardous] waste in Chunbuk province by its incineration in Kunsan plant; and treat industrial wastewater and to promote the reuse of treatment plant effluent on a major scale in Pusan City.

Assessment. The objectives were clear, important for the country and consistent with the overall Country Assistance Strategy (CAS) and the graduation plan for Korea. The CAS had identified the need to improve the environment, which involved managing wastewater and solid waste, as an area in which the country would benefit from Bank participation. Accordingly, the project included two diverse components each focused on a special environmental issue. Its design provided for the construction of facilities which would maintain or improve air, soil and water quality, and for delivery of technological and operational expertise in specified waste management. It also linked expansion and upgrading of a major wastewater treatment plant with water conservation. The project components were neither unusually complex or risky, nor unduly demanding given the implementing capacities of executing agencies, the Environmental Management Corporation (EMC) acting on behalf of the Ministry of Environment (MOE) and the Pusan Sewerage Division (PSD) for the Pusan Metropolitan Government.

3.2 Revised Ohjec tive:
n.a.

3.3 Original Componen ts·

Kunsan component. This component comprised the construction of a specified waste incineration plant with a capacity of 60 t/d, and training for the incinerator management and operations staff. The incinerator plant was conceived as a state-of-the-art advanced specified waste technology serving as a model facility in the country. It would consist of a high-temperature rotary kiln supported by associated equipment and various environmental controls, in particular for the emission of stack gases. The incinerator plant was to be an integral part of a comprehensive treatment facility for specified waste, which includes a secured landfill and leachate treatment.

For various reasons, such as uncertainty in forecasting the generation of specified waste (related to the country economic performance), and public resistance to disposal sites or operation of facilities, the private sector has had little presence in intermediate treatment (incinerators) and almost none in final treatment (controlled landfill) of specified waste. In order to control the disposal of specified waste in the country, MOE decided to retain responsibility for disposal of specified waste and to construct one specific waste treatment facility in each of its six regions. Implementation of this program started with the Kunsan plant in Chunbuk province. The facility, the Kunsan Specified Waste Treatment Plant, is located about 20km west of Kunsan City. It was built and initially operated by EMC, mainly to serve the adjacent Kunsan Industrial

Estate (KIE) and several smaller producers of specified waste in Chunbuk province. KIE when fully developed in an area of 43 km2 would employ over 30,000 in heavy- and metallurgical manufacturing.

The Pusan component included construction of the second phase of the Janglim wastewater treatment plant (Janglim II) with a capacity of 265,000 m3/d, construction of tertiary treatment for Janglim I and II with a total capacity of 615,000m3/d, and construction of interceptor sewers (4.5km) with two associated pumping stations (45,800m3/d and 89,800m3/d). Janglim I and II use conventional activated sludge treatment technology. The proposed tertiary treatment consisted of conventional flocculation (using alum in combination with polymers), followed by rapid upward flow filtration, and disinfection if needed. Located on the bank of the mouth of the Nakdong River and discharging the effluent into Nakdong Bay, the Janglim WTP serves Pusan's principal catchment of 50 km2 with a population of over one million plus various textile, chemical, leather as well as heavy industries, including metallurgy and shipbuilding. Between 1993-94, the first phase WTP constructed in 1991 almost reached capacity at maximum flows, and on the basis of sewerage master plan projections, the City decided to construct the second phase WTP with completion in 2000.

During project preparation, MOE ruled that in view of sensitive ecology, seaweed farming and the newly established migratory bird sanctuary in the Nakdong Bay, the Janglim effluent from both the first and second phases should be discharged outside the Nakdong Bay through the sea outfall over 15 km long. Otherwise, the effluent must comply with stricter environmental standards than those applicable to other treatment plants in Korea. Upon examination of the alternatives, Pusan City decided to discharge Janglim effluent into the Nakdong Bay. In order to comply with MOE requirements, it would construct tertiary treatment facilities for the combined capacity of Janglim I and II. Future re-use of such highly treated effluent for industrial purposes in the catchment was also taken into account.

3.4 Revised Components:

Revisions were made to each component, but these did not constitute a major restructuring and were thus not submitted for Board approval.

Kunsan component: The turnkey contract was amended in December 1997 to include facilities for dioxin removal from effluent gases to comply with MOE's new, stricter regulations. Following the Bank's no-objection, the costs and construction period were amended accordingly.

Pusan component: The component was substantially revised due to a necessary change in the technological process. The rationale for the change was as follows. Janglim I had been treating a mixture of about 80% residential and 20% industrial wastewater. The treatment performance was satisfactory in all parameters until about 1995-96 when the content of nitrogen in wastewater increased when additional manufacturing plants were connected to the WTP through gradual expansion of interceptor sewers in the catchment. The treatment performance remained satisfactory with the exception of nitrogen removal. Subsequently, the technology for tertiary treatment, which was supposed to improve and guarantee the effluent quality in accordance with environmental requirements, was found inappropriate in view of the varying quality of incoming effluent within the span of a few years; further studies and designs were stopped.

Between 1997 and 1999, Pusan focused on the key problem of high nitrogen content, which was not removable to the required degree by conventional activated sludge technology. Following extensive pilot experiments, Pusan adopted a technology (modified five-stage Bardenpho method) developed by two Pusan universities. The advantage of that technology was that it required only changes in equipment but not in civil works. The new process is built into the sedimentation and aeration tanks constructed for the initial

conventional secondary treatment. Procurement variations related only to the equipment, additional dosing of nutrients and the chemical house. The pilot experiments proved the removal of nitrogen and phosphorus to acceptable levels and, considering the changed wastewater quality, the Bank had no-objection to the proposed modifications to the component. The modified technology was implemented in Janglim II, and its extension to Janglim I will be decided upon following tests of the performance of Janglim II and its impact on the receiving Nakdong Bay throughout the year.

Assessment of the Design and Components

Kunsan component: The selection and design of both components correctly addressed the key environmental, waste management and conservation objectives of the Government. The particular Kunsan locality chosen was appropriate because it was in the vicinity of a quickly developing major industrial estate likely to generate great quantities of environmentally very dangerous waste. The Kunsan Specified Waste Treatment Plant was to provide for final disposal of specified waste since it included both an incineration facility and a secured landfill. The component, however, included only the incineration plant through which an advanced specified waste treatment technology not then available in the country could be demonstrated.

Pusan component: For wastewater treatment, Janglim in Metropolitan Pusan was chosen. In Pusan the Bank had earlier supported construction of the Nambu wastewater treatment plant, one of four major treatment plants. Therefore the Bank was in a strong position to understand the technical and institutional sector issues in the city. The Janglim plant serves Pusan's old industrial area which has difficult-to-treat wastewater, and the plant discharges treated effluent in an environmentally sensitive area. Instead of the proposed initial alternative of conventional treatment with effluent discharge into the ocean through a piped outfall several kilometers long, the Bank supported tertiary treatment, which would comply with environmental requirements for discharge quality. This alternative also made it possible to reuse water in industrial plants in the area. This, in turn, reduced the amount of residual pollution discharged and at the same time demonstrated water conservation on a major scale.

In both cities, the implementing agencies had strong institutional capacity to carry out their respective component

3. 5 Quality at Entry:

The project quality at entry was **satisfactory.** The project objectives were consistent with the Government priorities and with the CAS. Appraisal was based on an advanced status of preparation. The designs and draft bidding documents for Kunsan were completed, and the designs for the Pusan wastewater treatment plant were advanced. The assessment of implementing agencies and their financial analyses was appropriate. The implementing agencies, the Environmental Management Corporation (EMC) for Kunsan and the Pusan Sewerage Division (PSD) for Pusan, carried out preparation studies and designs. A supporting firm of consultants was selected and financed by EMC and PSD from their own resources, thus signaling strong government commitment to the project. Bank reviews of studies resulted in selecting a lower capacity design for the incinerator over the alternatives considered in Kunsan, and in a decision favoring water conservation instead of discharging wastewater through a long sea outfall in Pusan.

The Bank's safeguard policies were taken into account satisfactorily. Both Kunsan and Pusan plants are on reclaimed land not previously occupied. The Kunsan plant was constructed on 10 ha of land reclaimed in 1988 by the Korea Land Development Corporation along the left bank of the Kum River and purchased by MOE in 199 1. It had never been used and its acquisition did not involve involuntary resettlement or

related compensation issues. The Pusan plant was constructed on 8 ha of land reclaimed in 1988 by the Korea Water Resources Corporation along the left bank of the Nakdong River and purchased by Pusan City in early 1995. Its only use was by a sawmill, which rented the plot for storage of wood logs. Its acquisition, therefore, did not involve involuntary resettlement or related compensation issues. The implementing agencies, EMC and Pusan, prepared their respective environmental impact assessments (EIA). These were approved by MOE, reviewed by the Bank, and summaries were made available to the Board in September 1994. Project preparation took about 12 months; negotiations were carried out in field following appraisal.

4. Achievement of Objective and Outputs

4.1 Outcome/achievement of objective:

Kunsan component: Under the 1993 National Comprehensive Waste Disposal Plan (hereafter refered to as the Plan), the roles of the government and private sector were placed in the context of a policy aimed at environmental protection by reducing the volume of waste, recycling and appropriate treatment. In the Plan the private sector was to play an important role in reducing the volume of waste and recycling, but was not expected to be involved in the treatment of specified waste. The Plan's strategy led the Government to take the initiative to establish integrated waste treatment plants in major industrial estates.

The Kunsan plant was the first integrated specific waste treatment plant designed to use the state-of-the-art technology to set standards for specified waste treatment plants and to serve as a training facility. The plant is a model facility, which demonstrates in practice the feasibility of higher quality treatment on one hand, supported by a series of respective regulations controlling the handling of specified waste on the other. During construction of the Kunsan plant, the Government made complementary reforms in sector policy and legislation. The February 1999 amendment to the Waste Disposal Act adopted: (a) a stronger specified waste tracking system; (b) increased penalties for illegal disposal; (c) penalties for both the waste generator and disposal agent for inadequate treatment; and (d) owner's liability for polluted land.

These stricter monitoring regulations succeeded in significantly reducing industrial waste generation, stimulating more demand for treatment of specified waste, and generating private sector interest in operating treatment facilities. This success is demonstrated by the fact that in the late 1990s, the number of secured landfills and incinerators for specified waste increased to 17 and 129 respectively, the majority being operated by private operators, as shown in following table.

Treatment Plants for Specified Waste

Facilities	Landfill		Incinerator	
	Number	Capacity (million m3)	Number	Capacity (tons/day)
Public	4	0.2	1	60
Private	13	1.0	128	2,273
Total	17	1.2	129	2,333

The Kunsan component fully achieved the project's and the Government's objectives in a satisfactory manner. The plant was the first integrated specific waste treatment plant using state-of-the-art technology to set standards. It is a model facility, which demonstrates in practice the feasibility of higher quality treatment. Although the desired highest performance of the Kunsan plant in all parameters is costlier than less sophisticated facilities, it has provided MOE with an important understanding of the relationship

between costs and environmental standards.

Pusan component: In 1994, the wastewater quantity flowing into the Janglim I WTP was already nearing its design capacity of 330,000m3/d. As the interceptor sewer program progressed and connected up more sections of the catchment area, flows were expected to increase to about 500,000m3/d by 2001. Extension of the plant was essential to avoid unacceptable overloading, which would have resulted in a deterioration of its treatment performance. That apparently standard technical and institutional task proved difficult from the start through implementation.

The first difficulty occurred during preparation. Following review of the EIA, MOE stated that the effluent quality being achieved by the activated sludge treatment technology used in Janglim I and II was not acceptable for discharge into an ecologically sensitive area such as the Nakdong Bay, so MOE requested that the effluent be diverted outside the Bay by a long sea outfall. In the pursuing discussions, Pusan agreed to implement adequate treatment to comply with environmental regulations and proposed tertiary treatment to raise the effluent to the quality required for discharge into the Bay. The Bank supported that decision since the proposed additional treatment would allow for future water reuse and water conservation; the Bank subsequently appraised that component.

During the early stages of Janglim II construction, a second more serious problem arose. In 1995-96 it became clear that the industries newly connected to the WTP through the expanded interceptor system substantially changed the raw wastewater quality, which could not be treated by the proposed combination of secondary and tertiary treatment. With this finding Pusan stopped all works on tertiary treatment and started studies on a suitable treatment technology for the new wastewater quality. Several studies by consulting firms and research institutes failed to find a solution. Only in early 1999 did two Pusan universities propose and demonstrate in a pilot experiment a treatment process with satisfactory results. On the basis of this study, Pusan decided to replace the initially designed activated sludge process now unsuitable for the new wastewater quality arriving in Janglim WTP. The Bank expressed its no-objection to that decision.

The third issue arose with implementation of the agreed tertiary treatment. The modified process only replaced the secondary treatment. The treatment performance of the process would comply with the country's strict regulations for good quality rivers; however, to be accepted into the especially sensitive Nakdong Bay, the effluent still required additional improvement through some type of follow-up polishing. Considering the circumstances, Pusan decided to implement the modified process in Janglim II, then evaluate the treatment performance and impact on the Nakdong Bay. Subject to satisfactory results, it intended to carry on with similar modifications to Janglim I. In parallel or following completion of Janglim I, it would implement the facilities necessary to polish the effluent to comply with MOE requirements. The Bank reviewed the status and agreed to close the project following the completion of Janglim II construction.

A further issue which ran in parallel with implementation of Janglim II involved the sludge from the WTP. At appraisal it was agreed that upon completion of the project, the sea disposal of digested and de-watered sludge generated in Janglim I would be discontinued and that the sludge generated in both Janglim I and II would be disposed of in a sanitary landfill. PSD negotiations with sanitary landfill management to accept treatment plant sludge were negative, and PSD proposed to the City to construct an incinerator for intermediate disposal of sludge at Janglim. The Bank was willing to consider financing the construction of the incinerator within the component. Finally, due to financial constraints, the City decided to continue sea disposal for several years more, and the amount of loan reserved for that was cancelled.

Tests carried out on the completed Janglim II have shown that the effluent from the plant has consistently achieved or surpassed design parameters except for nitrogen, which it failed to reduce to the required level. The reasons are not clear but a preliminary assessment indicates high nitrogen content in the raw wastewater and possibly non-compliance with the process technology. PSD is now carrying out a detailed examination of nitrogen sources and a review of technology with the aim of achieving design parameters for removal of nitrogen.

This component achieved its objectives only partially. Through physical implementation of the treatment plant it supported the Government in addressing environmental, institutional and technological concerns regarding treatment of industrial wastewater. However, unexpected changes in wastewater quality during construction, in combination with new, extremely strict environmental regulations for the treated effluent scuttled the initial project concept. The originally designed combination of conventional secondary treatment with tertiary stage was rendered an unsuitable treatment technology and had to be abandoned together with its potential reuse of treated effluent. Technological modifications of the treatment process, which should respond to the raw water quality change, were identified and implemented, though after a long period of indecision by Pusan authorities. Currently, the residential and industrial wastewater generated in the Janglim catchment is treated before its discharge into the Nakdong Bay, which represents a considerable environmental improvement. However, additional polishing of effluent is required to comply with current MOE regulations, particularly with regard to nitrogen content.

4.2 Outputs by components:

Kunsan component: The Kunsan component was implemented under a turnkey contract which included the incinerator and associated equipment with a capacity of 60 t/d of specified waste. It included the plant design, construction, commissioning and management support during the early operational stages. The contract was awarded in December 1995 and the facility was ready for testing by August 1998. Commissioning of the plant was delayed to October 1998 because of a shortage of suitable specified waste (with a higher content of hydrocarbons). The one-year management support started from September 1999. The contract was modified during construction in December 1997 to include facilities for dioxin removal from effluent gases. The contract construction period of two years was extended by eight months, accordingly. The construction of structures, installation of equipment, construction supervision by EMC, and land acquisition proceeded as scheduled without disruptions or problems, with only minor delays in testing operations of the completed plant. The workmanship is of a very good standard. Special care and attention were given to environmental requirements such as effluent gases, dust, noise, and disposal of ashes. EMC has regularly carried out operational monitoring of compliance with EIA during construction and after the start of operations, and results were included in the semi-annual progress reports. In addition, the local government and MOE's regional office carry out separate independent environmental monitoring of the plant. Six months after completion, EMC submitted a report, which summarizes and evaluates data collected during the one-year environmental monitoring program, which began six months prior to the start of operations. The report shows that the plant performs satisfactorily and complies with environmental regulations.

Financially, Kunsan has been in a deficit situation from the start of operations as a consequence of the tariff levels set up for the sector by MOE. The tariffs reflect general costs of facilities in the country but are not adapted to the highly sophisticated and costly plant in Kunsan. The current private operator indicates that it will reduce the deficit with improved efficiency but would not be able to generate revenues to pay MOE for the full depreciation until the controlled tariffs for specified waste disposal are liberalized.

The Kunsan component fully achieved its physical output objectives. The construction of structures,

installation of equipment, construction supervision by EMC, and land acquisition proceeded as scheduled without any disruption or problems. The contractor's training has educated the national staff in the technical and management aspects of the Kunsan plant. Smooth operations have successfully demonstrated the performance of the plant. Incineration of specified waste generated in Chunbuk province is carried out in a strictly controlled way, which eliminates health hazards caused by air contamination The plant secured landfill is equipped with sophisticated treatment for its leachate and with safety protection against soil and groundwater contamination.

Pusan component: The construction of Janglim I, as well as the interceptor sewers and associated pumping stations, was divided into several contracts. The civil works contract was awarded in May 1996, the electrical contract in December 1997, two civil works contracts for interceptor sewers in February 1998, the equipment contract in March 1998 and the contract for landscaping in November 2000. The construction supervision contract was awarded in July 1996. On the basis of the amended designs, Pusan negotiated changes in civil works, electrical and equipment supply and installation, respective costs and schedules and concluded all variation orders in March 2000. The structural and mechanical modifications involved grit chambers, primary settling tanks, aeration tanks, technological equipment, instrumentation, and construction of a chemical building. The construction workmanship is of a very good standard, and special care and attention were given to training operational staff.

Pusan regularly carries out operational monitoring of compliance with EIA during construction, and the results have been included in semi-annual progress reports. Also the Pusan metropolitan government and separately, the MOE regional office, carry out independent environmental monitoring of the plant. Six months after completing the plant, Pusan submitted a report, which summarizes and evaluates data collected during a one-year environmental monitoring program, which began six months prior to the start of operations. The report shows satisfactory compliance with environmental regulations and satisfactory plant performance except for nitrogen reduction. The report also indicates that the wastewater quantity reaching Janglim I and II is about 100,000m3/d lower than the 500,000m3/d projected in the sewerage master plan. The reasons for this drop of wastewater quantity are not clearly documented, but preliminary assessments indicate that both the population and industrial wastewater levels are lower than projected. (Wastewater levels are not specified by sector.)

Pusan component has achieved its output objectives only partly. The plant's three months of test operations, which started in September 2001, confirmed the plant's design capacity and performance parameters except for nitrogen reduction. Tertiary treatment and reuse of treated effluent could not materialize due to the changes in wastewater quality during the Janglim II construction. The management of digested and de-watered sludge has also not achieved the proposed targets. The financial status of PSD during construction was satisfactory.

4.3 Net Present Value/Economic rate of return:

The economic rate of return was not calculated at appraisal for the following two reasons. First, detailed information regarding the various impacts of the pre-project pollution levels on water quality on users, including potential damage caused by inappropriate disposal of specific waste, was not readily available and generation of such data was considered impractical. Second, the methodologies available for estimating the economic benefits, which would result from protecting or improving the quality of environment, had many limitations. However, the project facilities clearly contribute to sustained environmental development, provide consumers and industries with better service in disposing of waste, and contribute to general improvements in the health and welfare of the population.

Kunsan component: The key benefit is the safe disposal of the most hazardous waste, which would have a serious adverse impact on the environment and would endanger the population's health if disposed of in uncontrolled manner or if waste were scattered around the countryside. The Government implemented the Kunsan component within its 1993 National Waste Disposal Plan as the first integrated specific waste treatment plant. In accordance with the Plan's goals, Kunsan uses state-of-the-art technology to set standards for specified waste treatment plants and to serve as a training facility. Accordingly, the design, location and chosen technology represented the least-cost solution for the task.

Pusan component: For Pusan, the qualitative project benefits identified at appraisal included reducing health risks for commercial fishing, water sports and recreation from contact with polluted water, improving air quality by eliminating unpleasant odors, improving the city's overall environment, and protecting beaches important for tourism. These all proved valid. Benefits from water reuse were not realized. The revised design of the treatment plant reflects a least-cost approach to achieve the objective of nutrient removal, which has become critical for the protection of the seaweed farms and natural bird habitats in the estuary of the Nakdong River.

4.4 Financial rate of return:

Kunsan component: The financial assessment of the entire Specified Waste Treatment Plant follows the assessment at appraisal. It concludes that from October 1998 through April 200 1, the Kunsan account has not been able to achieve the agreed financial targets, which were set to produce sufficient revenue to cover the sum of its total operating expenses. These include (a) direct operation and maintenance costs and depreciation; and (b) indirect expenses contributed towards the operator's (EMC) headquarters costs. In April 2001, operations were stopped to allow time for the bidding process that changed the operator from EMC to a private company. While in earlier years MOE reported losses, for 2002 and 2003 with operations contracted to the private operator, MOE expects to receive rental payments of approximately Won 900 million and 1,030 million. These payments, however, are not able to cover the annual depreciation of the landfill and incinerator, estimated at Won 2,2 12 million. An FRR was not calculated at appraisal and is not, therefore, calculated for the ICR. Though MOE made efforts to achieve a better financial performance through the management contract with the private operator, it was not able to achieve the original financial objectives, partly because waste tariffs have not been adjusted to reflect costs. MOE is now in the process of drafting new national waste tariff guidelines, which would give treatment plants more flexibility in determining the tariff levels they charge.

Pusan component: PSD maintained its Sewerage Special Account (SSA) in good financial position throughout the project. Sewerage tariff levels were adjusted to ensure sufficient revenues are generated to cover operating costs and depreciation, and provide funds towards its capital expenditure program. The average tariff has been increased from Won 79/m3 in 1993 to Won 256/m3 in 2001. Contributions of internally generated funds to investment remained consistently above the 25% target as specified in the financial covenant. The completion of the Janglim II and the new WTP in Noksan resulted in a significant increase in operating expenses in 200 1. The average operational cost of Janglim II is around Won 120/m3 during six months of operations, compared to around Won 55/m3 for Janglim I. This is largely attributable to the increased cost of chemicals used and the sludge removal associated with the process for nutrient removal, but also to the continuous testing of the new plant. In order to maintain its financial position, the city raised its wastewater tariff in 2001, by an average of 3 1%. As a result, the financial positions of the SSA not only remained healthy but actually improved in 2001. The FRR for the Pusan component is calculated at 7.4%. Key assumptions of the calculation include: (a) tariff increases attributed to the project, (b) Janglim to reach its treatment capacity by 2020 (instead of 2010 as expected during appraisal)

and sewerage flow will be distributed evenly between the phases before that. The FRR is quite robust. For example, even if actual sewerage treatment in Janglim remains at 2001 level with no increase, the FRR will still be at 6.8%.

4.5 Institutional development impact:

Institutional development was not among the project's prime objectives. Both of the project's implementing and operating institutions had been in existence for some time, had experienced staff, and had established acceptable management and financial procedures. At the time of appraisal, Bank staff considered important and included in the project only training of staff involved in the management and operation of newly provided facilities. While during preparation attempts were made by Bank staff to discuss the involvement of the private sector with MOE and Pusan City, private sector participation was found premature in Korea at that time. The current Government policies, however, encourage private sector participation in both the development and operation of public services facilities. Accordingly, MOE contracted operations of the Kunsan plant to a private operator. Pusan decided to reduce its direct involvement in operations of facilities, and for that purpose, created a municipal enterprise, the Pusan Environmental Installation Corporation (PEIC), responsible for operations and maintenance of the city's wastewater treatment plants. (More on PEIC is provided below.)

Kunsan component: In 2000 MOE studied the status of specified waste facilities in the country and concluded that the legal framework governing the generation, transport and disposal of specified waste had had a decisive, positive impact on the protection of the environment. It also found that the private operators of specified waste facilities had gained experience and could provide acceptable guarantees for controlled transport and disposal of specified waste. With those findings, MOE decided to terminate the management contract with EMC and off-load its four treatment plants, (Hwasung, Onsan, Kwangyang and Kunsan), to interested private companies. There were no bidders for the purchase of the plants in the first round. A new round of bidding was, therefore, opened for their management. In this second round, two bidders were pre-qualified and the contract was awarded in June 2001 to a joint venture of two companies, one being the resident and providing environmental service in Kunsan town while the partner is experienced in managing residential waste incinerators in Korea. During the take-over period, the operator tested the Kunsan incinerator functions for about two months. At the same time, specialized laboratories confirmed its environmental performance as satisfactory. Normal operations started in May 2002, after some technological parts were replaced. To ensure that the technological process is followed, MOE has arranged for the presence of EMC staff trained by the incinerator contractor to, in turn, train the private operator to manage the equipment during the early stages of the new operations.

Pusan component: There were two reasons leading to the creation of the Pusan Environmental Installation Corporation (PEIC): the city's need to reduce municipality staff on one hand, and the need for uninterrupted availability of specially trained operational staff at treatment facilities on the other. The latter could not be achieved with municipal terms of employment under which periodic movement between departments is required. For these very reasons, Pusan had already created other municipal corporations, such as a health corporation (hospitals), a land and housing corporation (municipal housing), and a facilities corporation (street cleaning, parks). Following that pattern, the Mayor established the PEIC by decree in January 2000. The responsibilities for managing the wastewater treatment plants and associated interceptor sewers, nightsoil treatment plant, and solid waste incinerator were transferred to PEIC from Pusan's Environmental Bureau. PEIC operates under a budget approved by Pusan (Won 34.5 billion in 2001 and Won 42.7 billion in 2002) and financed from wastewater and solid waste revenues. Its current staff of about 350 manages four municipal wastewater treatment plants with a total capacity of

1,700,000m3/d, a nightsoil treatment plant (3,500m3/d), a solid waste incinerator (200t/d), and 250km of interceptor sewers. The Environmental Bureau and its Sewerage and Waste Divisions remain responsible for maintaining secondary sewers (through 16 district offices), collecting solid waste (through contractors), operating sanitary landfills, implementing sector development projects, and collecting sewerage and solid waste revenues.

Although capacity building was not a major project objective, in view of the strong institutional capacity demonstrated by the implementing agencies of each component, the rating given is **substantial.**

5. Major Factors Affecting Implementation and Outcome

5. I Factors outside the control of government or implementing agency.

Since the completion of the Kunsan plant in August 1998, the plant has been operated only sporadically because of shortages of specified waste resulting from reductions due to the recent **Asia economic crisis and reduced industrial production** in the Kunsan Industrial Complex. For example, the Daewoo Automobile Plant, located in the Industrial Complex has been closed since 1998. During 1998 and early 1999, local civic groups resisted the importation of specified waste from other provinces. Subsequently, the plant incurred substantial financial losses from the start of its operations until its transfer to a private operator in November 200 1.

Local civil resistance caused a series of delays during preparation and especially operations. Total stoppages of plant operations are estimated at over two years. The Kunsan Resident Support Committee (KRSC), representing the collective management of 16 smaller NGOs was involved in the project since the early planning stages, through early review of the environmental impact assessment and later the construction phase. While the discussions may have delayed construction, major difficulties arose at the start of EMC operations when the KRSC opposed the importation of specified waste from other provinces. Finally after lengthy discussions, the KRSC agreed to the importation, subject to receiving substantial payments related to the volume of the imports. The situation was repeated after MOE concluded a contract with a private operator. In August 2001 the KRSC succeeded in obtaining a court order for MOE to stop plant operations. Following the court settlement, the MOE/operator agreed to regular payments related to the volume of waste, periodic monitoring of the plant's performance by KRSC's experts, and permanent presence of a KRSC representative in the plant to verify operations. The estimated US$2.0 million collected by KRSC so far in connection with Kunsan specified waste plant has reportedly been used mainly for administrative expenses of area NGOs and scholarships of Kunsan students.

5.2 Factors generally subject to government control.

In 1997, shortly before completing the plant, **MOE issued stricter environmental regulations** concerning the dioxin levels permitted in incinerator exhaust gas. That necessitated a halt in on-going construction, redesign of respective equipment, modification of the contract, manufacturing and installation of new equipment. The process resulted in increased costs (US$4.0 million) and a lo-month delay in completion of plant (October 1998 instead of December 1997). MOE's decision to privatize management of the specified waste facilities reduced the Government's financial losses while maintaining acceptable standards of service. Further improvements may follow after the specified waste tariffs are liberalized.

5.3 Factors generally subject to implementing agency control:

In the early 1990's Pusan started numerous major in frastructure projects in transportation, water supply, sewerage, solid waste and other sectors. The capital requirements exceeded the amounts planned, and in

1995 **Pusan City experienced serious budgetary constraints.** It realized that it would be difficult to support Janglim construction as agreed in the appraised financial projections. Upon lengthy review, Pusan finally decided to carry on with the construction of Janglim II but with a *more protracted implementation schedule.* The review also contributed to delays in declaring Loan effectiveness. (While the Loan Agreement was signed in March 1995, Pusan ratified the Project Agreement only in October 1995, making the project effective about four months later than planned.) And, in accordance with the City's decision, the start of construction of the Janglim WTP was delayed. Instead of starting in January 1995, the first civil works contract was awarded in May 1996, 17 months later than planned.

Another major factor affecting implementation was the **unexpected change in wastewater quality** arriving in Janglim I after starting construction of Janglim II, as a result of expansion of interceptor sewers in the catchment and connection of additional industries. The planning studies, the sewerage master plan for Pusan and the feasibility study of Janglim II had projected growth of industrial wastewater, but with regard to quality the projections assumed greater dilution after mixing with residential wastewater. The feasibility study also assumed that the municipality-forced transfer of most polluting industries from Janglim to the new specialized industrial estate at Noksan, west of the Nakdong River, would have a positive impact on wastewater quality in the Janglim catchment. Further, the feasibility study assumed that industrial discharges would comply with quality standards of effluent accepted in public sewers. *Almost none of these assumptions proved correct.* The mixing with residential wastewater has had a lower effect than expected since population growth was slower than projected. Only a few industrial plants were relocated to Noksan estate with little effect on wastewater quality in the Janglim catchment. And finally, the manufacturers did not comply with regulations for public sewers. In case of nitrogen for example, the discharged concentrations are many times higher than allowed by the standards. Control and enforcement of the regulations are the responsibility of the MOE office and laboratory in Pusan, which has been informed about the status by the Janglim WTP manager.

5.4 Costs and financing:

Kunsan component: The actual estimated cost is Won 29.9 billion (US$28.8 million). Expressed in Won the actual estimate is 22% higher and in US dollars, 6% lower than the appraisal estimate of Won 24.5 billion (US$30.6 million) due to exchange rate variations. The increase in Won is mainly due to the contract variation for controlling dioxin in exhaust gas. The Bank loan of $12.2 million financed about 50% of equipment foreign costs. The Government contribution of $16.6 million financed civil works, the remaining equipment, supervision, land acquisition, and other administrative costs. It also financed about US$1.55 in interest during construction. Expressed in US dollars, the actual loan amount was 18% lower and the Government contribution 6% higher than estimated at appraisal.

Pusan component: The actual estimated cost is Won 174.8 billion (US$218.5 million). In both Won and US dollars, the actual estimate is about 10% lower than the appraisal estimate of Won 194.1 billion (US$242.6 million). The Bank loan of $41.3 million financed 98% of equipment costs. Pusan's contribution of US$ 177.2 million equivalent financed civil works, supervision, land acquisition, and other administrative costs. In addition, Pusan financed interest during construction of US$3.82 million in respect of the Bank loan and another US$9.57 million in respect of the Environmental Fund. Expressed in US dollars, the actual loan amount and the Government contribution were 3 1% and 2 1% lower than estimated at appraisal.

Comparison of actual and appraisal estimate slightly distorts the different scopes of work proposed versus work actually constructed. The actual estimate includes only the construction of Janglim II while the appraisal estimate includes tertiary treatment for Janglim I and II. On the other hand, the appraisal includes

a cost estimate for 4.5km of interceptor sewers while about 5.2 km were actually constructed.

The final closing date was extended for a total of 18 months for reasons discussed in the achievements section and section 5.3.

6. Sustainability

6.1 Rationale for sustainability rating:

The project components are likely to be sustainable. All physical assets are completed, successfully tested and are operational. Clear institutional responsibility and financial viability of the operating agencies and the technical and professional knowledge of the private operator in Kunsan and PEIC in Pusan will ensure high operational standards and eminent performance of facilities provided by the project. The Government's commitment to better environmental protection combined with public interests and controls confirm the high probability of the project's sustainability.

Kunsan component: Improvements in Korea's economy and accelerating industrial activity have begun to increase the amount of specified waste for disposal. A considerable quantity of specified waste disposed earlier in an uncontrolled manner is now directed to specified waste plants as a result of a February 1999 amendment to the Waste Disposal Act and accompanying strengthening of enforcement capacity. These new conditions create a steady demand, and thus steady business, for the disposal of specified waste, making it possible for private operators to enter into the sector and to maintain the sustainability of the Kunsan component.

Pusan component: Established regular environmental monitoring in the Nakdong Estuary, supported by steady pressure from independent citizen groups, in combination with a permanent flow of wastewater in the plant provide adequate incentives for keeping the plant in a good state of repair and maintaining a high performance. PEIC, the operating agency, manages three major and a number of smaller wastewater treatment plants including associated interceptor sewers and pumping stations. Expansion of the Janglim plant represents only 11% of total treatment capacity in the city, and is easily absorbed within the wastewater management organization. The positive sewerage tariff policy supports financial viability of PEIC and contributes to the likelihood of the component's sustainability.

6.2 Transition arrangement to regular operations.

The staff involved in managing and operating the facilities were trained during the test operations of completed works. In the case of Kunsan, the contractor provided operational support for one year of operations, even when the operations were irregular due to a lack of specified waste and its unfavorable (non-calorific) composition. In the case of Pusan the test operations with intensive training of staff under various flows and quantity conditions were carried out for three months.

7. Bank and Borrower Performance

Bank

7.1 Lending.

Bank **identification** of the project was satisfactory. The CAS and graduation plan for Korea had identified the urban environment, specifically waste disposal, as an area where the Bank's expertise would be desirable, and the project was ably targeted toward that sector. The design of the Kunsan and Pusan components correctly reflected the Bank's dialogue with the Government on sector policy. The design was not overly complex, especially given the strong capacity of the implementing agencies.

The Bank's performance in **preparation** was satisfactory. The Bank provided professional guidance to the implementing agencies. The implementing agencies assisted by consultants they selected and financed carried out preparation studies and designs. Bank reviews of studies resulted in selecting a lower capacity for incinerator from the one considered as an alternative in Kunsan and in a decision for water conservation instead of discharging wastewater through a long sea outfall in Pusan. The Bank gave sound guidance on the production of the environmental assessments and reviewed them for compliance with safeguard policy. They were also reviewed and approved by MOE, and summaries were made available to the Board before appraisal.

The Bank's **appraisal** was comprehensive, extensively addressing all aspects of the components which were all in an advanced stage of preparation with the exception of Pusan tertiary treatment documented only in preliminary outline. The Bank's appraisal mission was necessarily heavily staffed with technical specialists: two sanitary engineers, a municipal engineer, an incineration specialist, an environmental specialist, and a financial analyst. The appraisal correctly assessed the strong commitment of the Government and implementing agencies, including the regulatory environment, incentives to sustain the project, and allocation of staff and resources for implementation. No significant risks were expected during the project execution. The Bank's safeguard policies were appropriately taken into consideration, including setting of detailed monitoring systems for controls of physical performance, financial viability of agencies, and environment protection actions. Lessons from previous Bank lending in the sector and in Korea were taken into consideration. For example, the Annual Review on Evaluation Reviews, OED August 1992, states that, ". ..well defined objectives, with regard to project targets and commitment of responsible agencies, contributed to the success." Based on this lesson the proposed project's objectives focused on key physical and institutional goals and the project team ensured firm support from implementing agencies. Project processing was relatively rapid, extending over a 12 month period, including negotiations in the field following appraisal.

7.2 Supervision:

Bank performance during **supervision** was satisfactory. Supervision missions were appropriately spaced during the project's life although a few more in 1997-1998 might have been beneficial. The missions were adequately focused and provided sound professional guidance to the implementing agencies. One team member, a procurement-accredited sanitary engineer, worked closely on the project from preparation through completion, lending much needed consistency for both the Bank and especially the Borrower, in the face of numerous task manager changes. The Bank's supervision missions reviewed the Borrower's progress reports in great detail, held discussions with the implementing agencies and followed up appropriately in action letters. Mission reporting in project status reports was adequately detailed and gave realistic performance ratings. Proposed revisions of components (dioxin facility in Kunsan and treatment process in Pusan) were extensively reviewed and discussed with the proposing agencies prior to providing no objections. There were no deviations from Bank policies or procedures during implementation. Procurement revisions of both Kunsan and Pusan were complicated and took much longer than would be normally expected. In Kunsan the procurement involved two-stage bidding for turn-key construction of specialized incinerator and in Pusan the lowest evaluated bidder for treatment plant equipment belonged to the same holding company as the consulting firm, which prepared feasibility study and preliminary designs. In the first case the implementing agency has had no experience with two-stage bidding resulting in some misunderstanding of regulations, which required clarifications before the Bank issued its no objection to the recommended bidder. In the second case, after long discussions, Pusan finally accepted the Bank's rules and selected the second lowest evaluated bidder

7.3 Overall Bank performance:

Overall, the Bank performance during preparation and implementation contributed to completion of a generally successful project within the projected costs, within an extended schedule. In sumrnary its performance is rated satisfactory.

Borrower

7.4 Prepara tion

The borrower's performance during preparation was satisfactory. With intensive Government support and consultant assistance the implementing agencies prepared the project for appraisal within 12 months of identification. Technical reports and proposals were of high professional quality and design parameters were acceptable. Except for Pusan tertiary treatment alternative, which was decided shortly before appraisal, all components were in an advanced state of preparation and were of very good quality. The implementing agencies were fully committed to the project and allocated adequate staff and resources to project formulation and preparation.

7.5 Government implementation performance:

Government performance throughout implementation was satisfactory. It provided general guidance and assistance in the areas of financing, environment and procurement. Commitments and agreements reached on various aspects of the project during preparation were respected and the Bank's regulations and procedures were fully complied with. The Government ministries also helped coordinate the implementing agencies with Bank supervision missions.

7.6 Implementing Agency:

The performance of both implementing agencies was satisfactory. Both agencies successfully supervised and implemented their components within the agreed costs, performance parameters and a slightly extended timeframe. They also complied with the conditions stipulated in the Loan Agreement with some exception, essentially beyond the control of the agencies (Kunsan financial performance resulting from factors beyond EMC control, and Pusan's complex issues of change in wastewater quality, tertiary treatment and reuse of treated effluent). Semi-annual progress reports and annual audit reports were submitted to the Bank in the required time and were of high quality. The Borrower's contributions to the Implementation Completion Report were submitted to the Bank on time as required.

7.7 Overall Borrower performance:

Overall, the Borrower's performance was satisfactory. From the start of preparation through physical completion of the facilities the Government and the implementing agencies demonstrated high commitment to the objectives of the project, and while stressing project ownership, they fully respected Bank policies and requirements.

8. Lessons Learned

The main lessons learned from the design and implementation of the project are the following.

a) **Protection of the environment is expensive** as documented in both Kunsan and Pusan. To avoid excessive costs, the technical alternatives and their impacts should be thoroughly evaluated and discussed by both the environment protection agent and the initiating investor in order to find the least-cost solution for the society, and not just a solution capable of meeting maximum environmental requirements.

b) **Private operators of environmental facilities are, contrary to popular belief, less likely to be exposed to pressures from various local civic groups than the Government.** Currently, in Korea there are about 130 incinerators for specified waste, but only Kunsan is owned by the Government. Thus far, only Kunsan has been exposed to systematic demands from local civic groups for various payments, with arguments pertaining to the protection of public health. This is likely because the Government is much more sensitive to negative exposure in the press or at staged meetings than are private operators.

c) The expansion of interceptor sewers in Pusan was guided by environmental considerations, requiring all generators of wastewater to be connected to the sewerage network. The legal-commercial aspects of the sewerage service, requiring a contract between the service provider and the beneficiary, including permission for the quantity and the quality of wastewater, was not pursued. **This contractual relationship should be pursued to enable more efficient and better quality treatment.**

d) **A municipal land use policy and urban planning blueprint should be completed and available prior to designing any wastewater treatment plant.** This principle is all the more important for mixed residential and industrial areas, and should include enforcement of zoning and environmental regulations concerning the use and discharge of wastewater. Future feasibility studies of wastewater systems should include a detailed assessment of land use plans and enforcement of respective regulations.

9. Partner Comments

(a) Borrower/implementing agency:

The following email was received from the Government of Korea on June 24, 2002:

"Dear Ming Zhang

Thank you for your cooperation and the Bank's contribution to successful completion of the project(IBRD 3830-KO)

I inform you that we have no further comments on the draft ICR.

Meanwhile, In spite of completion of the project and no plan to withdraw undisbursed loan amount($5,531,791.02), the undisbursed loan proceeds have not cancelled yet.(Please find the attached file) Would you let me know how the undisbursed loan amounts will be proceeded or settled?

I am looking forward to hearing from you soon. Thank you in advance for your cooperation.

Best Regards
Lee"

(b) Cofinanciers:

N/A

(c) Other partners (NGOs/private sector):

N/A

10. Additional Information

Annex 1. Key Performance Indicators/Log Frame Matrix

Outcome / Impact Indicators:

Indicator/Matrix	Projected in last PSR[1]	Actual/Latest Estimate
KUNSAN COMPONENT		
Disposal of specified waste generated in Chunbuk province and elsewhere through incineration in Kunsan.	The incinerator disposes 60 t/d of specified waste	The incinerator disposes 60-90 t/d of specified waste from Chunbuk province and elsewhere
The Kunsan plant* revenues covers operating and indirect expenses and depreciation	The Kunsan plant revenues to cover operation and indirect expenses and depreciation	In 1998-2001 MOE incurred losses about W 9.3 billion In 2002-03 MOE expects from private operator rental payments of W 1,930 mill. Since this payment does not cover depreciation of the plant of W 2,212 million MOE will incur further losses.
Training of incineration management and operational staff	Incineration plant management and operation staff fully trained	The contractor provided training of EMC staff in operation of incinerator EMC trained staff transfered its skills to the current private operator
PUSAN COMPONENT		
Reduction of organic pollution expressed as biochemical oxygen demand (BOD) and of suspended solids (SS) in Nakdong River Estuary	Janglim plant (I+II=615,000m3/d) removes pollution equivalent to BOD=60 t/d and SS=109 t/d from wastewater	Janglim I (330,000m3/d) not yet modified. Janglim II capacity (285,000m3/d) would remove pollution equivalent to BOD=40t/d and SS=67t/d from wastewater
Pusan sewerage revenues contribution to capital expenditures	Contribution from revenues to capital expenditures not less than 25%	Actual contribution varied from 31 00% to 59 60% between 1995 through 2001
Reuse of Janglim treatment plant effluent in industries as cooling, washing, and technological water	Reuse of treated effluent reaches about 10% of Janglim I and II combined capacity	Changed wastewater quality cannot be treated by combination of secondary- tertiary technology as proposed. Suitable modified treatment process replaced the initial tertiary treatment only in Janglim II Further polishing of effluent can proceed only when the process is constructed in Janglim I.

Output Indicators:

Indicator/Matrix	Projected in last PSR'	Actual/Latest Estimate
KUNSAN COMPONENT		
Incinerator for specified waste is constructed in Kunsan	Incinerator for specified waste with capacity of 60 t/day is constructed in Kunsan	Incinerator with capacity of 60 t/d of specified waste is completed and in operation by private operator company in Kunsan
PUSAN COMPONENT		
Janglim II wastewater treatment plant is constructed in Pusan	Construction of Janglim II wastewater treatment plant with capacity of 285,000 m3/d	Janglim II plant with capacity of 285,000 m3/d is completed and in operation
Tertiary treatment of Janglim wastewater treatment plant is constructed in Pusan	Construction of tertiary treatment for Janglim I and II combined capacity of 615,000 m3/d	Construction of tertiary treatment has been postponed and its technology will be determined after the Janglim I impact on environment is evaluated

End of project

Annex 2. Project Costs and Financing

Project Cost by Component (in USS million equivalent)

Project Cost By Component	Appraisal Estimate US$ million	Actual/Latest Estimate US$ million	Percentage of Appraisal
Treatment Plant	153.73	210.53	137
Tertiary Treatment	55.92	0.00	0
Project Support	4.82	11.15	231
Land Acquisition & Compensation	24.5 1	25.61	104
Total Baseline Cost	238.98	247.29	
Physical Contingencies	10.72		
Price Contingencies	23.55		
Total Project Costs	273.25	247.29	
Interest during construction	31.85	5.37	17.00
Total Financing Required	305.10	252.66	

Project Costs by Procurement Arrangements (Appraisal Estimate) (US$ million equivalent)

Expenditure Category	Procurement Method[1] ICB	NCB	Other[2]	N.B.F.	Total Cost
1. Works	2.50	0.00	0.00	134.61	137.11
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
2. **Goods**	102.33	3.00	0.00	0.00	105.33
	(73.00)	(2.00)	(0.00)	(0.00)	(75.00)
3. **Services**	0.00	0.00	0.00	5.69	5.69
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
4. Land Acquisition	0.00	0.00	0.00	25.13	25.13
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
5. Miscellaneous	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
6. Miscellaneous	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total	104.83	3.00	0.00	165.43	273.26
	(73.00)	(2.00)	(0.00)	(0.00)	(75.00)

Project Costs by Procurement Arrangements (Actual/Latest Estimate) (US$ million equivalent)

Expenditure Category	Procurement Method[1] ICB	NCB	Other[2]	N.B.F.	Total Cost
1. Works		0.00	0.00	139.30	139.30
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
2. Goods	64.51	0.00	0.00	1.71	66.22
	(53.48)	(0.00)	(0.00)	(0.00)	(53.48)
3. Services	0.00	0.00	0.00	17.15	17.15

	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
4. Land Acquisition	**0.00** (0.00)	**0.00** (0.00)	**0.00** (0.00)	**24.61** (0.00)	**24.61** (0.00)
5. Miscellaneous	**0.00** **(0.00)**	**0.00** **(0.00)**	**0.00** **(0.00)**	**0.00** **(0.00)**	**0.00** **(0.00)**
6. Miscellaneous	**0.00** **(0.00)**	**0.00** **(0.00)**	**0.00** **(0.00)**	**0.00** **(0.00)**	**0.00** **(0.00)**
Total	**64.51** **(53.48)**	0.00 (0.00)	0.00 (0.00)	**182.77** (0.00)	**247.28** **(53.48)**

[1/] Figures in parenthesis are the amounts to be financed by the Bank Loan. All costs include contingencies.

[2/] Includes civil works and goods to be procured through national shopping, consulting services, services of contracted staff of the project management office, training, technical assistance services, and incremental operating costs related to (i) managing the project, and (ii) re-lending project funds to local government units.

Project Financing by Component (in US$ million equivalent)

Component	Appraisal Estimate			Actual/Latest Estimate			Percentage of Appraisal		
	Bank	Govt.	CoF.	Bank	Govt.	CoF.	Bank	Govt.	CoF.
Kunsan	15.00	16.18		12.21	18.17		81.4	112.3	
Pusan	60.00	213.92		41.27	190.58		68.8	89.1	

The above costs include interest during construction and a loan from the Environmental Fund.

Annex 3. Economic Costs and Benefits

No ERR was calculated at appraisal for reasons given in section 4.3.

Annex 4. Bank Inputs

(a) Missions:

Stage of Project Cycle	No. of Persons and Specialty (e.g. 2 Economists, 1 FMS, etc.)		Performance Rating	
Month/Year	Count	Specialty	Implementation Progress	Development Objective
Appraisal/Negotiation				
Appraisal: October 1994	6	2 Sanitary Engineers, 1 Municipal Engineer, 1 Incineration Specialist, 1 Environmental Specialist, 1 Financial Analyst		
Supervision				
May 1996	3	2 Sanitary Engineers, 1 Financial Analyst	S	S
May 1997	2	1 Sanitary Engineer, 1 Financial Analyst	S	S
May 1998	4	1 Municipal Engineer, 1 Financial Analyst, 2 Environmental Specialists	S	S
January 1999	3	1 Financial Analyst, 1 Environmental Specialist, 1 Sanitary Engineer	S	S
August 1999	3	1 Financial Analyst, 1 Economist, 1 Sanitary Engineer	S	S
October 2000	2	1 Economist, 1 Environmental Specialist	S	S
April 2001	2	1 Sanitary Engineer, 1 Environmental Specialist	S	S
October 2001	2	1 Economist, 1 Environmental Specialist	S	S
ICR				
April 2002	4	1 Economist, 1 Sanitary Engineer, 1 Environmental Specialist, 1 Translator	S	S

(b) Staff:

Stage of Project Cycle	Actual/Latest Estimate	
	No. Staff weeks	US$ ('000)
Appraisal/Negotiation	**304.0**	**346.5**
Supervision	**145.4**	**234.7**
ICR	**9.5**	**59.1**
Total	**458.9**	**640.3**

Cost incurred up to and including FY99 were increased 15% to take into account changes in accounting practices starting in FYOO.

Annex 5. Ratings for Achievement of Objectives/Outputs of Components

(H=High, SU=Substantial, M=Modest, N=Negligible, NA=Not Applicable)

	Rating
☐ *Macro policies*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Sector Policies*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Physical*	***OH*** ● ***suCw*** ***ON*** ○ *NA*
☐ *Financial*	*O H* ○ *SU* ● *M* ***O N*** ○ *NA*
☐ *Institutional Development*	*O H* ○ *SU* ● *M* ***O N*** ○ *NA*
☐ *Environmental*	*O H* ● *SU* ○ *M* ***O N*** ○ *NA*
Social	
☐ *Poverty Reduction*	○ *H* ○ *SU* ○ *M* ●
☐ *Gender*	*OH* ○ *SU* ○ *M* *ON* ● *NA*
☐ *Other (Please specify)*	○ *H* ○ *SU* ○ *M* *O N* ● *NA*
☐ *Private sector development*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Public sector management*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Other (Please specify)*	*OH* ○ *SU* ○ *M* ○ *N* ● *NA*

Annex 6. Ratings of Bank and Borrower Performance

(I-IS-Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HU=Highly Unsatisfactory)

6. I Bank performance	*Rating*			
☒ *Lending*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Supervision*	○ *HS*	● *S*	○ *U*	○ *HU*
☒ *Overall*	○ *HS*	● *S*	○ *U*	○ *HU*

4.2 Borrower performance	*Rating*			
☐ *Preparation*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Government implementation performance*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Implementation agency performance*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Overall*	○ *HS*	● *S*	○ *U*	○ *HU*

Annex 7. List of Supporting Documents

1. Report on Investigation of the Environmental Effect 1997- 1998 (Kunsan Treatment Plant), prepared by the Environmental Management Corporation, Korea, May 1998.

2. The Construction of the Second Extension of Janglim Sewage Treatment Plant: Report on the Examination of the Post Construction Environmental Effects, prepared by the Construction Headquarters of Pusan Metropolitan City, March 2002

3. Staff Appraisal Report, No. 13570-KO of November 14, 1994

Additional Annex 8.Monit oring Indicators for Kunsan and Pusan Components

KUNSAN:

Item	1995	1996	1997	1998	1999	2000	2001
	Actual						
1 .Waste treated (t/y)							
-Landfill Chunbuk					5 43	5,200	409
Outside					0	0	0
Total	10,755	9,912	8,769	3,260	5,430	5,200	409
-Incinerat Chunbuk					2,335	4,099	**0**
Outside					2,838	9,672	0
Total	--	--	--	a) 432	5,173	13,771	6629
2.Average tariff (Won)							
-Landfill	57,000	8 1,000	86,400	86,400	79,374	85,000	85,000
-Incineration	--	--	--	65,000	67,272	59,037	59,000
3.Personnel (number)							
-Landfill					3	3	3
-Incineration					35	32	23
Total	19	17	15	38	38	35	26
4.Revenues (Won mil)							
-Landfill					431	442	35
-Incineration					348	813	391
-Non-operat. Revenues					6	11	0
Total	615	805	883	282	785	1,266	426
5. Operating Expenses (Won million)							
-Personnel costs					1,229	1,383	
-Operational costs					689	1,700	
-Depreciation					206	114	
-Interest on loans							
-Subsidy to public					173	310	
Total Op. Expenses	1,573	1,931	1,832	2,391	2,297	3,507	910
&Operational Profit (Loss)	-958	-1,126	-949	-2,109	-1,512	-2,241	-484

Year	1995	1996	1997	1998	1999	2000	2001
1. Physical parameters							
Sewage billed 1,000 m3/year	382,921	396,380	392,597	370,494	380,417	366,923	353,053
Number of sewer connections '000	311	313	329	2) 318	317	320	350
Length (km) of combined sewers	4,975	5,026	5,140	5,346	5,479	5,612	5,755
Length (km) of separate sewers	800	950	1,120	1,270	1,284	1,290	1,295
Length of interceptors km		71	119	173	186	194	214
2. Operating capacity							
Days accounts receivable	44	39	42	40.3	41	41	41
Number of employees	276	283	359	365	353	254	295
Employees/ 1000 connections	1.2	1.2	0.92	1.15	1.11	1.04	1.04
3. Financial parameters							
Average sewerage tariff Won/m3	100.03	146.71	185.4	185.4	195.64	194.18	255.87
Working ratio	0.3	0.25	0.26	0.24	0.31	0.32	0.31
Rate of return	2.18%	4.42%	5.70%	4.00%	2 06%	1.64%	3.08%
Contribution to investment	33.20%	59.59%	38.27%	45.55%	31 00%	37.30%	38%
Debt service ratio	3.81	5.29	5.97	4 63	1.87	1.38	2.5
4. Capacity of treatment plant							
Janglim '000 m3/day	330	330	330	330	330	330	615
Suyong '000 m3/day	286	286	550	550	550	550	550
Nambu '000 m3/day	65	65	340	340	340	340	340
Other plants '000 m3/day		65	65	65	65	65	249
Total treatment capacity	681	746	1,285	1,285	1,285	1,285	1,754
5. Performance of Janglim STP							
BOD5 on outlet mg/l			12.2	12.3	10.2	11	9.8
Suspended solids on outlet mg/l			11.6	9.7	9.2	10.3	8.6

Waste Disposal Project (Kunsan Component)
Loan Number 3830 - KO
Evaluation Report

The Ministry of Environment
Republic of Korea

May, 2002

1. Introduction

In the course of rapid industrialization during the 1960s and 1970s the amount of waste generated in Korea brought about social and environmental problems. From the beginning of the 1980s the Government of the Republic of Korea strengthened its waste disposal policy and established the National Comprehensive Waste Disposal Plan (NCWDP) in 1993. The basic policy of this plan is intended to reduce the amount of waste generated; to increase recycling rate on one hand and expand sanitary landfills and incinerators for safe disposal of waste on the other hand.

This plan also indicates clearly that the central government will take the initiative in controlling specified waste that is very harmful and hard to dispose of and the local governments construct household waste treatment facilities. The Kunsan Specified Waste Treatment (KTP) constructed based on this plan is composed of a sanitary landfill in operation since March 1995 and the Kunsan Specified Waste Incinerate (SWI) built in accordance with the Kunsan Project.

In 1993 the government decided to push ahead with the Kunsan project by obtaining an IBRD loan, completed consultation with IRBD about Project implementation in 1994 and signed a Loan Agreement in March 1995. The agreed loan amount for the Kunsan project at that time was US$15,000,000 but withdrawal of US$2,776,000 was cancelled in February 1999 due to reduction of the project cost in the course of its implementation. After bidding on the project and the conclusion of a contract in 1995, the design, construction and trial run by the SWI were completed during the period of January 1996 to October 1998.

This evaluation report is an annex to the Implementation Completion Report (ICR) prepared by the Bank and describes the borrower s evaluation. The Ministry of Environment (MOE) has made out this report based on the data by the Environmental Management Corporation (EMC), which was the operator before privatization.

A. Statement / Evaluation of objectives

2. Project Objective

The objective of this Project is to install and operate the SWI (Kunsan Specified Waste Incinerator) with a loan from IRBD as a part of the National Comprehensive Waste Disposal Plan promoted by the Ministry of Environment. Environmental pollution may be prevented and a pleasant living environment can be maintained by treating waste that was generated by industrial facilities with the SWI safely and properly. Moreover the SWI can effectively treat the specified waste that private treatment facilities find difficult to dispose of, thus supporting industrial activities. In addition to this SWI being government-managed facilities can get trust of the local residents who tend to dislike waste treatment facilities.

3. Project Description

The SWI is designed to be fused by fire such specified wastes as waste oil, waste organic solvent, waste paint and sludge containing heavy metal. The SWI is located in Kunsan at 230km southwest to Seoul and constitutes an integral part of the KTP (Kunsan Specified Waste Treatment Plant) with a sanitary landfill.

Major equipment of the SWI include a storage of liquid and solid waste, pretreatment devices including a crusher, a rotary kiln incinerator capable of burning upto 60 tons of waste daily and exhaust gas cooling and treatment devices such as a boiler and electrostatic precipitator, a bag filter and scrubbers.

After being entrusted with the project implementation by the MOE, the EMC proceeded with bidding on the project and conclusion of a contract completing, the design, construction and trial runs of the SWI during the period of January 1996 to October 1998. Details of the project include the plant operational support to be after completion.

B. Achievement of Objectives

4. Physical Objective

The project's physical objective was substantially achieved. The physical component of the project is composed of designing, purchasing, installing and operating a waste incinerator with a daily capacity of 60 tons. On behalf of the EMC, the Office of Supply, the government of the Republic of Korea took charge of the bidding and concluded a contract with the joint venture of French SARP and Korean Hyundai Heavy Industry on turn-key basis which is advantageous for performance guarantee of the incinerator. After the conclusion of the contract, the EMC directly performed supervision during the period of design and construction reflecting its experiences of installing and operating other incinerators. The contractor did not have any difficulty either in designing and installing the incinerator in terms of technical aspect.

The construction work was initially scheduled for completion by the end of 1997 but was delayed to October 1998 because additional facilities had to be installed due to change of design. Since the contract for change of design was concluded, when the original work was almost completed, the construction period had to be extended considerably for designing the additional facilities, importing overseas materials and installing them. Therefore, the extension was minimized. Trial runs also had to be delayed but performance inspections found the amount of waste treated and exhaust gas measurement satisfactory.

Overall, commercial operation was delayed due to civil petitions after completion of the facilities in October 1998 and the Plant Operational Support for normal operation to be provided by the contractor had to be delayed, installation and trial runs were completed without serious problems except for some extension of the construction period.

5. Financial Objective

The MOE, the owner of the SWI, entrusted the EMC with the operation, maintenance and repair of the SWI including the financial matters arising from the operation. However, normal operation of treatment facilities was impossible for a long time due to civil petitions. It was argued that area resident should set a limit of waste imported from outside to the treatment facilities in Jeollabukdo. However, domestic waste was already being treated by the existing civilian treatment company, and there was little locally generated industrial waste. Therefore the waste of 18,000 tons of the year, which is necessary for the normal operation of the incinerator, could not be secured. With this, the EMC concluded agreement with the area resident to cancel the area waste import regulation (1999.7.6). By the agreement conclusion, the EMC could secure specified waste for incineration, which is necessary for the treatment facilities operation, but the financial objective improvement could not be achieved. Because, the resident interfered everything in the treatment facilities management and demanded a treatment facilities management standard much stricter than the related law, as a condition to cancel the area carrying-in limitation. Also, the resident have the authority that can make powerful penalty such as the treatment facilities closure action and require resident support money very excessively if the EMC were not conforming to this standard. After all, it recorded a management deficit above 2 billion Korean Won every year being opposite to the original plan at first, which was set to return the principal and interest accrual needed for the treatment facilities construction by operating income.

The treatment facilities became entrusted to the private sector operator on June 28th, 2001 with the public facilities privatization plan of the Korean government. The reasons of the negative financial results were compounded results of the opposition of the resident, the condition of location and the inefficient operation of the EMC, etc. The Kunsan Waste Treatment Facilities is located too remote from the place where wastes are generated and the shipping charges were expensive. By the reason, this plant fell behind the other plants in cost performance. The EMC is possessing human power who are very excellent about the operating technology of the treatment facilities in the public corporation which manages environment facilities. Also the EMC is possessing technical experiences, but it was evaluated that the public corporation fall behind in the competitiveness comparing to the private company about the specified waste treatment operation, which should do a marketing activity. In the end, the Korean government entrusted this treatment facility to the Future & Environment Inc. instead of the EMC of the public organization to manage it. This is a point which the bank must consider very carefully, in its promotion of similar projects in other countries in the future. The SWI processed about 25,000 tons specified waste which contained 1,550 tons during the period of before trial runs.

6. Environmental Objective

The project's environmental objective was partially achieved.

The environmental objective is to prevent environmental pollution by treating specified waste generated by industrial facilities safely and properly. The SWI has treated about 25,000 tons specified waste including 1,550 tons from trial runs. It has proved to have no effect on its surrounding environment according to the exhaust gas measurement and environmental influence investigation was conducted. In order to investigate the surrounding environmental state during the construction period and before operation of the incinerator, air quality, odors, noise and vibration were surveyed from December 1997 to May 1998 and the results were presented to the bank. In the latter half of 1999 when the incinerator is expected to operate normally another environmental influence investigation will be conducted for comparative analysis of the surrounding environmental states before and after operating the incinerator. Moreover, an automatic exhaust gas-measuring device will be operated during the operation of the incinerator to monitor any effect on the surrounding environment.

Even though the incinerator could not be operated for some time after completion, wastes were brought in continuously for pretreatment and storage, and some specified wastes neglected by bankrupt enterprises were brought in the plant at the request of the MOE, thus preventing environmental pollution.

7. Policy Improvement

In Korea, local governments are in charge of treating and controlling ordinary household garbage and central government is in charge of treating and controlling specified waste. At one time, for the purpose of treating the unmanageable specified waste in the private department, the Korean government installed the specified waste treatment facilities, which contained the KTP in the nationwide 5 areas and managed it. Recently the Korean government sold these to the private company or entrusted its management to the private sector. The specified waste public treatment facilities, which the public company managed so far, can be entrusted to the private sector. This is due to the judgement that the policy of the government to reform state owned companies, and the improvement of the waste throughput of the private company according to the upbringing of the environment allied industries.

C. Major factors Affecting Implementation

8. Factors Subject to Government Control

One of the major factors is the Government's policy of regulation on exhaust gas. In 1997 dioxin, which is contained in the pollutants discharged by incinerators, became a social issue. The government law to regulate the discharge standard of incinerators was revised for the pertinent burning up more than 50 tons of household garbage daily in response to the request of the citizens and social organizations.

When the law was revised, the construction work of Kunsan Specified Waste Incinerator was almost completed, but the MOE instructed the EMC to carry out additional work to install devices to reduce dioxin to cope with the regulation on the dioxin discharge. With this reason the construction period of Kunsan Specified Waste Incinerator was extended to October 1998 from the end of 1997 and the MOE invested an additional 5 billion Korean Won. At present new regulations on the discharge of dioxin by incinerator of the specified waste are in making.

Another factor that affected the project implementation is civil petitions. At the planning stage of the

SWI in 1994 its scale was estimated assuming that waste would increase. However, the amount of waste generated in Jeollabukdo was decreased due to change in the legal waste separation system, increased reutilization and delayed developing the industrial complex in the neighborhood.

In order to ensure stable operation of the SWI, the MOE planned to bring in the waste generated at other location including Jeollabukdo for a limited period but the resident opposing to operate the incinerator distrusted this plan. As a matter of fact, there were no legal problems involved in bringing in the waste, but it was impossible to ignore the opinions of local residents in operating the public specified waste treatment plant. After several months of consultations with local residents, the MOE finally succeeded in convincing them of the necessity to bring in waste generated elsewhere and the safety of the incinerator and obtained their agreement. In the course of the negotiation, promises were made to conduct environmental influence assessment and various supper measures for local residents. The continuous dialogues seem to be necessary for normal operation of the plant.

Even though the EMC is entrusted with the operation of the SWI by the MOE, the important matters related to operate including execution of operational budget funds, adjustment of operating personnel etc are subject to the approval of the MOE. The SWI is required to follow the operating policy of the MOE like other specified Waste treatment plants and to observe the obligations related to the loan.

9. Factors Subject to Implementing Agency Control

Entrusted by the MOE, the EMC has actually conducted design, construction, trial runs and commercial operation of the SWI. When construction work was underway the EMC carried out design change with the approval of the MOE. EMC delayed trial runs, as it failed to secure an adequate amount of waste and this was caused by the fact that the establishments discharging higher calorific power waste specified in the construction contract reduced its amount due to economic slowdown and reutilization was increased in the contrary.

In order to pay construction cost EMC submitted the request for withdrawal regularly to the IBRD and cancelled the withdrawal of some amount of the loan as requirements for the loan decreased due to appreciation of the Korean Won when the project was carried out.

D. Bank Performance

10. The bank's performance during project identification, preparation, appraisal and supervision was satisfactory in general.

The bank's bidding and procurement guideline requires that important matters related to project performance such as the contract basis, the selection of successful bidders at bidding stage must be approved by the bank. In case of the Kunsan Project the bank spent several months reviewing a certain stage of bidding when it took long time and it would be helpful for adjusting the schedule of succeeding work if the bank advises estimated approval date in advance. Even though performance of the bank was satisfactory in general, it came to light that more detailed information on the procedure for withdrawal of the loan and the time required is an important factor for project performance.

Sufficient consultation seems to have been made during the period of project performance but changed conditions from the initial appraisal stage seem to require consideration when the performance of the remaining project is appraised.

E. Borrower Performance

11. Generally the borrower performance was satisfactory.
Overall, the construction of the incinerator was completed successfully despite the construction period was extended due to additional facilities to reduce dioxin. Difficulties were encountered during the construction work and before normal operation but agreement made with local residents makes it possible to predict normal operation in future.

Maximum cooperation was extended in presenting the data requested by the bank concerning project performance during the period of the bank's project identification, preparation assistance, appraisal and supervision. The obligatory matters specified in the loan agreement such as the semi-annual report, audited financial statement and environmental monitoring report were faithfully submitted.

F. Assessment of Outcome

12.As indicated in the previous chapter of Achievement of objectives the project results arc partially unsatisfactory.

As the SWI has never been operated normally since its completion, the evaluation of the project results can be made when the SWI operates normally.

G. Future Operation

13. The EMC is entrusted with the operation of 4 specified waste treatment plants constructed by the MOE including the KTP.

Proxy Contract Agreement for installation and operation of the SWI was concluded between the MOE and the EMC in July 1995 and presented to the bank during the period of project appraisal. In addition to the above contract the MOE informed officially that the EMC should manage and operate various facilities of the completed SWI in accordance with the National Property Act. According to this notification, the EMC was commissioned to conduct all operating matters including operation, maintenance, repair and levy of treatment charges, and intend to prepare the audited financial statement and conduct environmental monitoring program stipulated in the loan agreement.

In terms of technical aspect of the operation of the SWI, no difficulty is expected for future commercial operation, because most of the operating personnel of the EMC participated in trial runs and have experiences of operating similar incinerators. The plant operational support to be provided by the SARP, the contractor, for a year will contribute greatly to the plant operation.

In terms of financial aspect of the operation of the SWI, It is required to the EMC that it was possible to become the black-ink management according to the management plan of the MOE. However, the EMC could not cross the opposite plea of the residents and a barrier with the corporate culture, which is peculiar to the public company, therefore recorded deficits every year. This is different management method from the private company which considers of the profit with the survival of the company. For that reason, the government entrusted treatment facilities to the civilian to introduce the originality and the management technique of the private department into the public treatment facilities management. The management results of the private assignee that operate the treatment in place of EMC cannot be evaluated, because the management period is too short. However, it is the point that the management income and expenditure of the treatment facilities was improved greatly. In 200 1, the private assignee

paid the trust commission about 240,000,000 Korean Won to the treasury by the management for about 4 months. The MOE expects that the trust commission of annual 1.5 billion Korean Won is stored to the MOE if the treatment plant starts to operate normally. It was greatly improved when comparing with the management of the EMC, which went into deficits above 2 billions Korean Won every year.

H. Key lessons learned

14. Physical Implementation

Delay in the completion of the facilities caused by change of design is an example. At the planning and design stage the devices used for reducing ordinary air pollutants and dioxin were reflected to cope with anticipated strengthening of regulations. However, in case of dioxin it became a serious social issue and led to a revision of the Environmental Preservation Law requiring much less amount of discharge than reflected on the design. Therefore, change of design and additional work had to be carried out in the middle of construction work, delaying the completion date and increasing the cost of construction.
Even though legal and regulatory requirements are satisfied, the demands of local residents affect project performance greatly. Forecast of such incident, however, is extremely difficult.

15. Financial Implementation

Korean economic downturn and rise in exchange rates affected project finance - the rise in exchange rates reduced the required amount of the loan in foreign currency but payment in the Korean Won for the foreign currency denominated contract portion increased. The operating income of the SWI became a marked decrease. The reasons were the decrease of the waste by the business condition stagnation, the opposition of the resident and excessive supports to soothe the opposition. Also, the treatment facilities were located in the distant far too from the place where the waste generated. That reflected a carriage expense rise and added up the difficulty of the treatment facilities management. On the other hand, the inflexible management method of the EMC increases expenditures too and that became consequently the cause to make a deficit in the management of the plant weight. The bank should consider very carefully these when it finances similar treatment facilities project in the future.

16. Consultation with Local Residents

With the recently heightened interest of the citizens in the environment, the SWI has encountered many difficulties caused by the local residents protest in the course of its construction and operation like any other environmental basic facilities. Due to the public nature of the treatment plant, the Kunsan Specified Waste Treatment Plant could not ignore the opinions of the local residents and it took a long time to obtain the agreement of the local residents on normal operation of the plant including bringing in waste from locations other than in Jeollabukdo and so forth. It is judged that continuous efforts have to be made not only to realize proper and safe operation of treatment plant but also to seek the agreement of local residents.

Additional Annex 10.Bo rrower's Evaluation Report - Pusan Component

This annex will be fully available in the gray cover version of the ICR.

PusanCompletion_Report-revised2

Sewage Treatment Plant (Pusan Component)

Completion Report of Implementation

(Loan 3830-KO)

October 2001

Pusan Metropolitan City

Republic of Korea

Sewage Treatment Plant (Pusan Component)
Completion Report of Implementation

1. Preface

0 Since the 1960s the environmental pollution covering the surrounding shores, rivers, and waterways of Pusan Metropolitan City has been in a critical condition due to the fast industrial development and over density of population. This caused the impossibility to naturally refine those pollutions themselves, and it is inevitable for Pusan Metropolitan City to establish a systematical countermeasure to improve the environmental condition.

In order to fundamentally resolve the problems of sewage treatment, Pusan City had once established a comprehensive countermeasure for the sewage treatment in 1974, and set up a basic repair project for drainage in 1983 to be completed in 2001. Among those projects, the city started the First Phase of Janglim sewage treatment plant with capacity of 330,000 m^3/day in 1966 and completed in December, 1990. Subsequently the city began the expansion work of the second Phase of Janglim sewage treatment with capacity of 285,000m^3/day in May, 1996 and finished in September, 2001, thus, which is totally equipped with the sewage treatment capacity (615,000m^3/day) enough to cover the sewage with 591,000m^3/day occurred in the district of Janglim Sewage Treatment Plant.

0 It had been difficult for Pusan Metropolitan City to acquire the fund for this expansion work due to locally poor financial condition, and decided to lend IBRD loan with internal funds. Through the advice of project implementation of IBRD in 1993, the city concluded the agreement for investment in 1995.

At that time, the agreed amount of Loan for the project was 60,000,000 US dollars, but the work project could be successfully completed thanks to cost reduction through the whole process of the project with 41,268,208.98 US dollars only.

2. The Purpose of the Project

The project aims to keep up the healthy lives of citizens and higher water quality spread the shores surrounding the city under the optimal environmental circumstance by introducing high sewage treatment method for factory waste water and precipitated water from the wastes together with domestic sewage, through further treatment of T-N comprehensively.

3. Introduction to this Project

This Treatment Plant is located approximately 2 km downstream from the barrage of Nakdong River with population of 1,064,000 persons within the district of treatment (A=47.580㎢).

- The capacity of this sewage treatment plant is totally 615,000㎥/day; the existing capacity of 330,000㎥/day and the expansion capacity of 285,000㎥/day which is under operation after the completion of the project.

- Related to the expansion facility, two water pump facilities were newly set up in order to collect the sewage come from Kamcheon district.

- The method of sewage treatment was originally adopted by a standard activated sludge system at the time of order. It adopted condensed circulation system capable to treat T-N against future reinforcement of legal sewage treatment. The change of the method caused to change the project design during the construction.

Details of facilities are as follows :

- General Description of Project Capacity

Description		**Existing (1996)**	**This Project** (2001)	**Future (2011)**	**Total**
Capacity of sewage (㎥/d)	Daily Average	45 8,820	504,083	646,227	646,227
	Daily Maximum	536,084	59 1,924	766,491	766,491
	Hourly Maximum	828,727	911,029	1,164,957	1,164,957
Project Capacity		330,000	285,000	155,000	770,000

- Description of the Loan Project

Name of Facility	**Dimensions and Capacity/Quantity**
Influent Culvert	W2.5m × L150m × H2.0m / 1EA

Influent Pumps	Φ2,600 × H8.5m (1 00㎥/min) / 4EA
Grit Chamber	W3.5m × L18.0m × H1.3m / 4 Tanks
Primary Settler	W10.8m × L46.5m × H3.2m / 15 Tanks
Bio Reactor Tank	**W8.0m × L43.0m × H10.4m / 21 Tanks** **• Pre Anoxic Tank : Beam, Baffle Remove** **• Aeration Tank : Wall Installation** **• Post Anoxic Tank : Beam, Baffle Remove** **• Anoxie Tank Mixer : 105 Sets** **• Internal Circulation Pump : 21 Sets**
Final Settler	W10.8m × L63.0m × H3.5m / 15 Tanks **• Installation of Interior Baffle**
Gravity Thickener (Existing)	Φ17.3m × H3.0m / 4 Tanks • Primary Sludge : 2,436㎥/d / 2 Tanks • Excess Sludge : 2,709㎥/d / 2 Tanks
De- Watering Building	W27.5m × L55.0m / 2 floor(Total Area : 3,025㎡) • Thickener : 60㎥/hr Centrifugal thickener / 3 EA • De-hydrator : 500kg/EA.hr(High Pressure Type) / 2EA
Chemical Building	**W 13.0m × L24.0m × H3.4m** **• NaOH Tank : ø6.0m × H4.6m / 4 Tanks** **• CH3OH Tank : ø3.8m × L9.0m / 2 Tanks**
Interceptor	Φ350~Φ1,350m / 5.2㎞

4. Performance of the Goal

0 Physical Goal

- The physical components of this project included design, construction, purchase and

installation of materials and equipment for the successful undertaking of the project with 285,000㎥/day. The bidding of the project was conducted by the Office of Supply, Republic of Korea, the engineering and construction work was made by HYUNDAI Construction Co., Ltd, the technology and equipment made by HYOSUNG Corporation, and the supervision of the project made by DOHWA Consulting Engineers Co., Ltd.

The contractors could have successfully performed the project in respect to design, work, and installation technologically without any difficulties through lots of experiences so far.

- The construction work was originally designed to be completed in June, 2000 but the work period was prolonged for 16 months more due to many changes of the project during the construction. Consequently, the cost of the project was increased. The construction was able to finish everything under the approval with IBRD for the changes of the design.

0 Environmental Goal

- The environmental goal of the project aims to prevent all the environmental pollutions adequately and properly through thorough sewage treatment come from the district.

- There had been lots of difficulties in operating the sewage treatment plant for the stable operation of the plant due to variation of water quality owing to inflow higher density of nitrogen than other plant. One of the reasons is that the plant covers all the treatment of factory waste-water, precipitated water from the waste simultaneously. However, it could be successfully completed to operate the trial testing without difficulties through adjustment of the operation to abide by the regulations for the designated outflow quality.

- Reasons of decreasing sewage inflow are the Government's recent strong policy for water saving and reduction of sewage inflow due to relatively lack of the amount of rainfall in 2001 since the collecting pipe of sewage installed in the area of Janglim Sewage Treatment is equipped with joining of rain water and sewage.

- Reasons of the consistency of sewage inflow are lack of rainfall, and the improvement of factory operation in the area of sewage treatment considerably thanks to the economic improvement in 200 1.

- Although there had been some resistances from the residents living here who were worrying about environmental pollution such as dust, noise, vibration and bad smelling during the project, the project was finished without difficulties thanks to the effort of negotiation with them in advance appropriately.

O Financial Goal

- The total project cost required was 296,066 million Won, the breakdown of which consists of 224,644 million Won of local fund, 58,000 million Won of IBRD fund, and 13,422 million Won of national fund in the aspect of support which were used appropriately for the successful project.

- As to IBRD fund, it was originally planned to borrow the amount of 60,000,000 US dollars and then adjusted to 46,800,000 US dollars in September, 2001, through some replaced by domestic fund with changes of design. The amount of the money drawn by December 31, 2001, is 41,268,208 US dollars.

- Pusan Metropolitan City have had a local public corporation to operate the project of drainage system since 1985, and the cost of drainage is appropriately met with the fee of utilization of the drainage.

- For the sake of healthy financial operation of local public corporation, the operation of sewage treatment plant was entrusted to Management Corporation of Environmental Facilities in 1999, which makes efficient management and control through restructure of human resources and acquiring professional human resources.

5. The Role of the Bank

The bank has dedicated itself to the support of the project through negotiation of loan needed for renovation of Korean environment, and visited to the job-site every half year in order to check the process of the work, technical and financial problem, quality of construction, and the provisions of the environment being applied. The bank has approved the withdrawal of the fund appropriately at the request of the Korean Government.

6. The Factors affecting the progress of the project

0 Sewerage Division

This division establishes a set of comprehensive administration related to budget, design, adjustment, supervision of the drainage, and controls the sewage treatment plant.

0 Headquarter of Construction

The headquarter divides the large-scale projects and places them into special departments, and supervises them.

0 Supervising Group

This group has successfully supervised the construction and test operation appropriately.

7. The Role of Borrower (Pusan Metropolitan City)

The borrower has successfully performed to report the bank the progress status of the project and various reports for financial operation every half year as well as to report the evaluation analysis of environmental impact to the Ministry of Environment to abide and pursued negotiation for change of project method.

For efficient operation of the plant, the city established a Management Office of Environmental Facilities, which shall be entrusted for the operation of the plant when the project finishes.

8. Evaluation of Outcome

The project is satisfactory, since there was no indicating point of faults throughout the whole process.

9. Future Management

0 Control of Water Quality

- The design change to higher treatment caused the different basis between the designed water quality and that of the Ministry of Environment. It is expected to impose excessive environment burden money in the process of the plant operation by mean of

administration action in the future. Therefore, it is necessary to re-negotiate with the Ministry of Environment in order to fix the designed water quality.

- The ability of the sewage treatment in the winter is possibly decreased in the efficiency of treatment because of lower water temperature. Therefore, it will be difficult to operate the plant stably, and seems to be more difficult in treating T-N in particular. It needs, therefore, to discuss with the Ministry of Environment for the application of water quality regulation lower than the designed basis of water quality.

- For the stable operation and management of the treatment plant, there must be a guideline to regulate manufacturers, who exhaust the high density of T-N in the district, to meet allowable basis of the density.

0 Management of Operation

- Pusan Metropolitan City is expected to control all the facilities effectively by establishing a management corporation entrusted with all the environmental facilities since 1999. The corporation has reduced human resources working with such facilities as well as cost through operation the plant efficiently.

- Pusan Metropolitan City has judged itself that it is more effective to introduce civil capital to construct all the facilities on the large-scale project in the future, anticipating lots of difficulties in management of sound finance in the future considering the impossibility of acquiring investment for the plant due to the poor financial structure, although it is urgent to increase more facilities and water collecting drains right now.

0 Financial Management

- Recently due to lingering economic depression and ✔ change of exchange rate between US dollar and Korean Won, the appreciation of Korean Won v.s. US dollars will reduce the amount of necessary money when invested, but depreciation of Korean Won will increase more money than the contracted money when it is returned. Furthermore, the interest rate of Korean banks lower than that of IBRD will affect the economic structure. Therefore, it is necessary to introduce the lower interest rate with future negotiation

- In operating this project, much quantity of expensive chemicals(sodium hydroxide and

methanol) were put. Therefore, it is necessary to develop alternative chemicals for cost reduction in the future.

0 Agreement with local residents

- Since it is expected to have lots of resistances with the residents who are sensitive to environmental facilities like other places in the future, it is required to investigate the impact of the surrounding environment for a certain period and control future management thoroughly in order to heighten the credibility of the residents toward the plant continually.

Tables:

A) Costs

Works	Appraisal Estimate		Actual Estimate	
	Won Million	US $ Million	Won Million	US $ Million
Treatment Plant	119,696	149.62	105,311	131.64
Tertiary Treatment	52,776	65.97	50,043	62.55
Interceptors	0	a) 0	22,444	28.05
Implementation Support	2,560	3.20	24,109	30.14
Land Acquisition	19,065	23.83	19,806	24.76
Total Project Costs	194,097	242.62	221,713	277.14

a) Costs of interceptors and associated pumping stations in the treatment Plant

(1 $ =800 Won)

B) Disbursement

1) Appraisal Estimate in US $ million (Calendar Year)

Works	Appraisal Estimate							
	Total	1995	1996	1997	1998	1999	2000	2001
Treatment Plant	149.62	8.32	43.37	54.18	35.63	8.12	0.00	0.00
Tertiary Treatment	65.97	0.00	4.15	30.26	26.91	4.65	0.00	0.00
Interceptors	a)0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Implementation Support	3.20	0.59	0.77	0.81	0.85	0.18	0.00	0.00
Land Acquisition	23.83	23.83	0.00	0.00	0.00	0.00	0.00	0.00
Total Project Costs	242.62	32.74	48.29	85.25	63.39	12.95	0	0

a) Costs of interceptors and associated pumping stations in the treatment Plant

2) Actual Estimate in US $ million(Calendar Year)

구 분	Actual Estimate							
	Total	1995	1996	1997	1998	1999	2000	2001
Treatment Plant	154.9	-	9.96	13.04	36.67	34.40	17.44	43.39
Tertiary Treatment	b)0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interceptors	28.53	-	-	6.25	17.50	1.35	3.43	
Implementation Support	10.24	2.10	0.40	1.92	1.64	3.65	0.01	0.52
Land Acquisition	24.79	17.22	5.95	1.62				
Total Project Costs	218.46	19.32	16 31	22.83	55.81	39.4	20.88	43.91

b) Cost for re-design of the plant with the elimination of tertiary treatment in order to remove Nitrogen and Phosphorus

C) Procurement

1) Appraisal Estimate in US $ million

Project Element	Procurement Method		N.B.F	Total Costs
	ICB	NCB		
Civil Works			134.20 (0.00)	134.20 (0.00)
Equipment	78.39 (58.00)	3.00 (2.00)		81.39 (60.00)
Implementation support			3.20 (0.00)	3.20 (0.00)
Land Acquisition			23.83 (0.00)	23.83 (0.00)
Total	78.39 (58.00)	3.00 (2.00)	161.23 (0.00)	242.62 (60.00)

N.B.F. : Remained money to be paid by the Bank

Amounts in brackets are already paid by the Bank

2) Actual Estimate in US $ million

Project Element	Procurement Method		N.B.F	Total Costs
	ICB	NCB		
Civil Works			116.17	116.17

Equipment	**60.46**		1.71	**62.17**
Implementation support			10.24	10.24
Land Acquisition			**24.79**	**24.79**
Total	**60.46**		**152.91**	**213.37**

N.B.F. : Remained money to be paid by the Bank

Amounts in brackets are already paid by the Bank

D) Financing

Financing Source	Appraisal Estimate		Actual Estimate	
	Won billion	US $ million	Won billion	US $ million
IBRD Loan	**48.00**	**60.00**	**43.37**	**60.46**
Regional Development Fund	**30.78**	**38.47**		
Environmental contribution	**47.88**	**59.85**	**71.10**	**88.88**
Government contribution				
Pusan city contribution	**15.56**	19.45		
Genetal account				
Developer's contribution				
Other contributions			10.76	13.45
Internal cash generation	**76.92**	**96.15**	**36.98**	**46.22**
Total Financing	**219.14**	**273.92**	**167.21**	**209.0** 1

※ Costs of the project(US $242.62 mil) and interest during construction(US $3 1.30 mil)

IMAGING

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