

添付資料 11-2: 成果1サブグループ会議

11-2-11: 11th SG1



Contents of Today's Topic

1. Current Progress of “Update of Evaluation Criteria for EMB of 10-year SWM plan” in Activity 1-6
2. Discussion about Review Result of the Criteria
3. Further step

Activity 1-6

“Update of Evaluation Criteria for EMB of 10-year SWM plan”

11th Subgroup Meeting for Output 1

22th February 2022 (Tuesday)

The Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies

1

Background and Objectives

Background

- NSWMC has formulated the “Guidebook for Formulation of Solid Waste Management Plan” and “Annotated Outline (10-year SWM plan)” as reference document and checklist for preparation of 10-year SWM plans.
- These guidebook and checklist are formulated based on RA9003 which was enacted on the premise that Waste to Energy (WtE) technology shall not be applied. Therefore, evaluation criteria for 10-year SWM plan will be requested to be revised by including criteria concerning the WtE projects.

Objective

- To support the revision of “Annotated Outline”, which is review criteria of 10-SWM plan, because of the development of WtE project
- To assist the revision of document such as guidelines for reviewing 10-year SWM plans, if necessary

Current Progress

- JET implemented initial work to update the “annotated outline” of evaluation criteria of 10-year SWM plan
- JET had a meeting with a reviewer of 10 years SWM plan with SWMD on 13, January
- During the meeting, it was founded that there are the “annotated outline” is used as the direction for LGU and for review by EMB regional office, and that Form 2 and Form 3 of the evaluation criteria is used for the review by EMB CO
- In the meeting, it was confirmed that the evaluation criteria reviewed and update in this TCP is only the “annotated outline”.
- JET prepared comments for the “annotated outline” of 10-year SWM plan and submitted to EMB SWMD officially and requested for further discussion about our comments and clarification.
- JET received the document of EMB CO evaluation forms (Form 2 and Form 3 for the review of a sample of a 10-year SWM plan)
- JET also preliminarily reviewed Form 2 and Form 3 and the reviewed result will be discussed with SWMD.

Review Result of Annotated Outline

- Better to describe “Waste Flow Diagram” clearly
- Detail explanation of 10-year SWM plan will be necessary, though only 5 years data is required in the parts of investment cost, annual cost and funding option
- Definition of “Diverted Waste” and “Diversion Rate” (should not include self-disposal, which is potential illegal dumping)

Necessary Parts to be added due to WtE

- Description of WtE facility in “SWM System”
- Waste Flow including receiving waste in WtE facility and residue from WtE facility
- Description of WtE components in Environmental and Social Consideration
- Others

- Discussion of the draft revised evaluation criteria of 10 years SWM plan in 11th SG meeting of Output 1 in the end of February
- Revise the criteria based on the above discussion today
- Finalize the evaluation criteria of 10 years SWM plan in 12th SG meeting of Output 1 in the end of April

PROJECT OUTPUT	JAN	FEB	MAR	APR	MAY
SGOP1	12	22		23	

Maraming salamat po !



The Project for Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies in the Republic of Philippines

Interview Survey for TSD Facilities (Activity 1-5 and 1-8)

JICA Expert Team

Introduction

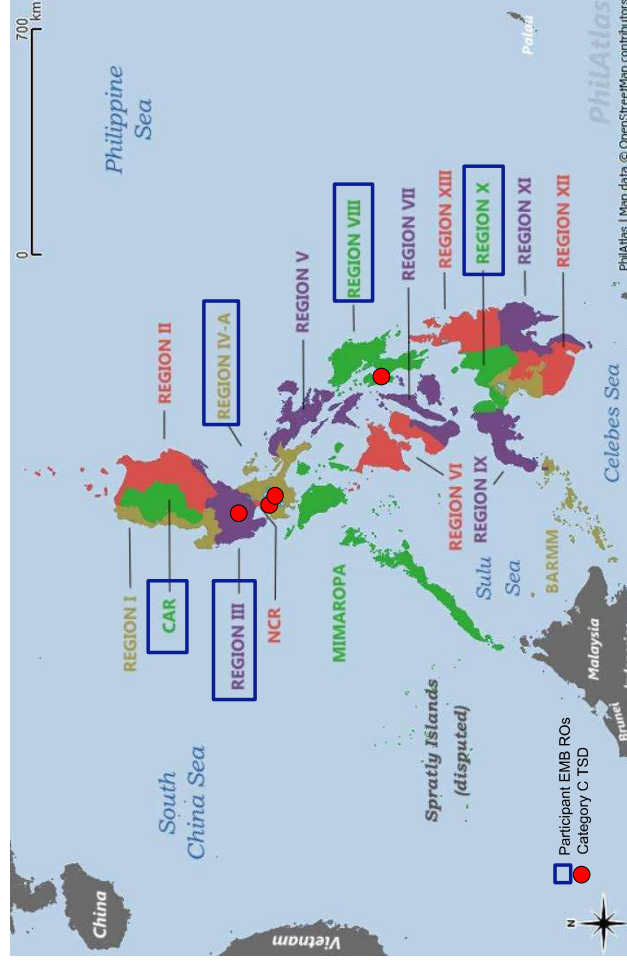
- Survey Participants
 - EMB Regional Offices with either Category A TSD : Onsite Treatment and Disposal Facilities or Category C TSD : Disposal Facilities.
 - **CAR, III, IVA, VIII, and X**
 - All Registered TSD Sanitary Landfills (only 4 facilities nationwide):
 - Metro Clark Waste Management Corporation (**MCWMMC**) – Tarlac, Region III
 - Cleanway Environmental Management Solutions Inc. (**CEMSI**) – Cavite, Region IVA
 - Jorm Environmental Services Inc. (**JESI**) - Cavite, Region IVA
 - Cleanway Philippines Inc. (**CPI**) – Leyte, Region VIII

*Based on lists of Registered TSDs as of March 31, 2021 published on [EMB Website](#).

Introduction

- Background
 - **Activity 1-5:** Prepare manual for management of bottom & fly ash discharged from WTE facility
 - **Activity 1-8:** Review and update the existing regulations of sanitary landfill for municipal solid waste where incineration ash will be disposed of.
- Objectives
 - To collect data on actual industry-based practices related to the current ash waste management in the Philippines;
 - To understand the roles of EMB Regional Offices (ROs) and Treatment, Storage, and Disposal (TSD) facilities in current landscape of ash waste management;
 - To confirm applicability of national laws related to Sanitary Landfills (Municipal and TSD).

Introduction



Status and Schedule of Interview and Data Collection

EMB Region / TSD	Meeting/Interview	Questionnaire	Data Request
CAR	N/A (No Ash-Accepting TSD)	OK (Jan 7, 2022)	N/A (No Ash-Accepting TSD)
Region III	OK (Jan 19, 2022)	Pending	Pending
Region IVA	OK (Jan 14, 2022)	OK (Jan 31, 2022)	OK (Jan 31, 2022)
Region VIII	OK (Jan 11, 2022)	OK (Jan 25, 2022)	N/A (No Ash-Accepting TSD)
Region X	OK (Jan 18, 2022)	OK (Jan 31, 2022)	OK (Jan 31, 2022)
MCWMC	OK (Jan 13, 2022)	OK (Feb 2, 2022)	OK (Feb 2, 2022)
CEMSI	OK (Feb 21, 2022)	Pending	Pending
JESI	Pending	Pending	Pending
CPI	Denied Interview (No Ash in TSD)		

Summary of Regulatory Reporting

Name of Report	Frequency	Responsible Party	Description
Self-Monitoring Report (SMR)	Quarterly	Proponent	<ul style="list-style-type: none"> Has modules dedicated for compliance to RA 6969, RA 9275, RA 8749, and PD 1586.
Compliance Monitoring Report (CMR)	Twice a Year	Proponent	<ul style="list-style-type: none"> Semi-annual Module 5 of SMR;
Compliance Monitoring and Validation Report (CMVR)	Twice a Year	Multi-partite Monitoring Team (MMT)	<ul style="list-style-type: none"> Third-party validation report for each CMR.

- Pro-forma of SMRs, CMRs and CMVRs are provided by EMB;
- MMT is an independent entity composed of stakeholders such as representatives from LGUs, local communities, NGOs etc.

Classification of Sanitary Landfills

- Municipal Sanitary Landfills:
 - Four (4) categories based on capacities per DAO 2006-10 : Guidelines on the Categorized Final Disposal Facilities (Sanitary Landfills)
 - Category 1 (≤ 15 TPD)
 - Category 2 (>15 TPD ≤ 75 TPD)
 - Category 3 (>75 TPD ≤ 200 TPD)
 - Category 4 (>200 TPD)
 - Category-based technical and ECC permitting requirements;
- TSD Sanitary Landfills:
 - No categorization; regardless of capacity, additional technical and permitting requirements.
 - Double Liner
 - Double Leachate Removal and Collection System
 - Wind Cover
 - Run-off and Run-on Water control (25 yr RP)

Monitored Parameters and Related Laws

Metric	Related Permits	Applicable Laws/Guidelines
Ambient Surface Water Quality	<ul style="list-style-type: none"> ECC/CNC 	<ul style="list-style-type: none"> Limits: DAO 2016-08 Parameters: DAO 2016-08, ECC Requirements, WQM Guidelines
Effluent Water Quality	<ul style="list-style-type: none"> Discharge Permit 	<ul style="list-style-type: none"> Limits: DAO 2016-08 Parameters: DAO 2016-08, ECC Requirements
Ground Water Quality	<ul style="list-style-type: none"> ECC/CNC 	<ul style="list-style-type: none"> Limits: DAO 2016-08 Parameters: DAO 2016-08, ECC Requirements
Ambient Air Quality	<ul style="list-style-type: none"> ECC/CNC 	<ul style="list-style-type: none"> Limits: DAO 2000-81 Parameters: ECC Requirements
Effluent Air Quality	<ul style="list-style-type: none"> Permit to Operate 	<ul style="list-style-type: none"> Limits: DAO 2000-81 Parameters: ECC Requirements

Parameters of effluents are based on nature of points sources. Outfalls/Stacks within the same facility, but different nature (ex. Office Building VS Processing Plant; Mill VS Kiln) will have different monitored parameters.

Ash Acceptance Criteria of TSD

Facilities

TSD Facility	Purpose of Acceptance	Acceptance Requirements
Republic Cement & Building Materials, Inc., Batangas Plant (RCBMI – Batangas)	A	<ul style="list-style-type: none"> • Requirements set by management. • Cement factories must satisfy Heavy Metal and Ash Content Requirements set by DENR (DAO 2010-06).
Republic Cement Mindanao, Inc. (RCMI)		
Holcim Philippines, Inc. Lugaít Plant (HPI – Lugaít)		
Metro Clark Waste Management Corporation (MCWMC)	C	<ul style="list-style-type: none"> • Treatment Certificate for ashes from other TSDs. • Must be within permitted waste codes. • TCLP results for ashes from other sources.
Cleanway Environmental Management Solutions Inc. (CEMSI)		
Jorm Environmental Services Inc.* (based on initial correspondence)		

- None of the Category C TSDs currently accepts from large scale industry producers such as Power plants, Broilers, etc.
- Category C TSDs accepts all solid forms of wastes, as long as it is accompanied by **treatment certificate** and is within their **waste codes**.

Summary of Initial Findings

- Ash is not specified in Table 2.1 of DAO 2013-22, and hence must undergo TCLP to determine its classification.
 - Non-hazardous: Municipal Sanitary Landfill
 - Hazardous:
 - Stabilization on TSD -> TSD Sanitary Landfill
 - Co-processing -> TCLP -> Recategorization
- The specific form of solid waste is not indicated in waste manifests; hence, tracking of ash waste is difficult.

Summary of Initial Findings

- The Philippine EIS system plays a major role in identifying the minimum monitoring parameters for Ambient and Effluent Air and Water Quality.
- In practice, the current TSD permitting evaluation process are anchored on effluent quality. The same is true in evaluation of Discharge Permits and Permits to Operate.

Way forward

- Follow – up on pending data and interview scheduling requests;
- Extension of interview participants:
 - Large-scale industrial waste ash producer (Power Plant etc.);
 - Ash-waste accepting facility (Cement Plant etc.);
- Consolidation of results.

Thank you!

Activity 1-6

To prepare the Manual for Planning, Evaluation, Formulation, and Supervision of WTE project

22th February 2022

Makoto KOSAKA, SWM-PPP Expert



The Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies



Updates from Last SGOP1 (on Jan12)

3. PPPC general comments on Section 1 and 2 (Examples)

- Emphasis that a 10-year SWM plan is prerequisite to the formulation of the plans: Underscore the need to harmonize *facility plan and siting conditions* to the 10-year SWM plan of the LGU, => **Noted**.
- Differentiate *scope and depth* of each of the plans (Waste treatment master plan, Facility conceptual plan, Facility basic plan); => **Noted**.
- At which point shall the technology employed in the facility be finalized? => How to deal with increasing MSW shall be principally specified in Master Plan phase, for example, 3Rs and compost can reduce 44% of waste, WTE Incinerator reduces 88% its residue and rest CC% shall be disposed in Engineered Sanitary Landfill, etc. These quantified mass balance flow shall be required in 10-years MSWMP in Philippines.
- Where does the review of the current regulations of the LGU come in?
- *Restructuring of the report* to ease the flow of discussion, Arrange the details of the report in chronological order, => **Noted**.
- Detail *siting requirements and conditions*: Section 4.2. noted of "conditions mandated in regulations for land use and welfare, as well as safety, economy, and ease of land acquisition"; could be itemized in this section for clarity => **Noted**.
- Localizing the *list of regulations* that concern the establishment of WTF facilities, A similar summarized list of regulations like in Table 2-2 should be developed with the LGUs to specify the legal requirements that need to be satisfied => **Noted**.

1. Upcoming Timeline for Activity1-6

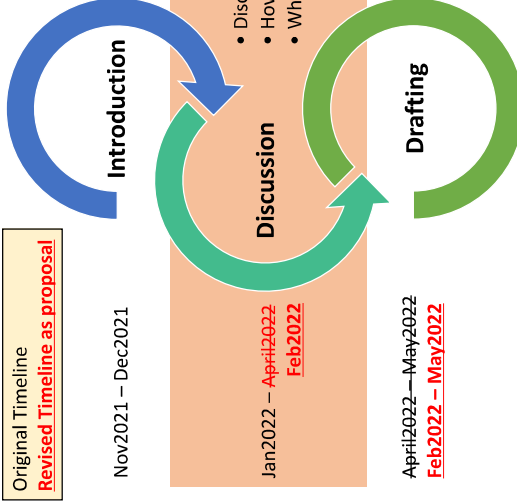
Timeline	Updates
January 12, 2022	10 th OP1 Subgroup Meeting Request SGOP members to review for Section 1 and 2 of "Japanese WTF dev. Guide"
January 17, 26, 31, 2022	Follow ups to the request for comments
January 31, 2022	Deadline for accepting comments to Sections 1 and 2

2. Comments from ITWG members for Activity 1-6

Members	Comments
DENR-SWMD	No comments in Japanese Guideline; comments will be reserved for the Philippine Guidelines once ready
DOE	No comments so far; shall focus their comments on the utilization of energy produced by WTE plants
DOST	No comments received
LGU-Quezon City	No comments received
NEDA	No comments received
PPPC	*detailed in succeeding page

Flow of Activity

Original Timeline
Revised Timeline as proposal

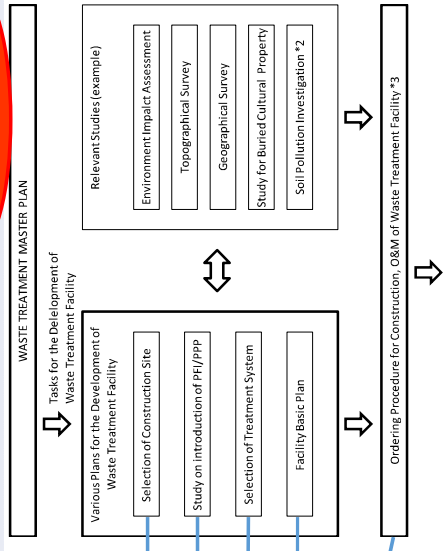


Request to approve revised timeframe

Chapter 4: Formulation of various plans for the development of WTFs

Sec	Table of Contents	Number of Pages
S1	Positioning the Various Plans regarding the Development of WTFs	5
S2	Selection of Candidate Construction Sites	9
S3	Survey on the PFI/PPP Introduction	3
S4	Selection of Treatment Methods	2
S5	Development of Facility Basic Plan	44
S6	Core Items in Waste Treatment Facility Design	11
S7	Safety Measures	4
S8	Dismantling of Incineration Facility	4
	Total	79

Further Comment for the drafting Manual



Note 1) Required in EIA rule and regulation both national and provincial government,
 Note 2) Investigation required by Soil Pollution Control Law,
 Note 3) There are cases combined and/or separate contract of construction and O&M

Figure 4.1-1. The positioning of the various plans for the development of WTFs

Guideline for Planning and Designing of WTFs 2017

Title	Guideline for Planning and Designing of Waste Treatment Facilities (WTF) 2017
Publisher	Japan Waste Management Association
Price	JPY 27,000-
Last Update	May 2017
Size and Pages	A4 x 850 pages
TOC	<ul style="list-style-type: none"> Volume I Planning Guidelines <ul style="list-style-type: none"> Chapter 1 Formulation of waste treatment master plan Chapter 2 Formulation of a regional plan for promoting the formation of a recycling-oriented society Chapter 3 Formulation of WTF life prolong plan Chapter 4 Formulation of various plans for the development of WTFs Chapter 5 Legal Procedures for setting up a WTF Chapter 6 Procedures for ordering WTF construction work Chapter 7 Financial Resources for Construction of Waste Disposal Facility Volume II Design Guideline <ul style="list-style-type: none"> Chapter 1 Basic matters regarding waste incineration facilities Chapter 2 Matters concerning the functions of waste incineration facilities (excluding gasification and melting facilities and gasification reforming facilities) Chapter 3 Continuous operation type waste incineration facility Chapter 4 Intermittent operation type waste incineration facility Chapter 5 Gasification and Melting Facility / Gasification Reforming Facility Chapter 6 Incineration Residue Melting Facility Chapter 7 Non-combustible / Oversized / Container and Packaging Recycling Facility Chapter 8 Waste Transport and Transfer Facility Chapter 9 Refuse Derived Fuel Production Facility Chapter 10 Waste Carbonization Facility Chapter 11 Waste Methane Recovery Facility

ごみ処理施設整備の計画・設計要領
2017改訂版

全国都市清掃会議

Appendix

S2. Selection of Candidate Construction Sites

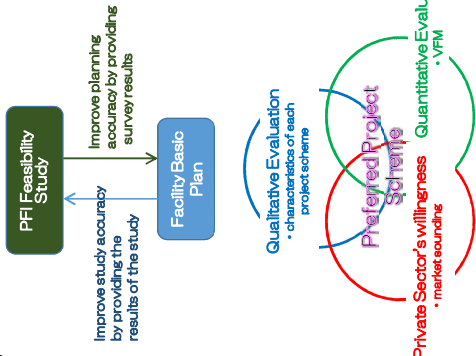
Sub-section	Contents
2.1	Background Background of selection of candidate construction sites.
2.2	Laws for regulation of the potential construction site Lists up environmental protection laws as well as laws on facility establishment, land use and construction which should be taken into consideration.
2.3	Candidate site selection procedure Illustrates candidate site selection procedure.
2.4	Conditions and criteria related to candidate site selection Shows examples of conditions and evaluation items related to candidate site selection.
2.5	Sample procedural flow for selection of candidate site Illustrates procedural flow for selection of site.
2.6	Considerations in the selection of candidate sites Describes the points for consideration in selection of sites.
2.7	Actions after the selection of candidate site Describes the actions to be taken after selection of the site.

Main Contents of PFI/PPP Applicability Study

Evaluate the possibility of introducing PFI schemes (BOO, BOT, BTO, DBO, etc.) and determine the project scheme. The survey will be conducted in conjunction with the basic facility plan.

- ◆ **Examination of Project Scheme**
Examine the scope of the project, project period, and risk sharing.
- ◆ **Evaluation of Project Scheme**

The project will be evaluated comprehensively through quantitative evaluation (economic evaluation) based on the private sector's willingness to participate and VFM, and qualitative evaluation (merits and demerits of each project scheme) based on the characteristics of the project scheme at the business entity selection and implementation stages.



PFI/PPP Feasibility Study (1)

Major Project Schemes applied in Japanese WTE Projects

PPP Modalities	Role						Owner of Facility			Explanation
	Construction Period		Operation Period		Finance	Const. Period	Op. Period	After Op. Period		
	Design	Const.	Op.	Mt.						
PFI	BOO	Private	Private	Private	Private	Private	Private	Private	PFI cover BOO/BOT/BTO, which Private sector raise funds, design, construct, and operate the facility thru project period.	
	BOT	Private	Private	Private	Private	Private	Public	Public	[BOO] Ownership will not be transferred to the public even after the operation period.	
	BTO	Private	Private	Private	Private	Private	Public	Public	[BOT] Ownership will be transferred to the public at the end of operation period.	
Non-PFIs	DBO	Public	Public	Private	Private	Public	Public	Public	[BTO] Ownership will be transferred to the public after completion of the facility.	
	DBM	Public	Public	Public	Public	Public	Public	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, operation of the facility to the private.	
	Public Build + long term O&M contract	Public	Public	Public	Private	Public	Public	Public	The public sector raises funds through bonds and grants, and comprehensively outsources the design, construction, maintenance of the facility to the private.	

Objectives of PFI/PPP Feasibility Study

- To list up different business schemes to see which can be selected for the LG to introduce private sectors to ensure efficient and economical construction, operation, maintenance, and management of the waste treatment facility
- To compare and evaluate which business schemes should be selected in consideration of regional circumstances, business stability, economic efficiency, and intention of the private operators,

Selection of Business Scheme (PPP? DBO?)

View points to evaluate business methods

- Whether participation of multiple private companies is expected (interest survey)
- Whether quantitative effects (economic effects) can be expected (quantitative evaluation)
- Whether qualitative effects can be expected (qualitative evaluation)
- Whether comprehensive effects are expected after introduction of such (comprehensive evaluation)

S4. Selection of Treatment Methods

1) Sort out applicable treatment technologies

2) Select methods for comparative evaluation

3) Set evaluation criteria

4) Collect data for evaluation

5) Evaluate treatment methods

Sub-section	Contents
5.1 Background	Describes background of developing facility basic plan.
5.2 Ordering conditions relating to facility development	Explains how to set out ordering conditions for facility development. <ol style="list-style-type: none"> 1) Planned waste amount 2) Capacity of the facility 3) Planned Waste Quality 4) Pollution prevention standards 5) Waste heat utilization
5.3 Planned waste quality	Describes the points to be considered when determining the planned waste quality. <ol style="list-style-type: none"> 1) Type of waste 2) Items for Waste Quality Analysis 3) Items of Waste Quality Analysis and their Purposes 4) General trend of waste quality 5) Example of Waste Quality Analysis 6) Setup the Quality of Target Waste in a Waste Incineration Facility 7) Setting of planned target waste quality in recycling centers (MRFs) for non-combustibles, bulky and packaging waste
5.4 Structure of Facility Basic Plan	Describes the details to be included in Facility Basic Plan.
5.5 Stable supply of electricity	Introduces the outline of power liberalization, FIT system and widening of power generation business.
5.6 Measures against disaster waste treatment	Discusses how to deal with disaster waste that should be taken into account in the development of waste treatment facilities.

7.1 Accidents at waste treatment facilities

- Occurrence of accidents
- Example of accidents

7.2 Facility safety measures

- “fail-safe” and “fool-proof” of equipment

7.3 Formulation of accident response manual

- Accident response manual
- Crisis management and safety assessment

Sub-section	Contents
6.1 Notifications to government offices	Shows a reference example of application procedures to various government agencies by a local government that will be the project proponent.
6.2 General structure of waste treatment facility	Describes general structure and design considerations of waste treatment facility.
6.3 Earthquake-resistant and disaster prevention structure of waste treatment facility	Discusses the necessity of disaster countermeasures, earthquake-resistant design of major facilities, prevention of secondary disasters, and examples of disaster prevention measures.
6.4 Measures in snow-covered cold regions and areas affected by salt	Illustrates measures in snow-covered cold regions and areas affected by salt.

8.1 Dismantling of Incineration Facility

- Addressing dioxins and asbestos
- Dismantling cost issues

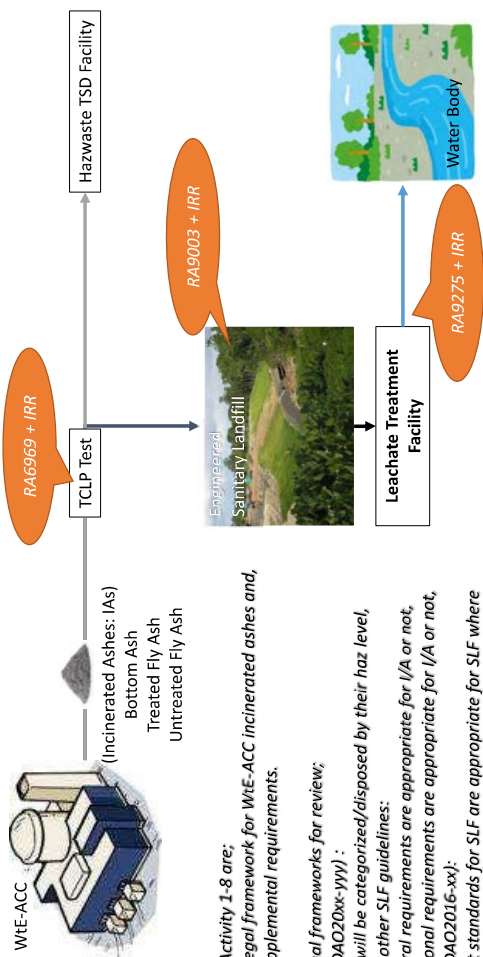
8.2 Dismantling Manual

- Regulations, guidelines and manuals
- Method of dismantling

8.3 Estimation of Dismantling Costs and Financial Resources

- Estimation of dismantling costs
- Subsidy system

Basic Framework of Activity 1-8



Basic Concept of Activity 1-8 are; to check present legal framework for WtE-ACC incinerated ashes and, to recommend supplemental requirements.

Target present legal frameworks for review;

1. RA6969 + IRR (DAO20xx-yyy) :
2. RA9003 + IRR + other SLF guidelines: Check if structural requirements are appropriate for I/A or not, Check if operational requirements are appropriate for I/A or not,
3. RA9275 + IRR (DAO2016-xx): Check if effluent standards for SLF are appropriate for SLF where I/As will be disposed.

PROPOSED SCHEDULE OF MEETINGS for 1st half of CY 2022 (as of Feb.22, 2022)

PROJECT OUTPUT	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
PMO	06	09	09	06	11	08	06	03	07	05	02	02
JCC					25						29	
ITWG			23		18			24		19		
SGOP1	12	22		20								
SGOP2			30			15						
OP2 (LGUs)	06	15DC	15CC	13QC	17DC	22CC						
OP2 (PPPC)												
SGOP3			11									
SGOP4		16										
SEMINAR			29					28				

10TH SUB-GROUP MEETING FOR PROJECT OUTPUT 1

ENHANCEMENT OF NATIONAL GOVERNMENT'S CAPACITY FOR SUPPORTING AND COORDINATING OF LGU'S WTE PROJECT UNDER THE TECHNICAL COOPERATION PROJECT (TCP) RE CAPACITY DEVELOPMENT ON IMPROVING SOLID WASTE MANAGEMENT THROUGH ADVANCED/INNOVATIVE TECHNOLOGIES

22 February 2022, Tuesday, 9:00 AM (via on-line)

TENTATIVE AGENDA

- Call to Order/Meeting Objectives/Acknowledgement of Attendees and Adoption of Agenda (20 mins) - Ms. Elvira S. Pausing, EMB-SWMD, PMO
- Technical Presentations by JET:
 - Under Activity 1-6: The Manual for Planning, Evaluation, Formulation, and Supervision of WTE project
Mr. Makoto Kosaka (Presentation 15 mins + Q&A 5 mins)
 - Under Activity 1-6: Evaluation criteria for EMB on 10-year SWM plans
Mr. Satoshi Higashinakagawa (Presentation 10 mins + Q&A 5 mins)
 - Under Activity 1-8 and 1-5: Interview Survey for TSD Facilities
Ms. Rose Quioco (Presentation 10 mins + Q&A 5 mins)
- Updates of JAO of WTE Technical Guidelines, (TBN, DENR/EMB)
- Updates of WTE bill and DOC-DC, (TBN, DOE)
- Wrap-up/Required Actions/Agreements/Timelines - Engr. Andrei Mallare, JET (Presentation/discussions/comments 15 mins)
- Schedules of the next meetings - Ms. Elvira S. Pausing, EMB-SWMD-PMO (Presentation/discussions/comments 15 mins)
- Other Matters

PROJECT FOR CAPACITY DEVELOPMENT ON IMPROVING SOLID WASTE
MANAGEMENT THROUGH ADVANCED/INNOVATIVE TECHNOLOGIES IN THE
PHILIPPINES

Questionnaire for Sub-Group 1 (SG1) Meeting

Thank you for participating in the SG1 meeting on 22nd February.

In order for us to make our project more fruitful, it will be highly appreciated if you would fill the following questions. You can choose one of following 5 answer and put the Number after each question.

1. Very good	2. Good	3. Normal	4. Not so good	5. Bad
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1. Overall

- 1) How was your overall impression to the meeting on 22nd February? →
- 2) How was the length of the meeting time (2 hours)? →
- 3) How was the time zone of the meeting (from 9:00 AM)? →
- 4) How was the Internet connection? →
- 5) How was Microsoft Teams meeting system? →
- 6) How was the Management of the meeting? →

If you have any comments or questions, please fill out below

--

2. Presentation (overall)

- 1) How was your overall impression to the presentation? →
- 2) How was the length of each presentation time? →
- 3) How was the structure of the presentation material? →
- 4) How was the explanation by the presenter? →

If you have any comments or questions, please fill out below

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3. Understanding on the Presentation

For the following questions, please choose one of following 5 answer and put the Number after each question.

1. Very Well understood	2. Well understood	3. Generally understood	4. Partially understood	5. Not clearly understood
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- 1) How was your understanding on “Activity1-6 To prepare the Manual for Planning, Evaluation, Formulation, and Supervision of WTE project”?
(presented by Mr. Makoto Kosaka from JICA Expert Team)

If you have any comments or questions, please fill out below.

- 2) How was your understanding on “Activity1-6 Update of Evaluation Criteria for EMB of 10-year SWM plan”?
(presented by Mr. Satoshi Higashinakagawa from JICA Expert Team)

If you have any comments or questions, please fill out below.

- 3) How was your understanding on “Activity1-5, 1-8 Interview Survey for TSD Facilities”?
(presented by Ms. Rose Quiocho from JICA Expert Team)

If you have any comments or questions, please fill out below.

4. Suggestions and Others

- 1) It will be highly appreciated if you can freely give us your suggestion, question, comments or others below.

5. Your Profile

Name:
Organization:

End of questionnaire, thank you again for your contributions!

添付資料 11-2:
成果1サブグループ会議

11-2-12: 12th SG1



The Project for Capacity Development on Improving Solid Waste Management through Advanced/Innovative Technologies in the Republic of Philippines

Interview Survey for TSD Facilities
(Activity 1-5 and 1-8)

JICA Expert Team

Outline

- Introduction
 - Background
 - Objectives
 - Interview Participants
- Status and Schedule of Interviews and Data Collection
- Recap of Previous Presentation
- Additional Findings
- Way forward

Introduction

- Background
 - **Activity 1-5:** Prepare manual for management of bottom & fly ash discharged from WTE facility
 - **Activity 1-8:** Review and update the existing regulations of sanitary landfill for municipal solid waste where incineration ash will be disposed of.
- Objectives
 - To collect data on actual industry-based practices related to the current ash waste management in the Philippines;
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 - To confirm applicability of national laws related to Sanitary Landfills (Municipal and TSD).

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 - Cleanway Environmental Management Solutions Inc. (**CEMSI**) – Cavite, Region IVA
 - Jorm Environmental Services Inc. (**JESI**) – Cavite, Region IVA
 - Cleanaway Philippines Inc. (**CPI**) – Leyte, Region VIII
 - Ash Accepting Facility
 - Cement Factory (Republic Cement Batangas - RCB)
 - Industrial Ash Generator
 - Powerplant (Pagbilao Power Station - PPS)

*Based on lists of Registered TSDs as of March 31, 2021 published on [EMB Website](http://EMB.Website)

Status and Schedule of Interview and Data Collection

EMB Region / TSD	Meeting/Interview	Questionnaire	Data Request
CAR	N/A (No Ash-Accepting TSD)	OK (Jan 7, 2022)	N/A (No Ash-Accepting TSD)
Region III	OK (Jan 19, 2022)	OK (Mar 22, 2022)	Pending
Region IVA	OK (Jan 14, 2022)	OK (Jan 31, 2022)	OK (Jan 31, 2022)
Region VIII	OK (Jan 11, 2022)	OK (Jan 25, 2022)	N/A (No Ash-Accepting TSD)
Region X	OK (Jan 18, 2022)	OK (Jan 31, 2022)	OK (Jan 31, 2022)
MCWMC	OK (Jan 13, 2022)	OK (Feb 2, 2022)	OK (Feb 2, 2022)
CEMSI	OK (Feb 21, 2022)	OK (Feb 28, 2022)	OK (Feb 28, 2022)
CPI	Denied Interview (No Ash in TSD)		
RCB	OK (March 15, 2022)	OK (March 15, 2022)	OK (March 15, 2022)
PPS	OK (April 11, 2022)	Pending	Pending

Recap of Previous Presentation

- Ash is not specified in Table 2.1 of DAO 2013-22, and hence must undergo TCLP to determine its classification.
 - Non-hazardous: Municipal Sanitary Landfill, Onsite Disposal, Reutilization
 - Hazardous: Stabilization on TSD -> TSD Sanitary Landfill
- The specific form of solid waste is not indicated in hazardous waste manifests; hence, tracking of ash waste is difficult.
- The Philippine EIS system plays a major role in identifying the minimum monitoring parameters for Ambient and Effluent Air and Water Quality.
- One of the major considerations in the current TSD permitting evaluation process is effluent quality. The same is true in evaluation of Discharge Permits and Permits to Operate.

Additional Findings

- Cement Manufacturing Plants maintains two (2) separate permits for operating facility:
 - TSD Permit
 - Co-Processing Permit
- While Cement Plants could technically accept hazardous ash, the interviewed facility only accepts non-hazardous ash.
 - Ash are primarily utilized as an additive to cement (alternative raw material; added as is with no treatment done) which is limited by their Co-processing Permit.
 - Ash has low calorific value, hence is not cost effective to be treated in their TSD; Transportation of hazardous wastes must be done by an accredited hauler.

Additional Findings

- Cement plants and ash producers like powerplants usually have contracts.
 - In the case of Pagbilao Power Station, they have previous and ongoing agreement with Republic Cement and other cement manufacturers.
 - Current contract includes 100% hauling (Bottom and Fly Ash).
 - Accepted fly ash are paid by cement factories.
- Cement plants has an internal/separate set of standards for accepting ash.
 - Non-hazardous (Quarterly TCLP, courtesy of suppliers)
 - Other Parameters: Moisture, SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, SO₃, K₂O, Na₂O (Per batch, courtesy of cement plant)

Additional Findings

- TCLP is only done once quarterly on powerplant ash as a requirement of ECC.
 - No distinction on bottom and fly ash with regard to testing.
 - No prior record of generated hazardous ash.
 - Heavy metals are monitored on ash lagoon effluents.

Way forward

- Follow – up on pending data requests;
- Consolidation of results.

Thank you!

Activity 1-6

To prepare the Manual for Planning, Evaluation, Formulation, and Supervision of WTE project

4th November 2021

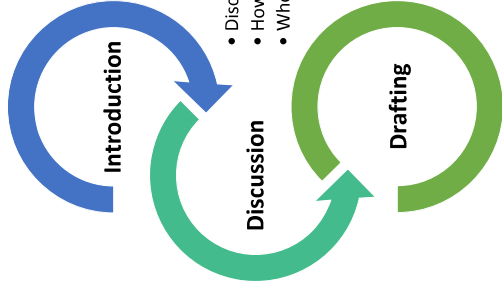
Makoto KOSAKA, SWM-PPP Expert

The Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies



Guideline for Planning and Designing of WTEs 2017

Title	Guideline for Planning and Designing of Waste Treatment Facilities (WTF) 2017
Publisher	Japan Waste Management Association
Price	JPY 27,000-
Last Update	May 2017
Size and Pages	A4 x 850 pages
TOC	<p>Volume I Planning Guidelines</p> <p>Chapter 1 Formulation of waste treatment master plan</p> <p>Chapter 2 Formulation of a regional plan for promoting the formation of a recycling-oriented society</p> <p>Chapter 3 Formulation of WTF life prolong plan</p> <p>Chapter 4 Formulation of various plans for the development of WTEs</p> <p>Chapter 5 Legal procedures for setting up a WTF</p> <p>Chapter 6 Procedures for ordering WTF construction work</p> <p>Chapter 7 Financial Resources for Construction of Waste Disposal Facility</p> <p>Volume II Design Guideline</p> <p>Chapter 1 Basic matters regarding waste incineration facilities</p> <p>Chapter 2 Matters concerning the functions of waste incineration facilities (including gasification and melting facilities and gasification reforming facilities)</p> <p>Chapter 3 Continuous operation type waste incineration facility</p> <p>Chapter 4 Intermittent operation type waste incineration facility</p> <p>Chapter 5 Gasification and Melting Facility / Gasification Reforming Facility</p> <p>Chapter 6 Incineration Residue Melting Facility</p> <p>Chapter 7 Non-combustible / Oversized / Container and Packaging Recycling Facility</p> <p>Chapter 8 Waste Transport and Transfer Facility</p> <p>Chapter 9 Refuse Derived Fuel Production Facility</p> <p>Chapter 10 Waste Carbonization Facility</p> <p>Chapter 11 Waste Methane Recovery Facility</p>



Nov2021 – Dec2021

- Introduction to Japanese “Guideline for Planning and Designing of Waste Treatment Facilities (WTF) 2017”

Jan2022 – April2022

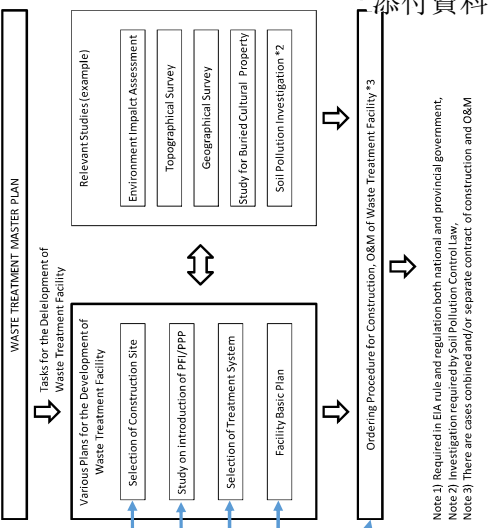
- Discussions in ITWG SG Meetings under Output 1
- How to adopt Philippines Context
- Whose authority will be attached (DAO? MC? or EMB’s guide?)

April2022 – May2022

- Drafting the Guidelines for Philippines

Chapter 4: Formulation of various plans for the development of WTEs

Sec	Table of Contents	Number of Pages
S1	Positioning the Various Plans regarding the Development of WTEs	5
S2	Selection of Candidate Construction Sites	9
S3	Survey for the Possibility of PI/PPP Introduction	3
S4	Selection of Treatment Methods	2
S5	Development of Facility Basic Plan	44
S6	Core Items in Waste Treatment Facility Design	11
S7	Safety Measures	4
S8	Dismantling of Incineration Facility	4
	Total	79



Note 1) Required in EIA rule and regulation both national and provincial government.
 Note 2) Investigation required by Soil Pollution Control Law.
 Note 3) There are cases combined and/or separate contract of construction and O&M

Figure 4.1-1: The positioning of the various plans for the development of WTEs

ごみ処理施設整備の計画・設計要領

2017 改訂版

全国都市清掃会議

S2. Selection of Candidate Construction Sites

Sub-section	Contents
2.1	Background of selection of candidate construction sites.
2.2	Lists up environmental protection laws as well as laws on facility establishment, land use and construction which should be taken into consideration.
2.3	Illustrates candidate site selection procedure.
2.4	Shows examples of conditions and evaluation items related to candidate site selection.
2.5	Illustrates procedural flow for selection of site.
2.6	Describes the points for consideration in selection of sites.
2.7	Describes the actions to be taken after selection of the site.

S3. Survey for the possibility of PFI/PPP introduction

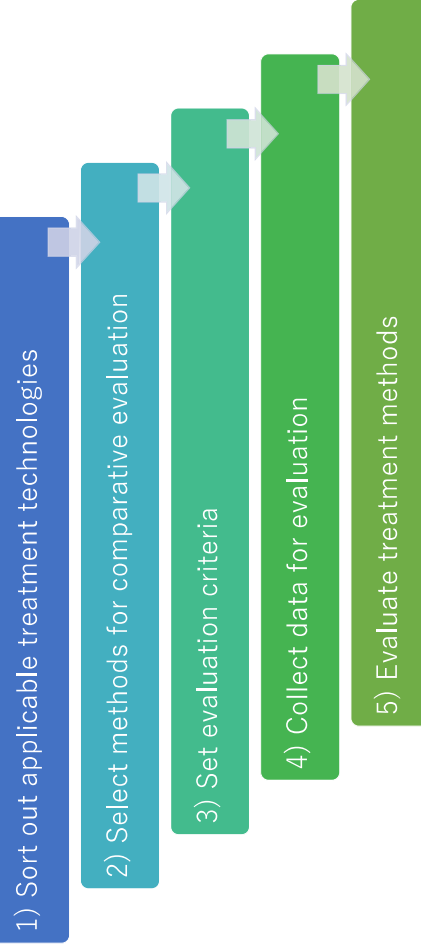
Objectives of PFI/PPP Feasibility Study

- To juxtapose different business methods to see which can be selected for the local government to introduce private sectors to ensure efficient and economical operation, maintenance, and management of the waste treatment facility
- To compares and evaluates which business methods should be selected in consideration of regional circumstances, business stability, economic efficiency, and intention of the private operators

View points to evaluate business methods

- Whether participation of multiple private companies is expected (intention survey)
- Whether quantitative effects (economic effects) can be expected (quantitative evaluation)
- Whether qualitative effects can be expected (qualitative evaluation)
- Whether comprehensive effects are expected after introduction of such (comprehensive evaluation)

S4. Selection of Treatment Methods



S5. Development of Facility Basic Plan

Sub-section	Contents
5.1	Background Describes background of developing facility basic plan. Explains how to set out ordering conditions for facility development.
5.2	Ordering conditions relating to facility development 1) Planned waste amount 2) Capacity of the facility 3) Planned Waste Quality 4) Pollution prevention standards 5) Waste heat utilization
5.3	Planned waste quality Describes the points to be considered when determining the planned waste quality. 1) Type of waste 2) Items for Waste Quality Analysis 3) Items of Waste Quality Analysis and their Purposes 4) General trend of waste quality 5) Example of Waste Quality Analysis 6) Setup the Quality of Target Waste in a Waste Incineration Facility 7) Setting of planned target waste quality in recycling centers (MRFs) for non-combustibles, bulky and packaging waste
5.4	Structure of Facility Basic Plan Describes the details to be included in Facility Basic Plan.
5.5	Stable supply of electricity Introduces the outline of power liberalization, FIT system and widening of power generation business.
5.6	Measures against disaster waste treatment Discusses how to deal with disaster waste that should be taken into account in the development of waste treatment facilities.

S6. Core Items in Waste Treatment Facility Design

Sub-section	Contents
6.1	Shows a reference example of application procedures to various government agencies by a local government that will be the project proponent.
6.2	Describes general structure and design considerations of waste treatment facility.
6.3	Discusses the necessity of disaster countermeasures, earthquake-resistant design of major facilities, prevention of secondary disasters, and examples of disaster prevention measures.
6.4	Illustrates measures in snow-covered cold regions and areas affected by salt.

S7. Safety Measures

7.1 Accidents at waste treatment facilities

- Occurrence of accidents
- Example of accidents

7.2 Facility safety measures

- “fail-safe” and “fool-proof” of equipment

7.3 Formulation of accident response manual

- Accident response manual
- Crisis management and safety assessment

S8. Dismantling of incineration facility

8.1 Dismantling of Incineration Facility

- Addressing dioxins and asbestos
- Dismantling cost issues

8.2 Dismantling Manual

- Regulations, guidelines and manuals
- Method of dismantling

8.3 Estimation of Dismantling Costs and Financial Resources

- Estimation of dismantling costs
- Subsidy system

Activity 1-6

To prepare the Manual for Planning, Evaluation, Formulation, and Supervision (PEFS) of WTE project

At SGOP1 on 17th May 2022

Makoto KOSAKA, SWM-PPP Expert



The Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies



2022/5/17

1

PEFS-JA-016 ENGINEERING CONSULTANTS, INC.

Progress of Activity 1-6 Development of PEFS manual

Updated

1. Upcoming Timeline for Activity 1-6

Timeline	Updates
November 4, 2021	9 th OP1 Subgroup Meeting, Introduction of "Japanese WTE dev. Guide"
January 12, 2022	10 th OP1 Subgroup Meeting, Request SGOP members to review "Japanese WTE dev. Guide"
January 31, 2022	Deadline for accepting comments to Sections 1 and 2
February 22, 2022	11 th OP1 Subgroup Meeting

2. Comments from ITWGW members at 11th SGOP1 for Activity 1-6

Members	Comments
DENR-SWMD	No comments in Japanese Guideline; comments will be reserved for the Philippine Guidelines once ready
DOE	No comments so far; shall focus their comments on the utilization of energy produced by WTE plants
DOST	No comments received
LGU-Quezon City	No comments received
NEDA	No comments received
PPPC	*detailed in succeeding page

To be the Philippines' WTE dev. manual, following activities are taken;

- Introduction of Philippines MSWM context.
- Insert Philippines manuals and guidelines as the reference,
- Kept Japanese examples as the variety.
- Recommend WTE dev. Manual for Philippines,

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Updates from Last SGOP1 (on Jan12)

Updated

3. PPPC general comments on Section 1 and 2 (Examples)

- Emphasis that a 10-year SWM plan is prerequisite to the formulation of the plans; Underscore the need to harmonize facility plan and siting conditions to the 10-year SWM plan of the LGU. => **Updated.**
- Differentiate scope and depth of each of the plans (Waste treatment master plan, Facility conceptual plan, Facility basic plan). => **Supplemented the information.**
- At which point shall the technology employed in the facility be finalized?
 - => **How to deal with increasing MSW shall be principally specified in Master Plan phase, for example, 36s and compost can reduce AA% of waste, WTE incinerator reduces BB%, its residue and rest CC% shall be disposed in Engineered Sanitary Landfill, etc. These quantified mass balance flow shall be required in 10-years MSWMP in Philippines.**
- Where does the review of the current regulations of the LGU come in?
- Restructuring of the report to ease the flow of discussion, Arrange the details of the report in chronological order, => **Noted.**
- Detail siting requirements and conditions: Section 4.2. noted of "conditions mandated in regulations for land use and welfare, as well as safety, economy, and ease of land acquisition"; could be itemized in this section for clarity => **Tried to lay down the mandated requirements in Philippines, and analyze the gap with Japanese one for suggestion.**
- Localizing the list of regulations that concern the establishment of WTE facilities. A similar summarized list of regulations like in Table 2-2 should be developed with the LGUs to specify the legal requirements that need to be satisfied => **Reflected.**

2022/5/17

3

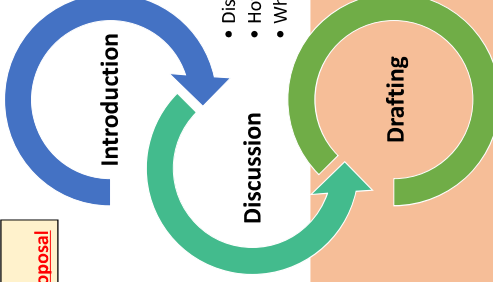
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Flow of Activity

Original Timeline
Revised Timeline as proposal

Nov2021 – Dec2021

• Introduction to Japanese "Guideline for Planning and Designing of Waste Treatment Facilities (WTF) 2017"



Jan2022 – April2022
Feb2022

- Discussions in ITWGW SG Meetings under Output 1
- How to adopt Philippines Context
- Whose authority will be attached (DAO? MC? or EMB's guide?)

April2022 – May2022
Feb2022 – May2022

- Drafting the Guidelines for Philippines,
- **Once completed, distributing ITWGW members for review (Email sent 15May2022)**
- => **Propose the deadline of comment, 31May**

Today's Scope

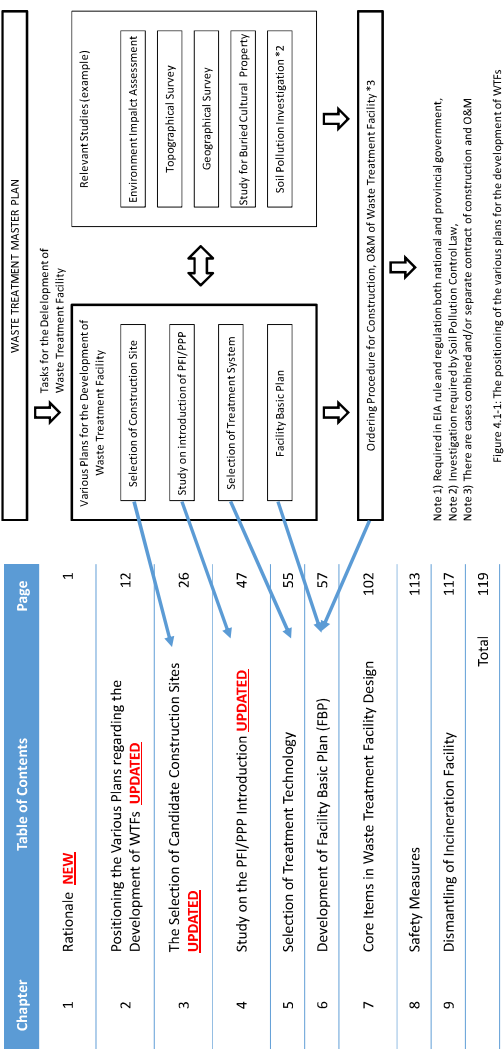
添付資料11

2022/5/17

4

PEFS-JA-016 ENGINEERING CONSULTANTS, INC.

Chapter	Table of Contents	Page	Recent Updates
1	Rationale NEW	1	Inserted the background, objective, and table 4.1 , which copied from PRR(2) activity 2-5 Points and Issues Associated in formulating WTE project by LGUs in Philippines, which contain; > LGUs need technical expertise. > Solicited planning approach must be needed for the evaluation of unsolicited private proposal which is common in Philippines, etc.
2	Positioning the Various Plans regarding the Development of WTEs UPDATED	12	Inserted Philippines legal framework and mandates of NG/Province/LGU in planning stage. Need discussion about 2.4 Role of Waste Treatment Consultant in Japan (how about in Philippines?) as the knowledge source who take an initiative in the planning stage.
3	The Selection of Candidate Construction Sites UPDATED	26	JET tried to lay down the Philippines legal requirements for siting, environmental protection, etc. and compare with the Japanese legal requirements, and highlighted some gaps identified. Then selection procedure. JET illustrated 2 examples in Japan and 1 NSWMC resolution flow for SLF, then proposed WTE site selection procedure for Philippines.
4	Study on the PFI/PPP Introduction UPDATED	47	JET tried to lay down the Philippines legal framework on PFI.
5	Selection of Treatment Technology	55	No drastic change. only minor correction works were done.
6	Development of Facility Basic Plan (FBP)	57	No drastic change. only minor correction works were done.
7	Core Items in Waste Treatment Facility Design	102	No drastic change. only minor correction works were done.
8	Safety Measures	113	No drastic change. only minor correction works were done.
9	Dismantling of Incineration Facility	117	No drastic change. only minor correction works were done.
	Total	119	



PROJECT ACTIVITY : 12th SUB-GROUP MEETING FOR PROJECT OUTPUT 1 (ENHANCEMENT OF NATIONAL GOVERNMENTS' CAPACITY FOR SUPPORTING AND COORDINATING OF LGUs' WTE PROJECT)

DATE/TIME : 17 May 2022, 10:00AM - 12NN (Philippine Time)

VENUE : Video Conference through Microsoft Teams

MATERIALS : <https://bit.ly/12OP1SGMtg>

Agenda Topics	Issues/Discussions/Actions	Comments/Agreements/ Timelines	Required Actions/Responsible Agency/Person
<p>1.) Call to Order/ Meeting Objectives/Acknowledgement of Attendees (Ms. Elvira Pausing, EMB-SWMD-PMO)</p>	<ul style="list-style-type: none"> ● Ms. Elvira Pausing of EMB-SWMD-PMO commenced the 12th subgroup meeting for Project Output 1 with quorum achieved and all presenters logged in. ● Ms. Pausing recapped the highlights of the 11th OPI SG Meeting held last February 22, 2022 where Japanese WTF Guidelines were presented, along with the updates on JET's comments on the Annotated Outline, and general updates on other finished activities including the Technical Standards and BAT/BEP Guidelines. DOE also shared updates on the status of the WTE Bill being developed by DOE. ● Ms. Pausing presented the agenda and asked the subgroup members if anything else needed to be discussed. 	<ul style="list-style-type: none"> ● Agenda was moved for adoption with no comments and modifications from the participants. 	
<p>2a.) Technical presentation on Activity 1-6: Manual for Planning, Evaluation, Formulation and Supervision of WTE Project (Mr. Makoto Kosaka, JET)</p>	<ul style="list-style-type: none"> ● Mr. Makoto Kosaka revisited the presentation on Activity 1-6: To prepare the Manual for Planning, Evaluation, Formulation, and Supervision of WTE project, and discussed the changes that have been made from the Japanese 	<p>Past Milestones: [November 4, 2021]</p> <ul style="list-style-type: none"> ● 9th OPI SG Mtg, introduction of Japanese WTF Guideline <p>[January 12, 2022]</p>	<p>[OPI SG Members] To review PEFS Manual v4 and send comments to JET on or before May 31, 2022. [JET]</p>

	<p>guidelines to localize the manual in the Philippine setting.</p> <ul style="list-style-type: none"> ● During the 11th OP1 SG Meeting, it was decided that JET develop the Philippine manual first before the subgroup's review. It was also agreed that while JET is working on the Philippine manual, the OP1 subgroup members shall review the document and offer references to JET on how to contextualize the document in the Philippine setting. <ul style="list-style-type: none"> ○ Mr. Kosaka shared the comments from PPPC and the respective actions taken by JET to address them. ○ Mr. Kosaka reported that JET has disseminated the PEFS Manual v4 as of May 16, 2022, for the review and comments of the OP1 SG Members. ● The framework of the PEFS Manual v4 was discussed, highlighting the updates that have been incorporated in each section for the guidance of the subgroup members. Mr. Kosaka also presented the file distributed to SG OP1 members while running down the updates one by one. <ul style="list-style-type: none"> ○ It was noted that majority of the updates pertain to Chapters 1-4, while only minimal edits were made on succeeding sections. 	<ul style="list-style-type: none"> ● 10th OP1 SG Mtg, Request for comments on Japanese WTF Guideline [January 31, 2022] ● Deadline for accepting comments to Sections 1 and 2 [February 22, 2022] ● 11th OP1 SG Mtg, decision to develop Philippine manual first ● Upcoming activities: ● Distribution of the manual to the subgroup members for review (via email + SG Meeting, sent last May 16, 2022) <ul style="list-style-type: none"> ○ Deadline for comments on PEFS Manual v4 was agreed by the subgroup to be set on May 31, 2022 ● After finalization and with the concurrence of the subgroup, the manual will be endorsed to the ITWG, and later on to the JCC. ● Ms. Pausing asked the body if a formal correspondence will be necessary to solicit comments from the subgroup. <ul style="list-style-type: none"> ○ PPPC and DOE denoted that an email correspondence through the same email thread can be 	<p>To issue a followup email to indicate the May 31, 2022 deadline for comments to the subgroup members.</p>
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<p>2b.) Technical presentation on Activity 1-5 and 1-8: Interview Survey for TSD Facilities (Ms. Rose Quioco, JET)</p>	<ul style="list-style-type: none"> ● Ms. Quioco shared the updates on Activity 1-5 and 1-8, following the last Subgroup meeting last Feb 2022. ● Activity 1-5 entails the preparation of a manual for the management of ash discharge from WTE facility, while Activity 1-8 entails the review and update of the current regulations on the SLF management in the country where incineration ash will be disposed of. ● Data collection efforts were set up with EMB Regional Offices (CAR, III, IVA, VIII, and X) and TSD facility operators (MCWMC, CEMSI, JESI, and CPI) in order to understand the current practices, issues with the current procedure, and later on to guide JET in providing recommendations on how these current practices can be improved. 	<p>utilized to solicit comments.</p> <ul style="list-style-type: none"> ○ No further contentions were raised by the other subgroup members ○ It was decided that a formal correspondence will no longer be necessary- an email reminder from JET shall suffice to relay the request for comments and the indication of the deadline for comments. 	
		<ul style="list-style-type: none"> ● Ms. Pausing inquired how these findings will be relayed to EMB, particularly to HWMS. <ul style="list-style-type: none"> ○ Mr. Kamishita responded that following the collection of pending data, the consolidated insights shall be shared with EMB in fulfillment of Activity 1-5 and 1-8. 	

<p>3.) Update on the NSWMC review of the Evaluation criteria for EMB on 10-year SWM Plans (Ms. Elvira Pausing, EMB-SWMD-PMO)</p>	<ul style="list-style-type: none"> ○ Based on the insights from these meetings, JET decided to extend the interviews to ash-accepting facilities (Republic Cement Batangas) and Industrial ash generators (Pagbilao Power Station) ○ The current status of the meetings, questionnaire and data request were shown, highlighting some pending requests to EMB R3 and Pagbilao Power Station. ● In addition to the findings presented in the last meeting, further insights from the meeting with the cement plant were presented, noting their current practices and soliciting their personal recommendations on how the current ash management practices can be improved. ● Moving forward, JET plans to follow up on all pending requests for information, and then consolidate the results to provide a more exhaustive analysis on the current ash waste management practices in the Philippines. ● Aligned to Activity 1-6: Evaluation criteria for EMB on 10-year SWM plans, that primarily intends to support the review and updating of the assessment materials used by DENR in reviewing the 10-year SWM plan to consider the establishment of the WTE facilities, JET has previously shared 		
			<p>[PMO] To update JET on the schedule of the NSWMC discussion of the Annotated Outline</p>

	<p>comments on how the “Annotated Outline” can be improved, as one of the assessment documents utilized in the review.</p> <ul style="list-style-type: none"> ● Ms. Pausing reported that NSWMC Secretariat has yet to schedule the discussion with the NSWMC Executive Committee on the comments on the Annotated Outline in their agenda. <ul style="list-style-type: none"> ○ The ExeComm has confirmed that this will not be covered still in their upcoming meeting on May 19, and has deferred the discussion to their meeting on June 2, 2022. 		
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<p>4.) Wrap-up, Required Actions, and Agreements</p>	<ul style="list-style-type: none"> ● Ms. Andrei Mallare of JET wrapped up the earlier discussions and reiterated the arrangements and timelines as agreed. [JET] To issue a followup email to indicate the May 31, 2022 deadline for comments to the subgroup members. [PMO] To update JET on the schedule of NSWMC discussion of the Annotated Outline [OP1 SG Members] To review PEFS Manual v4 and send comments to JET on or before May 31, 2022. 	<ul style="list-style-type: none"> ● No clarifications and/or alterations raised by the subgroup members. 	
<p>6.) Way forward, schedule of the next meetings</p>	<ul style="list-style-type: none"> ● Ms. Barcnas presented the tentative calendar of activities for 2022, as shown below, for the reference of the subgroup members. <ul style="list-style-type: none"> ○ Ms. Mallare reiterated that the conduct of the upcoming ITWG and JCC Meetings will be in person, following the suggestion of Dir. Cunado during the 5th ITWG Meeting last April 2022. 		

PROPOSED SCHEDULE OF MEETINGS for 1st half of CY 2022 (as of **May 11, 2022**)

PROJECT OUTPUT	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
PMO	06	09	09	01	13	03	06	03	07	05	02	02
JCC						14					29	
ITWG				05		1		24		19		
SGOP1	12	22			17							
SGOP2			20					TBD				
OP2 (LGUs)	06	15CC	17CC	12DC 21DC	TBD DC	TBD (22CC)						
OP2 (PPPC)												
SGOP3			24									
SGOP4		16				TBD						
SEMINAR						2		28				

添付資料 11-2:
成果1サブグループ会議

11-2-13: 13th SG1

Activity 1-5 and 1-8

Recommendations on the existing regulations of sanitary landfill where incineration ash will be Disposed of.

7th October 2022

Takuya KOKETSU, Final Disposal Expert

The Technical Cooperation Project (TCP) for Capacity Development on Improving Solid Waste Management (SWM) through Advanced/Innovative Technologies



1. Challenges of sanitary landfill regulations in the Philippines
2. Challenges of existing sanitary landfills in the Philippines
3. Design sanitary landfill where incineration ash will be disposed of
4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

1. Challenges of sanitary landfill regulations in the Philippines

The following table list the laws and regulations regarding sanitary landfill in the Philippines and a summary of these laws and regulations

Laws and Regulations	Title	Summary
DAO 1998-49	Technical Guidelines for Municipal Solid Waste Disposal	This is a technical guideline for municipal solid waste disposal. Final disposal sites are classified into four types: open dumping, controlled dumping sites, sanitary landfill level 1, and level 2, and the characteristics and regulations for each are presented.
DAO 1998-50	Adopting the Landfill Site Identification and Screening standard for Municipal Solid Waste Disposal Facilities.	The report presents evaluation items, standard, considerations, and data sources for selecting a site for a final disposal site.
RA 9003	Ecological Solid Waste Management Act of 2000	This is a law on solid waste management and, for final disposal sites, it prohibits open dumping (all open dump sites must be converted to controlled dump sites within three years and be operational within five years) and establishes standard for the suitable location, design, and operation of sanitary landfills.
DAO 2004-34	Implementing Rules and Regulations of RA 9003	Implementing Rules and Regulations (IRR) promulgated pursuant to Article 59 of RA 9003. For final disposal sites, the IRRs provide detailed rules for site selection, design, and operation of sanitary landfills.
DAO 2006-10	Guidelines on the Categorized Final Disposal Facilities (Sanitary Landfill)	Final disposal sites are classified into four categories according to the amount of waste delivered per day, and technical standards are specified for each category.
DAO 2013-22	Revised Procedure and Standards for the Management of hazardous Wastes (Revising DAO2004-36)	This is a revision of DAO 2004-36. Procedures and Standards for the Management of Hazardous Waste. It classifies hazardous waste by type and specifies categories. A through H for facilities that treat, store, and dispose of hazardous waste. Final disposal sites are classified as Category C.

1. Challenges of sanitary landfill regulations in the Philippines

Structural standard for sanitary landfill liner in DAO 2001-34

DAO 2001-34 provides detailed structural standard for sanitary landfill liner. The structural standard for the liner are listed below:

- ❖ Landfill shall be provided with a base liner system consisting of clay and/or geosynthetic membrane (geomembrane).
- ❖ If clay is used, it shall have a minimum thickness of 0.75m and permeability of 1×10^{-5} cm/sec or less.
- ❖ Geomembranes shall be at least 1.5 mm thick with a permeability of 1×10^{-14} cm/sec or less.
- ❖ Geosynthetic Clay Liners (GCL) shall have a thickness of at least 6.4 mm and a permeability of 1×10^{-9} cm/sec or less.

1. Challenges of sanitary landfill regulations in the Philippines

Structural standard for sanitary landfill liner in DAO 2006-10

DAO 2006-10 was promulgated after DAO 2001-34; DAO 2006-10 divides waste into four categories that show how much waste is delivered per day to the sanitary landfill.

	Category 1	Category 2	Category 3	Category 4
Daily waste disposal volume	≤15 TPD	> 15 TPD ≤75TPD	> 75 TPD ≤200TPD	< 200TPD

In DAO 2006-10, the standard are determined by the amount of waste delivered to the landfill per day, with category 4, which has the highest volume of waste delivered, having the most stringent standard.

1. Challenges of sanitary landfill regulations in the Philippines

Structural standard for sanitary landfill liner in DAO 2006-10

DAO 2006-10 stipulates the standard for liners of categories 1 to 4 of sanitary landfills as follows: In DAO 2006-10, liner standards have become stricter as the volume of waste sent to landfills per day increases.

Category 1	Category 2	Category 3	Category 4
Clay liner should be at least 60cm thick and have a permeability of 10^{-5} cm/sec	Clay liner should be at least 75cm thick and have a permeability of 10^{-5} cm/sec	Clay liner should be at least 75cm thick and have a permeability of 10^{-6} cm/sec or better, or composite liner consisting of as least 1.5mm thick HDPE membrane over at least 60cm thickness of compacted fine material with permeability no more than 10^{-6} cm/sec	Synthetic liner should be at least 1.5mm thick HDPE membrane over at least 60cm thickness of compacted clay materials with permeability no more than 10^{-7} cm/sec
Clay liner at least 60cm thick, a permeability of 10^{-5} cm/sec	Clay liner at least 75cm thick, a permeability of 10^{-5} cm/sec	Clay liner at least 75cm thick, a permeability of 10^{-6} cm/sec or better or HDPE membrane liner at least 1.5mm thick Clay liner at least 60cm thick, a permeability no more than 10^{-6} cm/sec	HDPE membrane liner at least 1.5mm thick Compacted clay material liner at least 60cm thick, a permeability no more than 10^{-6} cm/sec

1. Challenges of sanitary landfill regulations in the Philippines

Structural standard for sanitary landfill liner in DAO 2001-34 and DAO 2006-10

The challenge with the standards for liner for sanitary landfill is that DAO 2001-34 and DAO 2006-10 have the following differences:

- ❖ DAO 2001-34 states that liner system consisting of clay and/or geosynthetic membrane is required, but DAO 2006-10 does not allow liner consisting only of geosynthetic membrane.
- ❖ DAO 2001-34 states that if clay is used, it shall have a minimum thickness of 75cm and permeability of 1×10^{-6} cm/sec or less. However, according to DAO 2006-10, for Category 1 liners, the clay liner is at least 60 cm thick and has permeability of 1×10^{-5} cm/sec, both the thickness and permeability are less than the standards of DAO 2001-34.
- ❖ DAO 2001-34 allows the use of geosynthetic clay liners (GCL), but DAO 2006-10 does not allow the use of GCL.

1. Challenges of sanitary landfill regulations in the Philippines

Structural standard for leachate collection and treatment facilities

In DAO 2001-34, the structural standard for leachate collection and treatment facilities are listed below:

- ❖ Leachate collection and removal system shall be provided and designed to minimize leachate buildup in the landfill while maintaining leachate level of not more than 0.60 meters over the liner system.
- ❖ If leachate is discharged to a receiving body of water, the discharge shall meet effluent discharge and water quality standards prescribed by DENR.
- ❖ Leachate storage facility shall be designed with containment systems to prevent leachate from spillage and its migration into underlying groundwater or nearby surface body of water.

In DAO 2006-10, there is no description of standard for leachate collection, and leachate treatment has the following standard for categories 1 to 4.

	Category 1	Category 2	Category 3	Category 4
Leachate treatment	Pond System	Pond System	Pond System	A combination of physical, biological and chemical treatment

1. Challenges of sanitary landfill regulations in the Philippines

Structural standard for leachate collection and treatment facilities

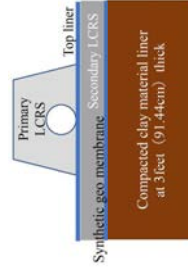
The standard for leachate collection and treatment facilities include the following challenges:

- ❖ DAO 2006-10 does not specifically address the design of leachate collection facility.
- ❖ For leachate treatment facility, categories 1 through 3 are defined as pond systems, which is a method of purifying leachate by leachate pond and aerating the pond to purify the leachate with microorganisms. As shown above, the leachate treatment facility is specified by the amount of waste delivered per day, but since the quality of leachate varies depending on the type of landfill waste, **it is appropriate to specify the leachate treatment facility according to the type of landfill waste.**

1. Challenges of existing sanitary landfill regulations in the Philippines

Structure standard for hazardous waste landfill

The figure below shows the standard for liner and leachate collection stipulated in the technical guidelines of TSD facilities:



- ❖ According to the technical guidelines of TSD facilities, the top liner is the geomembrane and the lower liner is a composite liner of geomembrane and compacted clay liner, **in effect, triple liners.**
- ❖ The technical guidelines of TSD facilities do not specify the thickness or permeability of the geomembrane and compacted clay liner.
- ❖ Triple liners and Double Leachate Collection and Removal System (LCRS) are not currently used in the landfills for hazardous waste in operation **because of the higher construction cost.**

Structure standard for hazardous waste landfill

Structure standard of liner for hazardous waste landfill is shown

- ❖ Ash generated from the WTE facility will be subjected to the TCLP test, and if ash is classified as hazardous waste, it will be disposed of in hazardous waste landfill in accordance with DAO 2013-22.
- ❖ For structural standard for hazardous waste landfill, the Technical Guidelines for Specific Categories of Treatment, Storage, and Disposal (TSD) facilities 2015 EMB ("TSD facilities Technical Guidelines), specify the following for liner:

2. Challenges of existing sanitary landfills in the Philippines

1. Challenges of sanitary landfill regulations in the Philippines
2. **Challenges of existing sanitary landfills in the Philippines**
3. Design sanitary landfills where incineration ash will be disposed of
4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

Summary of Sanitary Landfill Visits

Name	Location	Category	Ownership	Date of Visit
San Pascual Municipal Sanitary Landfill	San Pascual, Batangas	1	LGU	May 26, 2022
Bauan Solid Waste Management, Inc.	Malindig, Bauan, Batangas	2	Private	May 26, 2022
San Pablo City Sanitary Landfill	San Pablo City, Laguna	3	LGU	May 26, 2022
New San Mateo Sanitary Landfill	Guinayang, San Mateo, Rizal	4	Private	May 27, 2022
MetroClark Sanitary Landfill	Sito Kalangitan, Capas, Tarlac	4 / TSD	Private	May 23, 2022

The following are the results of field survey of categories 1-4 and hazardous waste landfill:

- ❖ The landfill in the Philippines is not collecting and draining leachate properly, which means that leachate is stored in the landfill. This causes leachate to accumulate in the landfill, **which causes bad smells and the breeding of mosquitoes.**
- ❖ The leachate collected in the leachate collection pipes is discharged into the leachate pit and pumped to the leachate pond. However, **the leachate pit was not collecting leachate, and the pump was not operating** due to lack of electricity.
- ❖ There were landfills that had the leachate collection pit but **no leachate pond.**

The following are two examples where **there is no leachate pond**, and leachate pits where leachate has not collected.



The following pictures are examples of leachate not being collected.



Leachate flowing into the drainage around the landfill



Leachate accumulation in landfill

As mentioned above, the site survey of existing landfills conducted by JET showed that some landfills had problems in the leachate collection facility and leachate treatment facility.

3. Design sanitary landfill where incineration ash will be disposed of

1. Challenges of sanitary landfill regulations in the Philippines
2. Challenges of existing sanitary landfills in the Philippines
3. **Design sanitary landfill where incineration ash will be disposed of**
4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

3. Design sanitary landfill where incineration ash will be disposed of

In the past, solid waste generated from households were transported directly to the landfill and disposed of in the landfill. Most of the landfill waste was paper and plastic. However, when WTE facility is introduced, combustible waste will be incinerated. Since the incineration ash generated from WTE facility is disposed of, **quality and quantity of landfill waste will change significantly.**

The points to consider when designing sanitary landfill disposed of incineration ash are as follows.

3. Design sanitary landfill where incineration ash will be disposed of

Setting the landfill capacity

The main landfill wastes after introduction of WTE facility are incineration ash, inert waste, and cover soil. **The amount of landfill wastes will be drastically reduced.** Therefore, the points to note when determining the landfill capacity are as follows.

- ❖ In Japan, about 10% bottom ash and about 3% fly ash are generated for the weight of incinerated waste. Since the specific gravity of ash is 1.0t/m³, incinerating the waste reduces the landfill capacity to about 1/10.
- ❖ On the other hand, the geomembrane laid in the landfill deteriorates under the influence of ultraviolet rays, and its life span is about 20 years from the results of durability tests.
- ❖ Therefore, it is necessary to set the landfill capacity so that the landfill period does not exceed 20 years.
- ❖ The landfill amount of incineration ash for 20 years is calculated by the following formula:
Incinerated waste weight/day (t) x 13% x WTE facility operating days/year (d) x 20 years x 1.0t/m³

3. Design sanitary landfill where incineration ash will be disposed of

Leachate treatment facility

The leachate generated from landfill where incinerated ash was disposed of will **have a different quality** than the leachate from landfills where solid waste was disposed of. Therefore, with reference to Japanese literature, the table below shows the quality of leachate from landfills where municipal solid waste is mainly disposed of and leachate from landfills where incineration and inert waste are disposed of.

Water quality	Municipal solid waste	Incineration ash and inert waste
BOD	1,200mg/L	50~250mg/L
SS	300mg/L	100~200mg/L
COD	480mg/L	50~200mg/L
T-N	480mg/L	50~100mg/L
Ca ²⁺	—	500~3,000mg/L
Cl	—	2,000~20,000mg/L

As shown in this table, the following can be concluded.

- ❖ Quality of leachate from incineration ash and inert waste landfills is low in all items.
- ❖ When ash is disposed of, **it is necessary to consider Ca²⁺ and Cl⁻.**
- ❖ This is because the flue gas treatment facility sprays slaked lime to remove HCl from the flue gas generated from the WTE facility, and the fly ash contains a large amount of CaCl₂, which dissolves in leachate in the landfill and leaches out as Ca²⁺ and Cl⁻.

3. Design sanitary landfill where incineration ash will be disposed of

Leachate treatment facility

- High calcium concentrations in leachate can cause scaling in pumps and other equipment, which can interfere with facility operation, and many leachate treatment facilities in Japan have adopted calcium removal equipment.
- If the leachate-treated water is discharged in agricultural canals, desalination treatment is necessary in some cases because the Cl in the leachate-treated water may cause crops to wither.



Normal paddy rice after rice planting Start to wither due to salt damage Withered rice

3. Design sanitary landfill where incineration ash will be disposed of

Leachate Treatment facility

As mentioned before, when ash generated from the WTE facility is disposed of in a landfill, it has a large impact on the leachate treatment facility. Therefore, two proposals regarding leachate treatment are made below.

Proposal 1

If ash generated from WTE facilities is to be disposed at a landfill where municipal solid waste is currently disposed, it would be realistic to measure the quality of the leachate periodically (about once/month) and consider adding treatment facilities, when items that worsen leachate quality are detected, since the ratio of ash to total landfilled waste is small and SS content may be filtered out in the process of leachate percolation through landfilled waste that has already been landfilled.

Proposal 2

Many landfills in the Philippines use lagoons for leachate treatment because of their superior economic efficiency. In the case of lagoons, leachate volume can be adjusted and treated together by aeration of the leachate pond. In contrast, if the SS concentration in the leachate increases due to the impact of disposing ash, it is necessary to add a coagulation sedimentation treatment facility or other equipment.

3. Design sanitary landfill where incineration ash will be disposed of

Leachate Treatment facility

Incineration ash includes heavy metals and dioxins. Heavy metals and dioxins are difficult to dissolve in water, the concentrations of heavy metals and dioxins in leachate are often low. But in Japan, there are cases in which concentrations of lead, zinc, and soluble iron in leachate exceed effluent standards. Therefore, there are many cases where the following heavy metals include in the effluent standards in Japan.

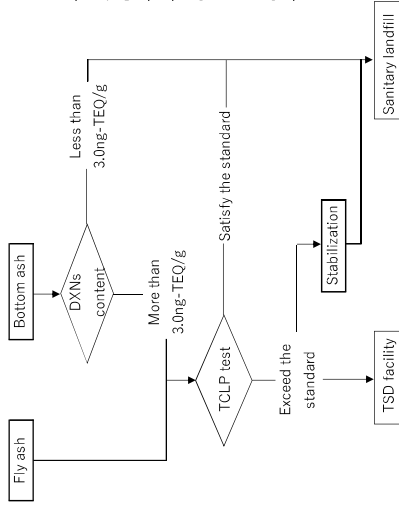
No.	Item	Effluent standard	No.	Item	Effluent standard
1	pH	5.8-8.6	15	Phosphorous	≤15mg/L
2	BOD	≤60mg/L	16	Alkyl mercury compounds	≤0.4mg/L <small>Shall not be detected</small>
3	COD	≤90mg/L	17	Mercury, alkyl mercury and other mercury compounds	≤3mg/L
4	SS	≤60mg/L	18	Cadmium and its compounds	≤0.05mg/L
5	n-hexane extract content (mineral oil content)	≤5mg/L	19	Lead and its compounds	≤0.02mg/L
6	n-hexane extract content (animal and vegetable oils content)	≤30mg/L	20	Organophosphorus compounds	≤0.06mg/L
7	Phenol content	≤5mg/L	21	Hexavalent chromium compounds	≤0.03mg/L
8	Copper content	≤3mg/L	22	Arsenic and its compounds	≤0.1mg/L
9	Zinc content	≤2mg/L	23	Cyanide	≤1mg/L
10	Soluble iron content	≤10mg/L	24	PCB	≤0.003mg/L
11	Soluble manganese content	≤10mg/L	25	Trichloroethylene	≤0.5mg/L
12	Chromium content	≤2mg/L	26	Tetrachloroethylene	≤0.3mg/L
13	Number of coliform bacteria	≤3,000 units/cm ³	27	Dichloromethane	≤0.2mg/L
14	Nitrogen content	≤120mg/L	28	Carbon tetrachloride	≤0.02mg/L
			29	1,2-dichloroethane	≤0.04mg/L
			44	Dioxins	≤10ng-TEQ/nm

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

- Challenges of sanitary landfill regulations in the Philippines
- Challenges of existing sanitary landfills in the Philippines
- Design sanitary landfills where incineration ash will be disposed of
- Proposed regulations of sanitary landfill where incineration ash will be disposed of

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

The following is a flow chart of how bottom ash and fly ash generated from WTE facility will be disposed of in landfill.



Bottom ash will be disposed of in the sanitary landfill if the Dioxins test is conducted, and the concentration is $3\text{ng-TEQ/g} \leq$.

On the other hand, bottom ash exceeding 3ng-TEQ/g in the Dioxins test can be disposed of at a sanitary landfill if the TCLP test satisfies the standard. If the standard is exceeded, it will be disposed of in the hazardous waste landfill (TSD facility).

In addition, fly ash will undergo a TCLP test, and ash exceeding the standard can be disposed of at the TSD facility, and ash below the standard to the sanitary landfill.

4. Proposed regulations of sanitary landfills where incineration ash will be disposed of

As mentioned above, incineration ash will undergo a TCLP test, and if it is below the standard, it will be disposed of in the sanitary landfill, and if it exceeds the standard, it will be disposed of in the TSD facility.

On the other hand, the structural standard for sanitary landfill is DAO 2006-10, and the structural standard for TSD facilities is TSD facilities Technical Guidelines. Therefore, referring to two structural standards structural standards for the main facilities of the sanitary landfill and the TSD facility for the disposal of incineration ash are shown. The main facilities mentioned here are the liner, leachate collection facility, drainage facility, gas control and recovery system, and leachate treatment facility.

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

Table Structural standards for sanitary landfill

Facility	Draft structural standard	Remark
Liner	Double Liner Synthetic liner should be at least 1.5mm thick HDPE membrane over at least 60cm thickness of compacted clay materials with permeability no more than $1 \times 10^{-7}\text{cm/sec}$	Adopted the structure in category 4 in DAO 2006-10
Leachate collection facility	Adopted semi-aerobic landfill Install a pipe that can drain with a cross-section of 1/2 against leachate generated by rainfall with a probability of 10 years	Adopted the structure in JICA Technical Guidebook on Solid Waste Disposal Design Operation & Management
Drainage facility	Install a facility that can drain rainfall with a probability of 25 years	Adopted the structure in Technical Guidelines for Specific Categories of TSD Facilities
Gas control and recovery system	A series of vertical wells or horizontal trenches containing permeable materials and perforated piping placed in the landfill to collect gas for treatment or productive use as an energy source	Adopted the structure in RA 9003
Leachate treatment facility	Treatment Method Combination of physical, biological & chemical Facility scale The combination of the leachate pond and leachate facility can handle rainfall with a probability of 20 years.	Adopted the structure of category 4 in DAO 2006-10 Adopted the structure in JICA Technical Guidebook on Solid Waste Disposal Design Operation & Management

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

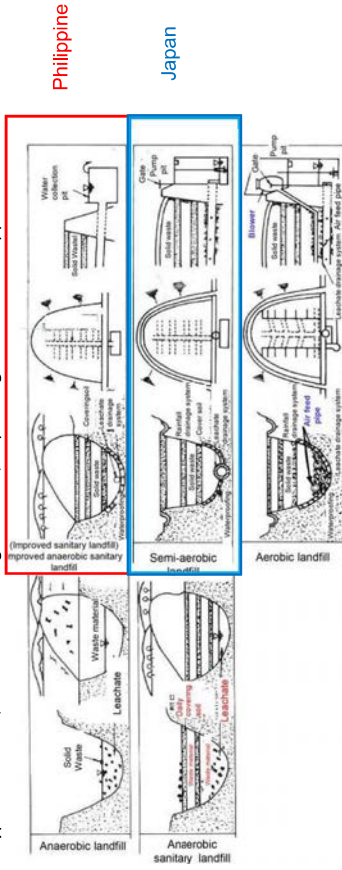
Table Structural standards for TSD facility

Facility	Draft structural standard	Remark
Liner	Double Liner Must consist of a top liner to prevent migration of hazardous constituents into the liner and a composite bottom liner consisting of a synthetic geo membrane and three feet of compacted soil material	Adopted the structure in Technical Guidelines for Specific Categories of TSD Facilities
Leachate collection facility	Double Leachate Collection and Removal System (LCRS) Adopted semi-aerobic landfill Install a pipe that can drain with a cross-section of 1/2 against leachate generated by rainfall with a probability of 10 years	Adopted the structure in Technical Guidelines for Specific Categories of TSD Facilities and JICA Technical Guidebook on Solid Waste Disposal Design Operation & Management
Drainage facility	Install a facility that can drain rainfall with a probability of 25 years	Adopted the structure in Technical Guidelines for Specific Categories of TSD Facilities
Gas control and recovery system	A series of vertical wells or horizontal trenches containing permeable materials and perforated piping placed in the landfill to collect gas for treatment or productive use as an energy source	Adopted the structure in RA9003
Leachate treatment facility	Treatment Method Combination of physical, biological & chemical Facility scale The combination of the leachate pond and leachate facility can handle rainfall with a probability of 20 years.	Adopted the structure of category 4 in DAO 2006-10 Adopted the structure in JICA Technical Guidebook on Solid Waste Disposal Design Operation & Management

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

What is semi-aerobic landfill ?

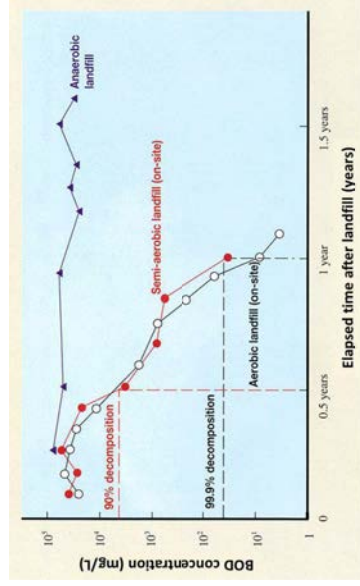
There are five types of landfills, as shown in the figure below, depending on how air is supplied to the landfill:



The semi-aerobic landfill structure (Fukuoka Method) is used for final disposal sites in Japan.

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

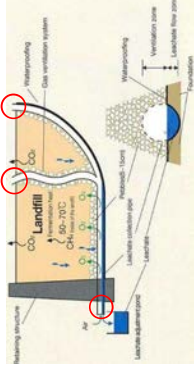
A graph of the change in BOD concentration of leachate in anaerobic and semi-aerobic landfill structures is shown below.



BOD concentration in leachate generated from semi-aerobic landfill have dropped sharply over a year, indicating that landfill waste is quickly stabilizing.

4. Proposed regulations of sanitary landfill where incineration ash will be disposed of

A cross-sectional view of a semi-aerobic landfill structure is shown below:



- The diameter of the leachate collection pipe is enlarged to drain leachate in half its cross-section, and the end of the leachate collection pipe, indicated by the red circle, is opened to allow air (oxygen) to be supplied through this pipe into the landfill.
- When the landfill is in an anaerobic atmosphere, methane is generated from the decomposition of landfill waste, but by supplying air to the landfill to create an aerobic atmosphere, CO₂ is generated instead of CH₄. Since the greenhouse effect of CO₂ is about 1/25 that of methane, the introduction of a semi-aerobic landfill structure is an anti-global warming measure.
- The semi-aerobic landfill structure is also economical because it can be introduced by opening the ends of the pipes and securing the air circulation cross section in the leachate collection pipes (increasing the pipe diameter).

Thank you for your attention!