JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
OF THE GOVERNMENT OF THE PHILIPPINES

THE STUDY
ON
INDUSTRIAL HAZARDOUS WASTE
MANAGEMENT
IN
THE REPUBLIC OF THE PHILIPPINES
(PHASE 2)

FINAL REPORT
(SUMMARY)

October 2002

EX CORPORATION
KOKUSAI KOGYO Co.,Ltd.

Preface

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Study on Industrial Hazardous Waste Management in the Republic of the Philippines (Phase2), and the study was implemented by the Japan International Cooperation Agency (JICA).

JICA sent a study team, led by Mr. Masato Ohno of EX CORPORATION and organized by EX CORPORATION and KOKUSAI KOGYO Co., Ltd., to the Republic of the Philippines 4 times from September 2001 to September 2002.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation throughout the study.

October 2002

川上隆朗

Takao Kawakami
President
Japan International Cooperation Agency

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Exchange Rate:1PHP ≒2.7yen

Abbreviations

A	ADB	Asian Development Bank
	APCD	Air Pollution Control Device
	ASME	American Standard of Mechanical Engineers
B	BOI	Board of Investments
	BOO	Build-operate-own Scheme
	BOT	Build-operate-transfer Scheme
C	CAA	Clean Air Act
	CALABARZON	CAvite, LAguna, BAtangas, Rizal, QueZON
	CBR	California Bearing Ratio
	CDO	Ceased and Desist Order
	CENRO	City Environment and Natural Resource Officer
	CIF	Cost, Insurance and freight
D	DAO	Department Administrative Order
	DBM	Department of Budget and Management
	DBP	Development Bank of the Philippines
	DENR	Department of Environment and Natural Resources
	DOE	Department of Energy
	DOF	Department of Finance
	DOH	Department of Health
E	ECC	Environment Compliance Certificate
	EIA	Environmental Impact Assessment
	EIRR	Economic Internal Rate of Return
	EIS	Environmental Impact Statement (System)
	EISCP	Environmental Infrastructure Support Credit Program
	EMB	Environmental Management Bureau
	EMB-EQD	EMB Environmental Quality Division
	EMB-HWMS	EMB Hazardous Waste Management Section
	ERA	Environmental Risk Assessment
	ESP	Electrostatics Participator
F	FIRR	Financial Internal Rate of Return
	FRP	Fiber Reinforced Plastic
G	GIS	Geographic Information System
	GOJ	the Government of Japan
	GOP	the Government of the Philippines
H	HDPE	High Density Polyethylene
	HWM	Hazardous Waste Management
	HWMS-EQD	Hazardous Waste Management Section - Environmental Quality Division
I	IATAC	Inter-Agency Technical Advisory Council
	ICB	International Competitive Bidding
	IDF	Induced Draft Fan
	IEC	Information, Education & Communication
	IFC	International Finance Corporation
	IRR	Implementing Rules and Regulations
J	JBIC	Japan Bank for International Cooperation
	JICA	Japan International Cooperation Agency
	JIS	Japan Industrial Standard

L	LAN	Local Area Network
	LGU	Local Government Unit
	LLDA	Laguna Lake Development Authority
M	MIF	Model Integrated Hazardous Waste Treatment Facility
	MIS	Management Information System
	MMDA	Metropolitan Manila Development Authority
N	NCR	National Capital Region
	NEDA	National Economic and Development Authority
	NPV	Net Present Value
	NRDC	Natural Resources Development Corporation
O	ODA	Official Development Assistance
	ORP	Oxidation Reduction Potential
	OSHA	Occupational Safety & Health Administration
P	P/O	Permit to Operate
	PCO	Pollution Control Officer
	PCDD	Polychlorinated Dibenzo-p-dioxin
	PCT	Physico-Chemical Treatment
	PD	Presidential Decree
	PENRO	Provincial Environment and Natural Resource Officer
	PEZA	Philippines Economic Zone Authority
	PPP	Public-private partnership
	PSME	Philippine Society of Mechanical Engineers Code
R	RA	Republic Act
	ROP	the Republic of the Philippines
S	SCC	Secondary Combustion Chamber
	SCF	Standard Conversion Factor
	SS	Suspended Solids
T	TEQ	Toxicity Equivalent Quantity
	TOC	Total of Organically bound Carbon
	TSD	Treatment, Storage, and Disposal
U	UPS	Uninterruptible Power Supply
V	VAT	Value Added Tax

Introduction

INTRODUCTION

With the recent progress of industrialization, industrial waste generation has been increasing in the Republic of the Philippines (ROP). Due to little presence of the hazardous waste (HW) treaters dealing with waste acid, waste alkaline, waste oil, and sludge containing heavy metals, many of industries are facing difficulty in handling of HW.

The Government of the Philippines enacted the RA6969 (Toxic Substances, Hazardous and Nuclear Waste Act) in 1990. In 1992, DAO29 (Department Administration Order 29) of the Department of Environment and Natural Resources (DENR) was issued to enforce the RA6969. In addition, the environmental impact assessment (EIA) and issuance of environmental compliance certificate (ECC) system was established to control hazardous waste (HW) treatment facilities in terms of environmental concerns at the time of obtaining the building permits.

However, due to insufficient law enforcement mechanism of RA6969, the private HIW business is not yet grown enough to supply proper HIW services. Consequently, a considerable amount of HIW is assumed to be improperly handled or stored in the factories without any treatment, which may constitute a potential threat to the environment.

Responding to the promotion policy of inviting foreign capital investment by GOP, a number of industrial investments have been made in the newly industrial and free trade areas in the Philippines. However, many of these foreign factories are facing troubles in handling HW. Continuation of this situation will damage not only the environment, but also the national economy by keeping away the investment from foreign countries.

Proper hazardous waste management (HWM) becomes one of the most important issues to be solved for the environmentally as well as economically sustainable development of the national economy in ROP.

Under the situation above, GOP officially requested to the Government of Japan (GOJ) to implement the Master Plan Study on Hazardous Waste Management in the Republic of Philippines (Phase I Study).

In response to the request of GOP, GOJ has decided to conduct the above study as the technical cooperation program of the Japan International Cooperation Agency (JICA) so as to help GOP realize proper management of hazardous industrial waste.

The Master Plan Study on Hazardous Waste Management in the Philippines (Phase 1 Study) started in September 2000 and completed in July 2001. Phase 1 Study established the basic framework plan of HWM in the Philippines and formulated the Action Plan, in which it recommended that the following measures should be strongly promoted to improve HWM in the Philippines:

1. **Promotion of HW treatment facilities**

   (1) Formulation of the HW storage plan

   (2) Promoting development of the model integrated facility for HW treatment

2. **Establishment of HW management database**
3. **Capacity building of HWM administration**
4. **Establishment of the financial/economic incentives to promote proper HWM**
5. **Establishment of policy measures to promote establishment of proper HWM mechanism within HW generators**

From the recommended measures given above, ROP selected two as the priority projects, i.e. Development of the model integrated facility for HW treatment and Capacity building of HWM administration. Based on this decision, the Study on Hazardous Waste Management in the Philippines (Phase 2 Study) was conducted with the following purposes.

1. **Feasibility Study on Development of Model Integrated Facility (MIF)**
2. **Capacity Building of HWM Administration**

This Final Report compiles the achievement of the Phase 2 Study. The F/R has 2 (two) volumes i.e. Volume I: Feasibility Study on MIF Project (from Chapter 1 to Chapter 9) and Volume 2: Report on the achievement of supporting activities to strengthen capacity of HWM administration in the Philippines (from Chapter 10 to Chapter 14). Chapter 15 finally makes some recommendations regarding the issues to be addressed for further enhancing proper HWM in the Philippines.

Volume I describes in detail on the basic plan of MIF Project. Chapter 1 clarifies the rationale of the project in terms of its relevance to the National Strategy on HWM, the project objectives, and its expected benefits. Chapter 2 identifies topographic, geological, and physical conditions of the project site with the estimated demand for industrial HW treatment. Chapters 3 and 4 discuss in detail the basic design of the facilities to be built under MIF Project and the operation plan of the facilities with the estimate of their construction and operation costs. In Chapter 5, the basic policies of HW treatment business operation and organizational arrangement for construction and operation of MIF are recommended.

Chapter 6 examines the financing options for the project and makes several recommendations on fund raising and financing measures to be applied. Based on the detailed project plan formulated in the above chapters, financial and economic appraisal of the project is conducted in Chapter 7 by making use of key financial indicators. Although Chapter 6 and 7 recommended the use of Japanese Yen Loan and conducted the analysis of project cash flow based on its use for financing the project, it is the recommendation by the Study Team and does not represent any of Japanese Government. There is no discussion on this recommendation with GOJ. Chapter 8 provides the expected implementation plan of the project, focusing on the time schedule of preparation and construction stages of the project from the year 2002 to 2006. Finally in Chapter 9, the results of EIA Study are presented with the recommended environmental management plan of the project.

In Volume II, the achievement of supporting activities to strengthen HWM in the Philippines is described by the following orders:

Chapter 10: Updating of HW registration

Finally in Chapter 15, the Study makes some recommendations regarding the issues to be addressed for further strengthening HWM in the Philippines.

The following members of the JICA Study Team and the Philippine counterparts (DENR-EMB) carried out the Study.

JICA Study Team
1. Masato Ohno: Team Leader 2. Mitsuhiro Yamamoto: Enhancement of Administration Capacity 3. Tadao Tanaka: Treatment Facility Design 4. Junji Anai: Treatment Facility Design/ HW Generator Registration 5. Marlito Cardenas: Industrial HW Management Administration/ Legal System 6. Fujio Igari: Site Survey/ Cost Estimate 7. Jude M. De Vera: Fund Raising 8. Christian Rouvier: Environmental Impact Assessment 9. Kaoru Oka: Hazardous Waste Management 10. Satoshi Sugimoto: Economic/Financial Analysis 11. Misako Takagi: Model HW Treatment Project Management 12. Kunito Ishibashi: Computer System Design (1) 13. Daisaku Kiyota: Computer System Design (2)

Philippine Counterpart (DENR-EMB)
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The Steering Committee comprised of the following members has been established under DENR/EMB for coordinating with relevant agencies and receiving helpful comments:

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4. Ramon J.P. PAJE	Undersecretary for Environment and Natural Resources Operations	DENR
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VOLUME 1:
FEASIBILITY STUDY
ON MIF PROJECT

Chapter 1

Justification

1 JUSTIFICATION

1.1 Current Conditions and Issues of HWM in the Philippines

Current conditions of HWM in the Philippines are outlined as follows:

- According to the JICA Study on hazardous waste management (Phase I), approximately 280 thousand tons of hazardous wastes are generated each year by the officially registered 719 HW generators.
- About 100 thousand tons of the above would be stored (on-site or off-site) or missing (i.e., destination of HW cannot be identified.) every year.
- Besides the registered HW generators given above, there are still many non-registered factories that generate a considerable amount of HW in the Philippines.
- The JICA Study estimated that there were approximately 150 thousand potential HW generators, of which 1400 are large-scale factories.
- The existing TSD (Treatment, Storage and Disposal) facilities are also very limited in number as well as their capacity of HW treatment. Most of the existing TSD operators are small-sized recyclers who deal with only easily recyclable materials. There is no landfill and thermal treatment facility available for HW in the Philippines.
- The Government of the Philippines enacted RA6969 i.e., Toxic Chemicals and Hazardous and Nuclear Waste Control Act in 1990 as the basic law on hazardous waste management. Key regulatory and administrative tools for HWM defined by this law include:
    1) Notification, registration and reporting duties of HW generators,
    2) Accreditation of HW transporters and issuance of HW transport permit,
    3) Issuance of TSD facility construction and operation permits and licensing of HW recyclers and treaters,
    4) Monitoring of HW by utilizing the Waste Tracking System (Manifest System), and
    5) Surveillance, compliance monitoring and enforcement.
- However, the above regulatory tools do not effectively work for proper HWM in the Philippines because of various factors.

1.2 Rationale of the Project (Model Integrated HW Treatment Facility)

Although development of proper HW treatment facilities is needed to solve the issues above, it cannot be carried out by private sector initiative only. Taking into account such difficulty as well as other conditions mentioned below, the Study suggested to promote development of a model HW treatment facility with governmental inititiative.

- The basic principle of HWM in the Philippines is called 3R and 1P, in which the priority of HWM is firstly given to reduction (waste minimization at sources), secondly to reuse, thirdly to recycling, and finally to proper treatment.
- However, the 3R of HW depend much on the individual efforts of HW generators, haulers, recyclers, and so forth. It will also take much time to raise their awareness on 3R.
- Due to insufficient preparation of legal and regulatory tools and limited capacity of the government, investment in the development of HW treatment and disposal facilities is still very risky in terms of the uncertain demand, large capital requirement, and so forth.
- The Philippines is currently facing the dilemma, wherein the government cannot strictly enforce the laws and regulations on HWM without the development of proper HW treatment and disposal facilities while the private sector is not willing to participate in HW treatment and disposal facility construction and operation without any strict enforcement of laws and regulations on HWM.
- Public-private partnership is the key of resolving this dilemma in HWM in the Philippines. This project on development of the Model Integrated TSD Facilities (MIF) will be the epitome of public-private partnership in realizing proper HWM in the Philippines.

The main objectives of the Model Integrated TSD Facility (MIF) are:

- To minimize possible environmental risk that may arise from improper or insufficient hazardous treatment by the present generators and treaters,
- To simultaneously facilitate law enforcement on proper HWM and development of proper HW TDS facilities through active public-private partnership in implementing the model project,
- To provide private sector with the good practices of hazardous waste management through the disclosure of MIF operation.

MIF is designed to properly treat the hazardous wastes that are difficult or not possible to be recycled with the presently available technologies in the Philippines. MIF will integrate the state-of-art HW treatment technologies into one place. The treatment processes to be applied in MIF include:

- Physicochemical processes (including neutralization, oxidization and deoxidization),
- Solidification (cementation),
- Thermal process (pyrolysis process)
- Controlled Landfill

The major expected benefits arising from the project include:

- Minimizing possible environmental risks that may arise from improper or insufficient hazardous treatment by the present generators and treaters,
- Facilitating law enforcement of hazardous waste management as well as accelerating establishment of overall hazardous waste management system in the Philippines,
- Realizing the potential market of HWM business in the Philippines.

Chapter 2

Preconditions of the Project

2 PRECONDITIONS OF THE PROJECT

2.1 Project Site

Based on the Master Plan formulated in Phase I Study, the MIF Project covers the HWM generated in Metro Manila and CALABARZON area.

EMB selected a 10 ha of project site in the future extension area of LIMA Technology Center according to the recommendation of the Master Plan prepared in the Phase 1 study.

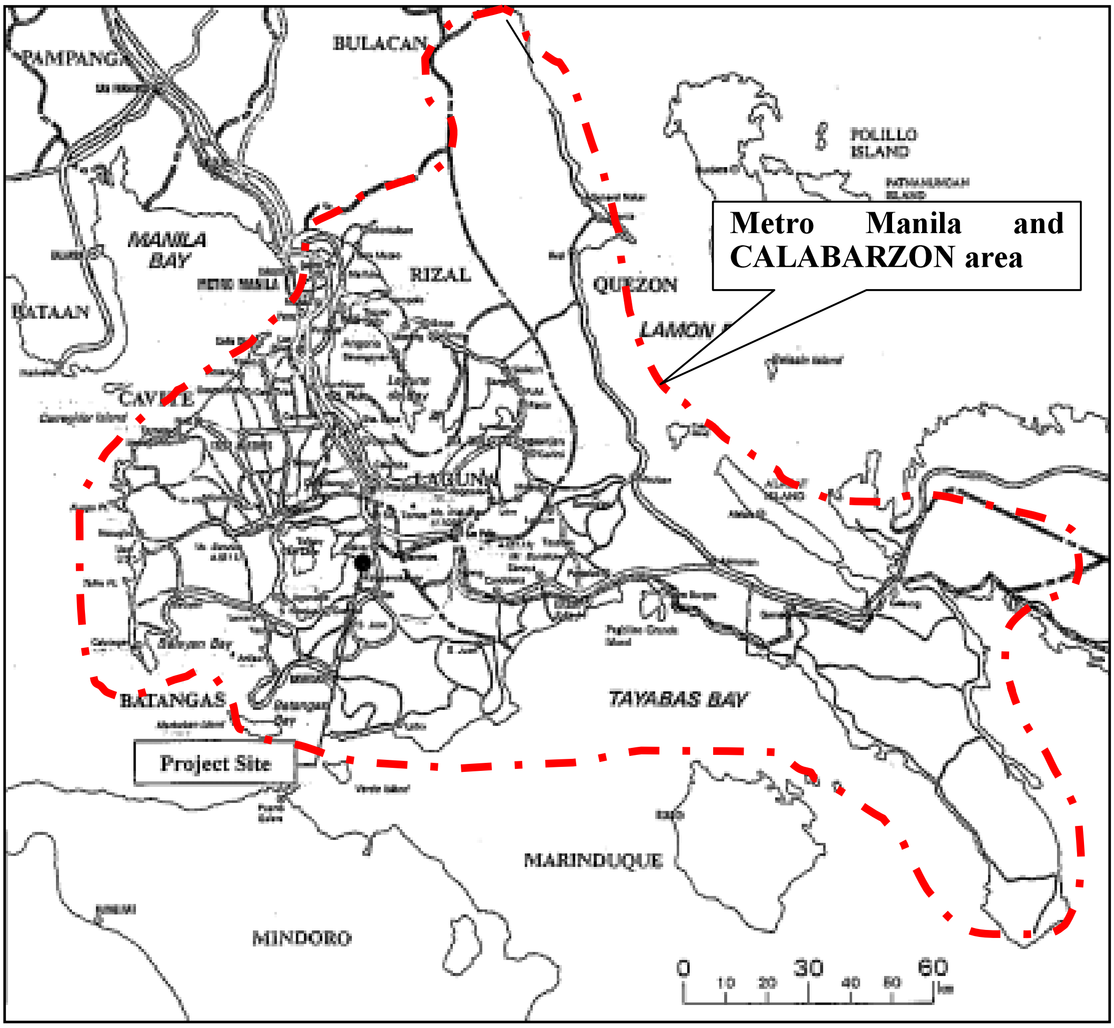


Figure 2.1.1 Location Map of the Project Site

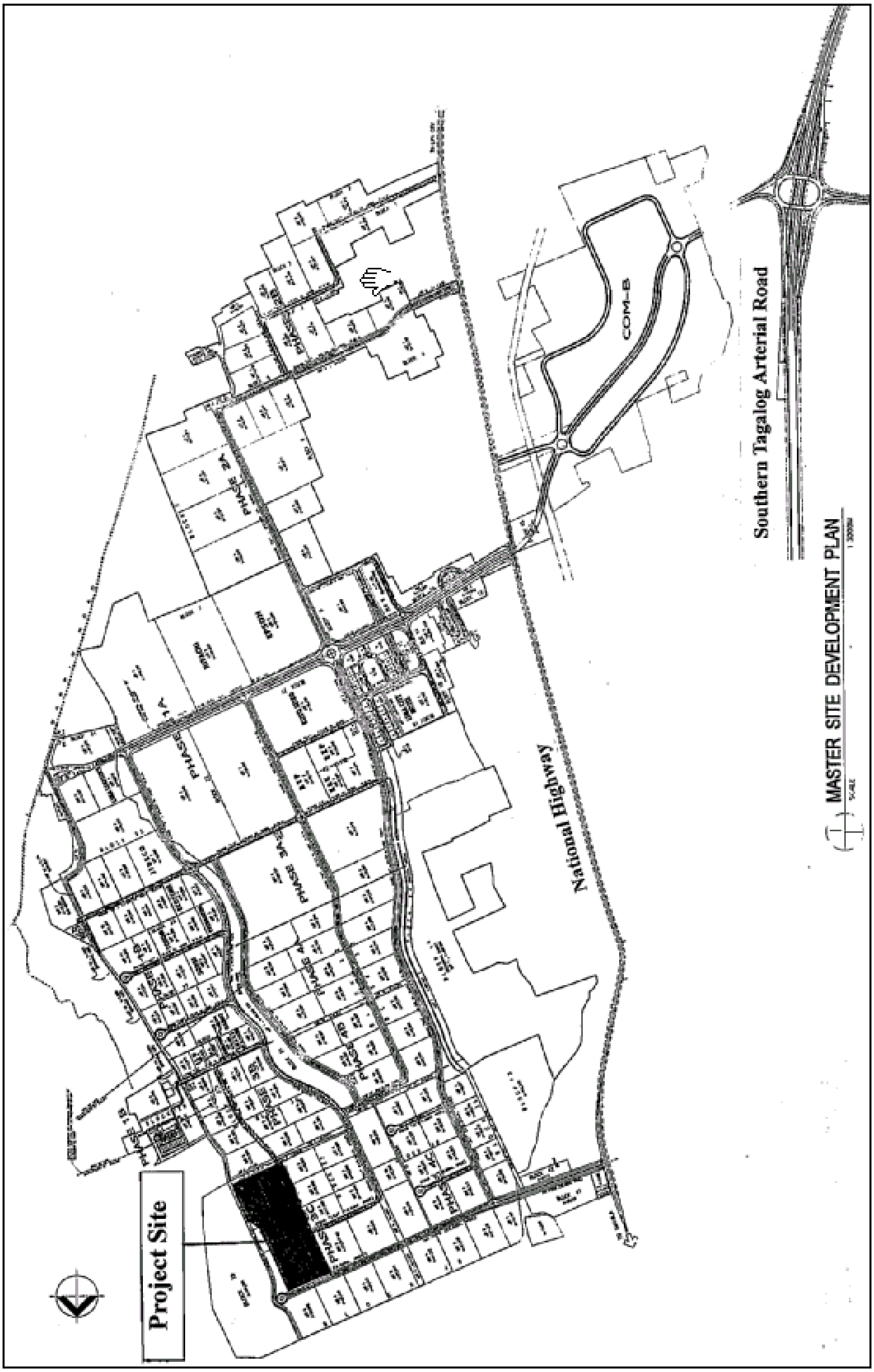


Figure 2.1.2 Location Map of the Proposed MIF Site in LIMA Technology Center

(1) Physical Conditions of the Site

The site is located in the future extension area of LIMA Technology Center and its area is approx. 10 ha. Though LIMA Technology Center lies in the Lipa and Malvar municipal areas, the project site is on the Malvar side.

The project site is on a gentle slope. A creek on the eastern side of the site joins the San Juan River and flows into Laguna Lake.

(2) Location and Accessibility

- Phase 1 studies show that 70% of HW is being generated in the CALABARZON and Metro Manila areas.
- The project site is located in northern Batangas adjacent to the Cavite and Laguna provinces where the industrial zones are concentrated.
- It is also connected directly to the Southern Tagalog Arterial Road linking Santo Tomas with Batangas port by the LIMA interchange to be constructed within three years. Therefore, the project site can have access to all the premises that generate HW in the CALABARZON and Metro Manila areas within two hours.
- In addition to the convenience of inland transportation, accessibility from the other islands is also serviceable because the site is only 35km far from the Batangas port.

(3) Infrastructure Availability

Water supply, electricity, and sewerage treatment system are all available from LIMA Technology Center.

2.2 Assumed Demand for Treatment

Based on the registration data of Metro Manila, CALABARZON and Region 5 as of the end of 2000, the generation amount and the actual treatment situation are expressed by types of wastes and treatment methods in Table 2.2.1.

Table 2.2.1 Categorization of Treatment Demand by Types of Processes

Code	HW Category	Off-Site Treatment
1. Thermal Treatment		
E	Paints/Resins/Lattices/Dyes/Adhesives/Organic Sludge	1,913
F	Organic Solvents	1,100
G	Putrescible/Organic Wastes	6,007
H	Textile	59
I	Waste Oil	4,337
J	Containers	1,597
L	Organic Compounds	631
M	Miscellaneous Wastes	11,382
	Thermal Treatment Total	**27,026**
2. Physicochemical Treatment		
A	Plating Wastes	258

Code	HW Category	Off-Site Treatment
B	Acid Wastes	510
C	Alkali Wastes	19,909
D	Chemical Wastes	118
	Physicochemical Treatment Total	**20,795**
3. Solidification/Landfill		
C	Alkali Wastes	19,909
D	Chemical Wastes	13,412
K	Immobilized Wastes	390
M	Miscellaneous Wastes	9,954
	Solidification/Landfill Total	**43,665**
	Total	**91,487**

Source: The Master Plan Study on Industrial Hazardous Waste Management in the Philippines (Phase I).

Regarding the potential demand for thermal treatment of approximately 27 thousand tons per year given in the table above, its actual demand is estimated to be larger since about 2 thousand tons of HW currently incinerated on site will give rise to residues requiring off-site treatment. Moreover, the amount of medical HW may be underestimated in the above estimation due to limited available generation data from hospitals and other medical facilities. Taking all of these into account, the Study established the potential demand of thermal treatment to be 30 thousand tons per year.

As to physicochemical treatment (PCT), a considerable number of generators may establish their own PCT facility to treat their HW on site. Local treaters are also currently employing this type of process. Therefore, the Study estimated that 75% of the above off-site treatment amount would be absorbed by generators' on-site treatment while a half of the remaining 25% will be handled by the existing local treaters. Accordingly, the potential demand of PCT at the model facility is established to be 2.5 thousand tons per year, about one-eighth of the above off-site treatment amount.

The 43 thousand tons of off-site treatment amount subject to solidification and landfill are considered to represent the amount that is stored on-or off-site for at least 4 to 5 years. Based on this, the Study assumed that the actual potential demand of solidification and landfill would be about 10 thousand tons per year (rounding out the result of dividing 43 thousand tons by 4 years). Although the landfill in the model facility is designed to accept residues generated from each treatment facility in MIF, the Study assumed to accept 60% of the above potential demand 6,000 tons) at the landfill in consideration of the limited availability of proper landfill and storage for HW in the Study area. In this case, 2,500 thousand tons (approximately 40%) of the above 6 thousand tons may be required for solidification to meet the acceptance criteria at the landfill while the remaining 3,500 tons (approximately 60%) can be directly disposed at the landfill.

Thus, the estimated potential demand of HW treatment in the model facility is estimated as shown in Table 2.2.2 below.

Table 2.2.2 Estimated Potential Demand of HW Treatment

Treatment System	Potential Treatment Demand (tons/year)
PCT Facility	2,500
Thermal Treatment Facility	30,000
Solidification	2,500
Controlled Landfill	3,500
Total	38,500

Remark: The potential demand of landfill only includes the amount of direct disposal. The amount coming from other treatment processes in MIF is not included.

Chapter 3

Basic Design of the Model Integrated Facilities

3 BASIC DESIGN OF THE MODEL INTEGRATED FACILITIES

3.1 Preconditions for Design

(1) Applicable Standard, Code and Regulation

Standards, codes, and regulations applied to MIF includes the following areas:

- Power Supply
- Power distribution system
- Water supply
- Emergency power supply
- Environmental management (pollution control)
- Construction code (building code)
- Others

(2) Emergency Measures

As to emergency measures, the model facility is required to have proper fire fighting system, handling of HW, and evacuation system in accordance with the relevant codes and regulations.

3.2 HW Treatment Facilities in MIF and Their Design Treatment Capacities

MIF consists of the following 4 (four) types of HW treatment and disposal facilities:

- Physicochemical Treatment Facility (PCT)
- Solidification Treatment Facility
- Thermal Treatment Facility
- Controlled Landfill Facility

Design treatment capacity of each facility above is established as shown in Table 3.2.1 below.

Table 3.2.1 Design Treatment Capacity of Each Treatment Facility in MIF

HW Treatment Facility	Design Capacity	Remark
PCT	10 tons/8hrs./day	250 days' operation per year
Solidification	20 tons/8hrs./day	300 days' operation per year PCT residues, fly ashes from thermal treatment and sludge are the main HWs to be treated.
Thermal Treatment	100 tons/24hrs./day	300 days' operation per year
Controlled Landfill	15,500 tons/year	Slag generated from thermal treatment process will be mainly disposed of.

The design thermal treatment capacity of 100 tons per day is determined in consideration of the projected treatment demand made in Chapter 2 as well as the scale economy of the facility. Treatment capacity of thermal treatment depends on the size of inlet as well as the capacity of kiln. The kiln applied in the thermal treatment facility is designed to treat HWs with the drum containers of 200-litter capacity. In fact, there is almost no difference in cost of this type of kiln if its treatment capacity ranges from 60 to 100 tons per day. Therefore, the Study selected the design treatment capacity of 100 tons per day. If it exceeds 100 tons per day, the cost will be totally different and its operation risk may increase. Through 300 days of operation, the thermal treatment facility can treat 30 thousand tons of HW annually, which can accept additional 3,000 tons of HW annually to the potential thermal treatment of 27,000 tons per year, which is estimated in Chapter 2.

The thermal treatment facility also accepts treated residual liquid of 4 tons per day from PCT facility for thermal decomposition by the secondary combustion chamber.

To meet the estimated potential PCT demand of 2,500 tons per year, its design treatment capacity is set at 10 tons per 8 hours operation daily. Although the annual operational day is set at 250 days, it can be increased if the demand is more than the amount estimated above. The daily operation hours can also be extended in response to possible increase of demand. By applying such flexible operation of PCT facility, MIF can minimize scale of PCT facility as well as its operation related risks.

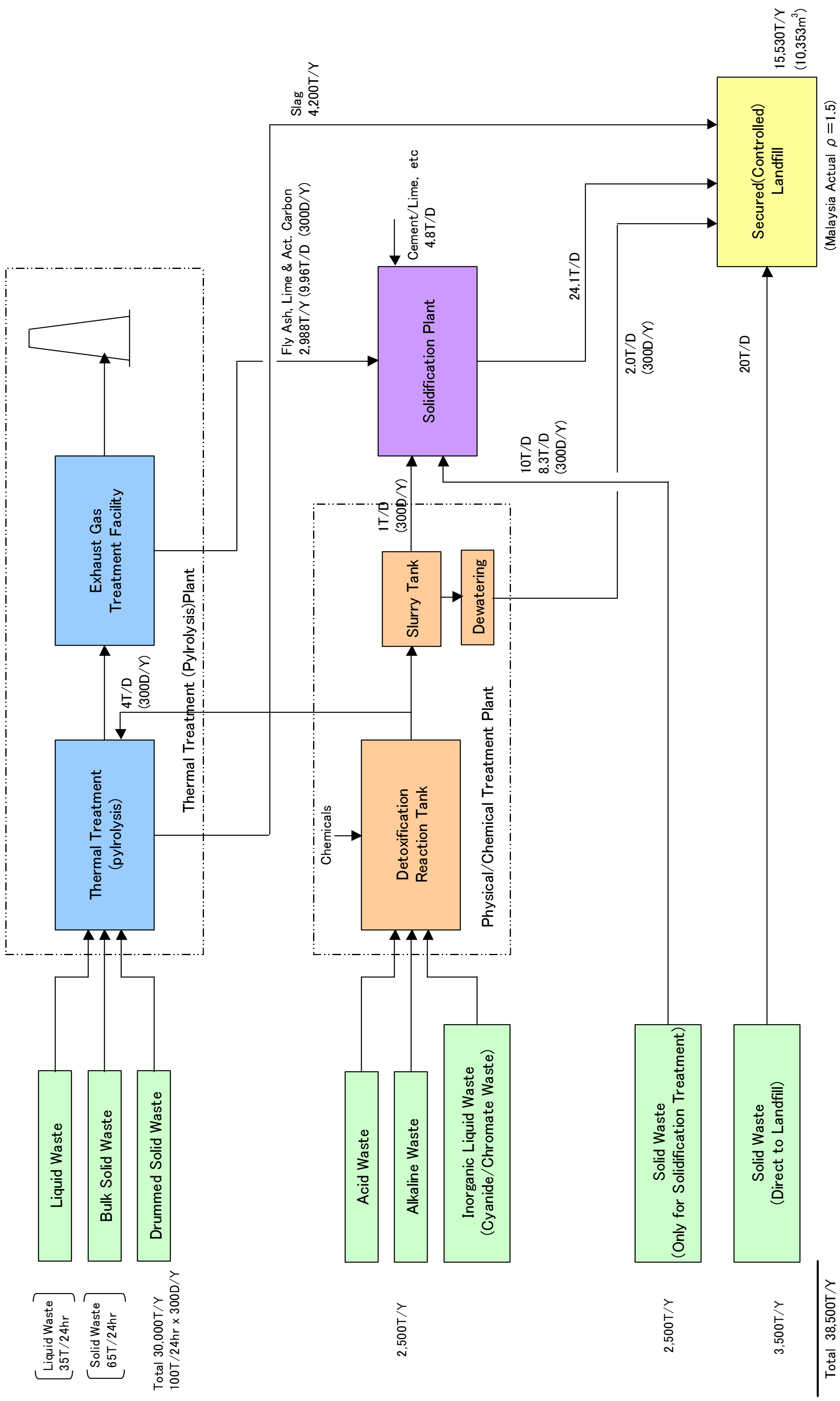
As to Solidification facility, its design treatment capacity depends on the amount of ashes from thermal treatment facility, sludge from PCT, and direct acceptance of HW. Although the amount of ashes is determined by the ash content of each HW accepted, the Study made a rough estimation based on the actual records of similar facilities in Japan that 10% of HW input to thermal treatment would generate as ashes. Therefore, 10 tons of ashes are accepted daily by solidification facility. Concerning PCT sludge, the Study assumed that about 1 ton of sludge would be required for solidification to meet acceptance criteria for disposal by landfill in MIF. Finally, as mentioned in Section 2.3, about 2500 tons of HW per year (more or less 8 tons per day for 300 days operation per year) will be subject to solidification treatment before disposal by landfill in MIF.

Take all the above into account, the Study established the design treatment capacity of solidification facility at 20 tons per 8 hours daily operation.

Landfill capacity is determined in consideration of the amount of residues generated from MIF facilities (PCT, solidification, and thermal treatment) as well as the limitation of available areas for landfill in the project site. The Study estimated that composition of the amount of HW disposed by landfill in MIF would be as shown in below.

Table 3.2.2 Composition of the amount of HW disposed by landfill in MIF

Types of HW	Amount (tons/year)
Slag from thermal treatment	4,200
Sludge from PCT	600
Solidified inert waste	7,200
Inert Waste directly disposed by landfill	3,500
Total	15,500



Remarks : The values above are subject to Waste Profile change.

Figure 3.2.1 Material Flow

3.3 Physicochemical Treatment (PCT) Facility

(1) Purpose of Physicochemical Treatment

To meet the requirement of the RA6969/DAO29, physicochemical treatment process is applied to detoxify some HW types that are acidic, alkaline, toxic, and/or reactive before its final disposal.

(2) Design Treatment Capacity

Design capacity for the PCT facility is determined as follows:

Daily treatment capacity: 10 ton per day (average daily operation of 8 hours)

(3) HWs to be treated

- Alkali wastes containing low cyanide content,
- Waste alkali (pH≥12.5), including caustic soda, caustic potash, and ammonium.
- Waste acid (pH≤4), including sulfuric, hydrochloric, phosphoric, fluoric, and acids and acids containing chromium compounds,
- Acid waste containing hexavalent chromium and other heavy metals, and
- Reactive chemical waste, including oxidizing agents, reducing agents, highly reactive chemicals.

(4) Treatment Process

- Oxidization of cyanide-containing liquids,
- Reduction of the liquid waste containing hexavalent chromium,
- Precipitation of fluorides-containing liquids, and
- Separation and precipitation of heavy metals.

(5) Basic Design of PCT Facility

PCT facility consists of five major components, such as a reactor tank, a waste storage tank, a chemical storage tank, equipment, and a building. Figure 3.3.1 shows the flow of PCT in MIF.

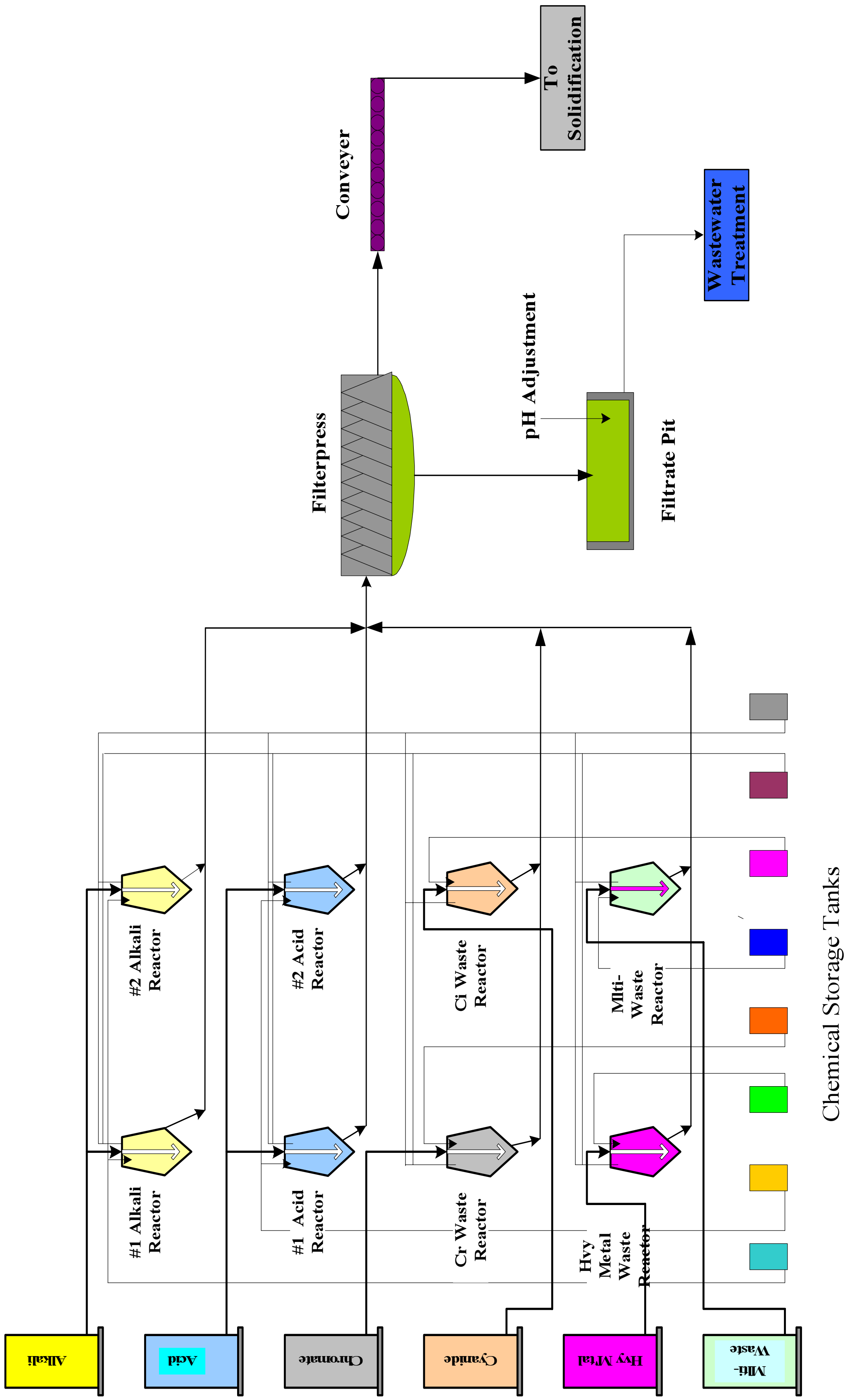


Figure 3.3.1 Flow of Physicochemical Treatment

3.4 Solidification Facility

(1) Purpose of Solidification

Solidification treatment is carried out to prevent the contamination of soil with toxic substances leached from solid HWs, so as to makes the waste comply with the landfill acceptance criteria. The other objective of solidification treatment is to control the elution from the HWs.

(2) Type of Waste to be treated

- Sludge contaminated with heavy metals
- Noncombustible and high viscosity sludge contaminated with heavy metals
- Metal hydroxide sludge from wastewater treatment system
- Oxide or sulfate from wastewater treatment facilities
- Residues from PCT (if contaminated with heavy metal)
- Fly ashes contaminated with heavy metals

(3) Design Capacity of Solidification Facility

Design capacity of the Solidification should be 6,250 tons per year.

(4) Process of Solidification

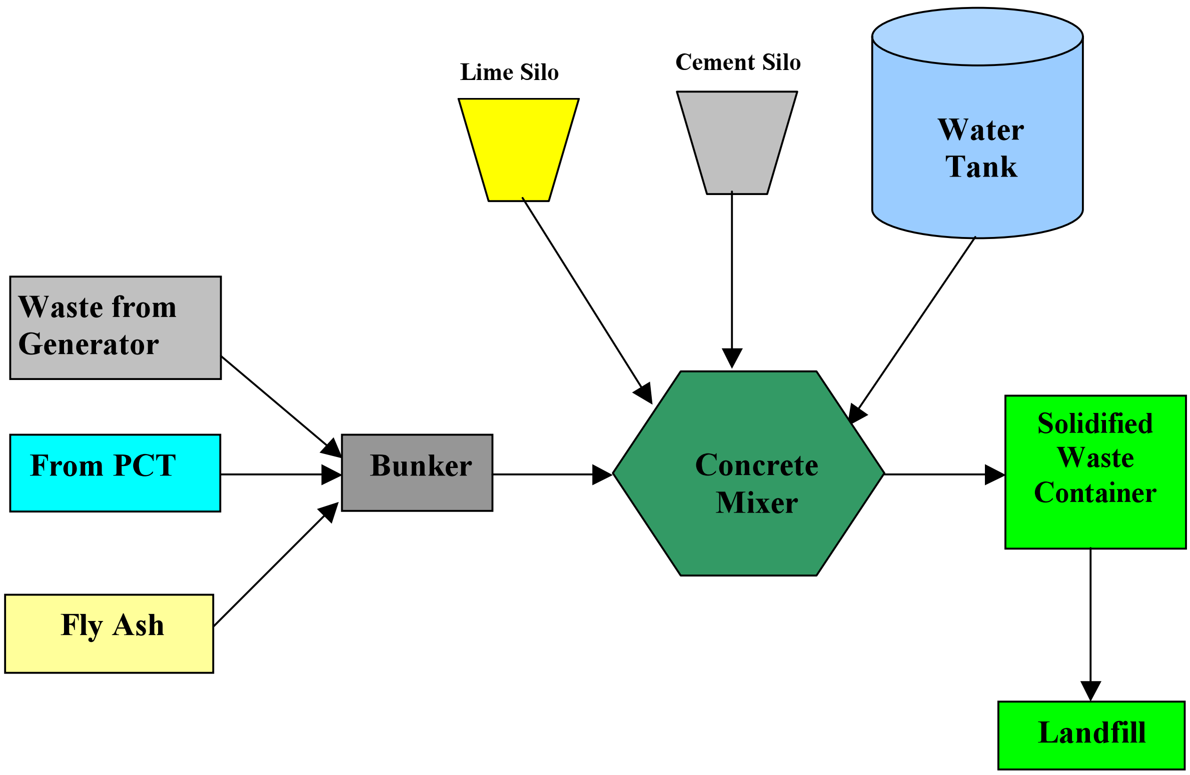


Figure 3.4.1 Solidification Process

3.5 Thermal Treatment Facility

(1) Purpose of Thermal Treatment

The purpose of thermal treatment is to reduce the pollution potential of targeted hazardous wastes by their conversion to the mineralized and stabilized form. According to RA6969/DAO92-29, the hazardous wastes shall be principally converted into an inert state, before it can be discharged at a landfill. Non-inert or unstable hazardous wastes cannot be discharged at a landfill site without proper treatment. Consequently, it is essential to convert such wastes into their mineral state through the thermal treatment.

(2) Category of Hazardous Wastes and Design Capacity

Thermal treatment capacity is designed as 30,000 tons per year. Following are the target hazardous wastes to be treated by the thermal process;

- Liquid organic wastes (Spent Solvent, Organic Acids)
- Solid organic wastes containing toxic materials (Organic Sludge, IC Waste)
- Poisonous wastes (PCB, Insecticide)
- Hi-Viscosity wastes (Oil sludge)
- Infectious wastes
- Special wastes (High Concentrated Cyanide Wastes, Cyanide Compounds, Laboratory Wastes, Highly Odorous Materials)
- Waste oils

(3) Selection of Thermal Treatment Process

a. Applicable Types of Thermal Destruction Furnace

- Rotary kiln incinerator
- Slagging rotary kiln
- Shaft type melting furnace
- Rotary kiln type gasification and melting furnace (indirect heating)

b. Evaluation Criteria

- Environmental compliance
- Economic feasibility
- Technical acceptability

c. Evaluation results

Based on the above criteria, the slagging rotary kiln has been selected as the best suitable thermal treatment technology.

(4) Basic Design of Slagging Rotary Kiln Facility

a. Thermal treatment process

The wastes are gasified in a low temperature zone of the kiln furnace, then the combustion gases and the fixed carbons are combusted at higher temperature emanating from the radiation of refractory materials in the calcination zone. Generated ashes are melted and converted into slag at high temperature (approximately 1300℃) in the high temperature zone. In order to control the temperature properly, the outlet gas temperature shall be maintained above 1200℃ by combusting of auxiliary fuels.

The non-combusted or incompletely combusted gases from the kiln furnace are transferred into the secondary combustion chamber (SCC), retained there for 2 or more minutes for complete combustion. The outlet temperature of SCC shall be controlled at approximately 950℃.

The slag is cooled down by spraying water at cooling chamber, then discharged from the SCC.

b. Treatment of residues

c. Wastewater treatment system

d. Flue gas treatment system

1. In order to comply with the Emission Standard, special attention should be paid to HCl (10mg/Nm^3), HF (1mg/Nm^3), Dioxins and Furans (0.1ng/N m^3), and Heavy Metals. The method that can effectively and economically removes these chemicals is Dry absorber + Bag Filter + Scrubber.

e. Energy recovery system

(4) Process Flow Diagram

The flow diagram for Slagging Rotary Kiln Type Thermal Treatment System is described in Figure 3.5.1.

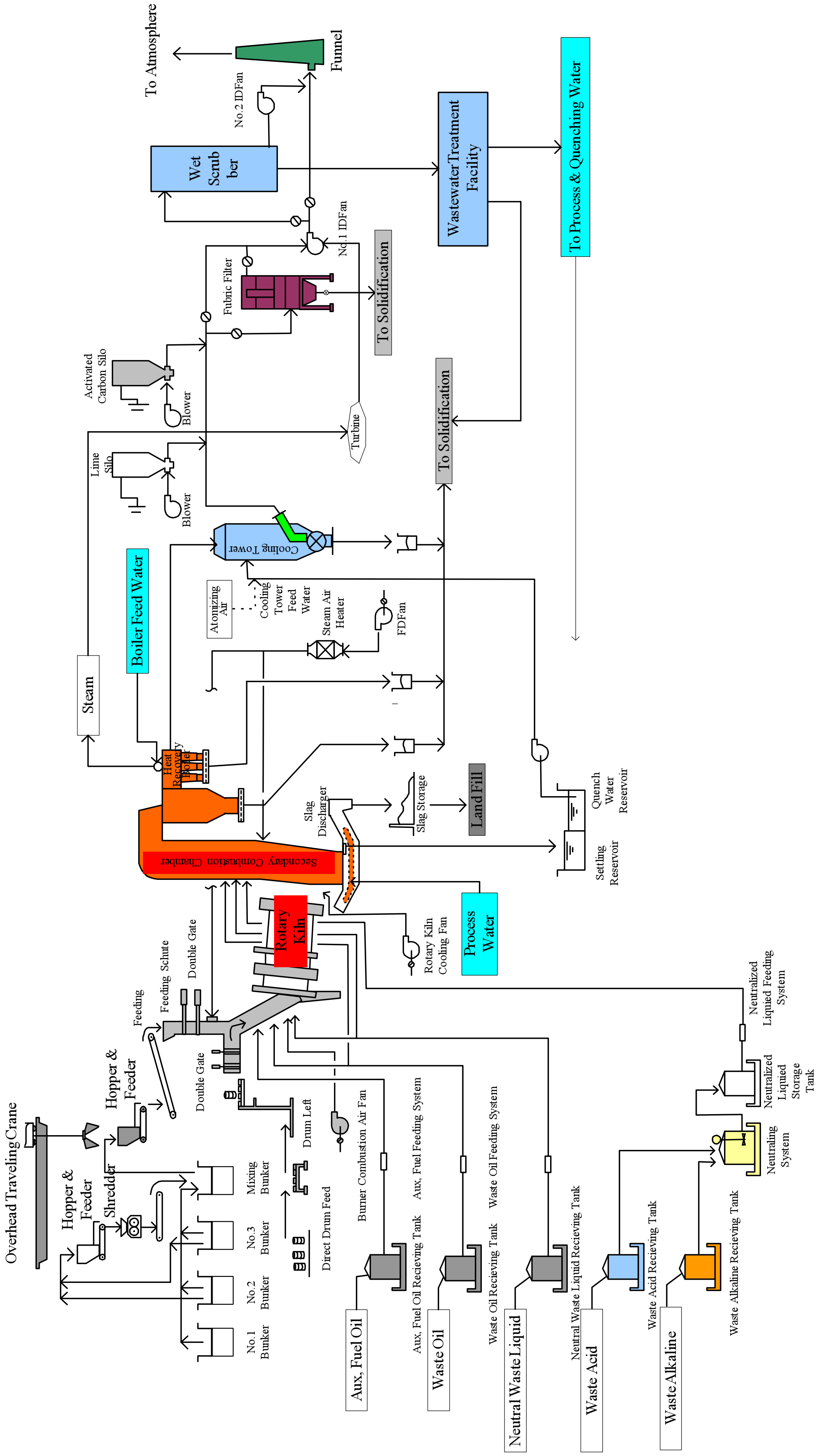


Figure 3.5.1 Process Flow of Thermal Treatment System (Slagging Rotary Kiln)

3.6 Disposal Facility

(1) Planned Disposal Volume

38,500 tons of hazardous waste are annually reduced to 15,530 tons of inert waste to be disposed through the solidification and thermal treatment process. The design disposal volume estimated is shown in Table 3.6.1. The apparent specific gravity of the disposed waste is assumed as 1.5 tons/m^3.

Table 3.6.1 Design Disposal Volume

Items	Unit	First 5 Years	Second 5 Years	Total
Daily amount	t/day (m^3/day)	52.1 (34.5)	52.1 (34.7)	52.1 (34.7)
Annual disposal volume	m^3/year	10,420	10,420	10,420
Top covering soil	m^3	4,050	4,050	8,100
Accumulated waste volume	m^3	52,100	52,100	104,200
Accumulated covering soil	m^3	4,050	4,050	8,100
Total disposal volume	m^3	56,150	56,150	112,300

(2) Disposal Facilities

a. Landfill area development

The gross area of the site is approximately 10 hectares. The disposal area is planned to be located at the southern part of the site, in an area that is almost one third of the total usage area.

The total area of the design disposal capacity is 112,300m^3, which will suffice for ten years of landfill operation. However, two landfill pits will be separately constructed in 2 phases so that the initial construction cost can be reduced by half.

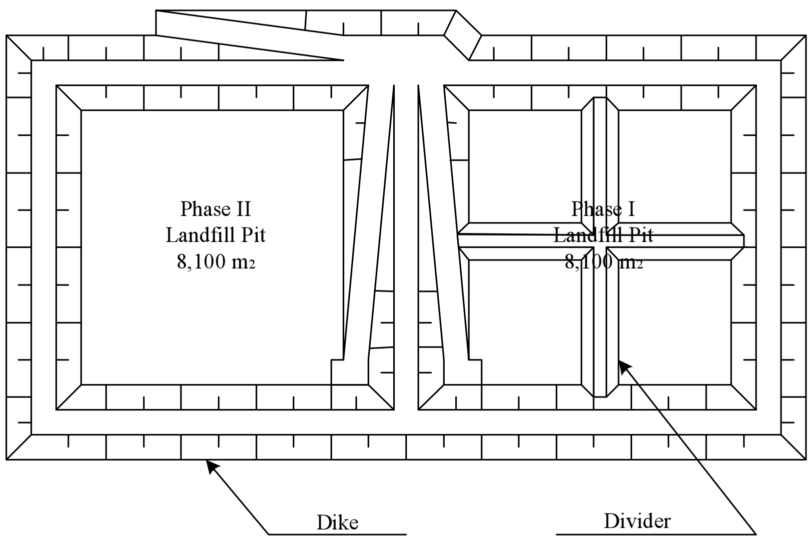


Figure 3.6.1 Plan of Disposal Facility

b. Drainage system (to be developed)

c. Leachate

i) Leachate collection

A perforated reinforced concrete pipe placed on the liner made of HDPE plastic sheet will collect leachate.

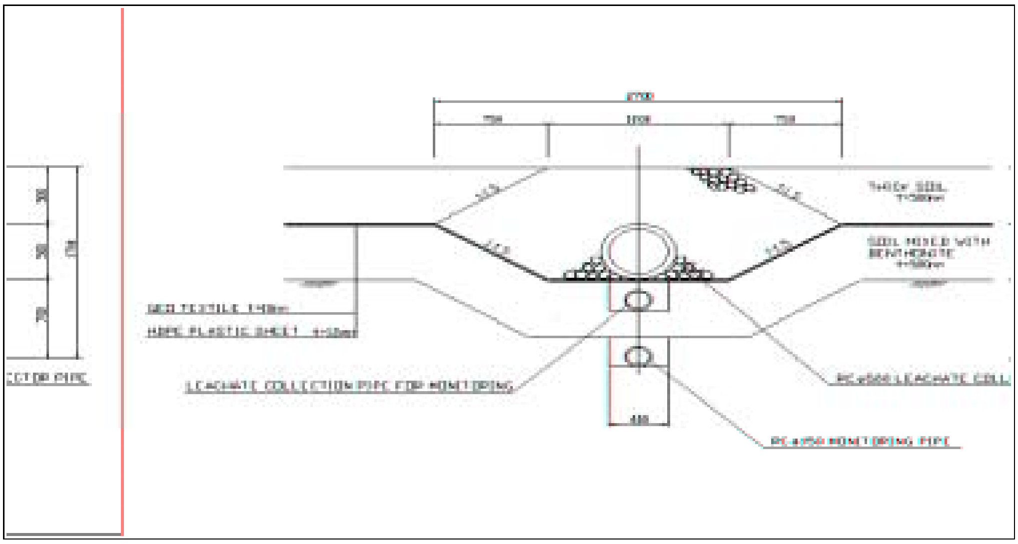


Figure 3.6.2 Cross Section of Leachate Collection Pipe

ii) Others (Liner, Leachate Reservoir, Leachate Leakage Detection)

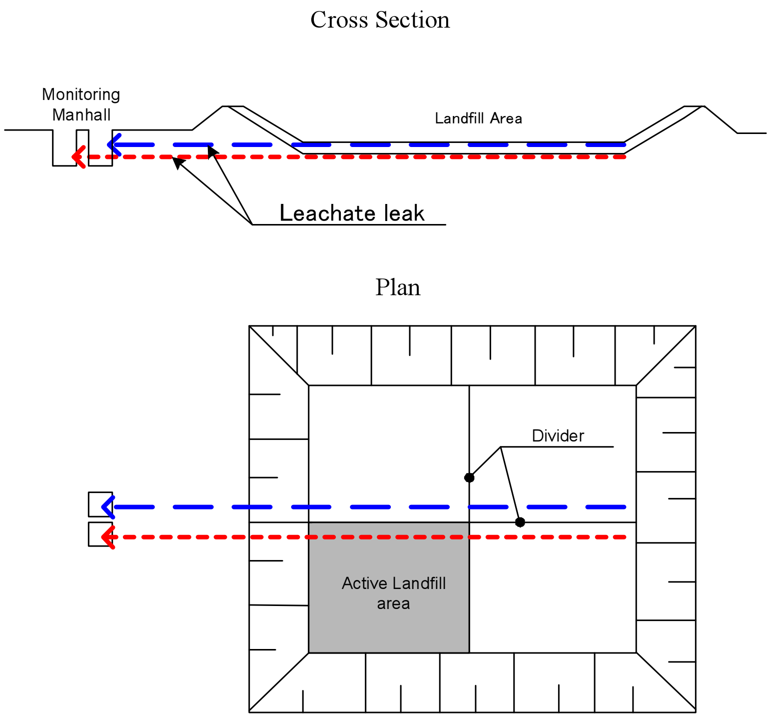


Figure 3.6.3 Monitoring System for Leakage of Leachate

3.7 Equipment

The following equipment will be prepared in the Project.

a. **Waste Handling Vehicle and Equipment**

b. **Landfill Equipment**

c. **Analytical Equipment**

d. **Waste Reception and Management Equipment (Truck Scale, Manifest data management system)**

3.8 Layout Plan

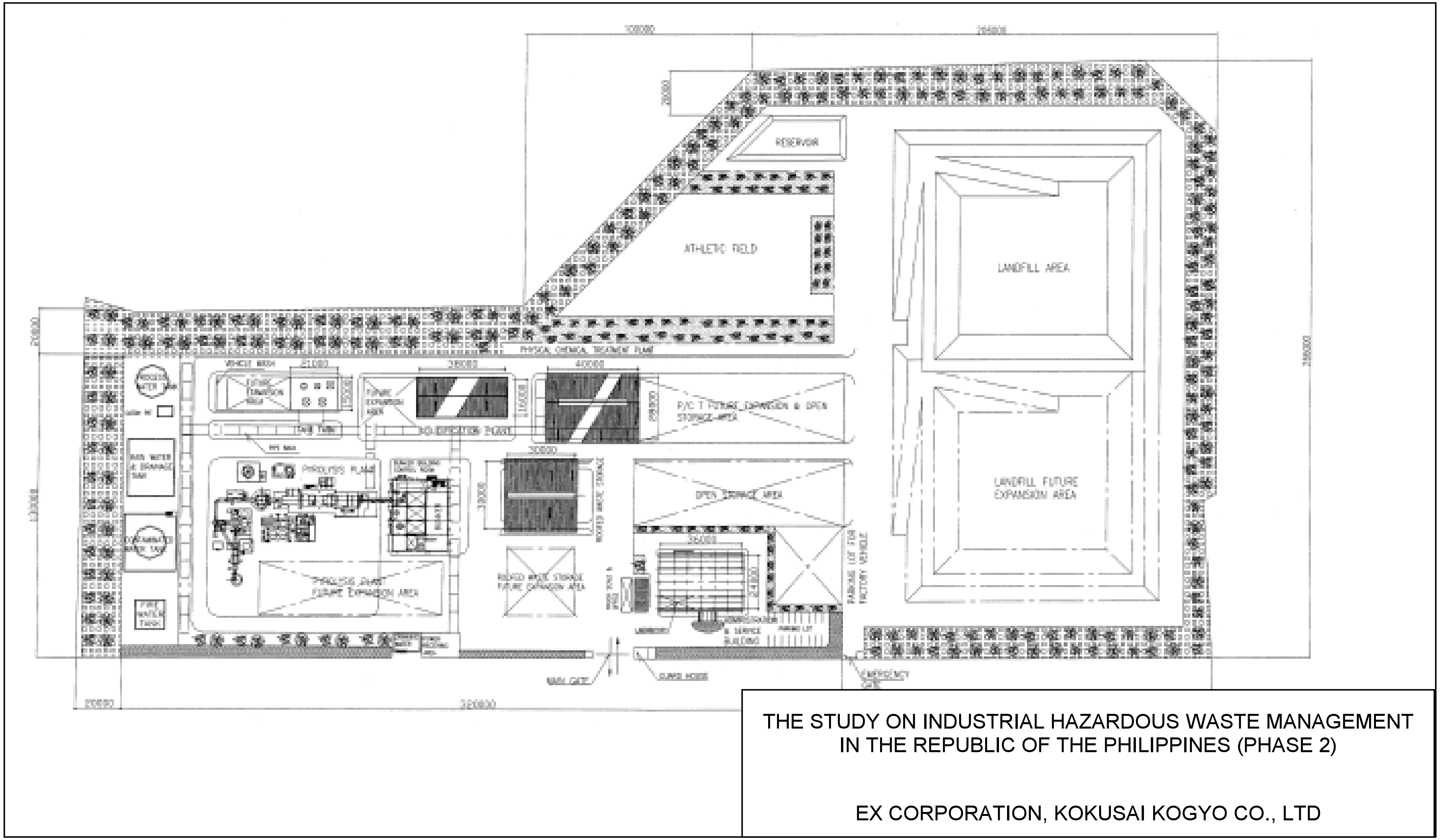


Figure 3.8.1 Layout Plan of the Industrial Hazardous Waste Treatment Facility

3.9 Cost Estimates

Construction cost of MIF is estimated as follows:

Table 3.9.1 Cost Estimates for the Facility except Landfill

Unit: Pesos

Item	Foreign Cost	Local Cost	Total
Thermal Treatment Facility			
Plant	800,000,000-	0-	800,000,000-
Structure & Civil Work	80,000,000-	200,000,000-	280,000,000-
Electrical & Control	80,000,000-	40,000,000-	120,000,000-
Sub Total	960,000,000-	240,000,000-	1,200,000,000-
PCT Facility			
Plant	24,000,000-	28,000,000-	52,000,000-
Structure & Civil Work	0-	40,000,000-	40,000,000-
Electrical & Control	0-	8,000,000-	8,000,000-
Sub Total	24,000,000-	76,000,000-	100,000,000-
Solidification Facility			
Plant	20,000,000-	8,000,000-	28,000,000-
Structure & Civil Work	0-	28,000,000-	28,000,000-
Electrical & Control	0-	4,000,000-	4,000,000-
Sub Total	20,000,000-	40,000,000-	60,000,000-
Laboratory Equipment			
Major Equipment	32,000,000-	0-	32,000,000-
Other Special Instrument	8,000,000-	0-	8,000,000-
Sub Total	40,000,000-	0-	40,000,000-
Storage Facilities & Others			
Storage Facilities: * Wastewater Tank * Contaminated Water Tank * Fire Fighting Water Tank	20,000,000-	32,000,000-	52,000,000-
Other Facilities: * Road Construction * Plantation & Landscaping * Fencing * PA & Lighting * Related Civil Works	0-	40,000,000-	40,000,000-
Sub Total	20,000,000-	72,000,000-	92,000,000-
Utility &Other Equipment			
Drinking Water Tank & Supply System	0-	80,000,000-	80,000,000-
Sub Total	0-	80,000,000-	80,000,000-
Administration Building			
Building Construction	0-	60,000,000-	60,000,000-
Related Equipment & Others	0-	20,000,000-	20,000,000-
Sub Total	0-	80,000,000-	80,000,000-
Grand Total	**1,064,000,000-**	**588,000,000-**	**1,652,000,000-**

Table 3.9.2 Cost Estimates for Landfill

Unit Pesos

Item	Phase 1	Phase 2	Total
1 EARTH WORK	102,300,000	19,055,000	121,355,000
2 SLOPE PROTECTION	1,750,000	1,250,000	3,000,000
3 PAVEMENT WORK	4,027,250	4,027,250	8,054,500
4 DRAINAGE WORK	2,700,000	300,000	3,000,000
5 LEACHATE COLLECTION WORK	2,363,000	1,463,000	3,826,000
6 MISCELLANEOUS WORK	4,055,000	2,990,000	7,045,000
7 LINING WORK	31,145,200	29,535,000	60,680,200
TOTAL	**148,340,450**	**58,620,250**	**206,960,700**

Remark: Construction of Landfill facility is divided into 2 phases.

Table 3.9.3 Total Construction Cost of MIF

Unit: Pesos

Facility	Foreign Cost	Local Cost	Total
PCT (plant only)	24,000,000-	28,000,000-	52,000,000-
Solidification (plant only)	20,000,000-	8,000,000-	28,000,000-
Thermal Treatment (plant only)	800,000,000-	0-	800,000,000-
Civil Works (exc. landfill)	100,000,000-	340,000,000-	440,000,000-
Electrical & Control (Plant related)	80,000,000-	52,000,000-	132,000,000-
Landfill (Phase I only)	26,000,000-	122,000,000-	148,000,000-
Laboratory Equipment	40,000,000-	0-	40,000,000-
Administration Office (exc. civil works)	0-	60,000,000-	60,000,000-
Others (Storage, Utilities, etc.)	0-	100,000,000-	100,000,000-
Physical Contingency*	25,200,000-	92,400,000-	117,600,000-
Total	**1,115,200,000-**	**802,400,000-**	**1,917,600,000-**

* Physical Contingency cost is 20% of civil works and landfill.

3.10 Replacement Cost

Based on the establishment of replacement schedule of facilities, replacement cost is estimated as follows:

Table 3.10.1 Replacement Cost

Unit: Pesos

Facility	Foreign Cost	Local Cost	Total
Thermal Treatment	80,000,000-	55,000,000-	135,000,000-
PCT	3,000,000-	20,000,000-	23,000,000-
Solidification	10,000,000-	4,000,000-	14,000,000-
Laboratory Equipment	8,000,000-	3,000,000-	11,000,000-
Others	0-	20,000,000-	20,000,000-
Total	**101,000,000-**	**102,000,000-**	**203,000,000-**

Chapter 4

Operation Plan

4 OPERATION PLAN

4.1 Waste Acceptance and Management of Waste Flow in MIF

In receiving HW, MIF will obtain information on the HWs from each generator for examining their acceptability at MIF. Prior waste analysis may be carried out as the need arises.

If the HWs are acceptable, MIF will make a treatment agreement with the HW generator. The agreement will specify the name of generator, types and quality of HWs accepted.

Although normal confirmation of the types of HWs is conducted by visual inspection and manifest checking, direct analysis of HWs will also be carried out periodically.

If MIF finds that the HWs accepted is not in accordance with those specified in the agreement, the issuance of manifest will be ceased until they are confirmed acceptable.

4.2 Waste Collection and Transportation

(1) Principle of Waste Collection and Transportation Services

- MIF will provide waste collection and transportation services for HW generators
- The basic treatment fee includes the cost of containers and waste pick-ups
- Waste pick-up service is provided
- Standardized containers are supplied to the clients, but clients can use their own containers and/or transportation, if the facility approves

(2) Amount of HW to be collected

According to the design treatment capacity of the facility, the expected amount of wastes to be collected is estimated to be 38,500 tons per year.

(3) Collection of Non-Bulky Waste

Collection of non-bulky waste (liquid and solid) waste is planned as follows:

a. Containers

- Drums and lid seal-able metal cans
- Polyethylene containers

b. Types of Transport Vehicle

Commercial truck type vehicles are employed to collect the waste, but the vehicles should be equipped with devices to load and unload drums, steel cans, and polyethylene containers.

c. Loading Plan

All the containers should be placed on a pallet and then loaded on the transport vehicle. Loading capacity required for the transport vehicle is 4 drums per a pallet, which is 1.2 squire meters in size. The loading height is approximately 1.25 meter.

d. Number of Vehicles

Long bed light truck (30 drums: 4.5 tons):	3
Long bed truck (60 drums: 9.0 tons):	2

(4) Collection of Bulky Solid Wastes

Collection of bulky waste is carried out by making use of large loading containers.

- Planned loading capacity: 6 m^3 container x 4
- Number of vehicles: 3
- Spare vehicle: short bed light truck: 1 unit

4.3 HW Data Management in MIF

HWs data in MIF is managed through the manifest system. Identification number of HW generator and HW code are given to each type of HW accepted at MIF. By making use of bar code format, flow of HW in MIF is managed by centralized computer in the main office. All the HW haulage vehicles will be equipped with bar-code entering and reading device.

In receiving HW at MIF, types and amount of HW are confirmed by reading the barcode on the manifest sheet. The reading data will be directly sent to the data center in the main office so as to confirm whether the HWs accepted are in compliance with the agreement with the HW generators. The process of HWs in MIF will also be electronically managed by the same data system.

The HWs accepted at MIF will be managed in accordance with the mechanism shown in Figure 4.3.1 below.

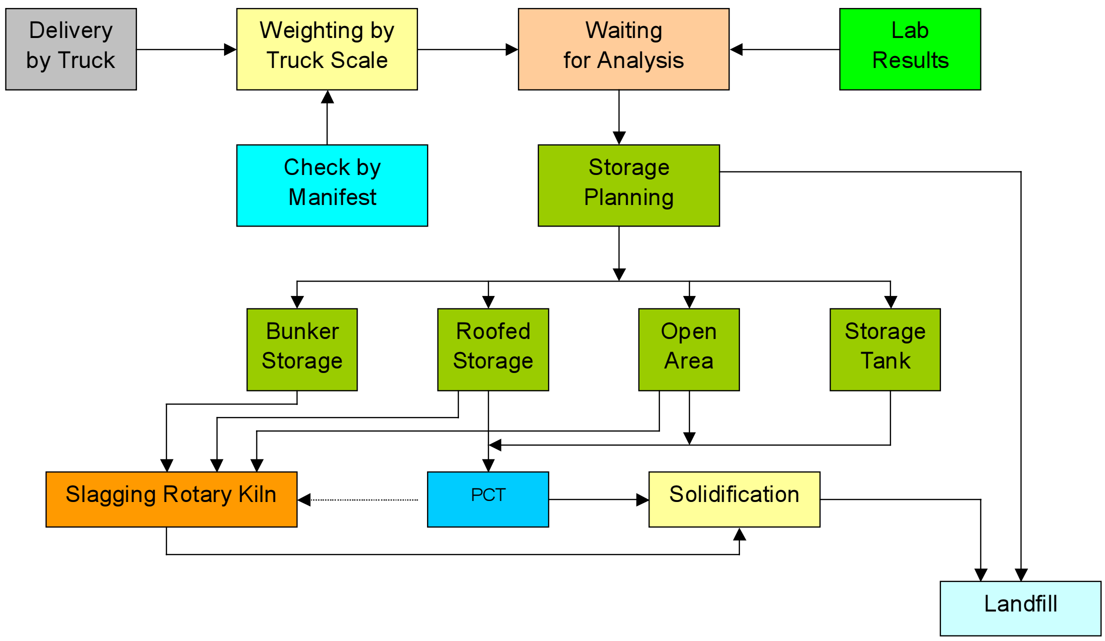


Figure 4.3.1 Management Flow of HW in MIF

4.4 Safety and Environmental Management and Education

(1) Safety Measures

MIF will establish its own safety management committee and appoint a plant safety manager. A safety regulation will also be established in MIF, in which the emergency response measures are specified. Training of emergency measures and safe plant operations will be carried out for MIF workers.

(2) Environmental Management

MIF will make an environmental agreement with the neighboring community, in which a self-environmental management standard will be established. MIF will also establish environmental management committee and appoint an environmental management officer in charge of overall environmental management of the facilities.

(3) Education

Seminars and training programs on HWM, RA6969 and DAO92-29 will be held for MIF operators, users, and other relevant stakeholders.

4.5 Maintenance of Treatment Facilities

Facility maintenance will be as follows.

(1) Maintenance of PCT Facility

Filter cloth, shaft seal of pump, tanks, and flue gas scrubber are subject to maintenance.

(2) Maintenance of Solidification Facility

A concrete mixer, feeding conveyer, pump, hoist crane and etc. should be mechanically checked periodically.

(3) Maintenance of Thermal Treatment Facility

Major causes of the malfunction include built-up scale in pumps and pipelines, changing a combination of fuels, and sudden breakage of nozzles, controllers, and similar units. Preventive maintenance is always the best technique to avoid those malfunctions.

4.6 Operation of Facility

(1) Operation of Facility

a. Reception of Wastes

The facility can manage to receive wastes from generators 12 hours in weekdays but except on the Saturday and Sunday.

b. Storage Facility

All accepted wastes shall be temporally stored at the classified storage facility.

c. Facility Operation

i) PCT Facility

The PCT facility shall be operated for 8 hours in weekdays, but no operation on the Saturday and Sunday.

Treated residue is discharged in a waste-bin and normally transported to the landfill site by a small truck (2 tons) whenever it is fully loaded. However, the waste, which is contaminated with heavy metals shall be transferred to the solidification facility.

ii) Solidification Facility

The solidification facility shall be operated for 8 hours daily. A waste as well as a cake (sludge) from the PCT that needs solidification shall be dumped into a mixing pit. The operator shall determine desirable volumes of sands and cements to be required for the solidification process. However, ashes that are contaminated with such as heavy metals shall be once into an airtight measuring hopper until an appropriate volume of ashes will be accumulated per a batch operation. Ashes shall be directly loaded in the cement mixer from the hopper.

iii) Thermal Treatment Facility

The thermal treatment facility is basically designed to operate for 24 hours per 300 days annually. However a regular inspection work shall be scheduled for a week every 3 months as well as an annual maintenance work for 30 days within a year shall be required.

Slag shall be manually discharged out from the kiln furnace by the slag-discharger and brought into landfill every operational day of thermal treatment facility.

The separated ashes shall be transferred to the solidification facility every operation day of thermal treatment facility.

iv) Landfill Facility

The landfill facility shall be scheduled to operate for 8 hours in weekdays except the Saturday and Sunday to treat both wastes that will be directly delivered from generators as well as discharged from the solidification facility. But the landfill shall accept the slag for 24 hours per day while the thermal treatment is operated.

v) Laboratory

Waste analysis laboratory shall be operated for 12 hours daily except Saturday and Sunday.

(2) Organization for Facility Operation

For MIF operation, the Study suggested to establish an organization composed of Treatment Department (operation, planning, storage control), Maintenance Department, Laboratory (analysis of received and treated wastes), and Business Management Department (sales and marketing, dispatch control of vehicles, HW data management, purchasing and procurement, accounting, management planning).

Table 4.6.1 Manpower Allocation for Facility Operation

Position	Number
Executive Officer	3
Manager	10
Engineer	6
Technical Staff	25
Facility Operator	26
Office administration officer	5
Total	75

4.7 Consumable Parts and Materials

Consumable parts and materials needed for MIF operation are as follows:

(1) Consumables for PCT Facility

1) Sodium Hypochlorite
2) Aqueous Sulfuric Acid
3) Slaked Lime
4) Ferrous Sulfate
5) Sodium Hydroxide (Caustic Soda)
6) Sodium Sulfide
7) Ferric Chloride
8) Flocculant
9) Activated Carbon
10) Lime
11) Lubricants: for driving mechanism, pumps
12) Filter Cloth
    For Filterpress: replacement will be required every 3~5 years

(2) Consumables for Solidification Facility

1) Lime
2) Cement
3) Lubricants: for driving mechanism, pumps

(3) Consumables for Thermal Treatment Facility

1) Lime: for the flue gas treatment system
2) Activated Carbon: for the flue gas treatment system
3) Caustic Soda: for the wet scrubber
4) Lubricants: for waste feeder, slag conveyer, driving mechanism of rotary kiln, ID fan, quenching water feed pump, cooling water pump, etc.
5) Refractory (for rotary kiln: replacement will be required every $1\sim1^1/_2$ years, and for SCC: replacement will be required every $2\sim2^1/_2$ years

(4) Consumables for Other Facility

1) Lubricants: for loading equipment at storage area

2) Testing Chemicals: for laboratory
3) Other Consumable Materials: for laboratory

4.8 Operation Cost

Operation cost of the facilities except for the landfill is summarized as shown in Table 4.8.1 below.

Table 4.8.1 Total cost of operation

Cost Items	Operation Cost per Year (Peso)
Utilities	**14,238,000-**
Chemicals and Agents	**22,505,250-**
Fuels	**39,960,000-**
Maintenance and Repairing	**13,600,000-**
Manpower	**42,873,600-**
HW Collection & Haulage	**46,200,000-**
Miscellaneous Cost	**17,185,000-**
* Safety & Medical related	860,000-
* Refractory Replacement	11,400,000-
* Labo Equipment, Computers	1,200,000-
* Office Equipment	800,000-
* Wastewater Discharge Fee	1,125,000-
* Access Road Fee	1,800,000-
TOTAL	**196,561,850-**

4.9 Operation Cost of Landfill

(1) Summary of Landfill Operation

The material of daily covering waste is the slag produced in the thermal treatment plant. Therefore, all-weather sheets cover the working face to reduce a generation of the leachate. When the top level of the landfilled waste reached the planned level, the waste will be covered by a 50cm thick layer of impermeable soil obtained in the site.

(2) Operation Cost

Annual O&M cost estimated is 5.3 million. In addition to the annual cost, the expenses for final covering soil, surface drainage and planting will be necessary for every 5 years after commencement of the operation. Therefore, the total O&M cost for ten years estimated as 55.6 million pesos.

Chapter 5

Project Implementing Organization and Business Operation Plan

5 PROJECT IMPLEMENTING ORGANIZATION AND BUSINESS OPERATION PLAN

5.1 Project Implementing Organization

Although DENR/EMB is proposed to be the proponent of the project, it is difficult for DENR/EMB to be the applicant of ECC of the project as it is the ECC issuing body as well. Therefore, Natural Resources Development Corporation (NRDC), a public corporation under the control of DENR is responsible for conducting the EIA and applying for ECC.

NRDC is currently responsible for development and use of natural resources including minerals and forest. It is also allowed in its charter for NRDC to deal with HW treatment project.

The Board of Directors of NRDC is chaired by DENR Secretary and organized by the representatives from Department of Finance, Trade and Industry, NEDA, and so forth. In this respect, NRDC, as the implementation body of the project, can receive assistance from key departments and government agencies through the discussion at the above Board of Directors meetings.

However, since NRDC has no experience in building such facilities as proposed in the project, organizational supports from DENR/EMB and other relevant government agencies are required for proper management of facility construction (see Section 8.4).

As to operation and management of MIF, NRDC also needs supports from those who have enough experience and know-how in HW treatment facilities. In this regard, the Study proposed to consign it to private O & M contractors by tendering. Taking into account that the experience and know-how in O & M of HW treatment facilities are very limited in domestic private treaters, the Study recommended inviting foreign experienced contractors in the tendering.

5.2 Use of Private O &M Contractors

The Study assumed the following options of private sector participation in Operation and Management of MIF.

Option A: Facility lease contract with private O & M contractor

In this case, the MIF built by NRDC is leased to a private O & M contractor, who operates MIF for HW treatment. The contractor pays leasing fee to NRDC from the revenue of MIF, i.e. HW treatment fees from HW generators. NRDC, on the other hand, collects the initial investment capital from the income of the above leasing fee.

Option B: Commissioning of O & M to private contractor

NRDC contracts out O & M of MIF to private contractor(s). In this case, NRDC pays commissioning fees of O & M while it collects HW treatment fees from HW generators. In this case, treatment fees are the sources of the above payment as well as collection of the initial investment capitals.

<u>Option C: Joint Venture with private contractor for O & M</u>

In this option, NRDC and private contractor(s) establish a joint venture company to carry out O & M of MIF. Both sides jointly take risks and responsibilities for the O & M. In the case of joint venture company, the conditions of financing the project are generally stricter than the case of public body. The loan conditions (interest rate, maximum borrowing amount, grace and repayment period) from bilateral donor agencies such as Japanese Yen Loan will be more limited. In terms of available fund raising measures, Option C is disadvantageous than other options.

MIF project is established as a model (pilot) project of HW treatment in Philippines considering that it is difficult for private sector to invest in HW treatment business that need large capital investment and specific experience/know-how in this field and is still not uncertain about the demand in the Philippines.

In principle, HW treatment should be carried out under the initiative of private sector including HW generators. According to this principle, Option B is not appropriate since the public body will take most of the risks in this case.

In the case of Option A, the private body takes all the risks arising in operation phase. From the viewpoint of private sector, all the risks has to be carefully examined to minimize those risks before making this type of contract. If those risks are minimized, the private company will have a chance to deal with HW treatment business without large capital investment. Important business experience and know-how can also be obtained from this operation as well. These are the merits for the private body.

In the case of Option C, allocation of risks between public and private bodies will be provided in the J/V agreement. Since risks are allocated under the agreement between both sides, they are diversified into two bodies so that project will become more stable. However, public intervention into O & M may increase the cost in comparison with private O & M. It is also afraid that the locus of responsibility may become unclear in this option. The contents of J/V agreement are of great importance in view of clarifying the roles and responsibilities of both sides.

Comparing Option A and C, Option C is more limited in the methods of fund raising for the project although the advantages and risks are mostly similar between these options. Thus, the Study suggested to take Option A for private sector participation in O & M of MIF.

5.3 Operation and Management Body

(1) Facility Construction

To ensure smooth implementation of the facility construction, a project taskforce will be established within the NRDC as shown in the organizational chart on next page.

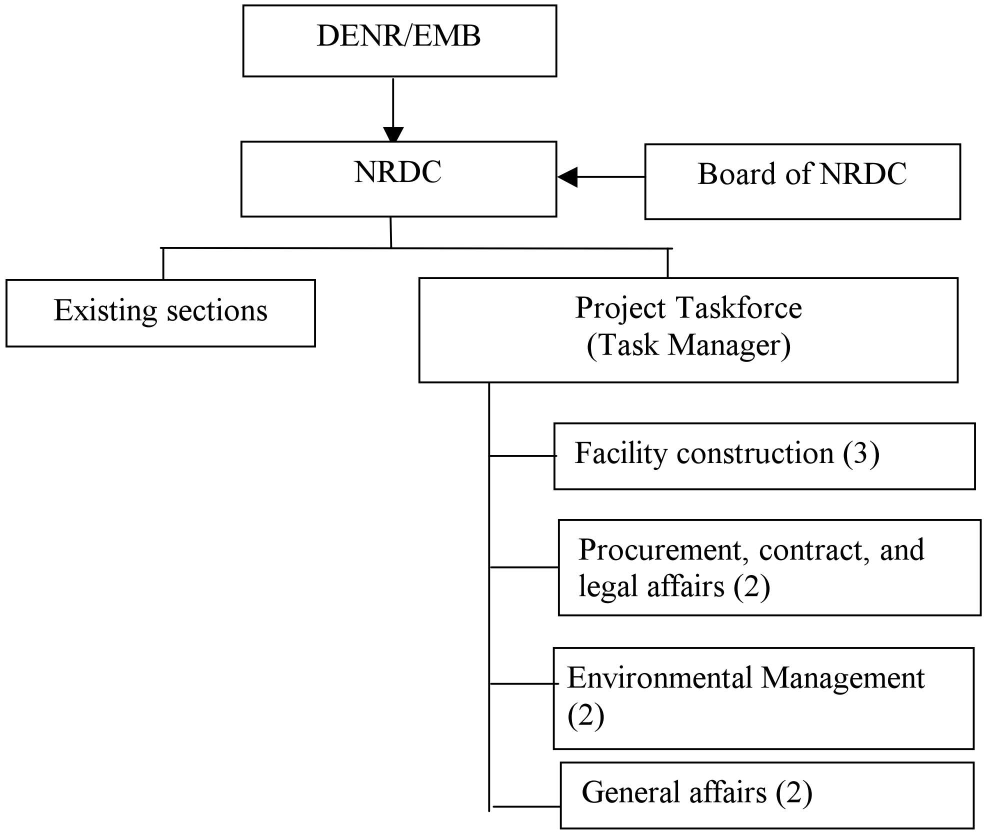


Figure 5.3.1 Chart of Organizational Structure

(2) Organization of O&M

O&M of MIF will be commissioned to the private sector entity that have enough experience in HW treatment operations.

The O & M Company will have an organizational as shown in Table 5.3.1. Waste collection and transportation will be contracted out to other companies.

Table 5.3.1 Proposed organizational structure of O & M Company

Dept./Section	Duties
President's office	➢ Secretary ➢ Personnel affairs ➢ Financial affairs ➢ Planning, collecting information ➢ Public relations
Treatment Department	➢ Operation of the treatment facility ➢ Storage management
Technical Department	➢ Maintenance of the facility, its repairing plan ➢ Supervision of the treatment operation ➢ Seminar for generators ➢ Preparation of reports on the business performance ➢ Consulting service for waste minimization ➢ Security management

Dept./Section	Duties
Sales Department	➢ Client development ➢ Client management ➢ Preparation of collecting and transporting plan, contract out for the collection and transportation ➢ Issue of invoice
Account Section	➢ Supervision of the credit and debit ➢ Financial report
Information Section	➢ Management of the related information ➢ Management of the web-site ➢ Management of the network in the facility
Laboratory Section	➢ Analysis of wastes ➢ Monitor of the treatment facility ➢ Monitor of the landfill

(3) Organization of Collection and Haulage

The collection and transportation will be contracted out to other companies. The contracted waste collectors/haulers will provide the following services:

- Collection and transportation of wastes
- Temporary Storage of wastes
- Provision of waste containers and pallet

5.4 Sales and Marketing

To obtain sufficient client of MIF, the Study established a business strategy as shown below.

(1) Sales Strategy

a. Marketing Strategy

- Understanding of the clients
- Provisional contracts with the clients and collection of HW for test run of TSD facilities
- Promotion to the potential clients
- Compliance with the requirement of clients at high quality level
- Establishment of proper HW treatment fees
- Complaints settlement and consultation

b. User Charge

Taking into account the financially feasible operation of MIF and also referring to the user charges applied at the similar facilities in other countries, the Study established the user charges in MIF as shown in Table 5.4.1.

Table 5.4.1 Assumed user charge

	Unit cost/ton (peso)
Thermal Treatment	15,000
PCT	16,000
Solidification Treatment	13,000
Landfill	5,000

(2) Client Management

To establish and keep mutual trust with the clients, the project will follow the following policies and measures on customer relations.

- Contract-based services
- Obtaining the clients' understanding regarding the policies of the project on waste acceptance and transport
- Provision of the information updates to the client such as new enactment or revision of the laws, rules, and regulations relating to HWM
- Information network with the clients
- Distribution of the annual report
- Provision of waste management consulting services

Chapter 6

Financial Plan

6 Financial Plan

6.1 Financing Options

The Study estimated that the initial investment cost of MIF project would be 2,570 million pesos.

The Study examined the following options of fund raising from domestic as well as foreign financial sources.

(1) Fund Raising Options from Domestic Sources

- Capital infusion by the project implementing body (DENR/NRDC)
- Fund raising through bond issuance by the project implementing body (DENR/NRDC)
- Allocation from the national budget to the Project
- Fund raising from domestic financial institutions (public/private)

(2) Fund Raising Options from Foreign Sources

- Financing from bilateral aid agencies
- Financing from multilateral aid agencies (the World Bank, ADB, etc.)

The most appropriate fund raising options should be selected from the above, taking into account profitability of the project and requirement of each fund raising options.

The Study conducted interview surveys to the relevant organizations regarding the availability of the above options. The results are described below.

6.2 Assessment of Financing Options from Domestic Sources

(1) Capital infusion by the project implementing body (DENR/NRDC)

NRDC, the public corporation under the control of DENR, is responsible for development and management of mineral and forest resources in the Philippines. According to the financial statements of FY 1998/99 and 1999/2000, about 50 million pesos of net profit had been achieved every year. The amount of retained earning by the year 2000 reached 250 million pesos. Current balance of borrowing is also held at minimum level. Taking into account such financial situation, NRDC may have the capacity to make some capital infusion to the Project as the implementing body.

According to an interview of an NRDC official by the Study Team, 50 to 100 thousand pesos of capital infusion may be possible as far as the current financial performance of NRDC is maintained.

However, because this amount covers only about 2 to 4% of the total initial investment, the problem of raising the remaining funds still remains.

(2) Bond issuance by the project implementing body (DENR/NRDC)

Taking into account the good financial performance of NRDC, bond issuance is also considered to be another option of fund raising for the Project.

The result of the interview of the Development Bank of the Philippines (DBP) clarified that the following conditions for bond issuance were required to be met by NRDC:

- The bond issued by NRDC needs to be endorsed by the Department of Finance (DOF) of the Philippines,
- Redemption period of the bond will be 5 years,
- Interest rate will be set at 16.25%

Furthermore, the quarrying right in Lahar Region, that was the main income source of NRDC at the time of the above interview of DBP, was transferred to the local authority, so that the financial situation of NRDC is now totally different and makes bond issuance a difficult proposition. However, the DENR management of gold mining operations in Mt. Diwalwal in Mindanao might positively change the financial status of NRDC.

(3) Allocation of the national budget to the Project

To obtain budget allocation from the Government, a series of budget approval steps has to be overcome by the project implementing body (DENR/NRDC). Such process includes approval of project budget allocation within NRDC and DENR, approval of project proposal by NEDA-ICC, approval of Congressional appropriation for the project, Presidential approval of the General Appropriations Act (GAA), budget release by the Department of Budget and Management to DENR, sub-allotment of budget to NRDC for the project.

Even if the above procedural hurdles are cleared, the amount of the budget to be appropriated to the Project may not be higher than to 10 to 20% of the total initial investment.

(4) Fund raising from domestic financial institutions (public/private)

Due to the limited availability of lending funds and tough conditions for borrowing such as the limited term of repayment and high rate of interest, it is very difficult to tap for the Project funds from domestic financial institutions.

6.3 Assessment of Financing Options from Foreign Sources

(1) Financing from bilateral aid agencies

As the financing from bilateral aid agencies, project loan based on the agreement by both governments can be considered. In the case of Japanese Yen loan, 85% of the total project cost can be financed to the project at its maximum under the borrowing conditions shown in below. The basic conditions of the Japanese Yen loan are as follows:

Table 6.3.1 Financing Conditions of Japanese Yen Loan

Loan Category	Repayment Period	Grace Period	Interest rate	Maximum loan amount
General project	30years	10years	2.20%	85% of the total project cost
Priority project	40years	10years	0.75%	

Special terms economic purpose of special yen loan	40years	10years	0.90%	

In the case of Japanese Yen Loan, 85% of the total cost project can be financed at its maximum under longer term of repayment period and lower interest than domestic financing institutes in the Philippines. However, it should be kept in mind that the long-term loans provided by bilateral aid agencies such as Japanese Yen Loan are usually carried out in the form of the currency of lending country. Currency risk has to be duly considered in utilizing these loans.

(2) Financing from multilateral aid agencies

International Finance Corporation (IFC) and ADB are the major multilateral financing institutes.

IFC is currently very active in financing the environmental projects such as this model project. Although IFC especially encourages private participation in such projects, it also provides financial support to public-private joint ventures. However, the financing limit is set at 25% of the total project cost and its conditions are also harder than Japanese Yen Loan.

The financing conditions of ADB are more or less similar to IFC.

(3) Overall Assessment of Financing Options

a. Domestic Sources

Capital infusion by the project implementing body and National Budget appropriation are the currently possible domestic financing sources in the Philippines.

According to the surveys done by the Study Team, the possible financing amount from domestic sources is estimated to be approximately 600 million pesos at the maximum. It covers about 25% of the total initial investment cost of the Project.

b. Foreign Sources

If the Project is implemented by a public body (DENR or NRDC), there is a possibility to utilize Japanese Yen loan to finance 85 % of the total project cost at its maximum.

In the case of utilizing the fund from multilateral aid agencies (IFC or ADB), the project implementing body can be private or public-private joint venture. The financing amount will be more limited than Japanese Yen Loan. Therefore, the remaining fund to be raised from other sources will be much bigger.

The model HW treatment project recommended in this Study is estimated not to be financially feasible enough to be implemented as a private sector business in the Philippines. That is why public body is recommended to be the implementing body of the Project. All of these indicate that it is difficult to utilize IFC/ADB finances since both of them requires that the Project has to be carried out by private sector.

Accordingly, use of Japanese Yen loan is considered to be the most appropriate financing option for the Project.

Chapter 7

Financial/Economic Appraisal of the Project

7 FINANCIAL/ECONOMIC APPRAISAL OF THE PROJECT

7.1 Estimation of the Project Cost

The total cost of the project mainly consists of initial investment and operation costs. Based on the project plan formulated in the former chapters, the initial investment and operation costs are estimated below.

(1) Initial Investment Cost

Initial investment cost of the project mainly include:

- Land purchase,
- Civil works,
- Facility construction (including contingency)
- Construction supervision
- Other Miscellaneous expenses

(2) Operation Cost

Operation cost of the project estimated here includes:

- Manpower cost
- Utility Cost
- Consumables (fuels, chemicals and other materials)
- Facility maintenance cost
- Waste collection/haulage fees to be paid to the contracted collectors/haulers
- Landfill cost to the contracted treater (after the closure of the landfill facility of the project)
- Other miscellaneous expenses

The total initial investment cost is estimated to be approximately 2,360 million pesos including VAT and interest during construction period.

Table 7.1.1 Initial Investment Cost

Unit: thousand Pesos

Item	Unit Price	Amount	Price	Remark
1. Land Purchase	1,539p/m^2	100,1000m^2	**153,900**	
2. Facility Construction			**1,800,000**	
1) Civil works	-	-	40,000	
2) PCT facility	-	-	100,000	
3) Solidification facility	-	-	60,000	
3) Thermal treatment facility	-	-	1,200,000	
4) Landfill	-	-	148,000	
5) Storage	-	-	52,000	
6) Laboratory	-	-	40,000	
7) Administration building	-	-	80,000	
8) Utilities	-	-	80,000	

Item	Unit Price	Amount	Price	Remark
3. Physical Contingency	-	-	**117,600**	20% of the total cost of civil works.
4. Engineering Services	-	-	**188,000**	1% of the total facility construction cost including contingency.
5. Price Escalation	-	-	**78,296**	5% for foreign currency portion and 2% for local currency portion.
6. Preparation for Business Operation	-	-	**23,086**	
Initial Investment Total			**2,360,882**	

Remark: The above initial investment cost excludes value-added tax and loan interest during construction period.
Cost of civil works is the sum of the cost of other facilities given in Table 3.13.1 of Chapter 3.
Construction cost of each facility (except landfill) is the same as Table 3.13.1.
Cost of landfill facility is the same as the total cost of landfill facility for phase 1 given in Table 3.13.2.

O & M cost of MIF is estimated as shown in below.

Table 7.1.2 O & M cost of MIF

Unit: thousand pesos/year

Cost Item	Cost	Remark
Manpower Cost	42,874	
Utilities Cost	14,238	Electricity and water supply
Consumables Cost	62,465	Fuels, Chemicals, cement, and sand
Facility Maintenance and Repair	13,600	
Consignment of HW Collection and Haulage	46,200	
Consignment of HW Final Disposal	54,600	After closure of landfill in MIF (11years after starting MIF operation)
Miscellaneous Cost	17,185	Safety and sanitation, refractories, analysis equipment, computers

7.2 Estimation of the Project Income

The sources of the income in the project come from various HW treatment operations. Based on the estimated HW treatment demand and established treatment charges by types of treatment processes applied, the Study estimated the annual project income from HW treatment operations as shown in Table 7.2.1 below.

Table 7.2.1 Estimated Annual Project Income

Unit: Peso

Treatment Processes	Unit Treatment Charge (peso/ton)	Estimated Annual Treatment Amount (ton/year)	Total Income (peso/year)
Physicochemical Treatment	16,000	2,500	40,000,000
Solidification Treatment	13,000	2,500	32,500,000
Thermal Treatment	15,000	30,000	450,000,000
Landfill	5,000	3,500	17,500,000
Total	**-**	**38,500**	**540,000,000**

The project incomes that may arise from the temporary storage of HW at project site as well as from supplementary services such as consulting, etc. are not counted in this project appraisal.

7.3 Financial Appraisal of the Project

(1) Estimation of the Financial Internal Rate of Return (FIRR)

To estimate FIRR, the annual net cash flow (NCF) is needed to be calculated based on the estimation of the actual revenue and expenses arising in the project. In the case of the current project, the actual revenue and expenses includes the following items respectively.

Revenue: -Gross income obtained from TSD facilities operation (the sum of HW treatment fees)

Expenses: -Initial investment (including land purchase, facility construction, engineering services, contingency, and VAT.)
-Operation expenses (including manpower, utility, consumables, and maintenance, and collection/landfill consignment fees)
-Replacement cost (landfill facility construction cost in the year 2010 and other facilities in the year.

Annual NCF is estimated for 28 years of the project period including 3years of facility construction and 25 years of facility operation.

The result of FIRR estimation based on the net cash flow given above is 11.15%, which is not financially viable if Japanese yen loan of low interest is not available for the project. Applying the discount rate of 15% considering the domestic commercial bank rate in the Philippines, the NPV of the project becomes approximately -450 million pesos, which indicates that the current project is not financially viable with the finance from the local banks or other lending institutes.

(2) Sensitivity Analysis

In order to assess the sensitivity of the project because of the fluctuation of income and expenditure, especially about its financial risks, the Study estimated the fluctuation of FIRR in the case of 10% decrease in income and 10% increase in operation expenses, as well as the case of simultaneous occurrence of the both cases. Table 7.3.1 below shows the results of FIRR estimation for each of these cases.

Table 7.3.1 Sensitivity of the project against the fluctuation of project income and expenses

	No change in project income	10% decrease in income
No change in project expenses	FIRR: 11.15%	FIRR: 8.94%
10% increase in operation expenses	FIRR: 10.30%	FIRR: 7.99%

Decrease in project income has a larger negative impact on the financial viability of the project than increase in operation expenses. In case 10% decrease in income occurs with 10% increase in operation expenses, FIRR of the project will go down to about 7.99%, which means that the project becomes financially risky even with the finance of long-term low interest loan. Securing the stable amount of HW for treatment by the TSD facilities will be the key of financially sustaining the project.

7.4 Economic Appraisal of the Project

7.4.1 Estimation of Economic Internal Rate of Return (EIRR)

Estimation of EIRR of the project is made basically in the same manner of estimating FIRR although the financial cost and benefit used in obtaining FIRR are required to be converted to economic cost and benefit.

All the cost factors in the project are divided into two categories: domestic procurement (local cost) and procurement from abroad (foreign cost). In the case of foreign cost, foreign exchange premium needs to be considered to adjust various market distortion factors including trade distortions, unsustainable current account balance, value added and other indirect taxes. According to the information provided by NEDA, the safe and suitable exchange premium to be used for converting the foreign cost of the project to economic cost is 20%. Therefore, the Study multiplied all the foreign cost by 1.2 to obtain its economic cost.

Meanwhile, the local cost also has to be adjusted by eliminating such market distortion factors, which are in this case value-added tax. Value-added tax is estimated as 9% of the market prices of commodities or services purchased domestically.

The Standard Conversion Factor (SCF), to be applied to adjust market prices of local cost to shadow prices, is also estimated.

Accordingly, the financial cost of local currency procurement is converted to economic cost as the result of multiplying the financial cost subtracted of 9% of VAT by the above 5 years SCF of 92.90.

Based on the allocation of foreign and local cost of the project done by the project cost-planning member of the JICA Study Team, the total financial cost was converted into economic cost for each item.

The benefits brought about by the model project are identified as follows:

(A) Saving in medical cost arising from the increase of disease caused by HW-induced pollution in the case of non-existence of the project,

(B) Avoided economic losses arising from decrease of foreign direct investment due to insufficient HWM system in the Philippines in the case of non-existence of the project including decrease in foreign capital inflow, industrial or export value, new employment opportunities, etc.)

(C) Opportunity cost arising in the case of non-existence of the project including construction and operation cost of additional HW storage facilities and restoration cost of soil (land) polluted by improper disposal of HW.

As to the benefit (A), it is very difficult to quantify because of the following uncertainties:

- Unclear epidemiologic cause-effect relationship between HW-induced pollution and specific diseases,
- Uncertainty regarding the projected impacts of HW-induced pollution in terms of the number of population affected as well as the intensity of impacts,

Likewise, the benefit (B) above is also difficult to quantify due to the uncertainty about the degree and extent of negative impacts of no available HW treatment facilities upon the foreign direct investment.

Therefore, the Study quantified the benefit (C), the opportunity cost arising in the case of non-existence of the project.

The Study estimated that the following incremental opportunity costs would arise in the case of non-existence of the project.

Table 7.4.1 Incremental Costs Arising in the Case of Non-Existence of the Project By Types of HW Handling Realized

HW Handling Realized	**Incremental Cost Arising**
Stored	Cost of constructing and operating additional storage facilities
Disposed improperly	Restoration of soil (land) polluted by improper HW disposal
Not clarified (missing)	Restoration of soil (land) polluted by improper HW disposal

The total opportunity cost arising in the case of non-existence of the Project is estimated as follows.

Table 7.4.2 The Total Opportunity Cost in the Case of Non-Existence of the Project

Type of Opportunity Cost	Cost (Pesos/year)
HW Storage Cost	261,840
Restoration Cost of the Soil Polluted by the HWs disposed	240,520
Restoration Cost of the Soil Polluted by non-clarified handling of HWs	364,894
Total	**867,254**

Based on the estimation of economic cost and benefit of the project, EIRR is estimated as 21.23%, which is higher than FIRR and considered feasible enough as the national project of economic development.

Chapter 8

Implementation Plan

8 IMPLEMENTATION PLAN

8.1 Time Schedule for Implementation

Assuming that it will take 4 years to build MIF and prepare for its operation, the Study established the following year-by-year schedule.

1st Year

- Completion of the Environmental Impact Assessment (EIA)
- Acquisition of the Environmental Compliance Certificate (4 months after submission of the Environmental Impact Statement)
- Preparation of the Project Proposal
- ICC Approval (3 months after submission of the project proposal)
- Approval of budget appropriation to the project
- Official request of foreign long-term loan

2nd Year

- Formulation of Implementation Plan and Program
- Procurement of consultants
- Basic design
- Preparation of bidding document
- Opening of the bidding

3rd Year

- Procurement of contractors (selection of contractors)
- Starting of facility construction

4th Year

- Completion of facility construction
- Trial run of facilities
- Acquisition of facility operation permits
- Starting of full-scale facility operation

Figure 8.1.1 shows the detailed time schedule of project implementation.

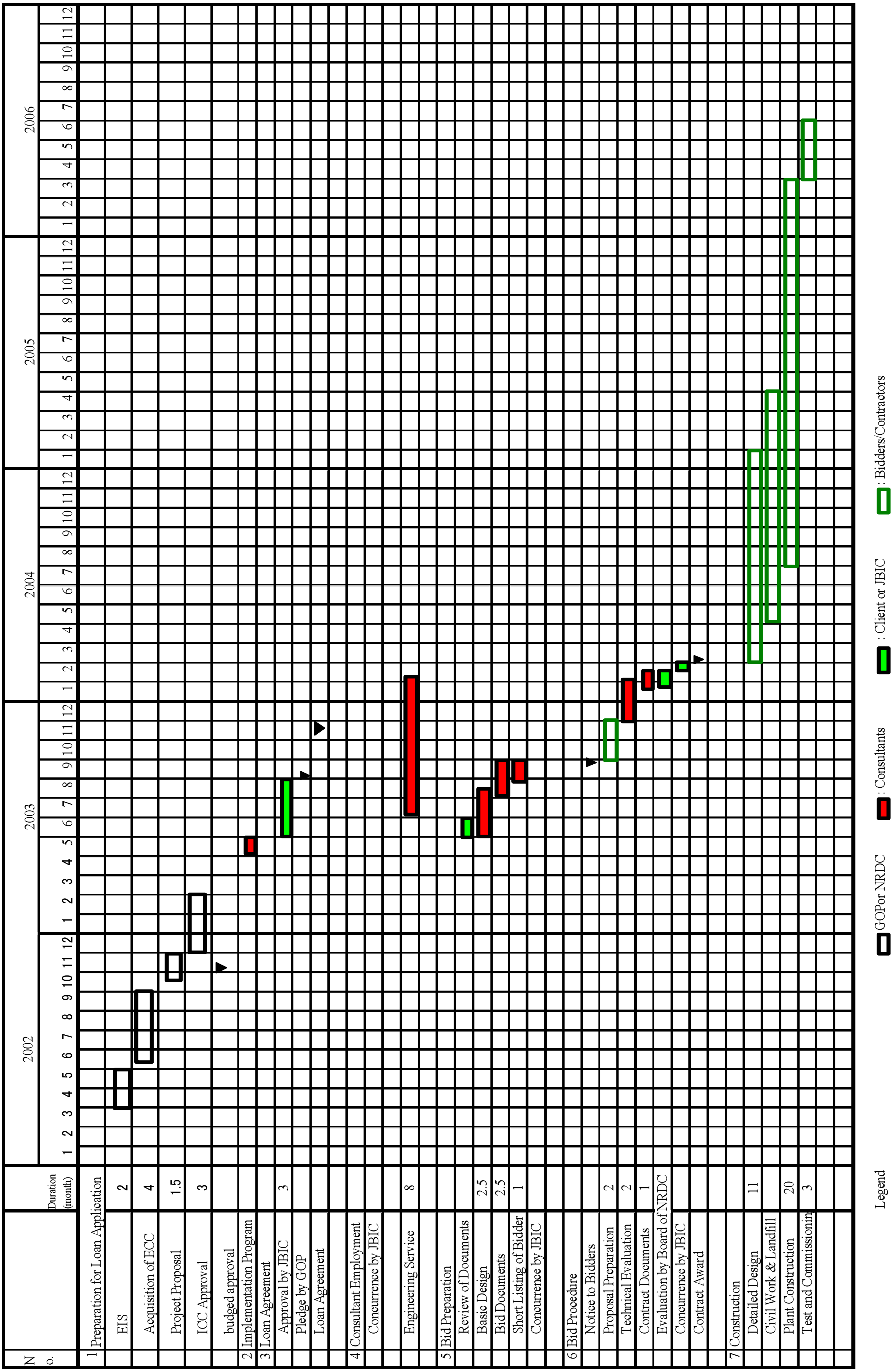


Figure 8.1.1 Project Implementation Schedule

Chapter 9

Environmental Consideration

9 ENVIRONMENTAL CONSIDERATION

9.1 Baseline Data and Field Surveys

Primary baseline data pertaining to the project site area and the primary impact area are provided from field investigations launched by the JICA Study Team. These field investigations have focused on the physical environment only. The secondary baseline data have been collected from existing data sources for the project site and its surrounding areas.

The following field surveys have been conducted within the scope of work of the EIA study:

- Surface water sampling;
- Well water sampling;
- Meteorological parameters measurement;
- Air sampling;
- Noise measurement;
- Traffic counting;
- Observation of biogeographic and socio-economic conditions of project site borders.

9.2 Environmental Impact Assessment

Environmental impact assessment of the project is conducted by applying the following methods:

- Checklist Approach
- Environmental Risk Assessment
- Outline of Health Risk Assessment
- Ground Level Air Pollutants Dispersion Modeling Study

9.3 Outline of Environmental Impacts of the Project

The evaluation of impacts shows that location of the project site is basically suitable from the point of view of environmental protection. Only minor negative impacts are expected and they can be mitigated through a set of measures. This statement assumes of course that the plant has taken all engineering measures needed for the achievement of environmental standards.

The operation of the project is planned to be made with best pollution control technologies and should then be possible without adverse impact on the environment. The plant is designed as an isolated system leaving few possibilities of pathways for environmental impacts.

Hazardous waste treatment contributes to the regional protection of health and ecosystems, with global positive result for well being and quality of life of people. At the local community level, there is possibility that people have a negative perception of the project and feel worsening of quality of life. The communication and transparency between parties involved in implementation of the project and local communities will be a key action to avoid such side negative perception.

9.4 Conclusion: Technical Acceptability of Impacts

The checklist of the importance of potential impacts of the project, with the standpoint that it will be designed as an integrated pollution control facility and implemented in an environment-friendly manner, is summarised in Table 9.4.1. It shows that the importance of adverse impacts is made minimal, while positive impacts are boosted according to the proposed measures. The adverse residual impacts associated with the construction phase will be temporary and manageable.

The global impact of the project on environment is obviously positive for the welfare and quality of life of people since it provides a way to eliminate the hazardous waste generated by industrial plants on a regional basis in the best environmental conditions.

The question of negative impacts of the project could be raised for the local communities living around the project site. The study has shown, however, that these impacts are very limited in scope and importance. The first reason for such potential performance is that the concept of integrated pollution control facility has been given a crucial importance in the engineering design of the project. The second reason is that an integrated environmental management plan has been conceptualised in order to minimise potential adverse impacts and maximise potential benefits. Then, the study has shown a good level of environmental acceptability of the project.

The EIA study has confirmed that the site for location of the hazardous waste treatment plant project was suitable for minimised impacts on the physical and living environment as well as public health. Main potential impacts of the project are those that can raise in terms of occupational health and industrial hazards and accidents. These are however similar to those of a classic industrial plant and require strict safety and prevention countermeasures.

Since the environmental benefit of the project for public health and natural ecosystems of the whole CALABARZON area is not questionable, it is concluded that the possible small side effects of the project are quite reasonable and acceptable.

Table 9.4.1 Evaluation Results on Technical Acceptability of Impacts

Expected Impacts	C1	C2	C3	O1	O2	O3
NATURAL ENVIRONMENT						
Threat of environmental hazard from toxic and hazardous chemicals	-			-		
Effect on surface and groundwater quality	-			-		
Effect on water diversion and withdrawal	0			0		
Effect on air quality and atmosphere	-			-		
Effect on noise / sonic environment	-			-		
Impact of geological conditions to the project	0			-		
Effect on open space and recreation	0			0		
BIOLOGICAL ENVIRONMENT						

Expected Impacts	C1	C2	C3	O1	O2	O3
NATURAL ENVIRONMENT						
Effect on Terrestrial Vegetation	-			-		
Effect on Fish and Wildlife	-			-		
Effect on Aquatic Flora and Fauna	-			-		
SOCIO-ECONOMIC CULTURAL ENVIRONMENT						
Effect on public and workers health and safety	-			-	-	
Effect on community structure	0			0		
Effect on land use and values	0					+
Effect on population dynamics and employment		+	+		+	+
Effect on livelihood and income		+	+		+	+
Effect on local planning, coordination and economic growth			+			+
Effect on workers' living standard			+			+
Effect on women's and children's Welfare		+	+			+
Effect on archaeology and culture	0			0		
Effect on vehicular traffic	-			-		

\+ The project has positive impact,
\- The project has negative,
\- The project has no impact.
Half-toned columns given in the table showed the estimated magnitude of each impact:
C: Construction phase of the Project, O: Operation phase of the project
1: Magnitude of impact is minimal or nil even if it arises.
2: Magnitude of impact is moderate if it arises
3: Magnitude of impact is significant if it arises.