

Framework for Operation of Hazardous Waste Treatment and Disposal Facility

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1. Introduction

Hazardous waste (HW) is waste having possible adverse impacts to human health and the environment as a result of physico-chemical and/or biological properties rendering it dangerous. According to the Egyptian Environmental Law 4/1994, hazardous waste is defined as:

“Waste of activities and processes or its ashes which retain the properties of hazardous substances and have no subsequent original or alternative uses, like clinical waste from medical treatments or the waste resulting from the manufacture of any pharmaceutical products, drugs, organic solvents, printing fluids, dyes and painting materials”.

Within the framework of this definition, a National Classification System for HW was developed, and waste identified as hazardous on the basis of four main characteristics: Ignitibility, Corrosiveness, Reactivity and Toxicity.

Integrated HW management relies on a number of basic components which ensure that the waste is properly handled from the point of generation till final disposal, through the operations of segregation, collection, storage, transportation, treatment, and any possible reuse and/or recycling. In this respect, HW treatment and disposal represent components essential for the successful implementation and operation of such an integrated system, and are frequently carried out at central facilities operating at regional or national levels.

Central treatment and disposal facilities encompass two main groups of activities: those concerned with the waste treatment – physical, chemical, biological and/or thermal, – as well as those concerned with waste disposal, usually carried out in specially engineered landfills. The operation of these facilities need to be carried out with minimal risk to the environment. In this regard, it is essential that the operational procedures in place are capable to trace waste within the facilities from the point of acceptance till its final disposal in the landfills. The details of these procedures would differ from one

facility to another based on the activities carried out within the facility, the types of waste accepted, as well as the capacity of the facility. However, these detailed procedures fall within a general framework minimizing all associated environmental risks, and ensuring the traceability of the waste at all times in the facility. This is presented in this paper, with the general roles and responsibilities of different units and departments within the facility, with particular reference to the Nasreya facility in Alexandria, as the first central hazardous waste treatment and disposal facility in Egypt.

2. Framework for Operation of Hazardous Waste Treatment and Disposal Facility

The framework presented in this section, addresses the basic operation components within the facility encompassing waste acceptance policy, waste delivery and reception, as well as the waste cycle within the facility.

Detailed operational procedures for hazardous waste treatment and disposal facilities are developed within such a framework.

2.1 Waste Acceptance

Every facility must have a waste acceptance policy, based on the treatment and disposal operations carried out within it as well as its capacity. A waste acceptance policy would include general specifications about the chemical and physical properties of waste to be accepted, as well as lists of waste types and/or streams that satisfy these set general specifications. In addition, the policy would also include detailed information about waste types and/or streams which cannot be accepted.

This waste acceptance policy should be publicly available, for all HW generators served (or potentially served) by the facility to refer to. The public availability of this policy is essential for the successful operation of the waste treatment and disposal activities. On one hand, it would assist clients (or potential clients) in the implementation of successful HW management systems within their own establishments, facilitating the streaming of waste to be sent to the facility, at points of generation, and minimizing unnecessary financial, as well as legal, burdens which would result from sending “unacceptable” waste to these central facilities. On the other hand, acceptance policies ensure that the operation of the central facilities is not disturbed with the receipt, and possible acceptance, of waste types which cannot be treated and/or disposed of. More importantly it would minimize risks associated with unnecessary transport operations of HW to the facility, then back to the generator, after rejection.

For the case of Nasreya, treatment processes carried out at its initial phase of operation, only entail physical treatment through solidification in solar evaporation ponds followed by burial of the waste in a landfill. Subsequent stages of operation would entail other physical treatment (such as solidification in cement blocks) as well as chemical treatment. In this respect, only inorganic HW is accepted by the facility at its initial phase. This comprises:

- Dry inorganic waste
- Slightly wet inorganic waste
- Highly viscous inorganic sludge

- Inorganic sludge with high water content with a pH between 5 and 9.¹
- Inorganic sludge waters with high concentrations of heavy metals with pH between 5 and 9.¹
- Demolition waste containing asbestos.
- Packages contaminated with inorganic waste, such as plastic containers taken out of use, big bags, steel barrels etc...

As for wastes that cannot be accepted by the Facility, these mainly comprise flammable or biodegradable organic hazardous waste, as well as wastes containing cyanides or metallic mercury. For organic wastes:

- Flammable organic waste would present fire hazards.
- Organic waste may react with the synthetic lining of the landfill adversely affecting its performance.
- Oils can form immiscible layers above aqueous waste, adversely affecting the evaporation process.
- Biodegradable waste would lead to the generation of methane in the landfill with no gas collection and venting system installed.

Cyanides and metallic mercury, are considered highly toxic. Wastes containing them can not be landfilled without chemical treatment.

Based on the above, the following table presents the classes/streams of waste to be accepted, and those rejected, by the facility.

2.2 Waste Delivery and Reception

For HW generators to deliver waste at the facility, an order form should first be submitted by them to the facility. The order form includes data about the waste generator as well as description of the waste and the date for waste delivery at the facility. This order form is essential to allow the facility plan for waste treatment/disposal prior to its delivery, and would minimize the arrival of waste that cannot be treated and/or disposed of by the facility be rejected by the facility.

Figure (1) presents a prototype of the order form suggested to be used by Naserya facility. Once the order form is received by the facility, its contents are reviewed and it is decided whether the waste would be accepted or not, in principle, on the basis of the type and amount of the waste recorded on the form. The facility then informs the generator of the acceptance or rejection of order. For some cases, the facility could request the generators to supply chemical analyses of the waste to be delivered, particularly for test which cannot be performed at the facility laboratory.

¹ The pH demand implies that metal fabricating waste of metallurgical sludge or wastewater must be neutralized by the client prior to delivering it to the facility.

Table (1): Classes of Waste Accepted by Nasreya Facility

Waste Accepted to Landfill	
Class of Waste	Notes
Asbestos	Handling with safety equipment in designated area. Must be covered with soil immediately
Carbon Waste	Must be covered with soil immediately
Metallurgical linings	
Heavy Metals Wastes, Dry or Dewatered Sludge	Watery sludge must be dried in the evaporation ponds
Waste Chemical Containers	Provided all steps have been taken to reduce hazardous residues and the containers are unfit for further use. No volatile organic contaminants accepted.
Resins and Polymers	
Contaminated Soil	Provided contaminant do not exceed any other limitations
Waste Chemicals	Only inorganic chemicals accepted
Inks, dyes and lacquers	Provided they are solidifies and do not contain any volatile residues of solvents
Paint Sludge	Provided they are solidifies and do not contain any volatile residues of solvents
Any other class of waste	Considered on a case by case basis
Dried material from evaporation ponds	
Waste Accepted to Evaporation Ponds	
Class of Waste	Notes
Heavy metal sludge	Provided pH is 5 till 9
Heavy metal water solutions	Provided pH is 5 till 9
Waste waters	Provided pH is 5 till 9
Any other class of waste	Considered on a case by case basis
Waste Accepted to Future Treatment Plant	
Class of Waste	Notes
Acid waste	Physico-chemical treatment
Alkaline waste	Physico-chemical treatment
Cyanide containing waste	Physico-chemical treatment
Cr (6) containing waste	Physico-chemical treatment
Spent Pesticides	Solidification
Expired pharmaceuticals	Solidification
Any other class of waste	Considered on a case by case basis
Waste Not Accepted by the Nasreya Facility	
Class of Waste	Notes
Oil sludge and wastes oil	
Flammable organic waste	
PCB waste	
Organochlorine waste	
Medical waste	Falling within the scope of the municipal solid waste collection system.
Radioactive waste	Falling within the scope of the National Center for Nuclear Safety and Radiation Control
Explosive waste	Falling with the scope of the Ministry of Interior

Order form										ID	
Generators Information											
Name of Generator:											
Generator HW Permit Number:											
Contact Person:											
Address:											
Tel:											
Fax:											
Date:											
Waste Description											
Description	Hazardous Class				Physical Status			Packing			Total Quantity
	Ignitable	Corrosive	Reactive	Toxic	Solid	Liquid	Sludge	Bulk	Packages (e)	Number	
											kg m ³
											kg m ³
											kg m ³
											kg m ³
Date of Waste Delivery:											
Generator Signature:											
Decision of the Facility											
Order Acceptance ()						Order Rejection ()					
In case of Acceptance Fees required: LE											
Facility Manager Signature:											

Figure (1): Order Form Prototype

For cases where the order form is accepted, the waste is then delivered to the facility at the date specified in the order form. At arrival at the gate of the facility, the waste type and amount are checked and one of the following three scenarios occurs:

Case One: The type and amount of the waste are consistent with the order form and the waste is accepted.

Case Two: The type and amount of the waste are not consistent with the order form, but the waste is still accepted, as it meets the acceptance policy of the facility.

Case Three: The type and amount of the waste are not consistent with the order form, and the waste is not accepted, as it does not meet the acceptance policy of the facility.

Figure (1), illustrates the waste delivery and acceptance procedures within a treatment and disposal facility.

For each case of the three cases stated above there are a number of actions that would take place. These actions are described in table (2) below:

Table (2): Procedures for Waste Acceptance and Rejection

Case One	Case Two	Case Three
<ul style="list-style-type: none"> • The facility accepts the waste, and generator pays the treatment/disposal fees • The facility signs the manifest form² and retains a copy of it, and the transporter retains another copy. • The facility sends a copy of the manifest to the generator 	<ul style="list-style-type: none"> • The facility accepts the waste and adjusts the manifest to indicate the actual type and amount of waste delivered at the facility. • The facility notifies the generator that the amount and/or type of waste delivered is inconsistent with what was agreed upon in the order form, and with what is recorded in the manifest • The facility sends the generator a copy of the signed amended manifest. • In case of waste amount less than what is recorded and/or waste type is inconsistent with what is recorded, an Incident Report is prepared by the facility and sent to the 	<ul style="list-style-type: none"> • The facility rejects the waste, and fills in a new manifest indicating the waste amount and type based on the analyses of the waste carried out by the facility. • The facility sends the transporter with the waste back to the generator, and also sends the generator the new manifest. The facility keeps the transportation and disposal fees. • An Incident Report is prepared by the facility and sent to the regulatory body indicating the inconsistency of delivered waste type with order form. • The generator pays the transporter the transportation fees of the two trips (Generator-Facility & Facility-Generator). The transporter retains a copy of the new manifest signed by the generator. • The generator sends the signed new manifest to the facility. If the facility does not receive the manifest from the generator within three weeks, it should inform the regulatory body. • When the facility receives the new

² The manifest is a form that monitors and controls the movement of waste from the point of generation through final disposal. It is filled and signed by the three main entities, namely: Generator, Transporter, and Treatment and Disposal Facility

	<p>regulatory body.</p> <ul style="list-style-type: none">• In case additional fees are required for waste disposal, the generator will send the additional fees to the facility. If the generator does not send the additional fees, the facility takes necessary legal actions	<p>manifest signed by the generator, it then sends back to the facility part of the transportation and disposal fees after deducting from it the handling fees of the waste in the facility.</p>
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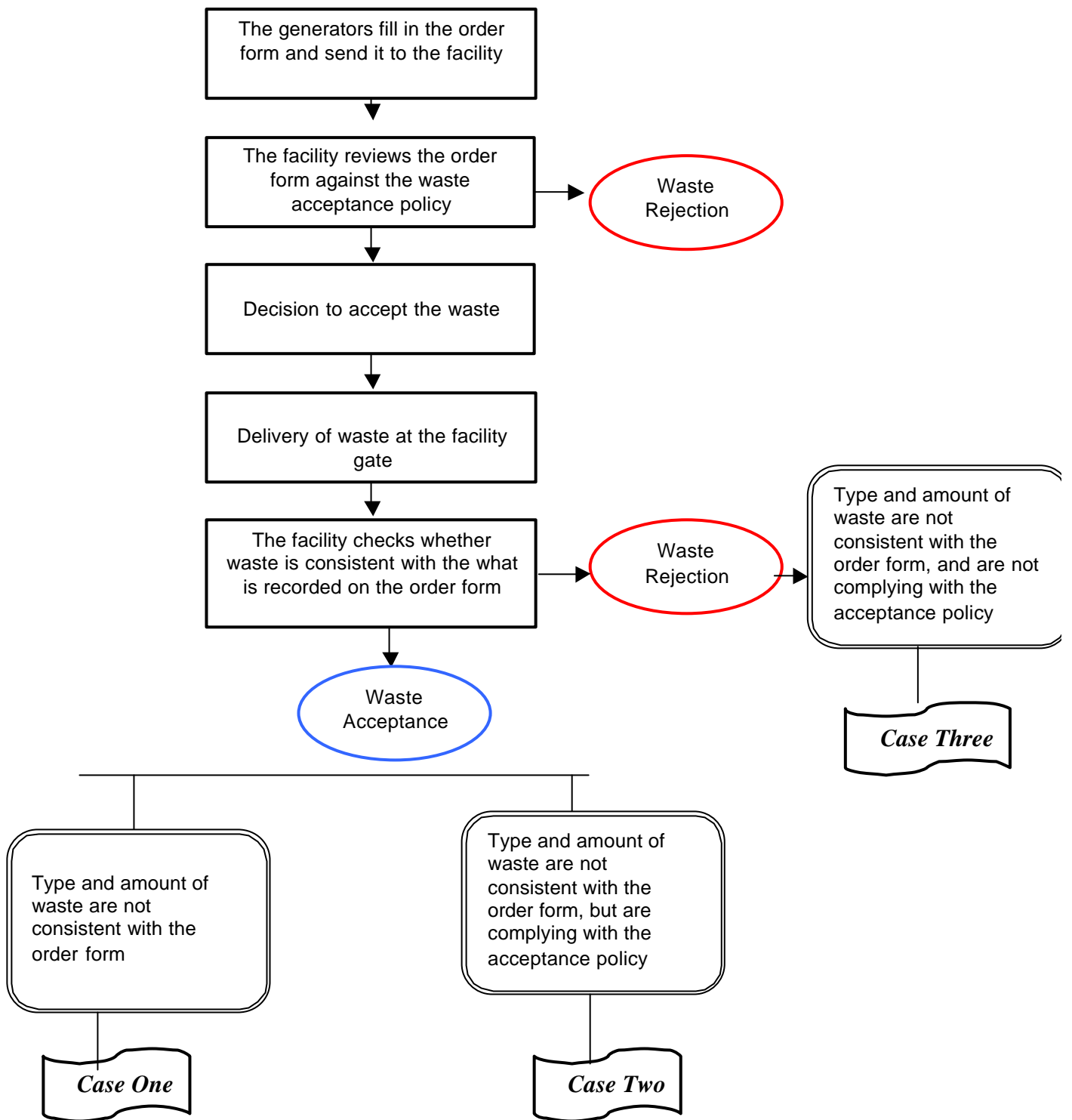


Figure (2): Waste Delivery and Reception Flowchart

2.3 Waste Cycle within the Facility

Generally a hazardous waste treatment and disposal facility consists of five main entities. These are:

- Management, responsible for the overall management of the facility and decision-making with what is concerned with order acceptance and rejection, as well as customer services, public relations, etc.
- Administration, responsible for the different administrative procedures including registering, filing, purchasing, etc.
- Gate, responsible for receiving and recording the waste and based on the management decision guiding the waste vehicles through the facility
- Laboratory, responsible for sampling and analyzing delivered waste
- Operations, responsible for all treatment and disposal activities.

Each of the five entities has specific roles in managing the waste shipments, from its arrival up till it is treated/disposed of and the empty vehicle departs the facility.

In order to track the waste within the facility, each waste shipment would be accompanied by a tracking form, where the decisions and locations of the waste are recorded. This form is essential for managing risks associated with the different waste shipments within the facility, and providing historical information to be accessed if necessary.

Figure (3) presents a prototype of the tracking form suggested to be used by Nasreya. In this respect, the waste (together with the tracking form) cycle are expected to take place in Nasreya Facility as follows:

1. Once the waste shipment arrives at the Gate of the facility, the Gate initiates the tracking form with the data of waste vehicles and transporter. The Gate checks the manifest accompanying the waste to ensure its consistency with the order form of the waste shipment, recording this on the tracking form. The Gate then sends the order form together with the manifest to Management.
2. Management checks both the manifest and order form and decides whether the waste could be conditionally accepted until laboratory analysis of the waste is carried out for a final decision to be taken, or the waste should be rejected. Management records this on the form. If the waste is conditionally accepted, Management sends the tracking form to the Gate, and the Gate in turn contacts the Laboratory to have the waste checked and analyzed.
3. The Laboratory checks and analyzes the waste recording the results on the tracking form. The Laboratory then signs the tracking form and forwards it to the Management.

4. Management reviews the waste analyses and decides whether to finally accept the waste or not. In case of waste acceptance, Management identifies the destination of waste disposal in the facility. Management records on the tracking form its decision of acceptance or rejection together with the waste destination in case of acceptance. In case of Acceptance, the tracking form is forwarded to the Gate.
5. The Gate notifies the transporter of the shipment acceptance. For fee payment at Administration, where applicable³. The Administration signs the tracking form, indicating receiving the fees, and the transporter returns back to the Gate with the tracking form.
6. The Gate weighs the loaded vehicle recording the on the tracking form and guiding the vehicle to Operations with the tracking form.
7. Operations dispose of the waste according to the destination specified in the tracking form by Management (either evaporation ponds or landfill for the initial phase of operation) recording this on the tracking form. Operations also supervise the cleaning of the vehicle before forwarding it to the Gate with the form.
8. The Gate weighs the empty vehicle and records the weight in the tracking form. The Gate then ensures the departure of the vehicle and signs the tracking form and sends it to the Administration. The Administration registers the tracking form, and takes the necessary financial procedures.

3. Roles and Responsibilities

As discussed above there are five main entities in a hazardous waste treatment and disposal facility. The organizational structure and size of each of those entities differ from one facility to the other. In Nasreya, the organizational structure of each of these entities has not been finalized yet. However, the main roles and responsibilities of each of them have been specified as follows.

3.1 Roles of Management

The Management role entails two main responsibilities, namely, the Operational Responsibilities and General Managerial Responsibilities. The Operational Responsibilities include the Operation Planning and the Daily Operations of the facility, while the General Managerial Responsibilities include all the other activities pertaining to the management of the facility entailing Strategic Planning, Marketing, Reporting, Permits and Legal Affairs, Public Relations, Customers Services and Health and Environment. The roles of the Management under each of these activities are specified below:

³ Payment of fees can also be carried out differently subject to contract arrangements.

Figure (3): Hazardous Waste Tracking Form

Hazardous Waste Tracking Form		Order Form ID
1 Gate	Vehicle and Transporter Data	
	Vehicle License Number	
	Transporter Name	
	Transporter Permit Number	
	Manifest Conformity with Order Form	
	Yes ()	If No, list differences and send to Management
No ()		
Gate Signature		
2 Management	<i>For cases where manifest information differs from order form</i>	
	Management Decision	
	Shipment Conditional Acceptance ()	Shipment Rejection ()
	Management Signature	
3 Lab.	Laboratory Analyses	
	Waste Appearance	Solid () Liquid () Sludge ()
	Waste Packaging	Packaged () Bulk ()
	Waste Chemical Composition	
	Laboratory Signature	
4 Management	Management Decision	
	Shipment Acceptance ()	Shipment Rejection ()
	Waste Destination	Landfill () Area Number ()
		Evaporation Pond () Number ()
Management Signature		
5 Admin	Payment of Fees Confirmation	
	Administration Signature	
6 Gate	Recording of Waste Amount	
	Waste Weight	<i>For bulk waste</i> Weight of loaded vehicle
		<i>For packaged waste</i> Weight of waste
Gate Signature		
7 Operations	Waste Disposal Confirmation	
	Waste Destination	Landfill () Area Number ()
		Evaporation Pond () Number ()
Operations Signature		
8 Gate	Recording of Vehicle Weight for Bulk Waste	
	Weight of empty vehicle	
	Vehicle Departure Confirmation	
Gate Signature		

3.1.1 Operational Responsibilities

Operation Planning

- Developing, maintaining and updating a disposal plan, where the actual situation of the landfill and Solar Evaporation Ponds (SEP) is specified as well as the expected waste deliveries and their assigned location in each of the landfill and SEP.

Daily Operations

- Reviewing order forms received from hazardous waste generators and taking decisions to accept or reject orders based on nature of waste and the disposal plan.
- Taking decisions on whether to conditionally accept or reject waste shipment, in case of manifest inconsistency with order form.
- Taking decisions on whether to accept or reject waste shipment, after checking both the laboratory analysis of the waste and the order form.
- Setting the destination of accepted waste shipment within the facility according to disposal plan.

3.1.2 General Managerial Responsibilities

Strategic Planning

- Developing strategic action plans for the facility.

Marketing,

- Developing and implementing marketing campaign, targeting hazardous waste generators, and organizing public relations events to promote the facility.

Reporting

- Writing and sending incident reports to regulators notifying them of the inconsistency in type of waste shipment with that recorded in the order form, or notifying them when the amount of waste shipment is less than amount recorded in order form.

Permits and Legal Affairs

- Reviewing and signing annual contracts with hazardous waste generators.
- Ensuring the continued implementation of the facility's permit conditions and permit renewal.
- Legal Affairs.

Safety and Environment

- Contacting concerned entities in case of emergencies.
- Safety and equipment.
- Environmental Management Systems

3.2 Roles of Administration

The Administration activities are focused on Registering and Statistics, Accounting and Invoicing, and Human Resources. The roles of the Administration under these activities are:

Registering and Statistics

- Registering order forms.
- Developing and maintaining a database for order forms and tracking forms.
- Developing a hazardous waste register for the facility, indicating waste entering the facility, its type and amount and the final destination of waste, based on the waste tracking form. Such a register will enable the facility to carry out statistics whenever needed.

Accounting and Invoicing

- Receiving fees from hazardous waste transporters and taking necessary actions to process them
- The Administration is responsible for paying transporter fees, when transportation fees are associated with disposal fees.
- In case waste shipment is rejected, Administration is responsible for calculating handling fees agreed upon and deducting it from the disposal fees and sending the remaining fees to the generator.
- In case waste is accepted although it is inconsistent with order form, Administration is responsible for calculating the remaining fees or the addition fees, and sending remaining fees to generators or invoicing generators for addition fees.
- Carrying out other financial and accounting activities within the facility, including, purchasing, wages, operating fees, maintenance fees, etc.

Human Resources

- Managing the status of the facility staff.

3.3 Roles of Gate

The activities of the Gate is composed of the Access Control of the waste to the facility, Recording and Weighing the waste shipments, and Directing Waste Movement within the facility. The roles of the Gate under these activities are:

Access Control

- Controlling the access to the facility.
- Checking the compliance of the manifest accompanying the waste with the order form of the same waste shipment.
- Contacting the Laboratory to have waste checked and analyzed.

Recording and Weighing

- Recording data on waste vehicles and transporters.

- Determining weight of accepted waste

Directing Waste Movement According to Management Decision

- Based on the Management decision of accepting or rejecting the waste, Gate informs transporters to enter the facility and guide them to Administration and then to Operations, or Gate informs transporters of waste rejection and ensures the departure of the vehicles out of the facility.

3.4 Roles of Laboratory

The activities of the Laboratory entails Waste Analysis, Laboratory Management and Environmental Monitoring of the facility. The roles of the Laboratory under these activities are:

Waste Analysis

- Examining the waste in the vehicles at the Gate, checking waste appearance and packaging.
- Taking waste samples and analyzing it, and recording the analyses results.
- Sending samples for analyses by outside laboratories, when necessary

Laboratory Management

- Management of the laboratory, upkeep of laboratory equipment, purchasing laboratory chemicals, and ensuring the safety conditions within laboratory.

Environmental Monitoring

- Environmental Monitoring through sampling and analysis either on-site, or at outside laboratories.

3.5 Roles of Operations

The activities of the Operations include Landfill and SEP Operations and Vehicles Washing. The roles of the Operations under these two activities are:

Landfill and SEP operations

- Guiding transporters of vehicles carrying bulk waste to tip it in the landfill or in one of the SEP based on the destination identified by Management.
- Unloading packaged waste and tipping it into its assigned disposal location.
- Moving and covering the waste in the landfill using front loaders.
- Removing solid residues from the SEP and tipping them in the landfill.
- Carrying out continuous monitoring for levels of water in the SEP.

- Sending daily report on the status of the SEP to the Management.
- Notifying the Management whenever a new landfill area is used.
- Inspecting and managing drainage water.

Vehicle Washing

- Supervising the cleaning of vehicles prior to leaving the facility.

4. Conclusion

Presented here was a general framework for the operation of hazardous waste treatment and disposal facilities. Within such a framework, individual facilities would develop detailed procedures with the aim of minimizing risks associated with HW handling within the facility. An example for the application of this general framework is presented. It encompasses the first central HW treatment and disposal facility to be established in Egypt, the Nasreya Facility in Alexandria.

5. References

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