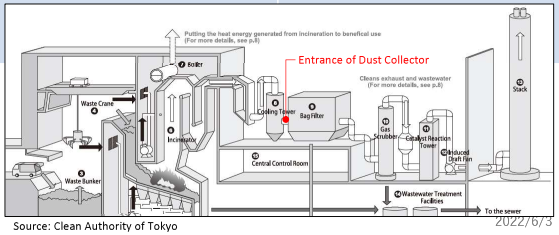
3.2 Cooling System for DXNs Prevention (cont. measurement)

Requirement for monitoring/recording of the temperature of combusted gas flowing into dust collector (bag filter, etc.).	(S/S) 7-5. **A device shall be installed for continuously measuring and recording the temperature of the combustion gas flowing into the dust collector** (In the case of the proviso of (7-2), the temperature of the combustion gas cooled in the dust collector). (OM/S) 2-9. **To continuously measure and record the temperature of the combustion gas flowing into the dust collector** (In the case referred to in the proviso of (2-8), the temperature of the combustion gas cooled in the dust collector).	Only generic description as below; 9. All measurement results shall be recorded, processed and presented in an appropriate fashion in order to enable the competent authorities to verify compliance with the permitted operating conditions and emission limit values laid down in this Directive in accordance with procedures to be decided upon by those authorities.	No requirement about temperature of flue gas at entrance of dust collector. => Recommend to include together with requirement of cooling down of flue gas.



Source: Clean Authority of Tokyo

3.3 Exhaust Gas Treatment System

Requirements for the exhaust gas treatment system to ensure pollution prevention standards such as emission standards under Clean Air Act by checking the pollutants removal process and its capacity. If the authority judges the proposed equipment in the facility is deemed insufficient to achieve required pollution control capacity, authority (in Japanese case, provincial governor) has to direct to improve its plan/design. Requirement for fly-ash management to avoid reducing combustion performance by piled up fly-ash. Requirement for air pollution substances contained in exhaust gas. (Not specify each item at this document).	(S/S) 7-6. **Exhaust gas treatment facilities** (Limited to those with an advanced function to remove fly ash) **capable of preventing the hindrance in the preservation of the living environment caused by the exhaust gas discharged from the chimneys of the incineration facility shall be provided.** (OM/S) 2-10. **To remove fly ash accumulated in cooling equipment and exhaust gas treatment equipment**. 2-15. **To prevent the hindrance in the preservation of the living environment caused by exhaust gas.**	Article 7 Air emission limit values 1. Incineration plants shall be designed, equipped, built and operated in such a way that **the emission limit values set out in Annex V are not exceeded in the exhaust gas.** Annex V (a) Daily Ave. Values; Dust, TOC, HCl, HF, Sox, NOx, (b) Half-hourly Values; Dust, TOC, HCl, HF, Sox, NOx, (c) 0.5 – 8 hours average; Cd, Tl, Hg, Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V (d) 6 – 8 hours average; Dioxins and furans, (e) CO,	DAO2019-21 requires WtE to comply with EIS, in which emission standards under RA8749 Clean Air Act and its IRR shall be cited, but no exact clause on the requirements that equipment has to be obviously capable to prevent environmental violation. ⇒ Recommend to include a clause to require that the equipment shall be obviously capable to prevent environmental burden prior to the construction. ⇒ It is also recommended that Specific exhaust gas limit (except DXNs) should not specified in this document and just refer EIS and CAA emission limit.

Of course, there is emission standards which WtE shall comply with.
However, prior to granting the building permit, the facility plan has to be verified that **the proposed facility is obviously capable to meet the emission standards** and other performance requirement **by provision of existing operation data, etc.**

3.4 Continuous measurement of CO in exhaust gas

Requirements for the measurement system of exhaust gas. CO concentration can be an indicator of complete combustion and DXN emission. If the facility will monitor DXNs concentration four times in a year, this clause can be exempted. Requirement for monitoring/recording of CO.	(S/S) 7-7. Equipment shall be provided for **continuously measuring and recording the concentration of carbon monoxide (CO) in the exhaust gas discharged from the chimney** of the incineration facility. (OM/S) 2-11. To incinerate waste so that **the concentration of carbon monoxide (CO) in exhaust gas discharged from chimneys is 100 ppm or less (as 1 hour average at 12% O2 basis)**. Provided, however, that this shall not apply to an incineration facility specified by the Minister of the Environment as an incineration facility for which it is inappropriate to use the concentration of carbon monoxide (CO) as an index for the maintenance of combustion in order to suppress the generation of dioxins in exhaust gas discharged from chimneys, and which measures and records the concentration of dioxins in said exhaust gas at least once every three months. 2-12. To continuously measure and record the concentration of carbon monoxide (CO) in the exhaust gas discharged from a chimney. This measurement shall be started at the time incineration facility starts its operation until CO concentration could be enough low after stop operation.	ANNEX V AIR EMISSION LIMIT VALUES (e) **The following emission limit values of carbon monoxide (CO) concentrations shall not be exceeded** in the combustion gases (excluding the start-up and shut-down phase): • 50 mg/m3 of combustion gas determined as daily average value; • 150 mg/m3 of combustion gas of at least 95 % of all measurements determined as 10-minute average values or 100 mg/m3 of combustion gas of all measurements determined as half-hourly average values taken in any 24-hour period. Exemptions may be authorized by the competent authority for incineration plants using fluidized bed technology, provided that **the permit foresees an emission limit value for carbon monoxide (CO) of not more than 100 mg/m3 as an hourly average value.**	No Specific Requirement is provided. => Considering the continuous monitoring of Dioxins and furans are not in place, CO can be an index to monitor the concentration of dioxins and furans. Therefore, it is recommended to put CO measurement requirement in the standards of Philippines.

3.5 Emission Limit Value / DXNs Concentration

Requirement for the control of DXNs concentration.	2-13. **Incinerate waste so that the concentration of dioxins in exhaust gas discharged from chimneys is less than the concentration specified in the right column of Appended Table 3** in accordance with the processing capacity of the combustion chamber listed in the left column of the same Table. Appended Table 3 (Relating to Article 4-5 and Article 12-7)	Article 10 Control and monitoring 10. The emission limit values for air shall be regarded as being complied with if: (c) **none of the average values over the sample period set out for heavy metals and dioxins and furans exceeds the emission limit values set out in Annex V(c) and (d)** or Annex II; ANNEX V AIR EMISSION LIMIT VALUES (d) Average values shall be measured over a sample period of a minimum of 6 hours and a maximum of 8 hours. **The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence in accordance with Annex I.** **Dioxins and furans: 0,1 ng/m3**	**DAO2019-21 already specifies 0.1ng-TEQ/Nm3 as DXNs emission standards.**

Capacity	DXNs emission Standard
4t/h or more (x24 =Approx. 200t/d)	0.1 ng/m^3
2-4t/h (x24 = Approx.100-200t/d)	1 ng/m^3
2t/h or less (x24= Approx. 100t/d)	5 ng/m^3
Electric Furnace	0.5 ng/m^3

Appendix 12

3.6 Monitoring Frequency of Exhaust Gas

			
Requirement for monitoring/recording and its frequency of DXNs, SOx, Dust, HCl and NOx. In this O&M/S, they're required as once in a year for DXNs and once in a half year for other substances. But in Circular 95 in 1977 (Kansei95), more than 200t/d capacity should be once in a couple of months.	2-14. **To measure and record the concentration of Dioxins in the exhaust gas emitted from chimneys at least once a year**, and the quantity or the concentration of soot and smoke (Limited to the substances related to sulfur oxides (SO_X), Dust, hydrogen chloride (HCl) and nitrogen oxides (NO_X).) **at least once in 6 months.** O&M/S: Mandatory Circular (Kansei 95): Recommendatory Target: All / For >200t/d DXNs: 1/year / - SOx: 2/year / 6/year Dust: 2/year / 6/year HCl: 2/year / 6/year NOx: 2/year / 6/year	Article 11 Measurement requirements: • Continuous measurements of the polluting substances: NOx, CO, total dust, TOC, HCl, HF, SO2; • Continuous measurements of the process operation parameters: temperature near the inner wall , concentration of oxygen, pressure, temperature and water vapor content of the exhaust gas; • **At least 2 measurements per year of heavy metals, dioxins and furans (once in 3 months for the first year).** • The resilience time as well as the minimum temperature and the oxygen content of the exhaust gas shall be subject to appropriate verification.	DAO2019-21 doesn't specify the frequency of measurement. **=> Recommend to put monitoring frequency in particular Dioxins and furans at least once a year, and SOx, HcL, NOx at least once in 6 months aside of CEMS.**

c. Components of Technical Standards ~ Recommendation to Philippines ~

1. General Conditions
2. Complete Combustion Control
3. Exhaust Gas Control
4. **Wastewater Control**
5. Ash Management
6. Other Environmental Pollution Control,
7. Other Requirement,

4.1 Wastewater Sealing / 4.2 Wastewater Management

			
4.1 Wastewater sealing	(S/S) 6. **The facility shall have a structure that** holding water of waste and **wastewater generated from waste treatment do not leak out or permeate underground.**	N/A	DAO2019-21 doesn't have such requirement. **=> Recommended to include.**
4.2 Requirements for wastewater management of all WTFs. Requirements for wastewater management.	(S/S) 15. **In the case that wastewater is discharged from facilities, the facilities shall have the wastewater treatment facilities necessary to ensure that the water quality does not hinder the preservation of the living environment**. (OM/S) 13. In the case of discharging wastewater from facilities, the water quality shall be such that it will not hinder the preservation of the living environment.	Article 8 Water discharges from the cleaning of exhaust gases 1. Waste water from the cleaning of exhaust gases discharged from an incineration or co-incineration plant shall be subject to a permit granted by the competent authorities. 2. Discharges to the aquatic environment of waste water resulting from the cleaning of exhaust gases shall be limited as far as practicable, at least in accordance with the emission limit values set in Annex IV.	**DAO2019-21 stipulates that "d) Effluents from WTE facilities must conform with DENR DAO No. 2016-08(Water Quality Guidelines and General Effluent Standards) and/or the latest relevant issuance thereof." in 6.3 Environmental Monitoring.**

c. Components of Technical Standards ~ Recommendation to Philippines ~

1. General Conditions
2. Complete Combustion Control
3. Exhaust Gas Control
4. Wastewater Control
5. **Ash Management**
6. Other Environmental Pollution Control,
7. Other Requirement,

Appendix 12

5.1+5.2 Ash Storage and Discharge System

Requirements for the ash storage and discharge system.	(S/S) 7-8. **An ash discharging facility and its storage facility capable of discharging and storing fly ash separately from incineration ash shall be provided**. However, this shall not apply to the case where fly ash and bottom ash produced in the said facilities are melted using a melting facility or are processed together by a baking method using a baking facility. (OM/S) 2-17. **To discharge and store fly ash from incineration ash separately.** Provided, however, that this shall not apply to the case referred to in the proviso to Article 4, paragraph (1), item (7-8).	Article 9 Residues **Residues** resulting from the operation of the incineration or co-incineration plant **shall be minimised in their amount and harmfulness. Residues shall be recycled, where appropriate**, directly in the plant or outside in accordance with relevant Community legislation. **Transport and intermediate storage of dry residues** in the form of dust, such as boiler dust and dry residues from the treatment of combustion gases, **shall take place in such a way as to prevent dispersal in the environment** e.g. in closed containers. Prior to determining the routes for the disposal or recycling of the residues from incineration and co-incineration plants, appropriate tests shall be carried out to establish the physical and chemical characteristics and the polluting potential of the different incineration residues. The analysis shall concern the total soluble fraction and heavy metals soluble fraction.	No regulation is provided in DAO2019-21. ⇒ Generally, weight ratio of fly-ash, contains pollutants, is 10% of total residue while bottom ash, less harmful, is 90%. If these ash collected and discharged in mixed manner, all of 100% shall be treated as fly-ash and it's highly costly. In Japan, incinerated fly-ash is categorized as "Specially-controlled Municipal Solid Waste", which requires special attention for its delivery and disposal. ⇒ Recommend separate storage and discharge requirement of fly/bottom ash.

5.3 Ash Handling

Requirements for the ash processing/ handling/ loading system.

In Japan, permitted ash treatment methods are 4 types as below.

Mode	Usage/ Disposal	Cost Lv
Melting	Concrete and asphalt aggregate	Very High
Calcination	Artificial sand (Civil material)	High
Cement Solidification	Limited usage / Landfill	High / Less
Chemical Treatment	Landfill	Less

Melted Slag
(Nagoya City)

(S/S) 7-9. An ash discharging facility shall be provided which meets the following requirements:
(1) The structure shall be such that fly ash or bottom ash do not scatter or flow out.
(2) In the case of melting fly ash or bottom ash, the following requirements shall be satisfied. (omit)
(3) In the case of baking (Calcination) fly ash or bottom ash, the following requirements shall be met: (omit)
(4) **In the case of carrying out cement solidification or chemical treatment of fly ash or bottom ash, a kneading device capable of uniformly mixing fly ash or bottom ash, cement or chemicals and water shall be provided.**
(OM/S) 2-18. In the case of melting fly ash or bottom ash, to keep the temperature of fly ash or bottom ash put into the ash discharging facility at or above its melting point.
2-19. In the case of baking fly ash or bottom ash, to keep the temperature in the baking furnace at 1000 degrees Celsius or more, and continuously measure and record the temperature in the baking furnace.
2-20. **In the case of carrying out cement solidification or chemical treatment of fly ash or incineration ash, fly ash or incineration ash, cement or chemicals and water shall be uniformly mixed.**

Stated Article 9 in immediately above.

Only states residue minimization but no specific residue utilization methods.

No requirement in DAO2019-21.

=> While ash utilization by melting, baking, cement aggregates are existing practices in Japan and EU, additional cost burden is not realistic in Philippines at this moment. JET recommended to include only "Cement solidification and chemical treatment"

Kneading Device
(Shin-Nichinan Co., Ltd.)

c. Components of Technical Standards ~ Recommendation to Philippines ~

6.1 Prevention of Noise and Vibration / 6.2 Odor

Prevention of noise and vibration	(S/S) 5. **The facility shall not generate extreme noise and vibration, nor damage the surrounding living environment.** (OM/S) 12. To take necessary measures so that the surrounding living environment will not be damaged by significant noise and vibration.	Article 5 Delivery and reception of waste 1. **The operator of the incineration or co-incineration plant shall take all necessary precautions** concerning the delivery and reception of waste in order **to prevent or to limit as far as practicable negative effects on the environment, in particular the pollution of air, soil, surface water and groundwater as well as odours and noise, and direct risks to human health.**	No specific requirement on noise and odor other than EIS. => Recommend to include.
Preventing scattering and offensive odors Requirements for scattering management.	(S/S) 4. **The facility shall have a structure or equipment necessary for preventing waste scattering and emission of offensive odors.** (OM/S) 10. To take necessary measures to prevent scattering of garbage and emission of offensive odors. 11. To endeavor to prevent the occurrence of mosquitoes, flies, etc., and maintain the cleanliness of the premises.	Contained in Article 5-1 (together with noise).	No specific requirement on noise and odor other than EIS. => Recommend to include.

Appendix 12

c. Components of Technical Standards ~ Recommendation to Philippines

1. General Conditions
2. Complete Combustion Control
3. Exhaust Gas Control
4. Wastewater Control
5. Ash Management
6. Other Environmental Pollution Control,
7. **Other Requirement,**

7.1 Periodical Inspection / 7.2 Record Management

			
Requirements for functional inspection and monitoring of water/emission quality.	(OM/S) 14. **In addition to the preceding items, taking the necessary measures to maintain the functions of the facility, and periodically conducting functional inspections and inspections of exhaust gas and water quality.**	Article 10 Control and monitoring 5. **Periodic measurements of the emissions into the air and water shall be carried out in accordance with Annex III, points 1 and 2.**	DAO2019-21 stipulates Self-Monitoring Report (SMR). **=> As a part of SMR, or role of EMB RO, periodical functional inspection is recommended to include.**
Requirements for the records management.	(OM/S) 16. **Records of check, inspections and other measures concerning the maintenance of facilities** (Including emergency measures prescribed in Article 21-2, paragraph (1) of the Law.) **shall be prepared and retained for three (3) years.**	Article 11 Measurement requirements 9. All measurement results shall be recorded, processed and presented in an appropriate fashion in order to enable the competent authorities to verify compliance with the permitted operating conditions and emission limit values laid down in this Directive in accordance with procedures to be decided upon by those authorities	**DAO2019-21 requires to maintain the records and documents at least five (5) years.**

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

Thank you for your attention!

Appendix 12

Dissemination Seminar

Good Practice of SWM Other Than WTE

3rd June 20202

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

Agenda

- The purpose of this session
- Good Practice and Good technology of Japan and 3rd countries
  1. Collection and Transportation
  2. Intermediate treatment / 3R
  3. Landfill
  4. Information Education and Communication (IEC)

The purpose of this session

In the Philippines, RA9003 require the proper manage of solid waste.

In our project, we collected the useful good practice and good technology for the implementation of SWM from Japan and 3rd countries.

Please use the content of this session as tips for improving waste management at each LGU!

Collection and Transportation

Charge on a waste bag designated by local government
Japan, USA, Portland, Taiwan and other countries

Outline

- Residents are required to purchase waste bags at supermarkets and convenience stores, which are determined by the volume of garbage.
- When introducing the system, numerous explanatory meetings need to be held to gain an understanding of citizens.

Good Practice Point

- This practice helps in providing fair fee collection and encourages residents to generate less trash to pay less collection fees. In some countries, the collection of recyclables is exempted in order to promote their use.
- Charge on waste bags are auxiliary budget of waste management. A survey reported that reduction in the amount of waste was confirmed.

Fukuoka City's Designated "Burnable Trash" bag

Official Portland City Bags
30 Gallon $2.70
15 Gallon $1.35

Trash bags in Portland

Appendix 12

Collection and Transportation

Station collection for recyclable waste

Japan, and other countries

Outline

- Decide the point of collecting waste in advance and collect specific waste on designated day of the week. Unsorted waste is not collected.
- For recyclable waste, separation boxes need to be installed every time.
- Collectors collect in the morning or late at night to avoid traffic jams.

Good Practice Point

- By setting the collection point, waste can be collected in a short time and cost can be save.
- Since unsorted waste is not collected and catch the eyes of neighborhood , the accuracy of separation of residents increases.

Bins, cans and plastic bottles is separately collected

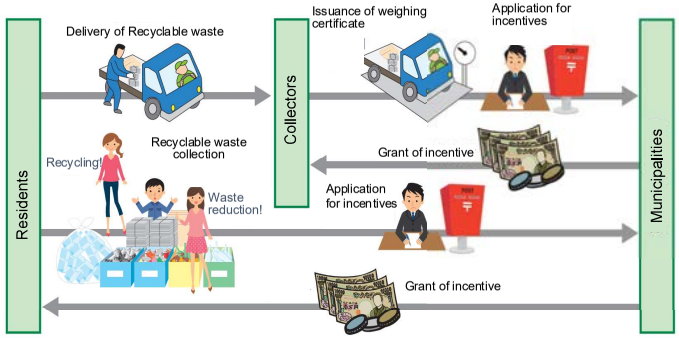
Collection and Transportation

Group Collection of Recyclable Waste

Japan, and other countries

Outline

- Registered residential groups and traders facilitate the collection of recyclable waste (paper, cloth, metal, bottles). In return, the city provides a subsidy corresponding to the volume collected.



The system of Group Resource Collection

Collection and Transportation

Kitchen waste collection

Shibushi City in Japan

Outline

- Residents put kitchen waste in a draining bucket at each household and discharge them to a dedicated container on the collection day.
- Collected food waste is sold or distributed to the residents as compost.

Good Practice Point

- Since these dedicated containers are also used by the entire neighborhood, residents make an effort to keep them free of contaminants other than food waste.

a draining bucket

Dedicated containers

Sell or distribute!

Collection and Transportation

Transfer Station

Japan and other countries

Outline

- A transfer station is facility that efficiently compresses and transfers garbage collected by small vehicles at bases, and transports them by large vehicles.
- Installation of these facilities requires capital investment such as procurement of hauling trucks.

Good Practice Point

- This is effective in cases where the transportation distance from the collection area to the intermediate treatment facility and Landfill is long.
- Alternatively, it is possible to reduce the number of trips and improve efficiency by transferring waste loaded on small vehicles to large vehicles. This is effective for cities that have areas where only small vehicles are allowed to pass.

Waste Transfer Station at Kuala Lumpur, Malaysia

Waste Transfer Station at Xian, China

Intermediate treatment facility /3R

Promotion of recycle: Refuse derived paper and plastics densified Fuel
Philippines, Vietnam and other countries

Outline

- Use RPF to make pellets that are used in thermal power plant, mostly small scale, to treat domestic solid waste.
- It is presumed that waste are collected separately.

Good Practice Point

- Having a high calorific value, the pellets produced from paper and plastic are ideal to use in incineration facilities in place for coal to help in processing wastes that would otherwise go to landfill sites.

RPF Facility

Segregation

RPF pellets

Intermediate treatment facility /3R

Promotion of recycle Waste bank (Bank Sampah)
Indonesia

Outline

- Waste bank is a system in which residents bring in recyclable wastes to sell to a recycler, and the profits generated are returned to the residents.
- In 2012, the Ministry of the Environment of Indonesia published implementation guidelines, which stipulate the roles of facilities, measuring of the weight and recording methods, etc.

Good Practice Point

- When collecting recyclable waste, the market value equivalent of recyclable waste is recorded in the "deposit passbook". Customers will be able to hand over recyclable waste to the garbage bank, save money in their account, and withdraw cash after a certain period of time.
- By transferring the responsibility of waste treatment, the cost shouldered by the local government is reduced.

Malang Waste bank

Recyclable waste classified into 72 types

Waste bank counter

Landfill

Using the land surface after the landfill closure
Japan

Outline

- Proper repository operations (soil cover, installation of gas vent pipes, and leachate treatment), followed by appropriate soil cover treatment, will ensure effective use of the site in the future.
- Since the land is not very strong, structures with low weight, such as solar panels and grounds, are suitable.

Good Practice Point

In Japan, where land is limited, former landfill sites are effectively utilized and returned to the surrounding citizens.

Landfill

Using the land surface after the landfill closure
Japan

Information Education and Communication (IEC)

Agreement on environmental pollution control

Japan

Outline

Emission standards for WTE facilities and landfills are regulated by law, but may be supplemented and self-regulated according to local conditions.

Good Practice Point

- For example, Representatives of local community associations attend landfill and environmental monitoring surveys every Monday, Wednesday, and Friday to confirm the safe operation of the repository.
- Four times a year, a briefing session on the results of environmental monitoring is held for the local community associations, etc., and the information is also published on the website.

Information Education and Communication (IEC)

3R Station at the WTE Facility

Japan

Outline

- Facilities specializing in 3R activities are operated either attached to incineration and power generation facilities or independently.
- Municipalities provide a place for residents to engage in 3R activities.

Good Practice Point

- The first two floors of the incineration and power generation facility are named 3R Stations, where residents bring in clothes, furniture, dishes, and books. The facility will sell them for a fee.
- Broken furniture and toys will be repaired by staff.

Information Education and Communication (IEC)

3R Station at the WTE Facility

Japan

Repair

Sell

Thank you very much!

Appendix 12-3:
2nd Dissemination Seminar

TECHNICAL COOPERATION PROJECT (TCP) FOR CAPACITY DEVELOPMENT ON IMPROVING SOLID WASTE MANAGEMENT (SWM) THROUGH ADVANCED/INNOVATIVE TECHNOLOGIES IN THE PHILIPPINES

2nd DISSEMINATION SEMINAR
8 SEPTEMBER 2022, THURSDAY, 10:00AM-4:30PM
JOY NOSTALG HOTEL
5F, NOSTALG ROOMS 1&2

Master of Ceremonies: Ms. Andrei Mallare, JICA Expert Team

TOPIC	TIME	SPEAKER
Registration	10:00-10:15	-
OPENING CEREMON Invocation National Anthem Opening Remarks Introduction of the TCP and the Program of seminar	10:15-10:30	 JICA Expert Team JICA Expert Team **Mr. Yo Ebisaw** **a** JICA Philippines **Mr. Takahiro Kamis** **h** JICA Expert Team
Remarks on WTE projects 1) As a treatment facility in entire SWM of LGU (Guidebook) 2) As a PPP project	10:30-11:15	**Mr. Takahiro Kamis** **h** JICA Expert Team Synthesis by PPPC
Q&A	11:15-11:30	
Lunch Break	11:30-12:30	
Procedure of the Plan **n** **Formulation, and** **WTE S** **project**	13:00-13:45	**Mr. Makoto K** **o** JICA Expert Team Synthesis by DOST-ITDI
Recommendations **ove** **the final disp**	13:45-14:15	**Mr. Takuya Kok** **e** JICA Expert Team Synthesis by EMB-SWMD
Q&A	14:15-14:30	
Tea Break	14:30-14:45	
Good practice of S **that WTE** **to be adopted in** **LGUs**	14:45-15:45	Cebu City Davao City
Q&A	15mins	
CLOSING CEREMON Closing Remarks Picture-taking, egress	16:00-16:15	**Ms. Ruby De** REMB, DOE

2nd Technical Dissemination Seminar

"Remarks on WTE Projects"

September 8, 2022 (Thursday)

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

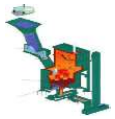
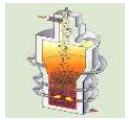
Contents

- As a treatment facility in entire SWM of LGU
- As a PPP project

Appropriately Controlled Combustion

- WTE Definition in DAO 2019-21
  - "the process of converting wastes with various technologies, usually **the conversion of non-recyclable waste materials into useable heat, electricity, or fuel through a variety of processes**"
- WTE options:
  - Gasification/Pyrolysis,
  - Refused Derived Fuel (RDF), and
  - Biomethanation (aerobic digestion, biogas)
- Main target: Appropriately Controlled Combustion (ACC)
  - Dominant in the existing cases
  - Reliable technologies with a long history of application

WTE technologies

	Stoker /Grate	Fluidized bed	Gasifying & direct melting	Pyrolysis Gasification	Plasma Gasification
Image					
Features	- The most conventional system in Japan - Large capacity of furnace (400 - 500t/d) is widespread	- No movable part inside furnace - Pretreatment is required for stable combustion - Generation of fly ash is larger	- High reduction rate - Slag can be utilized - Coke is necessary for ash melting 	- Waste is gasified in a primary combustion chamber - Synthesis gas can be introduced to gas engine	- This is for residual ash melting - Slag can be utilized - Large amount of self electric consumption

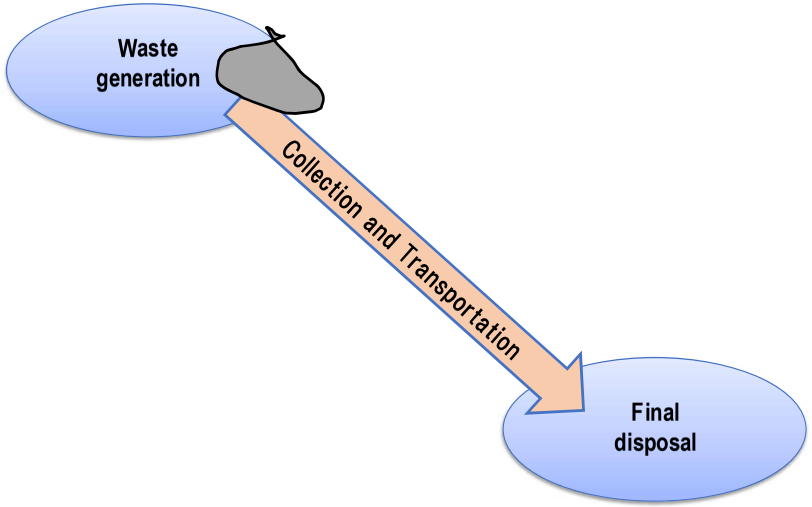
Appendix 12

Benefits of WTE-ACC

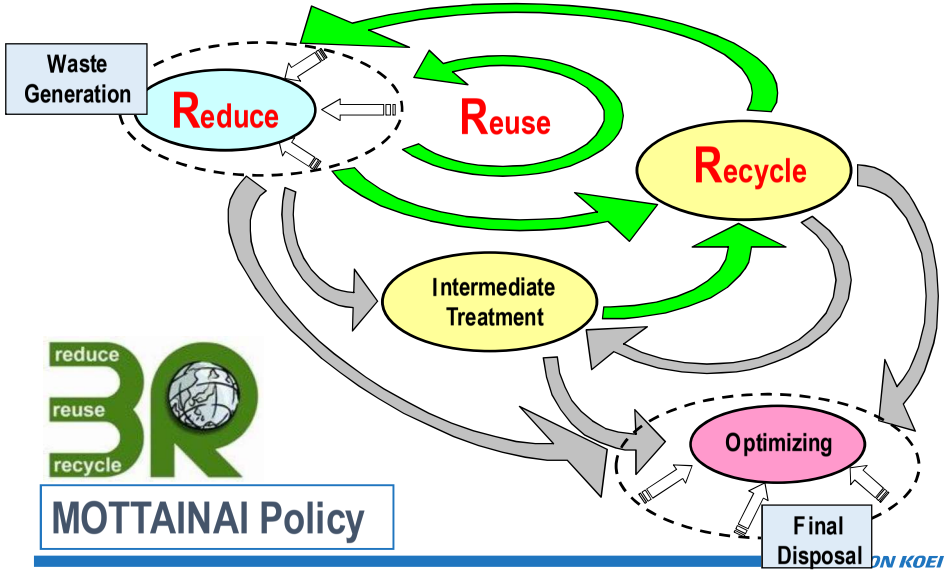
- Sanitary treatment of solid waste in a short time
- Volume/weight reduction of waste, resulting in less demand of the final disposal volume
- A proven technology with many cases
- Utilization of heat from thermal reaction
- Equipped pollution control to meet the environmental standards

1. As a treatment facility in entire SWM of LGU

Primitive flow of solid waste management



Integrated solid waste management, with 3R (Reduce, Reuse, Recycle)



WTE as one of the intermediate treatments

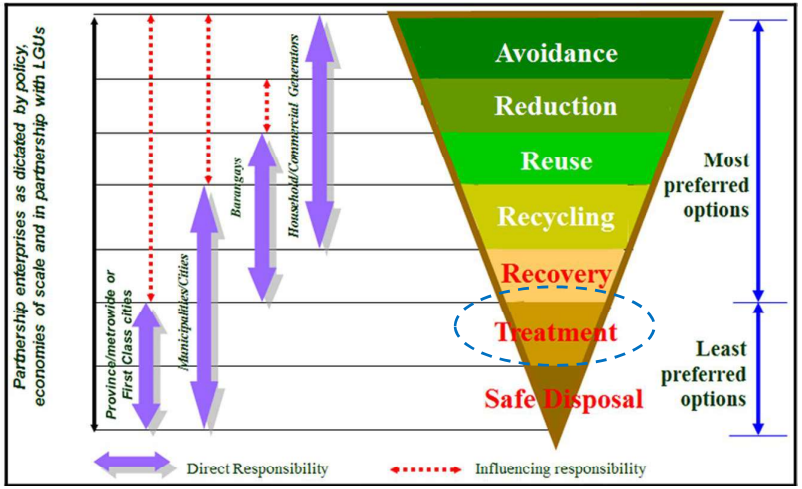
- After collection of waste
- Before and after material recovery
- Before final disposal

WTE, as a treatment facility

- LGU responsible for entire MSWM
- WTE is NOT a complete solution to meet the responsibility

WTE is NOT BEST option for all LGUs

- 3R to be prioritized as in Waste Hierarchy



Source: National Solid Waste Management Status Report (2008-2018), DENR-EMB

WTE is NOT BEST option for all LGUs

- Associated financial burden of CAPEX and OPEX
  - The following components must be upgraded to complete sanitary waste stream
    - Collection and transportation
    - final disposal (sanitary landfill)
  - Both physical (facility/equipment) as well as operational improvements are necessary

Unit Cost of waste treatment

- Typical Waste Management Costs by Disposal Type (US$/ton)

	Low-income countries	Lower-middle-income countries	Upper-middle-income countries	High-income countries
Collection and transfer	20–50	30–75	50–100	90–200
Controlled landfill to sanitary landfill	10–20	15–40	20–65	40–100
Open dumping	2–8	3–10	—	—
Recycling	0–25	5–30	5–50	30–80
Composting	5–30	10–40	20–75	35–90

Source: World Bank Solid Waste Community of Practice and Climate and Clean Air Coalition.
Note: — = not available.

Source: "What A Waste 2.0, A global Snapshot of SWM to 2050", World Bank

Capital and Operational Expenditures of WTE-ACC

- Capital expenditure: US$100,000-700,000/day-ton,
  tend to be "the more waste, the less USD/ton"
- Operational expenditure (3cases of Japan): US$75-150/ton

→ For WTE with 500ton/day of treatment capacity,

- CAPEX: US$50-350million
- OPEX: US$37,500-75,000/day

WTE is NOT BEST option for all LGUs

- A merit of WTE: economies of scale
  - More waste, more efficiency

However,

- Practical difficulties in clustering LGUs
  - Consensus building among LGUs
  - Cost associated with long distance transportation
  - NIMBY syndrome, fare cost and impact sharing

WTE in the 10-year SWM plan of LGUs

- LGUs to carefully evaluate if WTE fits for their SWM.
- Section 5 (Requirements) of DAO2019-21

  c) The host LGU including the LGUs where the source of the feedstock will originate from shall ensure that **the plan to establish and/or utilize WTE facility is integrated in their approved 10-year solid waste management plan** consistent with the provisions of RA 9003.

- LGU to consider the lifetime of WTE in the Plan, which could be more than 20years

Waste Flow Diagram

- A tool to illustrate waste movement designed in the MSWM-M/P
  - For both the present condition and future plan
- Identify and illustrate:
  - Present flow: issue and problem
  - the waste amount to be managed at all stages of MSWM from waste generation to final disposal
  - Future flow: necessary capacity of waste facility and equipment such as waste storage, collection, transportation, treatment including WTE/MRF etc.
- The facility plan to identify;
  - Capacity of equipment, machinery
  - Work force
  - Investment, operation and maintenance cost
  - Verification of feasibility before implementation

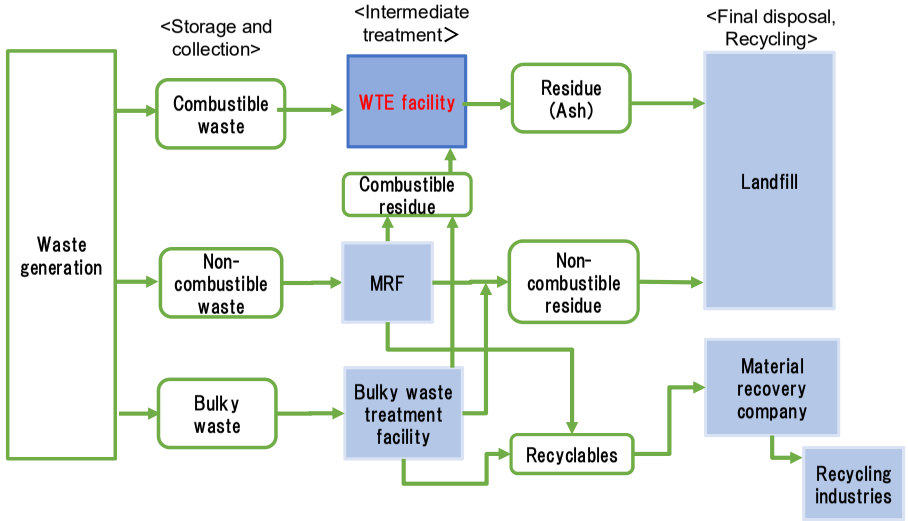
NIPPON KOEI
EJEC

Data necessary to prepare the waste flow diagram

- Amounts of generated waste from each waste generation source;
- Amounts of collected & transported waste by each waste collection service provider;
- Amounts of recycled waste by junk shops, recyclers;
- Amounts of treated / disposed waste by each waste treatment facility.

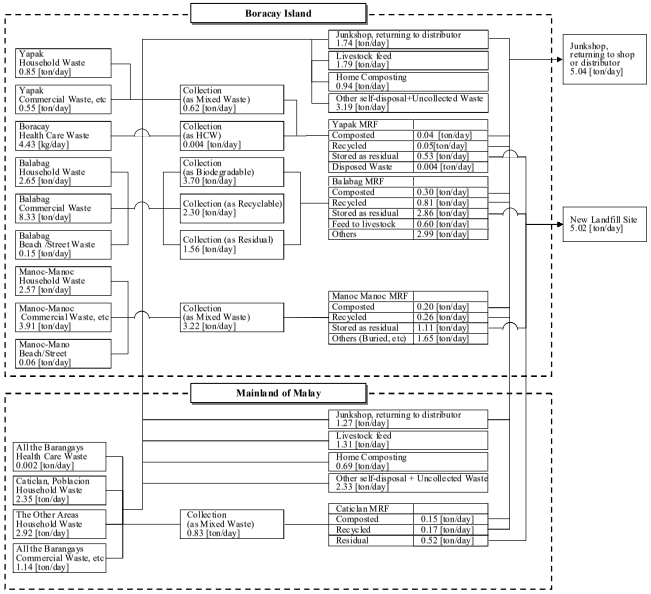
NIPPON KOEI
EJEC

Example of Waste Flow Diagram with WTE



NIPPON KOEI
EJEC

Example of Waste Flow Diagram



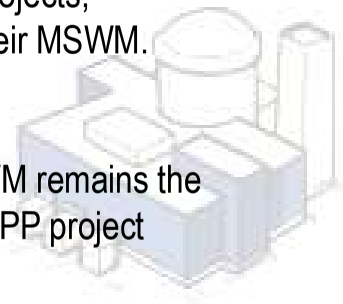
NIPPON KOEI
EJEC

Nippon Koei Co., Ltd. (2008) "M/P on SWM for Boracay Island and Municipality of Malay: F/R"

2. As a PPP project

WTE proposals in the Philippines

- WTE projects are promoted as PPP projects, while many LGUs actually operates their MSWM.
- The responsibility of the LGU for MSWM remains the same under the management by the PPP project



"WTE facility needed" for the LGU

- "the facility needed" to be identified by the LGU
- To complete the MSWM as planned, the LGU shall procure "the facility needed" through the PPP, otherwise the project will fail
- The facility to satisfy the conditions proper for the LGU:
  - Treatment capacity
  - Resources requirements (Financial cost, human resources, etc.)
  - Commencement of the operation,
  - Service years, etc.

Unsolicited or Solicited?

Unsolicited proposals

- Interests of private proponents
  - Promotion of their technology
  - Their benefit and profit
- Not necessarily meet the conditions of "the facility needed"
- If it fits "the facility needed", the development may be in the shorter time than "solicited case".

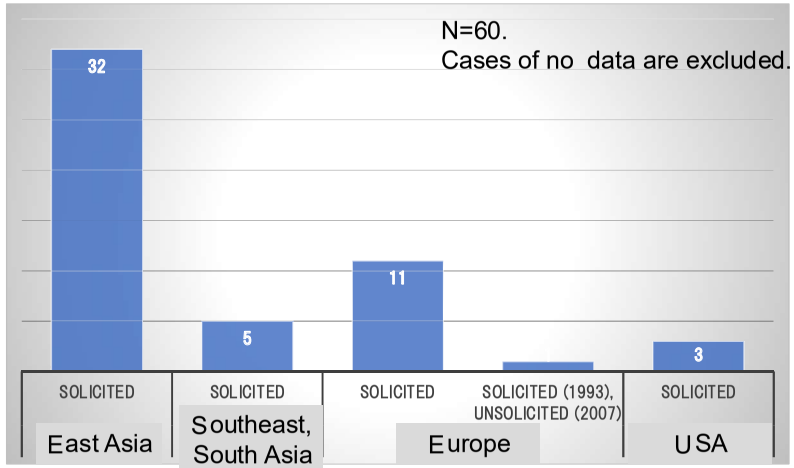
Unsolicited or Solicited?

Solicited proposal:

- Procurement for "the facility needed"
- Resources required for the technical analysis, could be same with 10year SWM planning
- Time requirements for the tender process by the LGU
- "Slow but steady wins the race"

WTE-ACC Cases of unsolicited and solicited

[Result of the Case Study in the TCP]



PPP project type of the SWM sector

- ✓ Three (3) types of PPP projects, #1: Service provision, #2: Financially free-standing, and #3 Mixed,
- ✓ In general, waste treatment facilities are categorized in #1 and WtE is categorized in #3. They never fall into #2,
- ✓ However, in many private proposals say "no tipping fee", "power tariff covers all CAPEX/OPEX", etc. and never realize.

#1: Service Provision Type;

Public pays fee to Private partner's service provision incl. its CAPEX/OPEX

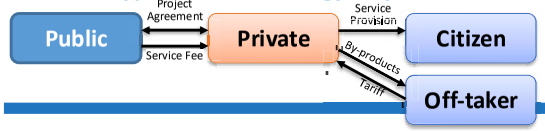
School, Government Building, Jail, Waste treatment facility, etc.

#2: Financially free-standing Type;

Project revenue covers CAPEX/OPEX / No financial support from Public

Toll Road, Airport, MRT, Parking, etc.

#3: Mixture Type (Waste-to-Energy Projects);



Project revenue <u>is not enough</u> to cover CAPEX/OPEX

Thank you for your attention!

Appendix 12

PPPs in the Solid Waste Management Sector

Synthesis and Key Message

Maria Lerma L. Advincula
Director IV, Project Development Service
PPP Center of the Philippines

September 8, 2022

Garbage crisis in the Philippines

The rapid waste generation in the Philippines is a **perennial environmental problem.** Due to steady development and economic growth, the Philippines has been producing too much garbage that is **beyond its solid waste management capacity**.

Waste generation in PH:	Approximately 21 million metric tons annually
Ave per capita of garbage in Metro Manila:	0.7 kilos per day



Reference: https://www.denr.gov.ph/images/DENR_News_Alerts/DENR_News_Alerts_10_January_2021_Sunday.pdf

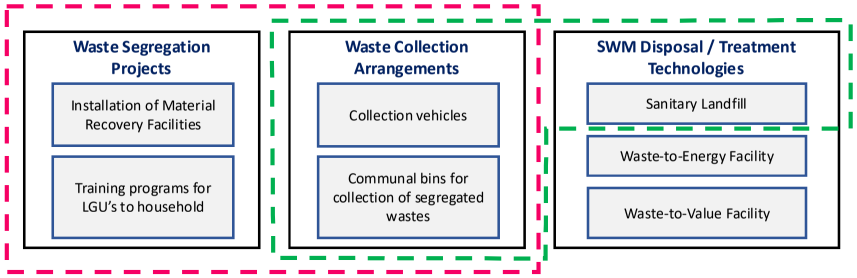
PPP Center of the Philippines and its SWM initiatives

The PPP Center facilitates the implementation of the country's PPP Program. It serves as a central coordinating and monitoring agency for all PPP projects in the country.

PPP Center and SWM

The PPP Center has identified solid waste management as one of its emerging sectors due to the increase in both public need and private interests.

Potential PPP projects in the SWM sector



Sample bundling of SWM Major Scopes as Potential PPP Projects

Reference: *PPP Center Conceptual Framework for the Development of Solid Waste Management PPP Projects, 2022*

Appendix 12

PPP options for solid waste management projects

A. Integrated / Full PPP approach	
Integrated development	Private sector partner (PSP) to develop and maintain the whole integrated solid waste management system
Possible scope	Financing, design, development, and maintenance of the integrated solid waste management system
Repayment scheme	**User Fees** • Applicable to services with potential for revenue generation **Availability Payments** • Applicable to sectors where the end-users are not expected to make payments for services availed or transactions made.
Advantages	• Single procurement process and point of accountability • Minimal interface risk between components

B. Hybrid Approach	
Specific stand-alone projects	PSP to undertake selected project components (e.g., design & construction only, operations & maintenance only, operations only) of the solid waste management system
Possible scope	Operations and maintenance of the integrated solid waste management system
Repayment scheme	Depending on the scope of the PSP, the repayment scheme can be through: • User fees • Availability payments • Combination of user fees and availability payments
Advantages	• Only key components will involve a PPP proponent

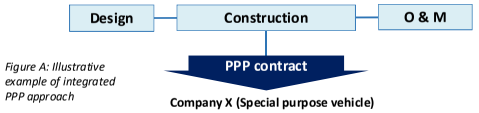


Figure A: Illustrative example of integrated PPP approach

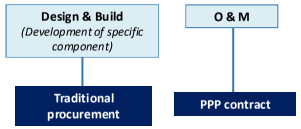


Figure B: Illustrative example of unbundled approach

Advantages of PPPs in solid waste management

Integrated approach
- Proper alignment of incentives (among contractor, operator and maintenance provider) in a whole-of-life approach

Private sector capacity
- Can address implementing agencies' limited absorptive capacity and government's limited fiscal space

Optimized risk allocation
- Allocation of risks to party who can best manage them (e.g. risk of cost and time overruns allocated to private partner)

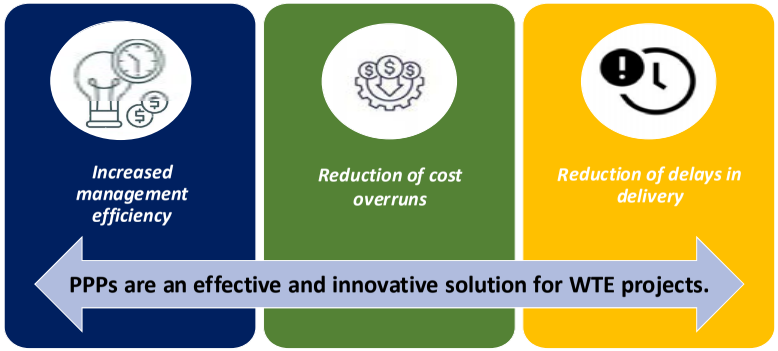
Output specifications
- Government can tap private partner's expertise in a design that adheres to output specifications

Revenue potential
- Revenue sharing with private partner
- Revenues from commercial activities

Incentive to improve service delivery and maximize value of government asset

Advantages of PPPs in solid waste management

In PPPs, there is a natural incentive for the private sector to ensure timely completion of the project since, **repayment commences during operations or availability of the facility.**



Reference: PPP Center Conceptual Framework for the Development of Solid Waste Management PPP Projects, 2022

The future for WTE PPPs in the Philippines

- Local government interest in waste to energy projects is an emerging opportunity for potential power investors in the Philippine PPP landscape.
- WTE has the potential to evolve into a mainstream SWM practice in the Philippines and may address the garbage crisis in the Philippines provided that an enabling environment for successful private sector participation in the implementation of WTE is available.
- Increased awareness and knowledge including studies on the WTE supply chain, WTE facility capital, operational costs and recovery are crucial to ensure the best chance for success for WTE PPPs in the country.
- Moving forward, the Philippines may look to the WTE experience and best practices of other countries like Japan, Korea and others.

The future for WTE PPPs in the Philippines

PPP Center can support the WTE initiatives of LGUs through the following:

Capacity building

- Support the conduct of capacity building activities (PPP 101, Project Identification, Project Concept Notes, etc.)

Policy assistance

- Assist in drafting and/or review of PPP Code/Joint Venture Ordinance and Implementing Rules and Regulations (IRR)

Project assistance

- Assist in assessing PPP potential of priority projects and preparation of project concept note
- Assist in the application for PDMF support for project preparation funding
- Assist in development (feasibility study, market sounding activity, etc.), procurement and implementation of PPP projects

*WTE: Waste-to-Energy with Appropriate Combustion Control

Procedure of the Planning, Formulation, Evaluation and Contract Management of WTEs

2nd Dissemination Seminar

8th Sep 2022 @ Joy Nostalg Hotel & Suites Manila, Ortigas

Makoto KOSAKA, SWM-PPP Expert

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

Outline

1. ***Planning Phase:***
   (1) *Master Plan and (2) Specific WTE conceptual Plan, (3) Site Selection,*
2. ***Formulation Phase:***
   Feasibility Study (Facility Basic Plan) contains;
   (1) "Technical Aspect",
   (2) "Financial Aspect" and
   (3) "Project Boundary",

+. ***About Evaluation of the Proposal, (Frequently Asked Question)***

3. ***Contract Management Phase (in the aspect of LGUs)***
   (1) Supervisory on Design and Construction,
   (2) Operation Monitoring,

Background and Purpose

LGUs in the Philippines don't have experience *to plan, formulate, procure, contract and monitor a WTE-ACC facility,*

In the JICA-TCP, Intergovernmental Technical WG (ITWG) is drafting ***"Manual for the Planning, Formulation, Evaluation and Contract Management of WTEs" to address such challenges in LGUs****,*

It is also discussed ***how to evaluate unsolicited proposal*** *for WTEs,*

Overall Timeline (in the case of Japan)

- The table below shows the typical timeline of the WTE development in Japan.
- Total process from MP to commercial operation (COD), it usually take 10 years. If necessary surveys, studies and decisions can be done in parallel and appropriately, some parts of time can be shortened.
- For the discussion purpose, this is divided into 3 phases (Planning, Formulation, Contract Management), and
- Unsolicited Proposal, this is usually submitted from Private Player regardless the LGUs' readiness.

▼ Contract Signing ▼ COD

	Year	1	2	3	4	5	6	7	8	9	10	11	Remarks
New Facility	MSW Treatment Master Plan (MP)			1. Planning Phase									Reviewed once every 5 yrs
	Facility Development Conceptual Plan												Decision on renewal & site
	Facility Basic Plan as Feasibility Study (FS)							2. Formulation Phase					Decision on processing method
	PFI/PPP Applicability Study												Decision on business scheme
	Topographic Survey												Reflected in facility basic plan
	Geological Survey												Reflected in facility basic plan
	Environmental Impact Assessment												1.5-4 yrs
	Bid/ Selection of Winning Bidder												standard 2 yrs
	Construction Work							Construction					standard 3-4 yrs
	Operation											Start	

+ Unsolicited Proposal

3. Contract Management Phase

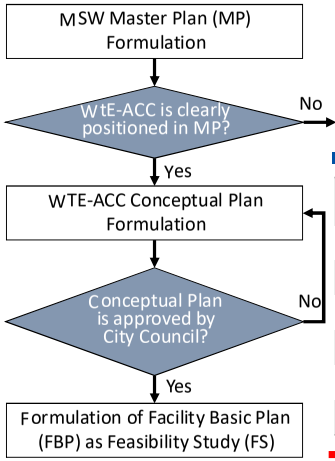
Appendix 12

Procedure of the Planning, Formulation, Evaluation and Contract Management of WTEs

1. Planning Phase
2. Formulation Phase
+. Evaluation of Unsolicited Proposal
3. Contract Management Phase

1. Planning Phase

(1) Procedure of WtE Project Planning



Since the Law clearly stipulates that "Local government is responsible for Waste treatment", even if LGUs contract out some parts to private, LGUs are still primarily responsible for waste. Therefore, WtE Project shall be led by local governments.

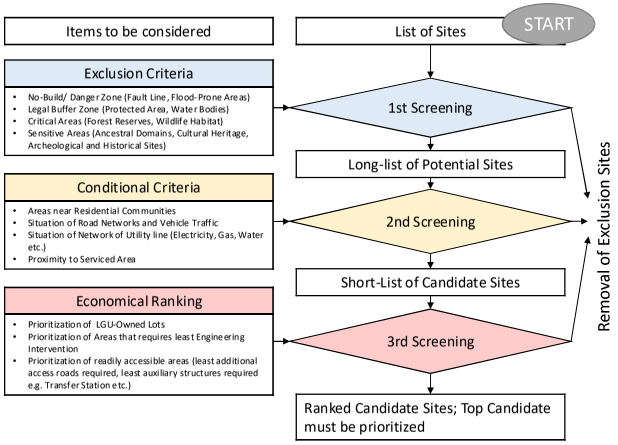
■ What to be decided by LG in Planning Phase

• Ideal state of waste management	⇒ Set Political Priority for Zero Waste (100% material recovery) or Heat Recovery (WtE-ACC) considering recyclable market, land
• Setting the service provision area	⇒ Single municipality or wide-area union (clustering)
• Current and future waste volumes	⇒ Target volume for WtE, how to handle plastics,
• Set up capacity of a WTE-ACC (t/day)	⇒ Annual Target waste volume for WtE ÷ Operating days
• Project Formulation Timeline	⇒ For EIA ( ) yrs, Bidding ( ) yrs, Construction ( ) yrs, *Should be set in practical manner.
• Appropriate Site Selection	⇒ Urban or Suburb, next to landfill, etc. *Recommend not to rely on private land.
• Appropriate Capital and Operational Cost estimation	⇒ Market cost based on precedent studies

➡ The WTE-ACC Conceptual Plan must be approved by City Mayor/Council.

1. Planning Phase

(2) Recommended Site Selection Procedure for WtE (Tentative)



- *JET tried to combine **some WTE site selection procedures used in Japan** and **the SLFs site suitability assessment flow of NSWMC2013-64** as left.*
- *From the list of candidate sites, areas which are prohibited by law for the WTE-ACC construction are excluded in 1st Screening as mandatory exclusion criteria, supported by GIS, etc.*
- *After that, some conditions set force by the LG and local residents will be removed in the 2nd screening.*
- *Finally, the evaluation of cost attached to the shortlisted sites will be carried out. An additional iteration of screening considering cost/financial prior to final site ranking is recommended.*

➡ Transparent and Public Involved Process shall be required bcs WTE is NIMBY.

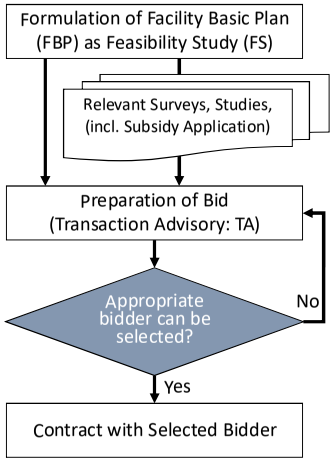
Procedure of the Planning, Formulation, Evaluation and Contract Management of WTEs

1. Planning Phase
2. Formulation Phase
+. Evaluation of Unsolicited Proposal
3. Contract Management Phase

Appendix 12

2. (Project) Formulation Phase

(1) Facility Basic Plan as LGU oriented Feasibility Study



■ What to be decided by LG in the FS Phase

Technical	• Treatment Technology Selection	⇒	Thermal (Stoker, fluidized bed or gasification, etc.), or Non-thermal (Biomethanation, etc.)
	• Quantity / Quality of WTE Feedstock	⇒ ⇒	How much MSW can be "continuously" supplied to WTE? How much LCV can be guaranteed? (This is out of control of private proposer)
	• Pollution Control Standards (Exhaust gas, Wastewater, Residues, etc.)	⇒ ⇒	Under Clean Air Act (National Standards), International Standards, and/or Stricter Voluntary Standards? Monitoring frequency shall also be identified.
Financial	• Business Scheme	⇒	Study on applicability of PPP modality (BOT, BOO or DBO, Concession, JV, etc.)
	• Project cost estimation (Capex/Opex), Financial Model, Financing Plan	⇒	Total cost, amount of funds to be procured …
Project Boundary	Role demarcation (Scope of Work)	⇒	Basic concept of task demarcation shall be identified at this phase so that **gov. budget can be forecasted**.
	Value Chain Analysis (Treatment Process flow for upstream/ downstream)	⇒ ⇒	Upstream arrangement (Segregation classification, pretreatment, how to deliver segregated waste, etc.), Downstream arrangement (Handling of bottom ash and fly ash, disposed at TSD? Monofill?)

➡ Since there are NO "Zero T/F" WTE projects in the World, LGU shall concept out what LGU can provide and what LGU expects to Private Operator, in such aspect, security of annual expenditure for T/F through project period must be the most important point.

2. (Project) Formulation Phase

(2) Technical : Technology Selection

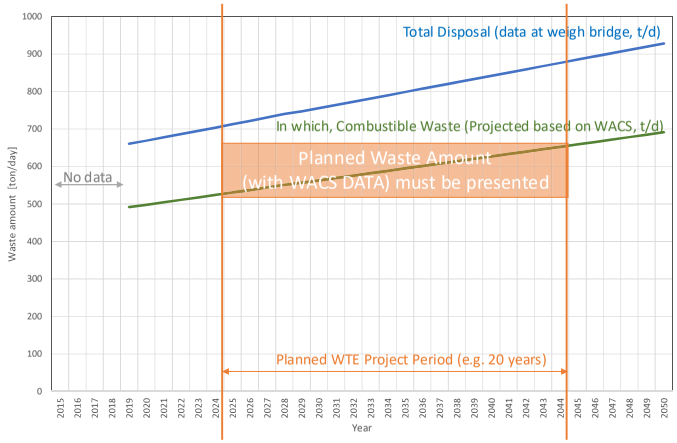
➡ Which kind of system is the most appropriate to address LGU's needs?
➡ It is necessary to avoid to choose "un-proven" technology/provider.

Thermal / Stoker Incinerator	Thermal / BFB Incinerator
	
• Widely applied in the world, • Mechanically driven stoker grates sequentially dry, combust and post-combust the waste for 1 to 2 hrs. • Bottom ash falls into the ash water-sealed conveyor from the tail end of the stoker together with the incombustibles, and after cooling, it is discharged by a conveyor. • Dust (fly ash) which captured in the exhaust gas treatment system contains poisonous components shall be collected, and treated before disposal.	• Widely applied in the world. • Crushed waste is fed into the fluidized bed of hot sand and dried, burned, and post-combusted almost at the same time (up to a dozen seconds). • The ash is discharged from the upper part of the furnace together with the combustion gas and collected as fly ash in the gas cooling chamber and dust collecting equipment.

Other MSW Treatment System	Explanations
	• A technology which the biodegradable waste is anaerobically fermented and obtain combustible biogas, • Segregated food waste will be crushed and separated to biodegradable fraction and non-bio fraction. Biodegradable fraction will be fed to digester after pulping, fermented in the digester for 3 weeks then collect digested gas (biogas), • Captured biogas can be used for fuel and digested sludge can be utilized after drying. Quantity of sludge might be the problem.
	• There are serval RDFs, following explains about RDF fluff; • A technology which the combustible waste is shredded and wrapped to be the alternative fuel, • Segregated paper and plastic waste will be further separated manually in the conveyor and air separator. Light combustible fluff will be shredded and wrapped as a cube shaped fuel (RDF fluff), • RDF fluff can be used as fuel at cement kiln, or WTE facility.
	• A technology which the biodegradable waste is aerobically fermented and converted to compost, • Segregated food waste will be manually separated, mechanically crushed (< 5cm) and piled up around 2.5m, add micro- organism for fermentation, • Pile will be mixed by wheel loader once in a couple of days and aged for 60 days. • Matured compost will be sieved by trommel to be the products,

2. (Project) Formulation Phase

(3) Technical : **Quantity** and Quality of Target Waste (to be fed to WTE-ACC)



- **The planned waste amount is the basis for setting the scale/size of the facility,** and is important for the prediction of future amount, and must have high accuracy.
- This Planned waste amount (t/d) x Tipping Fee (PhP/t) must be budgeted in annual basis.
- Considering the recent plastic ban and plastic recycling tech innovation, several scenarios shall be developed and reflected to the WTE project FS.
- **In the PPP Contract for WTE, waste quantity as well as quality (LCV) usually guaranteed by LGUs.**

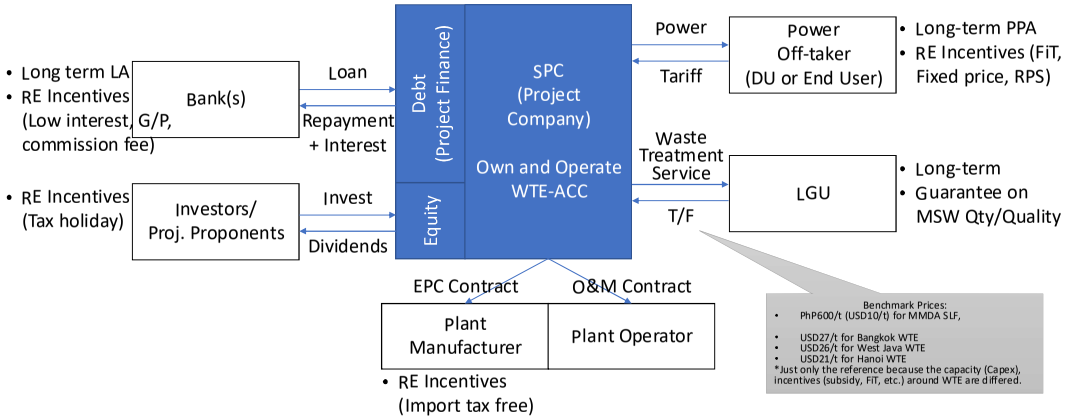
2. (Project) Formulation Phase

(4) Financial : Business Scheme / PPP Modality

PPP Modalities		Role: Construction Period – Design	Const.	Finance	Role: Operation Period – Op.	Mt.	Owner of Facility – Const. Period	Op. Period	After Op. Period	Explanation
PFI	BOO	Private	Private	Private	Private	Private	Private	Private	Private	PFIs cover BOO/BOT/BTO, which Private sector raise funds, design, construct, and operate the facility thru project period. [BOO] Ownership will not be transferred to the public even after the operation period. [BOT] Ownership will be transferred to the public at the end of operation period. [BTO] Ownership will be transferred to the public after completion of the facility.
	BOT	Private	Private	Private	Private	Private	Private	Private	Public	
	BTO	Private	Private	Private	Private	Private	Private	Public	Public	
Non-PFIs	DBO	Public	Public	Public	Private	Private	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.
	DBM	Public	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.
	Public Build + long term O&M contract	Public	Public	Public	Private	Private	Public	Public	Public	The public sector designs and constructs the facility, and the private is entrusted with the operation for multiple years.

2. (Project) Formulation Phase

(5) **Financial :** Business Model (Case of BOT/BOO)



➡ To ensure "Bankability" of the Project which is composed of "Financial Viability", "Risk Optimization" and "Contractual Robustness"

2. (Project) Formulation Phase

(6) **Project Boundary :** Role Demarcation / Scope of Work of Private Side

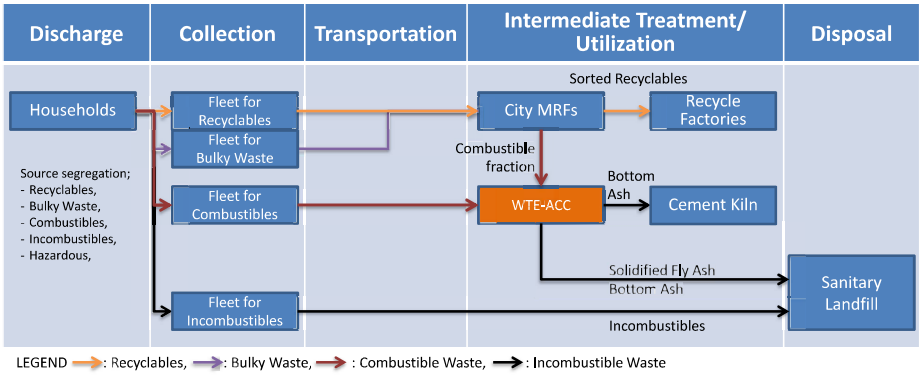
Category	No	Role	Gov.	SPC
Land Acquisition	1	**Project Site and water supply facility**	✓	
Design and Construction (including commissioning & testing)	2	MSW Acceptance Facility (Weighbridge and Registration Office, etc.)		✓
	3	Sample sorting facility (Dumping box, etc.)		✓
	4	Processing system and visitor center		✓
	5	**Water supply piping**	✓	
	6	**Adherent Landfill and Leachate Treatment Facility**	✓	
	7	**Supporting Infrastructure (Road, rainwater drainage, etc.) in MSWM complex but outside of Waste Treatment Facility Plot**	✓	
	8	Supporting Infrastructure (Road, rainwater drainage, etc.) in Waste Treatment Facility Plot		✓
Operation and Maintenance	9	**MSW supply to site and Unsuitable Waste removal prior to site delivery**	✓	
	10	Processing system (from MSW weighbridge until residue loading station), visitor center		✓
	11	**Water supply**	✓	
	12	**Landfill and Leachate Treatment Site operation including residue transfer to landfill**	✓	
	13	**Supporting Infrastructure (Road, rainwater drainage, etc.) in MSWM complex but outside of Waste Treatment Facility Plot**	✓	
	14	Supporting Infrastructure (Road, rainwater drainage, etc.) in Waste Treatment Facility Plot		✓
Financing	15	**Land for Project Site**	✓	
	16	Weighbridge, Registration Office, Sample Sorting, Processing System, visitor center		✓
	19	**Water supply facility**	✓	
	20	**Supporting Infrastructure (Road, rainwater drainage, etc.) in TPPAS complex but outside of Waste Treatment Facility Plot**	✓	
	21	Supporting Infrastructure (Road, rainwater drainage, etc.) in Waste Treatment Facility Plot		✓

➡ Not fully relying on to the Private, roles where LG has specialty should be responsible for LG to secure bankability.

2. (Project) Formulation Phase

(7) **Project Boundary :** Role Demarcation / Value Chain Analysis

Which parts of MSWM are you going to contract out to WTE partner? From Upstream to Downstream?

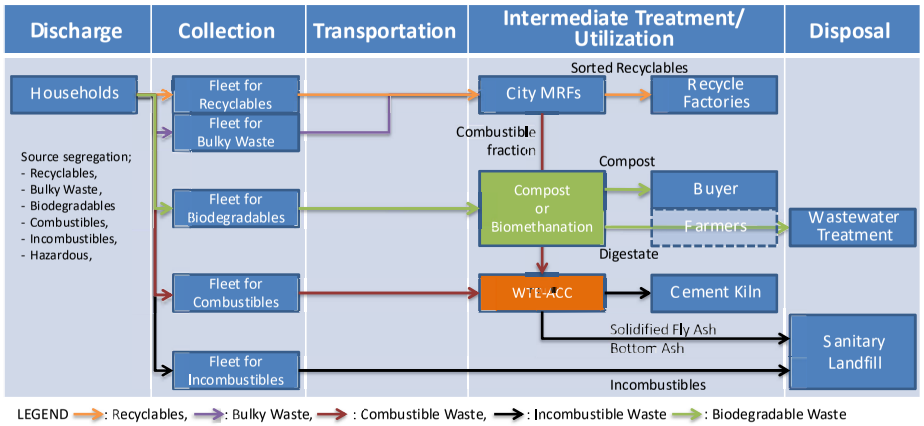


➡ Upstream arrangement (Segregation classification, segregated waste transport) is usually the role of LGU,
➡ Downstream arrangement (bottom/fly ash disposal) can be tasked to private but T/F must be increased.

2. (Project) Formulation Phase

(7) **Project Boundary :** Role Demarcation / Value Chain Analysis

Which parts of MSWM are you going to contract out to WTE partner? From Upstream to Downstream?

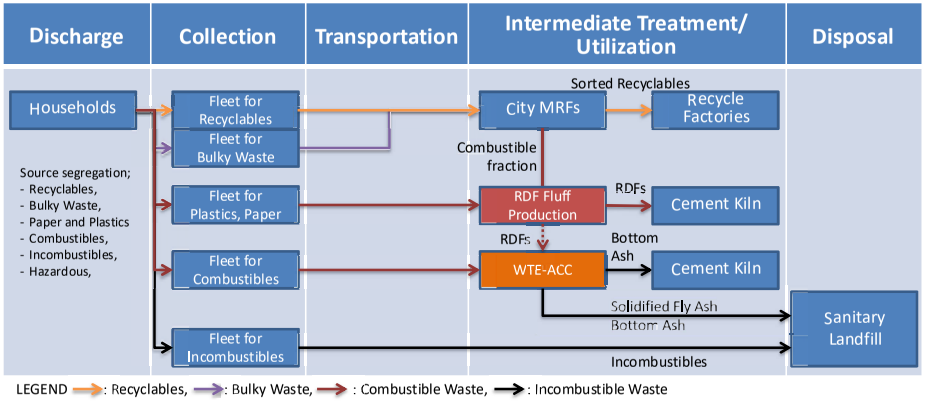


Appendix 12

2. (Project) Formulation Phase

(7) **Project Boundary :** Role Demarcation / Value Chain Analysis

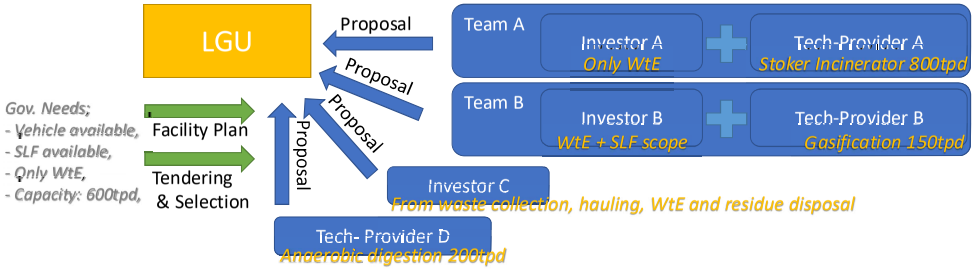
Which parts of MSWM are you going to contract out to WTE partner? From Upstream to Downstream?



Procedure of the Planning, Formulation, Evaluation and Contract Management of WTEs

+. Evaluation of Unsolicited Proposal

- ✓ How to evaluate "Unsolicited WTE-PPP Proposal"? is one of frequently asked questions,
- ✓ Unsolicited Proposal is usually the project based on the private investor's interest in terms on scope, capital size, applied technology, while existing status and effort/achievement of LGUs in MSW management is different in LGUs, so, simply it's quite difficult to evaluate,
- ✓ Simple comparison of different schemes / types / technologies of private proposals is not make sense,
- ✓ **LGU shall have own MSW MP-based FS or even WTE-ACC conceptual plan as "NEEDS"** to ease the evaluation and/or selection of the **better** private proposal,



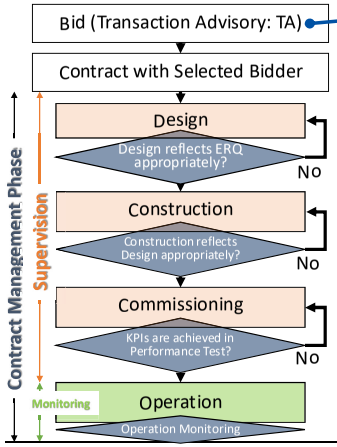
➡ Solicited approach is widely applied for the WTE-PPP project development in the world. If unsolicited approach will be adopted, at least WTE-ACC conceptual plan should be formulated beforehand.

Procedure of the Planning, Formulation, Evaluation and Contract Management of WTEs

Appendix 12

3. Contract Management Phase

(1) Procedure of Contract Management (in the aspect of LGU)



What to be specified in **"Bidding Document (Request for Proposal: RfP)"** by LG

• Selection method	⇒	Number of Envelop, Evaluation method (Merit Point, QBS, CBS)
• Instruction to Bidder (ITB)	⇒	Qualification criteria, Terms of payment, etc.
• **Employer's Requirement (ERQ)***	⇒	**Conditions of Input and Output specifications**
		Everything shall be written in here
• Evaluation criteria	⇒	Stability, economy, safety
• Contract documents	⇒	Draft basic agreement, construction/operation contract

During Contract Management Phase, it is necessary to confirm that the facility is being designed, constructed and operated as desired by LGU.
=> In many cases, employ the Independent Consultancy to check the conformity.

• Design Supervision (SV)	⇒	Review drawings for building & plant equipment
• Construction Supervision (SV)	⇒	Checking progress, witness to the inspections and tests incl. performance test

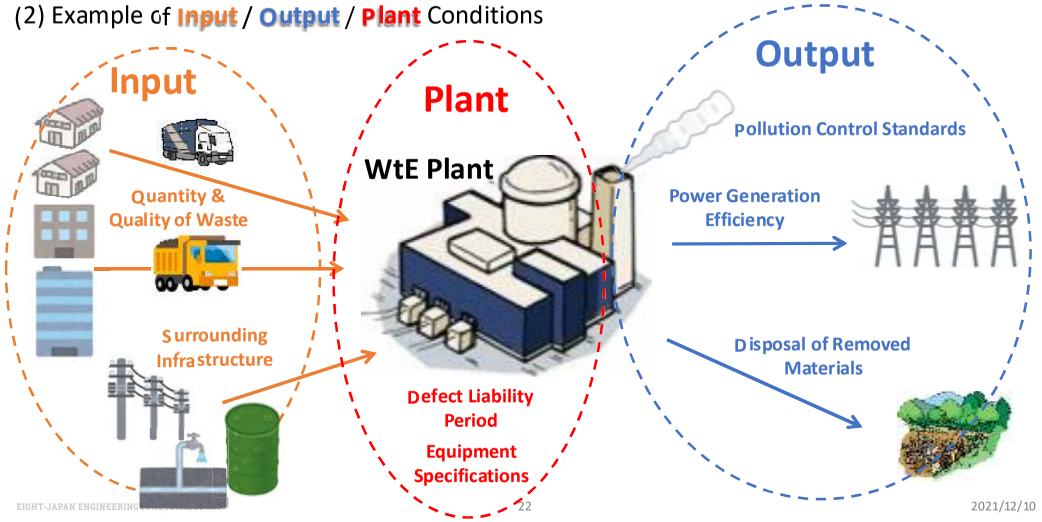
Operation Monitoring

• Compliance Status with **Employer's Requirement***	⇒	Power generation/transmission amount, Pollution control standards, etc.
• Facility maintenance status	⇒	Visual inspection, check self-inspection records, etc.

***Employer's Requirement (ERQ)** is defined as the document specifies the purpose, scope, and/or design and/or other technical criteria for the execution of the Works in FIDIC general conditions. It is used as "Technical Specification" in the Design-Build ordering system where the Employer specifies only some output/input conditions and let contractor to propose their best options.

3. Contract Management Phase

(2) Example of Input / Output / Plant Conditions



3. Contract Management Phase

(2) Example of Input / Output / Plant Conditions

Main contents of "Employer's Requirement (ERQ)" in Bidding Document

(A) COMMON	(B) CONSTRUCTION	(C) OPERATION
1. Capacity of the Facility, Project scheme	1. Quantity and quality of waste	1. Project implementation structure
2. Construction Site, Area	2. Performance Guarantee Matters;	2. Development of manuals and plans
3. Project period, time schedule	(1) Power generation efficiency	3. Operation and maintenance contents;
4. Topography and geology conditions	(2) Pollution control standards, etc.	(1) Operation management
5. Surrounding infrastructure, city planning related matters	3. Performance guarantee method	(2) Inspection, testing, repair and renewal
	4. Defect Liability Period	(3) Disposal of removed materials
	5. Equipment specifications	(4) Information management
	(1) Mechanical equipment specifications	4. Handling after the Project Period
	(2) Electrical instrumentation equipment specifications	
	(3) Civil engineering and building works specifications	

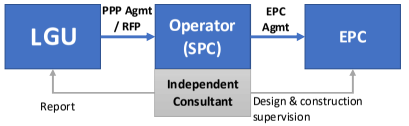
Source: Outline of WtE Technology and Requirements for WtE Project (JICA-TCP Online Training, 10Dec2021)

3. Contract Management Phase

(3) Relationship among LGU, Operator (SPC) and EPC contractor

Design/Construction Supervision;

- In the design/construction phase, LGU, the client of the Project, directly or indirectly through (SPC) monitor the design and construction of EPC contractor's drawings, as well as the work plan for commissioning and performance test.
- The purpose of monitoring is to confirm, **through approval and confirmation of drawings and implementation of inspections and tests, whether the construction work is planned and executed in accordance with the agreement, RFP, and the project proposal**.



Operation Monitoring;

- **In the operation phase**, the purpose of monitoring is to provide citizens with high-quality public services based on **an appropriate division of roles between the LGU and the Operator (SPC) by monitoring and confirming the implementation status of various tasks related to the operation and reflecting the results in the payment of fees.**

*Specific rules and procedures shall be designed in Contract Management Manual

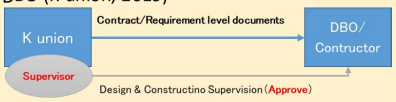
➡ Even though BOT/BOO, LGU can design the level of intervention to the Private Partner's role bcs this is Public Project.

Appendix 12

3. Contract Management Phase

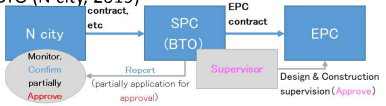
(4) **Design and Construction** Supervision / 4 PPP case studies in Japan

DBO (K union, 2019)



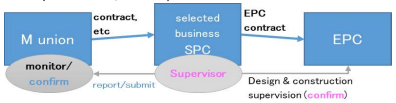
- No SPC. No monitoring on the business side.
- The union **supervisor approves** the various drawings and procedures. When the union lacks the capacity, it outsources the work.
- **The consent of the union** is a condition for proceeding to the next step.

BTO (N city, 2019)



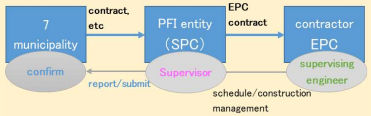
- City asks SPC to hire supervising company.
- The supervising company (supervisor) approves the various drawings.
- **Only the list of approved books and test procedures** are **approved** by the city.
- Other drawings are **reported*** by SPC **to the city**. When the city lacks the capacity, it outsources the work

BOT (M union, 2004)



- The union requests SPC to supervise the construction.
- SPC approves the various drawings.
- **Report and obtain confirmation*** of the approved documents from SPC to the city.

BOO (K city, etc., 2019)



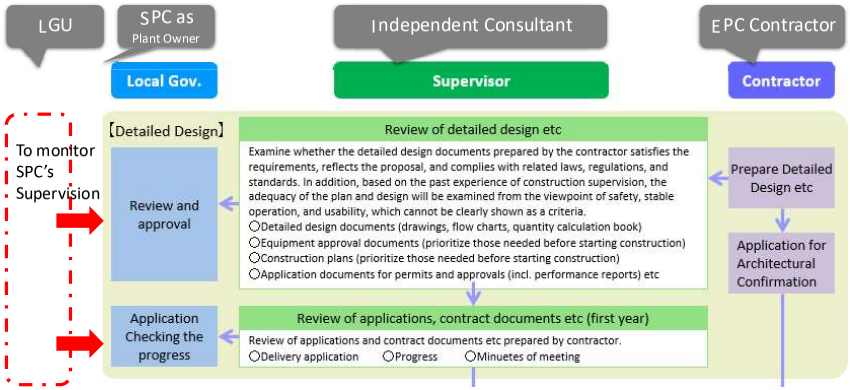
- The city requests SPC to supervise the construction.
- Supervisor of SPC approves the various drawings.
- **Report and obtain confirmation*** of the approved documents from SPC **to the city**.

- While LGU directly supervise contractor's design and construction in DBO, LGU indirectly monitor SPC's supervisory works in BOT/BOO,
- Compare with DBO, public involvement for BOT/BOO is light touch,
- Items to be needed for the LGU's approval in BOT/BOO shall be designed and determined in the contract clearly.

*Note that in Japan, the city's request for "confirmation" does not differ significantly from "acceptance/approval" in practice.

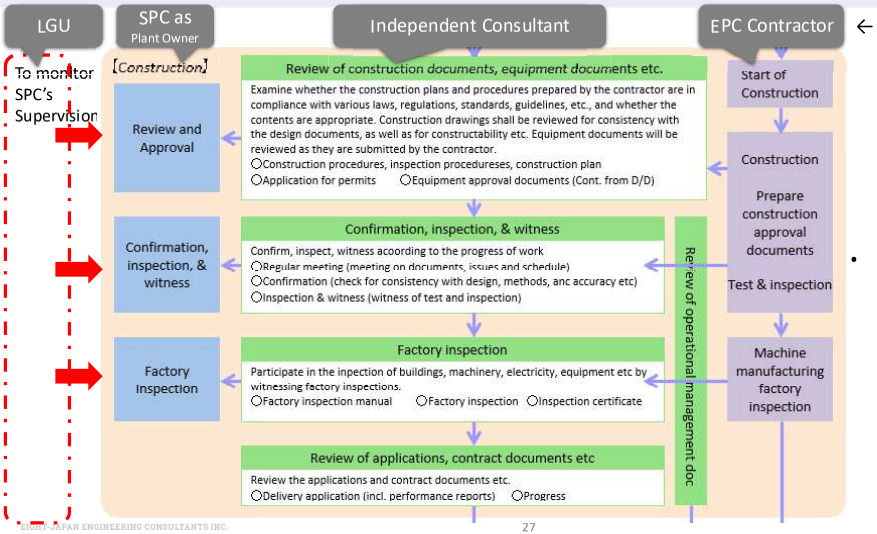
3. Contract Management Phase

(5) **Design and Construction** Supervision /
Detail Procedure in DBO Case / and implication of BOT/BOO;



- In BOT/BOO, detail review and approval for the design documents shall be done by SPC, and LGU shall/can review such supervisory results.

3. Contract Management Phase

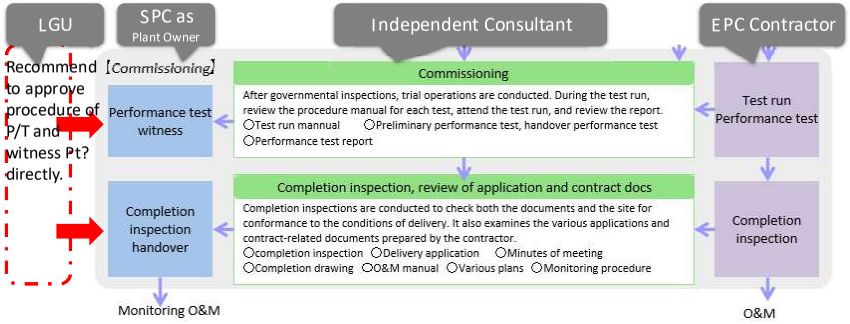


- In BOT/BOO, detail review and approval of the construction documents, inspection, witness, etc. shall be done by SPC, and LGU shall/can review such supervisory results.

3. Contract Management Phase

(4) **Design and Construction** Supervision /
Detail Procedure in DBO Case / and implication of BOT/BOO;

(5) **Design and Construction** Supervision /
Detail Procedure in DBO Case / and implication of BOT/BOO;



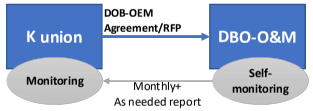
- Even in BOT/BOO, **approval of performance test procedure, and witness of performance test are recommended to be done by LGU directly.**

Appendix 12

3. Contract Management Phase

(6) Operation Monitoring / 3 PPP case studies in Japan

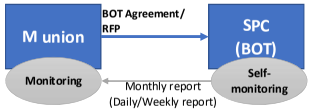
K union DBO



- Submission and **Approval** of the O&M manual.
- Submission and **Approval** of the annual biz plan.
- **Submission and Acceptance** of monthly/annual reports.

*Almost similar regulations will be applied to BTO because operation of BTO is after ownership transfer.

M union BOT / K city BOO



- **Submission** of O&M manual.
- **Submission** of annual business plan.
- **Submission and Acceptance** of monthly/annual reports.

*"Approval" is not specifically required.

- At the Operational Phase, **there is no significant difference in the RfP documents between DBO/BTO** where LGs own facilities, and BOT/BOO where private companies own facilities.
  ※As shown in above, there are differences in the expressions used for "**Acceptance**" or "**Approval**".
- Same as the Design and Construction Phase, it is a considerable matter if to assign experts who can check the SPC's self-monitoring and discuss countermeasures when any problems occur.

3. Contract Management Phase

(4) Design and Construction Supervision / Detail Procedure in DBO Case / and implication of BOT/BOO;

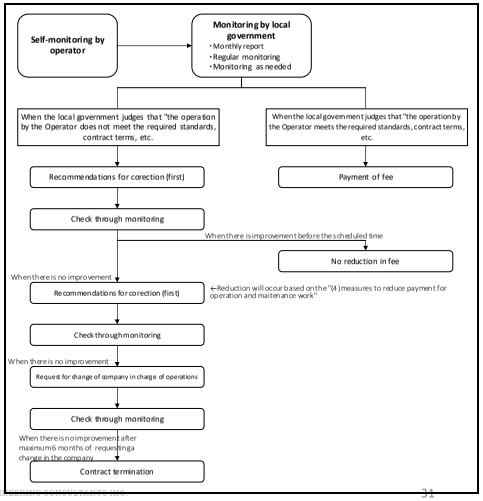
(6) Operation Monitoring / List of Documents to be requested to prepare to SPC

Documents to be prepared:	Manuals	Work Plans／Work Implementation Plans			Reports
Description	Procedural Standards	Work plans for the pre-determined period (all, annual, monthly) based on the requirement in Manuals			Reports correspond to the work plans
Name of Works / Period applied for	Thru Operation Period	Thru Operation Period	Annually	Monthly	* Correspond to the period in left;
1. Operational Management	Operational Management Manual				
(Operation Works)			Annual Operation Plan (AOP)	Monthly Operation Plan	Annual/Monthly Operation Report (A/MOR) *1
(Reception, Collection Charges)			(included in AOP)	(included in above)	(included in A/MOR)
(Delivery Control)	* Inspection, unsuitable MSW		(included in AOP)	(included in above)	(included in A/MOR)
(Efficient Utilization)	* Power generation and resource recovery plans		(included in AOP)	(included in above)	(included in A/MOR)
2. Maintenance Management	Maintenance Management Manual				
(Procurement)			Annual Procurement Plan	Monthly Procurement Plan	Annual/Monthly Procurement Report
(Check and Inspection)		(Overall) Check and Inspection Plan	Annual Check and Inspection Plan		Annual Check and Inspection Report
(Repair and Renewal)		(Overall) Repair and Renewal Plan	Annual Repair and Renewal Plan		Annual Reipair and Renewal Report
(Corrective Maintenance)		(Overall) Corrective Maintenance Plan			(Overall) Corrective Maintenance Report
(Functional Inspection)	*Required in Japanese reg.	(Overall) Functional Inspection Plan			(Overall) Funcitional Inspection Report
3. Environmental Management	Environmental Management Manual				
(Environmental Protection)		(Overall) Env. Protection Plan	(included in AOP)		(included in A/MOR)
(Working Environment Protection)		(Overall) Working Env. Protection Plan	(included in AOP)		(included in A/MOR)
4. Emergency Response	Emergency Response Manual	Planes to accident prevention, emergency control, etc.			Accident and Disaster Reports
5. Others	Manuals for other tasks				
(Clean up)		(Overall) Clean-up Plan	Annual Clean-up Plan		Annual Clean-up Report (+every time)
(Planting Plan)		(Overall) Planting Plan	Annual Planting Plan		Annual Planting Report (+every time)
(SPC Management)		(Overall) SPC Management Plan	Annual Managemetn Plan		Annual Management Report
(Fire Prevention)		(Overall) Fire Prevention Plan	Annual Fire Prevention Plan		Annual Fire Prevention Report
(Guard Duty)		(Overall) Safety Management Plan	Annual Safety Management Plan		Annual Safety Management Report
(Residents' Response)		(Overall) Residents' Response Plan	Annual Residents' Response Plan		Annual Residents' Response Report
(Visitors' Response)		(Overall) Visitors' Response Plan	Annual Visitors' Response Plan		Annual Visitors' Response Report
(Education and Training)		(Overall) Education and Training Plan	Annual Education and Training Plan		Annual Education and Training Report

*1: Daily reports should be attached

3. Contract Management Phase

(6) Operation Monitoring / Monitoring and Corrective Action



- Flow of Monitoring and Corrective Action in Operation Phase (example of DBO project in Japan).
- Based on self-monitoring by business operator, the monitoring method/frequency and evaluation criteria for LGU are stipulated.
- Check-sheet (draft)

Dissemination Seminar

Recommendations to Improve Final Disposal Site

8th September 2022 (Thursday)

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

Table of Contents

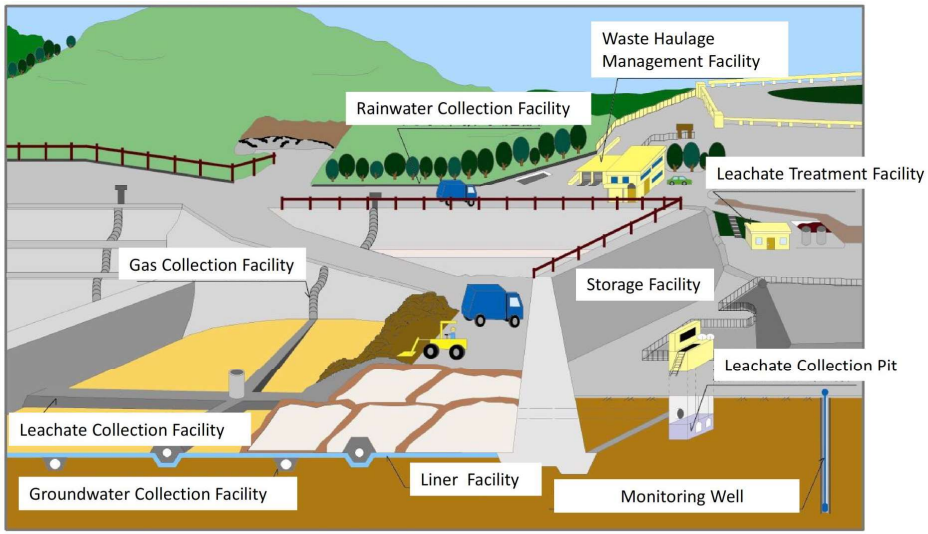
Sanitary landfill laws and regulations in the Philippines

The following table lists the laws and regulations regarding final disposal sites 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 2001-34	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.

The main facilities of a sanitary landfill

The main facilities of a sanitary landfill are shown in the figure below:



Structural standard for a sanitary landfill liner (1)

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

Structural standard for the liner in a sanitary landfill

- ❖ Landfills shall be provided with a base liner system consisting of clay and/or geosynthetic membranes (geomembrane).
- ❖ If clay is used, it shall have a minimum thickness of 0.75m and permeability of 1×10^{-6}cm/sec or less.
- ❖ Geomembranes shall be at least 1.5 mm thick with a permeability of $1x10^{-14}$ cm/sec or less.
- ❖ Geosynthetic Clay Liners (GCL) shall have a thickness of at least 6.4 mm and a permeability of $1x10^{-9}$ cm/sec or less.

Structural standard for a sanitary landfill liner (2)

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.

Structural standard for a sanitary landfill liner (3)

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^{-6}cm/sec	Clay liner should be at least 75cm thick and have a permeability of 10^{-7}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^{-6}cm/sec	Clay liner at least 75cm thick, a permeability of 10^{-7}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^{-7}cm/sec

Appendix 12

Structural standard for a sanitary landfill liner (4)

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 a base liner system consisting of clay and/or geosynthetic membranes is required, but DAO 2006-10 does not allow impervious structures 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 impervious structures, the clay liner is at least 60 cm thick and has a 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.

Structural standard for a sanitary landfill liner (5)

It is proposed to unify the standard for liner for a sanitary landfills as follows:

- The clay liner specifications for Category 1 should be changed to a minimum thickness of 75 cm and permeability of 1×10^{-6} cm/sec or less, in accordance with DAO 2001-34.
- DAO 2006-10 does not allow the use of liners using only geosynthetic membrane, but since clay material may not be available near the site, it is recommended that only geosynthetic geomembrane with a minimum thickness of 1.5 mm and permeability of 1×10^{-14} cm/sec or less be used. We believe it is acceptable to require the use of only geomembrane.
- Allow the use of geosynthetic clay liners (GCL) instead of compacted clay liners.

Structural standard for leachate collection and treatment facilities (1)

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 a 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 facilities 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

Structural standard for leachate collection and treatment facilities (2)

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

- DAO 2006-10 does not specifically address the design of leachate collection facilities.
- For leachate treatment facilities, categories 1 through 3 are defined as pond systems, which is a method of purifying leachate by storing leachate in ponds and aerating the ponds to purify the leachate with microorganisms. As shown above, the treatment system 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 system according to the type of landfill waste as well.

Structural standard for leachate collection and treatment facilities (3)

Proposed standard for a leachate collection facility

Install pipes, etc. with drainage cross-sections capable of collecting and draining the leachate generated by the rainfall that occurs once every 10 years.

Proposed standard for a leachate treatment facility

- The capacity of the leachate treatment facility is such that the leachate storage pond and leachate treatment facility can handle the largest rainfall over the past 20 years (the same number of years as the planned landfill period). However, the amount of discharge from the leachate treatment facility shall be less than or equal to the amount specified by DENR.
- The leachate quality is set according to the type and proportion of landfill waste, and a leachate treatment system combining physical, biological, and chemical treatment is adopted to satisfy the water quality standards prescribed by DENR.

Structural standard for a hazardous waste landfill (1)

Next, the standard of liner for a hazardous waste landfill is shown.

- Ash generated from the WtE facility will be subjected to the TCLP test, and if the ash is classified as hazardous waste, it will be disposed of in a landfill for hazardous waste in accordance with DAO 2013-22.
- For structural standard for a 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 liners:

Standard of liner for a hazard waste landfill

Facility	Specifications
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 geomembrane and three feet of compacted soil material.

Thus, the standard for a hazardous waste landfill liner is based on a double liner.

Structural standard for a hazardous waste landfill (2)

Standard of leachate collection for a hazardous waste landfill

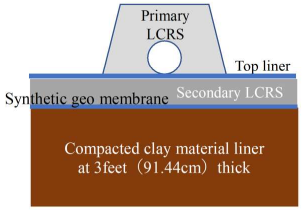
The standard for leachate collection in the Technical Guidelines for TSD facilities are as follows:

Facility	Specifications
Double leachate collection and removal system	▪Primary LCRS must be located above the top liner, while secondary LCRS must be located between the liners immediately above the bottom composite liner ▪Secondary LCRS, which also serves as the leak detection system, must be:.

Thus, in a hazardous waste landfill, the standard for leachate collection are also specified to be double.
In addition, this Technical Guidelines does not describe the standard for the leachate treatment facility.

Structural standard for a hazardous waste landfill (3)

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 LCRS are not currently used in the final disposal sites for hazardous waste in operation because of the higher construction cost of LCRS.

Structural standard for a landfill liner (4)

Suggestions for structural standard for hazardous waste landfill liner and leachate collection

The following are the proposed standard for hazardous waste landfill liner and leachate collection:

- The specifications of compacted clay material shall be the same as category 4 of DAO 2006-10, with a thickness of 60 cm and a permeability of 1×10^{-7} cm/sec or less.
- Eliminate the LCRS provision for leachate collection and make the leachate collection facility only installed on the top liner.

2. Challenges of existing sanitary landfills in the Philippines

Challenges of existing sanitary landfills in the Philippines (1)

The following are the results of survey of laws and regulations regarding landfill in the Philippines and a field survey of categories 1-4 and hazardous waste landfill:

- The structural standard of liner is evaluated to be comparable to the standards of other countries, and no problem was found in the field survey, as the geomembrane was laid.
- The landfill in the Philippines is not collecting and draining leachate properly, which means that leachate is stored in the landfill site. This causes leachate to accumulate in the landfill site, which causes bad smells and the breeding of mosquitoes.
- The leachate collected in the leachate collection pipe is discharged into the leachate collection pit and pumped to the leachate pond. However, the leachate collection pit was not functioning or the pumps were not operating due to lack of electricity.
- There was a landfill that had the leachate collection pit but no leachate pond.

Challenges of existing sanitary landfills in the Philippines(2)

The following are two examples where there is no leachate pond, and the leachate collection pit has been constructed but is not functioning.

Leachate collection pits where leachate has not collected.

Challenges of final disposal sites in the Philippines (3)

The following are examples of leachate not being collected.

Leachate flowing into perimeter ditches around the landfill

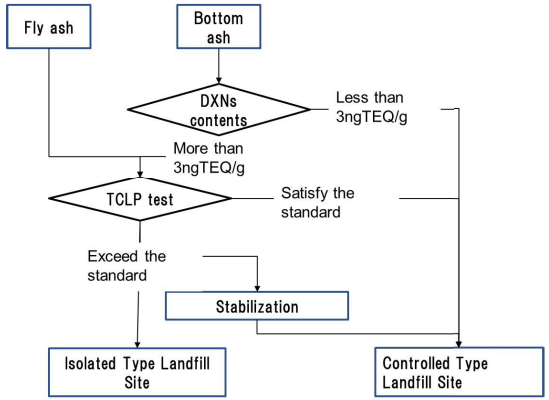
Leachate accumulation in landfill

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

3. Final disposal of ash generated from WTE facilities

Final disposal of ash generated from WTE facilities (1)

Until now, municipal waste generated from households and other sources that could not be used was directly transported to landfills, and the waste that was landfilled consisted mainly of municipal solid waste such as paper and plastic. However, with the introduction of WTE facilities, municipal solid waste will be incinerated, and the ash generated from WTE facilities will be newly disposed of in landfills, resulting in a significant change in the quantity and quality of landfill waste. The following is a flow chart of how bottom ash and fly ash generated from WTE facilities will be disposed of in landfill.



Final disposal of ash generated from WTE facilities(2)

The leachate generated from landfills where incinerated ash was disposed of will have a different quality than the leachate from landfills where solid waste was disposed of in the past. 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 ash and inert waste are disposed of.

Water quality	Municipal solid waste	Incinerated ash and nonsolid 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 ash and inert waste landfills is low in all items.
- When ash is landfilled, it is necessary to consider Ca^{2+} 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 $CaCl_2$, which dissolves in leachate in the landfill and leaches out as Ca^{2+} and Cl^-.

Discharge standards for treated leachate from landfill must follow DAO 2016-08, which does not specify discharge standards for Ca^{2+} and Cl^-.

- ❖ 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.



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. 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.

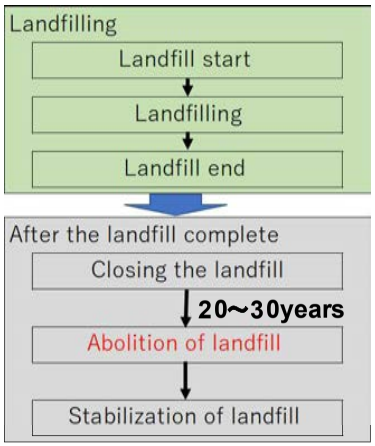
Proposal 2

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.

4. Introduction of Japanese sanitary landfill technology

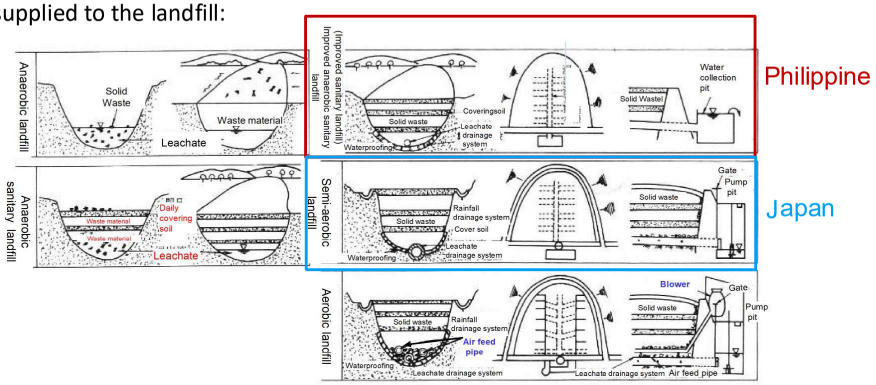
Introduction of Japanese sanitary landfill technology (1)

- ❖ The life cycle of a landfill is shown in the figure on the right. When the planned landfill height is reached and the landfill is completed, a final cover is placed on top of the landfill. Since leachate will continue to be generated even after landfilling is completed, it is necessary to continue operating the leachate treatment facility. Operation of the leachate treatment facility can be stopped when landfill waste stabilization has progressed and the quality of the leachate is below the quality of the water to be discharged.
- ❖ In Japan, after the landfill is closed, the landfill can be abolished if the quality of the leachate, the amount of gas generated from the landfill, and the temperature inside the landfill meet the standards. Abolition here means a state that does not require landfill management such as treatment of leachate.
- ❖ After closing the landfill, a minimum of 20 to 30 years is needed before the landfill is decommissioned. Therefore, Japan is taking various steps to promote the stabilization of landfill waste and shorten the time until landfills can be decommissioned. One of these efforts is the adoption of the semi-aerobic landfill structure.



Introduction of Japanese sanitary landfill technology (2)

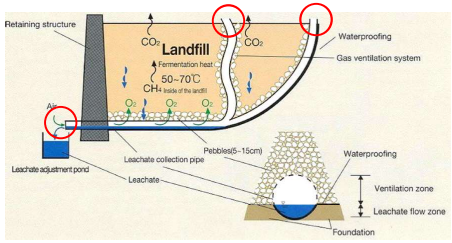
There are five types of landfills, as shown in the figure below, depending on how air is supplied to the landfill:



- The semi-aerobic landfill structure (Fukuoka Method) is used for final disposal sites in Japan.
- In contrast, in the Philippines, DAO 2001-34 allows the storage of leachate in landfills, which makes it an anaerobic sanitary landfill.

Introduction of Japanese sanitary landfill technology (3)

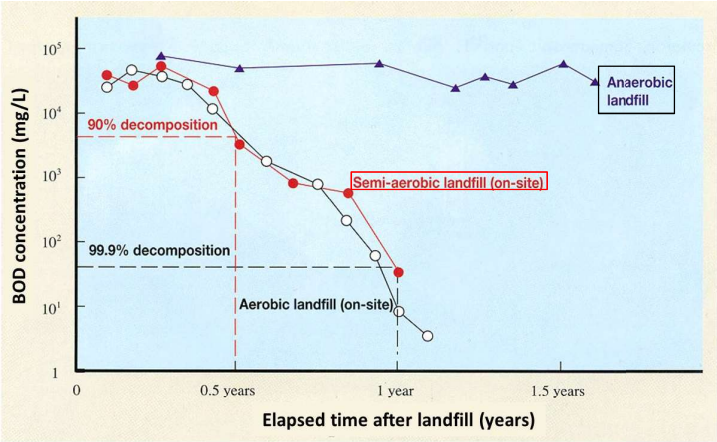
A cross-sectional view of a semi-aerobic landfill structure is shown below:



- 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 CO_2 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).

Introduction of Japanese final disposal technology (4)

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



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

Introduction of Japanese final disposal technology (5)

In recent years, new landfills being developed in Japan are of the type covered by building on a landfill, as shown in the following photo. Landfills covered with building on landfill is called "closed-type landfills.

As of 2021, 842 closed-type landfills have been constructed in Japan.

Appendix 12

Introduction of Japanese final disposal technology (6)

The characteristics of a closed landfill are shown below:

- ❖ Reduces the risk of impact on the external living environment, such as scattering of waste, odors, and groundwater contamination.
- ❖ Landfill operations can be carried out without being affected by weather conditions such as rainfall or snow accumulation.
- ❖ The amount of leachate generated can be controlled by sprinkler to stabilize the landfill waste.
- ❖ Considering the design of the building, it is easy to obtain the consent of local residents as a facility with a clean image.

Covering the landfill with a building can prevent the scattering of waste and odors.

Since the landfill is covered with building, landfill work is possible even during snowfall.

Introduction of Japanese final disposal technology (7)

Sprinkler on landfill. The size of the leachate treatment facility can be reduced by adjusting the amount of water sprayed.

This is an example of a closed-type landfill building that uses local timber for the walls in consideration of the landscape.

- ❖ In the case of a closed-type landfill, the construction cost of the building covering the landfill will be additional, but the scale of the leachate treatment facility can be reduced, thereby reducing construction and maintenance costs.
- ❖ Since the Philippines has a lot of rainfall, and there are many issues related to leachate treatment, the closed-type landfill can be adopted as a solution to these issues.

Thank you for your attention!

Appendix 12