

Pre-Feasibility Report

Chapter - 1 Introduction

1.1 Preamble

The proposed project is setting up of an Incinerator in the existing Hazardous Waste Treatment and Disposal Facility of Punjab Waste Management Project (PWMP) at Nimbuan Village, Dera Bassi Tehsil, Mohali District, Punjab State by providing for an Integrated Common Hazardous Waste Treatment Storage Disposal Facility (ICHWTSDF) to the hazardous waste disposal needs of the industries in the State of Punjab.

1.2 Background of the Project

Supreme Court during the year 2003, issued directives to all the states for creating a hazardous waste management facility in a time bound manner, and even appointed a monitoring committee for overseeing the progress. In order to ensure timely compliance of the directive, Punjab Pollution Control Board requested the industry to implement the project, for management of hazardous industrial waste in the state. Nimbua Greenfield (Punjab) Limited was, thus promoted by a group of nine companies to develop and implement the project for creation of a common facility for storage, treatment and disposal of hazardous waste being generated in the state. NPGL appointed IL&Fs for assistance in the project development, and in true spirit of private public participation, a grant of Rs. 12.69 crores for the project was sanctioned under Industrial Infrastructure Upgradation Scheme (IIUS), by the Department of Policy Promotion, Ministry of Industry & Commerce Government of India.

Project site at village Nimbua situated at about 10 Km from Dera Bassi, was finalized by Punjab Pollution Control Board, after carrying out environmental impact assessment studies. Punjab Government fully supported the Project, and in the true spirit of Public/ private sector participation, concerted efforts were made by Principal Secretary & Technology as well as chairman, PPCB for acquisition of 20 acres of land for the project, which was acquired by Punjab Pollution Control Board and was given to the company for the Project on a nominal lease. A high powered technical committee was constituted under the chairmanship of Principal Secretary & Technology, for approving all crucial matters like selection of operators/pre-qualification of TSDF/ finalization of bids etc. Committee included technical experts, and representatives from PPCB, CPCB, Ministry of Environment & Forests, NGPL, as well as Punjab Industry.

M/s Tetra Tech. India Ltd. were appointed consultants for carrying out detailed inventerisation studies, and as per their report, about 1800 industries are generating about 36,000 tonnes of waste per annum. M/s Senes (India) Limited were appointed technical consultants for preliminary design and engineering study.

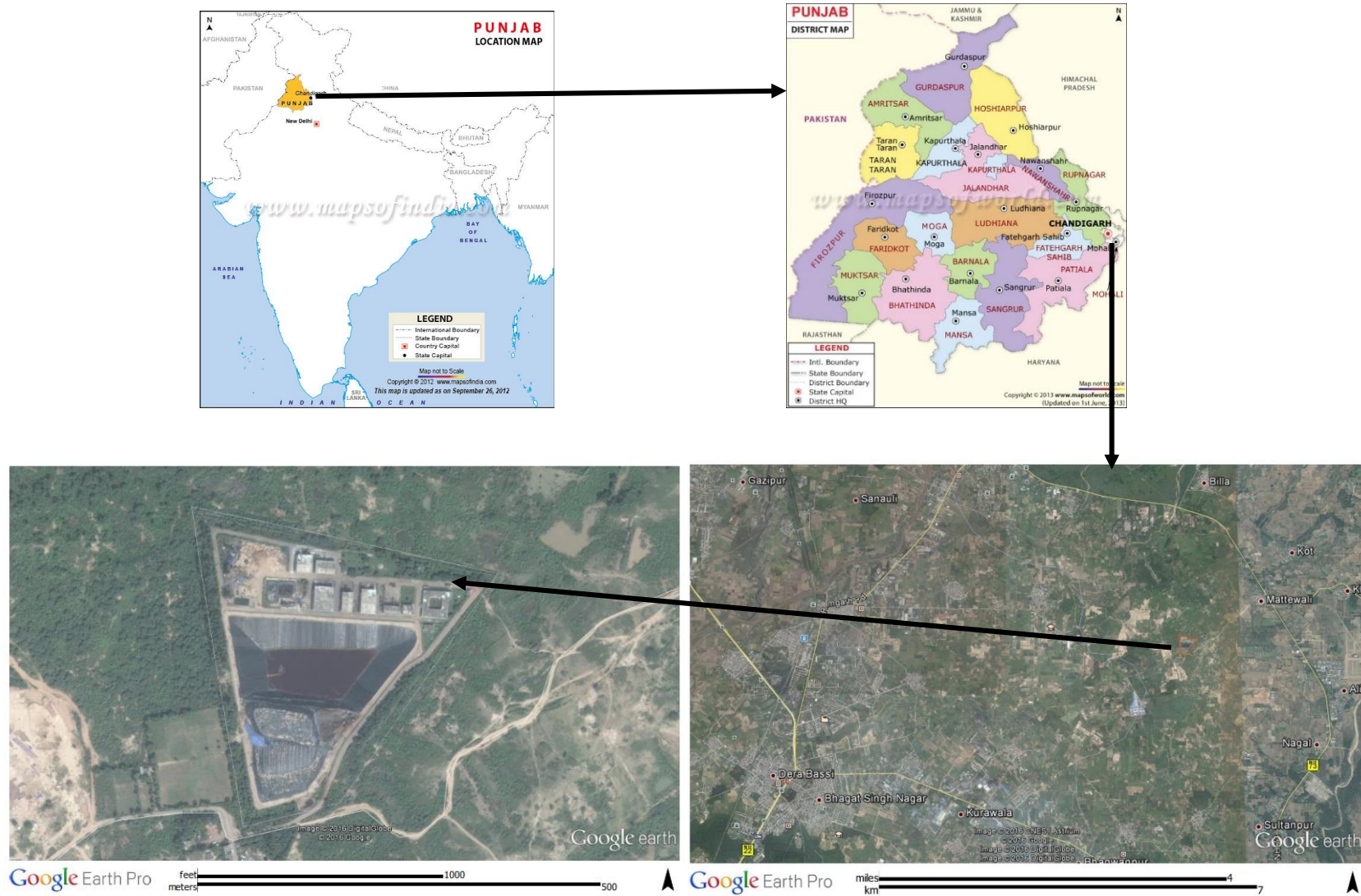
After going through a comprehensive and transparent bidding process, with the assistance of IL&Fs, which involved short listing of bidders in the 1st instance, NGPL awarded the contract for design construction & operation of the facility to M/s Ramky Enviro Engineers Limited Hyderabad, on design build and operate basis. Project was inaugurated on 3rd October 2007 by Honourable Chief Minister of Punjab S. Parkash Singh Badal, in the presence of Sh. Manoranjan Kalia Honourable minister of industries and S. Bikram Singh Majithi, Honourable Minister of Environment, Science & Technology. Operations are continuing on the site ever since, and we have already received about 170409 tonnes of waste for disposal till January, 2016.

1.3. Project Location

Punjab Pollution Control Board (PPCB) provided land to Nimbua Greenfield Punjab Ltd on Lease Basis. The land bearing Sy.No.1/7, 1/13, 1/14, 1/15, 1/16, /17, 1/18, 1/23, 1/24, 1/25, 2/20,2/21, 2/22, 2/23, 10/1, 10/2, 10/3, 10/8, 10/9, 10/10, 11/2, 11/3, 11/4, 11/5, 11/6, 11/7, 11/8 and 11/9 situated in Nimbuan Village, Teh: Dera Bassi, Distt. Mohali (Punjab). This Lease Deed between the Punjab Pollution Control Board as the Lesser and Nimbuan Green Field Punjab Ltd, as the Lessee (Consortium) was entered into in 2005 at Chandigarh.

The proposed site for setting up of incinerator is located within the existing TSDF of PWMP at Nimbuan Village, Dera Bassi Tehsil, Mohali District, Punjab State. The location map of existing TSDF is shown in Figure 1.3.1.

Figure 1.3.1 Location Map of Existing Hazardous Waste TSDF Site in Nimbuani



1.4. Objectives of the Project

The primary objective of this Project is to provide for an Integrated Common Hazardous Waste Treatment Storage Disposal Facility (ICHWTSDF) to the hazardous waste disposal needs of the industries in the State of Punjab. REEL is responsible for design, finance, construction, operation & maintenance of the Integrated Common Hazardous Waste Treatment Storage and Disposal Facility (ICHWTSDF). The system so designed is reliable for present and for the foreseeable future.

Objectives of the Project include

- To ensure that the environmental impacts are minimized.
- To ensure that resource conservation is maximized.
- To ensure techno-economic feasibility of the Project.
- To enable the TSDF to handle the hazardous wastes in a lawful manner.
- To prevent accumulation of the hazardous wastes at the Facility.
- To establish an administrative framework and recommend the necessary infrastructure to ensure proper collection transport, transit storage, treatment and disposal of the hazardous wastes.
- To minimize the health effects associated with hazardous waste handling and management activities.
- To ensure the technical reliability of the adopted technology in terms of safety, flexibility and sustainability under local conditions.
- To prevent or minimize waste generation.
- To ensure compliance with regulatory requirements at every stage of hazardous waste handling and disposal.

1.5. Project Proponent and Present Activities

The Punjab Waste Management Project of the ICHWTSDF has been undertaken the following as part of establishing and operating the Project.

- Transportation of hazardous wastes from the Generators Facility to the ICHWTSDF.
- Inspection of hazardous wastes as per the manifest system as prescribed under Hazardous Waste (Management & Handling) Rules 1989 and amended thereof as well as the authorization issued by the PSPCB to the Generators in respect of class of waste, quantum of

waste, method of treatment and disposal there under at Generators' Facility for preliminary investigations and detailed analysis at TSDF.

- Carrying out segregation, recovery, treatment, storage and disposal of hazardous wastes.
- Collection of charges from the Generators.
- Monitoring on-site including emergency procedures.
- Reporting to regulatory authorities.
- Undertaking closure and post-closure measures and monitoring on exhaustion of the site capacity or at the end of Project whichever is earlier.
- Compliance with existing state and central regulations and amendments made there under.

Chapter - 2

Project Description

2.1 Need of the Incinerator in TSDF

Out of 20,946 MTA of Hazardous waste generated by various Industries in the State of Punjab, 2.5 % of the waste is Incinerable Waste (545 TPA). To dispose the Incinerable waste in a scientific manner, PWMP is proposed to put up an Incinerator of the capacity 1.5 M Kcal/Hr at the existing TSDF at Nimbuan so that the existing TSDF will become an Integrated Common Hazardous Waste Management Facility. The spray drier of the incinerator is also used for the disposal of leachate duly utilizing the waste heat. Also, an Incinerable waste storage shed as per CPCB guidelines will also be established as a necessary infrastructure.

2.2 Site Features of the Existing TSDF

The ICHWTSDF is located at Nimbuan in Punjab State, which is about 10 Km Northwest of Dera Bassi city. The nearest surface water body to the site is river Ghaggar which is flowing around 5 Kms away from the site. The land has been provided on lease by PPCB for 45 years.

The site is located at about 230 m above mean sea level (amsl). The site is well connected by rail and road network. The site can be accessed through Roorkee - Panchkula National Highway (NH-73) or Ambala – Khab (Tibet) National Highway (NH-22).

2.2.1 Transportation of Hazardous Wastes to the TSDF

The hazardous wastes have been transported from generation point to the TSDF, through national highways running in the State. The existing TSDF near Dera Bassi can be accessed through following route:

- NH-73 connecting Roorkee - Panchakula
- NH-22 connecting Ambala – Khab (Tibet)

2.3. Existing Components in TSDF of PWMP

The following are the components exist in TSDF of Punjab Waste Management Project, Nimbuan Village, Dera Bassi Tehsil, Mohali District, Punjab State. The layout of the existing TSDF showing the location of the proposed Incinerator is shown in figure 2.3.1.

Various components of the facility include:

- Security Room
- Weigh Bridge
- Administration cum Lab Building
- Vehicle Maintenance Shed
- Vehicle Parking Area
- Temporary Waste Stores
- Waste Stabilization Unit
- Multi Effect Evaporator (10 KLD) - Leachate Treatment Facility
- D.G & Electrical Panel Room
- Toilet Block
- Under Ground Water Reservoir (4.40m Depth)
- Three Solar Evaporation Pond (Capacity 400 KL)
- Storm Water Pond
- Intractable Waste Stores
- Secured Landfill Area
- Sample Collection Platform
- Water Supply, Electrical network, Roads, Storm Water Drainage, Monitoring Borewells etc.
- Fire Fighting & Occupational Safety Equipments.

2.3.1. Activities Associated with Operation of TSDF

The following general guidelines shall relate to daily activities associated with the operation of TSDF:

- The facility operates during day light hours throughout the year.
- A security system has been maintained to avoid trespassing and hazard to the public.
- The Weigh Bridge at the main entrance records all movements and weights and receive waste tracking receipt as required by the waste manifest system.
- A waste manifest system has been developed in accordance with the requirement of the regulatory agencies to cover the transportation of the waste to TSDF and to provide for record of waste manifestation. The manifest system shall include details of the waste generator, waste transporter, quantity of waste, characteristics of waste, physical description, consistency of waste in terms of physical state and waste category number as per HW (M&H) Rules, 1989 and amendments thereof.

- Once a waste is received at the TSDF, a sample of waste collected, at the sampling bay/temporary storage facility and undergoes laboratory analysis based on which its pathway of treatment/ disposal shall be determined.
- Each load of waste arriving at the facility shall be located properly and logged to identify its pathway of treatment/ storage/ disposal by the well-established laboratory as per the CPCB guidelines, waste analysis protocols and waste acceptance criteria as per Annexures I to III.
- The landfill will be staged in cells so that the minimum practical area of waste is exposed and maximum practical area of waste has the final cap in place i.e., progressive filling and capping of the landfill ensuring minimization of infiltration of wastes.
- Monitoring and auditing of the facility shall be performed on a periodic basis.
- Meteorological data is recorded on a continuous basis round the clock.

2.3.2. Flow path of Wastes at ICHWTSDF

Outline pathway for waste manifestation within the HWTSDf shall be as below:

- Comprehensive analysis of the wastes - Laboratory facilities (Annexure - I)
- Decision of waste pathway of treatment/ storage/ disposal
- Collection and Transportation of wastes.
- Weighing and recording of waste receipt.
- Sample collection (representative)
- Storage at the temporary storage area.
- Analysis (finger printing) (as per Annexure - II)
- Waste disposal advise based on waste acceptance criteria (Annexure - III)
- Waste Treatment/ storage/ recycling /disposal.

In addition to the above existing facilities like waste characterization, transport, storage, treatment and secured landfilling, it is proposed to set up incinerator of the capacity 1.5 M Kcal/Hr, so that the existing facility can be made as an Integrated Common Hazardous Waste Management Facility.

2.4. Proposed Incinerator

The incinerator will be proposed in an area 1.20 Acres within the existing TSDF of PWMP site. Total land area for existing TSDF is 20.74 Acres out of which buildup area is 12.92 Acres including the land allotted for landfill construction. Total vacant land available is 1.20 Acres.

The components are proposed to setup along with incinerator given in Table 2.4.1.

Table 2.4.1. Proposed Components for Incinerator setup

S.No	List of Components	
1.	Rotary Kiln System with	Shell of IS : 2062 Grade “A”
		Riding rings with mountings
		Girth gear with support brackets and bolts
		Kiln drive assembly with VVVF Drive
		Support roller assembly
		Trunion & thrust roller assembly
		Sealing arrangement
		Refractory Material
		Cart dumping system
		Charging Hopper
2.	Inlet head with following material handling arrangement	Ram feeding system
		Refractory for Inlet Head
		Ash Conveyor
		Refractory Material
3.	Discharge Breeching with	CS Shell
		Emergency Vents
4.	Single Drum Pyrolyser with the following	Isolation Damper
		Refractory Material
		Combustion system
		Ducting
		Emergency stack
		Refractory Material
5.	Secondary Combustion Chamber with	CS Vessel
		SS Distributor

6.	Spray Dryer with the following	Disc Atomizer with motor
		Refractory Material
		Effluent Pumping Unit
		Pipe Line Connections
		Cooling Air fan
		Rotary valve
		Shell of SS construction with CS Supports
		Rotary Valve
7.	Multi Cyclones	Lime Silo with discharge bin
		Carbon storage hopper with bag holding mechanism
8.	Reagent System which includes the following	Screw feeder for both Lime & Activated carbon
		Venturi Injection system with Roots blower
		Interconnecting Pipe lines
		CS Housing, hopper and manifold
		Compressed air header and blow-tubes
9.	Bag Filter modules	Rotary air lock
		Filter bags of PTFE membrane on Fiber glass
		Bag cages
		Pulse valve
		Timer and sequence controller
		Inlet butterfly valve, Outlet poppet valves and bypass valve
		Internal coating,
		External insulation.
		Hopper Heaters & Pneumatic

		Vibrators
		CS Packed Bed Chamber
		Pre quench
10.	Wet Scrubber With The Following	Packing materials
		Scrubbing Liquid Circulation System
		Caustic dosing System
		Re-Circulation Tank
		Sampling Ports
		Platform with Ladder
11.	Stack of 40 Mtrs. Height with the following:	Aviation Lamp
		Lightning Arrestor
		Drain Point
		Man Hole
		as per layout with refractory material.
		Kiln energetic liquid / waste oil lance
12.	Interconnecting ducting	Kiln aqueous waste / water spray lance
13.	Combustion System for Rotary kiln with	Kiln auxiliary clean fuel oil burner with supply train
		Burner and lance supply train components
		Fuel supply piping train components
		Energetic liquid / waste oil lance
		Auxiliary clean fuel oil burner with supply train
14.	Combustion System for SCC with	Burner and lance supply train components
		Fuel supply piping train components
		Fuel pump with motor
		Liquid waste pump with motor

15.	Rotary Equipment's includes	Aqueous waste pump with motor
		Evaporator cooler pump
		Scrubber recirculation pumps
		Caustic dosing pumps
		C.A. Fan
		ID Fan
		Local push buttons
		Electrical cables and connectors
16.	Electrical panel as per drive list	Cable trays and supports
		Allen Bradley make
		Power supply with cable
17.	PLC System	PC Interface with PC and Laser Printer
		Analog Input and Output cards
		Fused digital input and output cards
		KT Interface card
		I/O Chassis
		Fuel
		High Energy Liquid Waste
18.	Day Tanks	Aqueous Waste
		Caustic Lye
19.	Instruments as per P& I Diagrams	
20.	Piping within the Battery Limit	
21.	Piping with fittings, valves, hard wares required	

2.4.1 Concept of Incineration

Incineration is an ultimate treatment process, applied to certain wastes that cannot be recycled, reused or safely deposited into a landfill. It is a high temperature, thermal destruction oxidation

process in which hazardous wastes are converted in the presence of oxygen in air into gases and incombustible solid residue. The gases are vented into the atmosphere with cleaning as deemed necessary while the solid residue is sent to landfill for disposal.

The proposed incinerator would cater for the disposal/ destruction of the following wastes:

- Spent Solvents
- Waste Oils, Oil Emulsions and Oil mixtures
- Pesticide Wastes
- Refinery Wastes
- Pharmaceutical Wastes
- Phenolic Wastes
- Grease and Wax Wastes
- Organic wastes containing halogens, sulphur, phosphorous or nitrogen compounds
- Solid materials contaminated with oils.
- Organics with high calorific value

The Incineration system is designed to handle the following wastes from various Industries:-

- Solids, semi-solid and tarry drummed wastes as made available in packets of definite size and weight
- Pumpable energetic liquid organic wastes free from suspended solids
- Pumpable aqueous wastes with limits as to T.D.S. & free from suspended solids

Advantages of Incineration

The following advantages of incineration of hazardous wastes

- Ability to handle heterogeneous waste
- High efficiency due to
 - Vigorous mixing in the bed
 - High retention time
- Low NO_x formation due to
 - Lower operating temperature &
 - Low excess air
- In bed neutralization possible for removing acid gasses
- Quick restart due to heat stored in the bed
- Absence of moving parts hence low maintenance

- Flexibility to handle diverse fuels
- Residence time can be adjusted by varying kiln speed
- Waste feeding without much preparation
- Waste heat recovery is possible
- Gas cooling systems can be fixed
- Well Scrubbing systems can be added
- Temperature control for constant efficiently
- Air control for adequate excess air
- Interlocks for safe operational shut down

2.4.2 Incineration System Design

An incinerator consists of a burner which ignites the supplied fuel and combustibles in the waste feed in a combustion chamber. Thermal destructions of most organic compounds occur at a temperature between 850 °C to 1100 °C. To achieve thermal destruction, residence time usually ranges from 30 to 90 minutes for solid waste and 0.5 to 2.0 seconds for liquid waste. Turbulent mixing is important because the waste and fuel must contact the combustion gases if complete combustion is to occur. Sufficient oxygen must be present and is supplied as ambient air or as pure oxygen through an injection system.

A typical incineration system consists of several distinct units. The first unit is the kiln or primary combustion chamber, in to which waste is fed and in which initial volatilization and destruction of contaminants take place. Gases formed during incineration in the kiln include un combustible organics or combustion by-products, which are generally referred as Products of Incomplete Combustion (PIC). These PICs' are drawn to a secondary combustion chamber to inverse the efficiency of destruction of PIC's. Residual bottom ash produced typically exist the kiln through a gravity drop and then cooled before disposal in to landfill.

The off-gases from secondary chamber is routed through an air pollution control system in which gases are cooled and removes particulate matter and final flue gases are emitted through a stack.

The installed capacity details of incinerator are given in Table 2.4.2.

Table 2.4.2. Technical Details of Incinerator setup

S.No.	Details	
1	Incinerator capacity	1.5 Million Kcal/Hr
2	Quantity of Hazardous Waste	500 kg/Hr
3	Calorific Value	3000 - 5500 Kcal/kg
4	Water Requirement	5 KLD
5	Fuel Requirement	HSD: 30Litres/ Hour, Furnace Oil: 90 Litres/ Hour

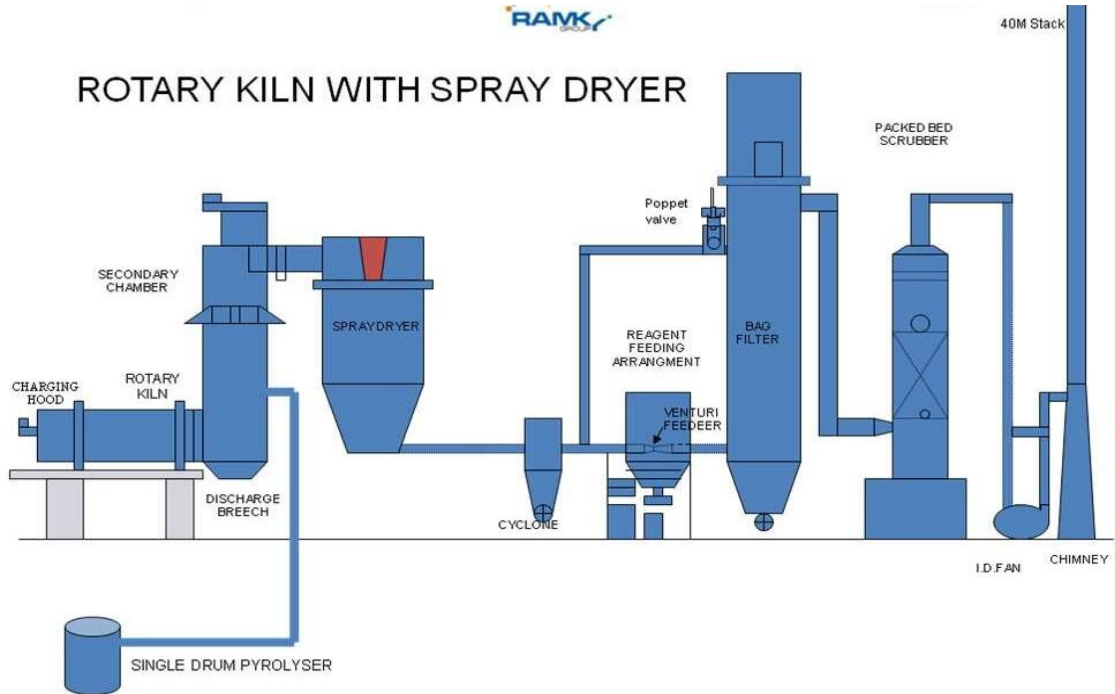
The Rotary Kiln is designed for ashing mode operation only.

- Incineration Feed Rate: Due to non-homogeneous nature of the waste, characteristics including the required Calorific Value and the feed rate through the kiln and system heat of combustion, moisture and ash content, bulk density will vary. All these factors will affect I influence the feed rate and auxiliary fuel requirement.
- The possibility of variations in liquid wastes feed rate to be incinerated due to its Calorific Values. Required heating value liquids are to be fed at Rotary Kiln and that of high to be in Secondary Combustion Chamber (SCC). The net LCV of the liquid waste should be such as to help sustain flame at the lances.

The incinerable wastes shall be pre-processed in case of necessary for making it uniform calorific value and maintain the norms of halogen concentrations less than 1% and all. Wastes are fed through cart dumper and ram feeder into the rotary kiln and the hot gases are sent to the secondary combustion chamber. Temperature at SCC will be min. 1100⁰C for wastes with a gas residence time of 2 seconds. The residence time and the desired temperatures are maintained at both primary and secondary combustion chambers for complete combustion as per CPCB guidelines for hazardous waste incineration. The gases after complete combustion shall be sent to spray drier I evaporative cooler for cooling followed by Gas cleaning equipment. The Schematic Diagram of Incineration process is shown in **Figure 2.4.1**.

The gases are passed through multi cyclones for removal of particulates. Then dry lime and activated carbon are injected for neutralization of acidic gases and removal of organic constituents if any. The flue gases then passed through bag filters for complete removal particulates and then through wet alkaline scrubber for neutralization. The flue gases after completely cleaned in all respects shall be sent out through a 30 m stack. Emission Standards for common hazardous waste incinerator is presented in **Annexure - IV**.

Figure 2.4.1. Schematic Diagram of Incineration Process



2.4.3. Storage of Incinerable Hazardous Waste

An Incinerable waste storage shed with adequate capacity as per CPCB guidelines will also be established as a necessary infrastructure. The design of storage shed will be considered as per following requirements.

- Minimum of 15m distance between storage shed
- Fire break of at least 4m between two blocks of stacked drums
- Maximum of 300 T incinerable waste storage limit in a block of drums
- At least 1m clear space between two adjacent rows of drums in a pair for routine inspection purposes
- Spillage or leakage control measures to be adopted in the event of any leakage or spillages
- Record keeping and maintenance of shed
- Fire detection, protection and safety measures as well as performing safety audits every year by the operator of a facility and externally once in two years by a reputed expert agency.

- Storage area shall be designed in such a way that the floor level is at least 150m above the maximum flood level.
- Signboards showing precautionary measures to be taken, in case of normal and emergency situations shall be displayed at appropriate locations.

2.4.4 Laboratory Facilities

The existing laboratory facility will be used for tests to be conducted at incineration facility with an objective to study the following

Storage and Feeding requirements: physical form of waste, pH, hazardous waste properties such as inflammability, reactivity, compatibility with other wastes etc. for segregating the waste and to store accordingly, in order to suit feeding mechanism.

Operating conditions of the furnaces: viscosity, moisture content, total organic carbon, calorific value, volatility of the waste, special incompatible wastes, inorganic salts, metals etc.

Air pollution control devices: chlorides & other halogens, sulphur, nitrates, mercury & other heavy metals etc. The laboratory of the TSDF facility shall be capable of monitoring all the parameters prior to disposal.

2.4.5 Waste Feeding

Waste-feeding plays an important role to achieve desired combustion efficiencies. Continuous feeding of homogeneous waste having same/similar calorific value to the combustion chambers is the desired option. However, often maintaining homogeneous feed of waste is not feasible due to incompatibility of different wastes for mixing. Conventionally, hazardous wastes in solid form are fed through a hydraulic system, which will have automatic two gates i.e. once the outside plate is closed, inner side plate is opened and solid waste mass is hydraulically pushed inside the Kiln and once the inner side plate is closed, outer plate is opened for next batch of solid waste. This system, besides negative pressure in the combustion chambers is required to ensure safety and to prevent workmen exposure to thermal radiation.

2.4.6 Combustion Chambers

Incineration plant shall be designed, equipped, built and operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogenous fashion.

Incineration plant will be equipped with one auxiliary burner which would be switched on automatically with the temperature of the combustion gases after the last injection of combustion

air falls below specified temperature. It will also be used during plant startup and shut-down operations in order to maintain the minimum specified temperature at all times during operations and as long as unburnt waste is in the combustion chamber.

The burners will be pressure-atomized type with approved certification from the Bureau of Indian Standards or equivalent.

Kiln and secondary combustion chamber of the incinerator will be made of mild steel conforming to IS: 2062 and of suitable thickness lined with high-grade refractory and insulation, so as not to buckle in or bulge out.

Combustion chambers (Kiln & secondary combustion chamber) will be designed to supply with excessive air to ensure complete burning of wastes. The blower will be provided with appropriate capability to supply of combustion air. Incinerator facility will have a window fitted with safety view glass to view the kiln (axially) and flame in secondary combustion chambers.

As the common incineration systems will be handling wastes having varying heat value, and while ensuring Total Organic Carbon (TOC) and Loss On Ignition (LOI) requirements in the ash/slag, there are possibilities for sudden rise of temperatures in the kiln. Therefore, the facilities will be designed with thermal refractory bricks and insulation capable of withstanding a minimum temperature of 1,300°C (typically, corundum / chromium bricks). Interlocking arrangements for CO and temperature controls (in primary and secondary chamber) with feeding devices will also be provided.

All the burners will be equipped with automatic flame control system. Exit doors will be provided at suitable place, one each on the primary kiln and the secondary chamber of the incinerator for ease in inspection and maintenance.

2.4.6.1 Rotary Kiln

To maintain designed heat capacity of the kiln, quantity of the solid waste injection package (kg/single injection) will be adjusted w.r.t. calorific value of the waste feed. When a high calorific value possessing solid waste is injected in packets, the size of each injection will be reduced, such that the peak CO concentration in the Kiln does not exceed too high in the initial stage, creating shooting of emissions to the secondary chamber, thereby crisis in ensuring the required retention time.

Appropriate slope (in general, 3 degrees), rotation rates (around 10/hr) and solid waste residence time (1-10 hr) will be adjusted for the kilns, in order to achieve total organic carbon (TOC) and loss on ignition (LOI) requirements in the ash/slag.

Feed silica and glass in appropriate ratios to the kilns to form a cover over the refractory lining, as and when the thickness of the layer reduces. This will improve the life of refractory and insulation bricks.

In the rotary kiln, the temperature will be maintained at 800+°C in order to complete burning of solid waste. Controlled flow of air will be maintained for complete volatilization of solid waste.

2.4.6.2 Secondary Combustion Chamber

Minimum temperature requirement in the secondary combustion chamber is 1100 °C. The design and operating conditions will be a minimum of 2 seconds residence time in the secondary combustion chambers, under critical feed conditions, so as to bring complete combustion of volatile matter evolved from the primary combustion chamber.

2.4.7 Pollution Control Devices

There are many combinations of treatment units installed for gas cleaning and removal of air pollutants, to comply with the standards. Designed treatment scheme will comprise of following equipment, in combination, with adequate efficiencies to meet the emission standards:

Dioxins: Keeping De-novo synthesis in the backdrop, steps must be taken to prevent reformation of dioxins by rapidly lowering the flue gas temperatures, particularly from 500 °C to less than 200 °C by adopting rapid quench / catalyst / adsorption by activated carbon etc.

Particulate matter: Fine particulates in the flue gases require specific dust separation technologies such as bag filters, electro static precipitator etc. in order to meet flue gas standard. In case of electro static precipitators, special care is required to avoid electric sparks due to the dust to avoid reformation of dioxins and adsorption to the fine dust.

Mercury: If the feeding waste contains mercury and its compounds, there is an every chance of these emissions to get air borne. Therefore, requires specific treatment for control of these

emissions. (Ex. activated carbon, conversion into mercuric chloride and then to mercuric sulphide etc.)

SO₂: Sulphur in the feeding waste upon thermal oxidation forms sulphur dioxide, which requires control measures to meet the standard. Conventional method followed is scrubbing by alkali (alkali dry / wet scrubber with hydrated lime or sodium hydroxide injection).

HCl & HF: In order to control halogen emissions to the desired level, in particular chlorides and fluorides, conventionally water/alkali scrubbers are in use.

Mist: Often there is a need to eliminate the mist in the stack emissions, therefore, where necessary de- mister may be provided.

Stack height:

A Stack height shall not be less than 30 meters, in any case. A Stack height requirement based on sulphur dioxide emissions by using the equation - stack height = $14 (Q)^{0.3}$

[Where, Q is the emission rate of SO₂ in kg/hr] By using simple Gaussian plume model to maintain ambient air quality requirements for all concerned parameters, in the receiving environment.

Annexure – I

**COMPREHENSIVE ANALYSIS REQUIREMENTS FOR
HAZARDOUS WASTES - GENERATOR /TSDF OPERATOR**

Method of Analysis	Comprehensive Analysis to be submitted by the Generators of Hazardous Wastes	
Physical Analysis	Physical State of the waste (liquid I slurry I sludge I Semi-solid I solid: inorganic, organic, metallic)	
	Description of different phases of the wastes (in cases of solid wastes slurries and sludge) contained in aqueous I non-aqueous liquids I solutions	
	Colour and Texture	
	Whether the waste is multi-layered (Yes/No)? If yes, quantify each layer	
	Specific Gravity	
	Viscosity	
	Calorific Value	
USEPA, SW-846; Method 1010 and 1020	Flash Point	
	% Moisture content loss on ignition at 105°C	
	% Organic content loss on ignition at 550 °C	
USEPA, SW-846; Method 9095	Paint Filter Liquid Test (PFLT)	
Chemical Analysis		
USEPA, SW-846; Methods 9040, 9041 and 9045	pH	
Inorganic Parameters Analysis		
USEPA; SW-846; Vol. 1C Part II; Test Method to determine HCN released from Wastes	Reactive Cyanide (ppm)	
USEPA; SW-846; Vol. 1C Part II; Test Method to determine H ₂ S released from wastes	Reactive Sulfide (ppm)	
USEPA; SW-846; 9010, 9011, 9012	Sulphur (elemental)	
USEPA; SW-846; Vol. 1A, 1B, 1C and Vol. 2	Concentration of In-organics [as per Schedule 2 of HW (M&H) Rules, 1989, as amended].	
Organic Parameters Analysis	Oil & Grease	
	Extractable Organic (in special cases only)	
	% Carbon	
	% Nitrogen	
	% Sulphur	
USEPA; SW-846; Vol. 1A, 1B, 1C and Vol. 2	% Hydrogen	
	Concentration of individual organics [as per Schedule 2 of HW (M&H) Rules, 1989, as amended]	
	USEPA; SW-846; Method 1311, 1330	Toxicity Characteristics Leaching Procedure (For the parameters identified in Section 2, Annexure -III and the listed parameters as presented in Method 1311 of SW 846; USEPA)

Annexure II

FINGERPRINT ANALYSIS REQUIREMENTS FOR HAZARDOUS WASTES - TSD FACILITIES

Method of Analysis	Fingerprint Analysis by the Operators of TSD Facilities
Physical Analysis	Physical State of the waste (liquid/slurry/sludge/semi-solid/solid: inorganic/organic/metallic)
	Identification of different phases of the wastes (in cases of solid wastes contained in aqueous/non-aqueous liquids/solutions for slurries and sludge)
	Colour & Textures
	Whether the waste is multi-layered (yes/no)? if yes, quantify each layer
	Specific Gravity
	Viscosity
USEPA, SW-846; Method 1010 and 1020	Flash Point
	Loss on ignition at 105° C
	Loss on ignition at 650° C
USEPA, SW-846; Method 9095	Paint Filter Liquid Test (PFLT)
USEPA, SW-846; Method 9096	Liquid Release Test (LRT)
Chemical Analysis	
USEPA, SW-846; Method 9040, 9041 and 9045	pH
USEPA, SW-846; Vol. 1C Part 11; Test Method to determine HCN released from Wastes	Reactive Cyanide (ppm)
USEPA, SW-846; Vol. 1C Part 11; Test Method to determine H ₂ S released from Wastes	Reactive Sulfide (ppm)

Annexure III

CONCENTRATION LIMITS/CRITERIA FOR ACCEPTANCE OF HAZARDOUS WASTES FOR DIRECT DISPOSAL TO SECURED LANDFILL

Leachate Quality *	Concentration
pH	4 – 12
Total Phenols	< 100 mg/l
Arsenic	< 1 mg/l
Lead	< 2 mg/l
Cadmium	< 0.2 mg/l
Chromium-VI	< 0.5 mg/l
Copper	< 10 mg/l
Nickel	< 3 mg/l
Mercury	< 0.1 mg/l
Zinc	< 10 mg/l
Fluoride	< 50 mg/l
Ammonia	< 1,000 mg/l
Cyanide	< 2 mg/l
Nitrate	< 30 mg/l
Adsorbable organic bound Chlorine	< 3 mg/l
Water soluble compounds except salts	< 10%
Calorific value	< 2500 K.Cal/kg
Strength	
Transversal strength (Vane Testing)	> 25 KN/m ²
Unconfined Compression Test	>50 KN/m ²
Axial Deformation	< 20 %
Degree of Mineralization or Content of Organic Materials (Original Sample)	
Annealing loss of the dry residue at 550°C	< 20% by weight (for non-biodegradable waste) < 5% by weight (for biodegradable waste)
Extractible Lipophilic contents (Oil & Grease)	< 4% by weight

Leachate quality is based on water leachate test

S.No	Parameter	Standards (mg/l)			
		Inland Surface	STP	CETP (See note)	Marine Coastal Areas
Additional Parameters Recommended					
1.	Adsorbable Organic Halogens (AOX)	0.50	-	-	0.50
2.	Poly Aromatic Hydrocarbons (PAH) (each)	0.059	-	-	0.059
3.	Benzene	0.14	-	-	0.14
4.	Toluene	0.08	-	-	0.08
5.	Xylene (sum of o, m, p-xylene)	0.32	-	-	0.32

Note:

1. In addition to the above, General Standards for discharge of environment pollutants Part-A: Effluents notified, vide G.S. R. 422 (E), dated 19.5.1993 and published in the Gazette No. 174, dated 19.5.1993 under the Environment (Protection) Act, 1986, and rules made thereunder, shall also be applicable for disposal of leachate into sewage treatment plant, common effluent treatment plant, Inland surface water bodies or coastal areas.
2. For each CETP and its constituent units, the SPCB/PCC shall prescribe standards as per the local needs and conditions; these can be more stringent than those prescribed above. However, in case of clusters of units, the SPCB/PCC may prescribe suitable limits.
3. Leachates having high COD shall be concentrated through evaporation (forced) and fed to the incinerator of the integrated TSDF in view of its high calorific value, and the residue ash shall be disposed off in their secured landfill.
4. The Bioassay test shall be substituted by 'Fish Toxicity' test, and a dilution factor of 2 (two) may be considered.

Annexure IV

**EMISSION STANDARDS FOR COMMON HAZARDOUS WASTES
INCINERATOR**

A. Flue Gas Emission Standards

Parameter	Emission standard	
Particulates	50 mg/Nm ³	Particulates
HCl	50 mg/Nm ³	HCl
SO ₂	200 mg/Nm ³	SO ₂
CO	100 mg/Nm ³	CO
	50 mg/Nm ³	
Total Organic Carbon	20 mg/Nm ³	Total Organic Carbon
HF	4 mg/Nm ³	HF
NO _x (NO and NO ₂ expressed as NO ₂)	400 mg/Nm ³	NO _x (NO and NO ₂ expressed as NO ₂)
Total dioxins and furans	0.1 ng TEQ/Nm ³	Total dioxins and furans
Cd + Th + their compounds	0.05 mg/Nm ³	Cd + Th + their compounds
Hg and its compounds	0.05 mg/Nm ³	Hg and its compounds
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	0.05 mg/Nm ³	Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds
Parameter	Emission standard	Parameter
Particulates	50 mg/Nm ³	Particulates
HCl	50 mg/Nm ³	HCl
SO ₂	200 mg/Nm ³	SO ₂
CO	100 mg/Nm ³	CO
	50 mg/Nm ³	
Total Organic Carbon	20 mg/Nm ³	Total Organic Carbon