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MONTGOMERY COUNTY RESOURCE RECOVERY FACILITY

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ABSTRACT

The Montgomery County Resource Recovery Facility is currently under construction with commercial operation scheduled to commence in late 1995 or early 1996. The facility will fire municipal solid waste in three 600 TPD mass-burn stoker/boilers with resultant power generation exported to Potomac Electric Power Co (PEPCO). The plant includes a state of the art air quality control system including semi-dry scrubber, baghouse, SNCR for NO_X control and activated carbon injection for mercury control. Extensive water treatment systems treat intake water discharged from PEPCO's existing once through cooling system and control quality of the plant discharge. A railroad refuse transportation system delivers containerized refuse to the facility from a transfer station in the center of the county. This paper reviews the overall development and design of the facility with emphasis on these systems.

INTRODUCTION

The Montgomery County, Maryland project consists of a transfer station in Derwood, the resource recovery (waste to energy) facility in Dickerson and railyards at both sites. This paper starts with a review of its history followed by a detailed discussion of the transportation system and final sections describing the mass-burn facility with emphasis on its air and water quality control systems.

HISTORY

In February, 1989 the Northeast Maryland Waste Disposal Authority (NMWDA), issued a request for proposals (RFP) for a mass-burn resource recovery facility. The RFP was one step in a process that had begun with several years of study by the County of every conceivable option available for managing the over 800,000 tons of solid waste generated by households and businesses within the County each year. By 1989, as a result of those years of study, County officials had decided on an integrated program including public education aimed at waste reduction, an aggressive recycling program, processing of non-recycled waste at an in-County resource recovery facility and landfilling of residue and non-processible waste. Implementation of this plan would require, in addition to many operational changes in the County's waste management system, construction of three major new waste management facilities. These facilities included an automated Material Recovery Facility (MRF) for separation of co-mingled recyclables collected separately from non-recyclable waste, a new landfill for disposal of non-recyclable, non-processible material and process residue and the 1800 ton per day Resource Recovery Facility (RRF) discussed herein.

Prior to settling on an in-County waste-to-energy facility as the primary disposal method for its non-recycled waste, County officials investigated other potential options. Included among these alternatives were long distance transportation to out-of-County landfills and to out-of-County waste-to-energy facilities or some combination of the two. The possibility of siting a new in-County landfill to handle waste without first processing it at a waste-to-energy facility was also considered. Ultimately the County opted for the combination of control and flexibility afforded by the integrated program previously described.

In formulating its criteria for the RRF the County had considered refuse derived fuel (RDF) technology as a possible option. In 1985 a test burn of RDF was conducted at a Potomac Electric Power Company (PEPCO) generating facility. Ultimately, PEPCO officials were unwilling to commit to a permanent RDF combustion program due to fears of long-term operational problems and a belief that the firing of RDF in their existing boilers was not economically or technically feasible. Based on the recommendations of various studies commissioned by the County and as a result of first hand information gained during inspections of several European waste processing facilities, RDF technology was ruled out and a decision was made to specify mass-burn technology for the County's waste-to-energy facility.

The site selected by the County for construction of its new waste to energy facility is located in the northwest region of the County adjacent to PEPCO's Dickerson electrical generating station. It is approximately eighteen miles from the County's already existing waste transfer station which is more centrally located relative to the County's population and waste generation sources (Figure 1). In order to prevent additional traffic congestion and air pollution from increased truck traffic, a decision was made by the county to transport waste by rail from the transfer station to the RRF for processing. The rail transportation system will utilize an existing main line track owned and operated by CSX Transportation, Inc. New rail sidings connecting with the main line will be constructed by Ogden Martin at the County's existing solid waste transfer station and at the RRF. The County waste transportation system will also utilize track owned by PEPCO near the RRF on a shared basis.

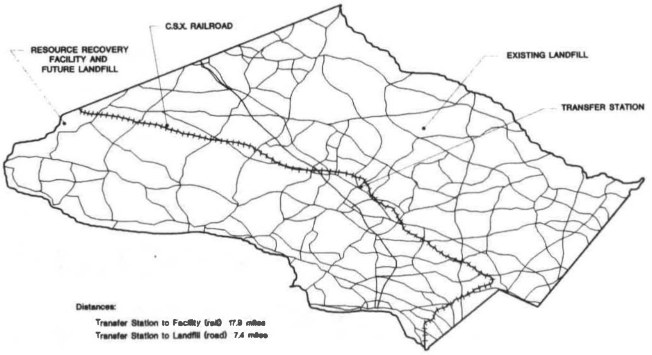


FIG. 1 EXISTING RAIL LINE CONNECTING TRANSFER STATION WITH FACILITY

TRANSPORTATION SYSTEM

General

The transportation system consists of a rail and truck transport system to interconnect the Resource Recovery Facility (RRF), the Transfer Station and the County's landfill near Laytonville. The system is designed to handle 1800 TPD of refuse which will be delivered to the RRF from the Transfer Station by rail in closed intermodal containers. Initially, combustion residue from the RRF will be returned to the Transfer Station in the same manner, from where the containers will be transported by truck to the County's existing landfill. After a new landfill adjacent to the Facility is built, the residue will be shuttled by truck directly from the RRF.

A single unit-train operated daily on the main railroad line between the Transfer Station and the RRF will be used to accommodate the entire tonnage. A CSX crew will operate the unit-train including the switching functions at both the Transfer Station and RRF.

The following components are included in the Transportation System:

- Intermodal closed containers for transporting refuse and residue.
- Unit-train stand-alone railcars to transport containers between the Transfer Station and the RRF.
- Compactors at the Transfer Station to produce refuse logs for transport in closed containers.
- Container handling gantry cranes at both the Transfer Station rail siding and the RRF rail siding to load and unload containers.
- At the Transfer Station, tractors and chassis to shuttle the refuse containers between the Transfer Station and the rail siding and residue containers between the rail siding and the landfill.
- At the RRF, tractors and chassis to shuttle refuse containers between the rail siding and the tipping floor, and empty containers from the tipping floor back to the rail siding for those containers that are used for refuse only. The containers being used both for refuse and residue will be transported from the tipping floor to the residue building to be loaded with residue and then shuttled back to the rail siding.

Railyards

A railyard will be provided at both sites designed to accommodate the unit-train, consisting of runaround tracks as well as tracks for maintenance of the cars (see site plans in Figures 2 and 3). The use of the gantry cranes for truck and train unloading is shown in the railyard cross section of Figure 4.

The site constraints at the RRF and Transfer Station prohibit the use of double-ended railyards as well as the effective use of a ladder track system employing a runaround track. Therefore, at both sites a runaround track will be provided outside of the railyard to allow the CSX locomotive to locate itself at the opposite end of the train for the return trip.

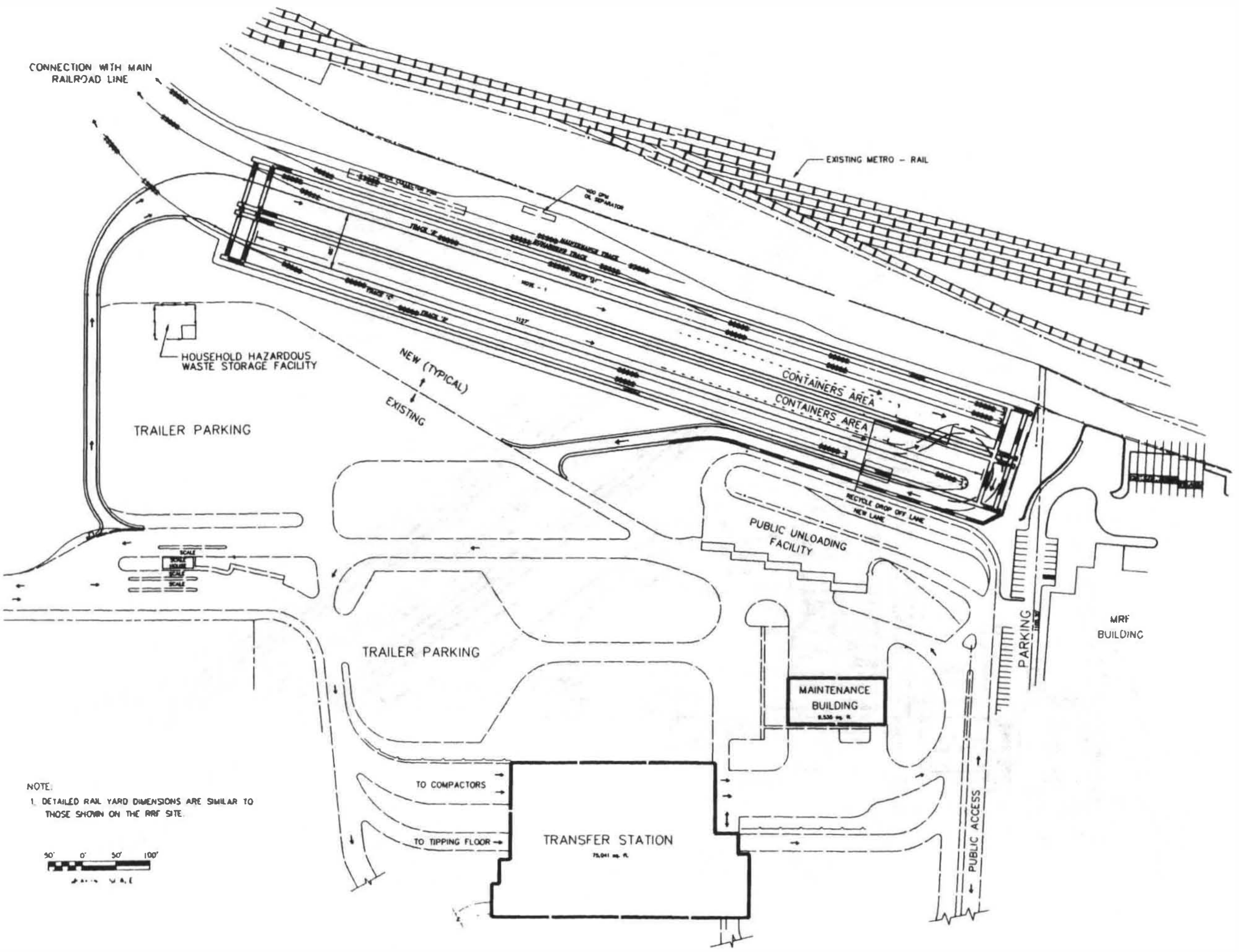


FIG. 2 TRANSFER STATION LAYOUT AND SITE PLAN

Transfer Station and Modifications

The existing Transfer Station is designed for top loading of trailers having walking floors. In order to maximize the payload weights for rail transport of the solid waste and to allow the use of sealable containers, three pre-load compactors will be installed at the Transfer Station. The compacted solid waste will be end-loaded into the intermodal closed containers and shuttled to the railyard. Bulky waste will be top loaded into open top intermodal containers and transported in the same manner without compaction.

The floor plan of the transfer station and the compactor arrangement are shown in Figure 5. The transfer station currently loads refuse into open top containers through openings in the tipping floor above. The openings will be modified to match chutework directly feeding compacter hoppers.

Transportation Equipment

Following is a brief description of the major items of equipment used in the transportation system (see Table 1).

- *Containers.* Standard size intermodal closed containers, 40 feet long by 8′-0″ wide by 8′-6″ high (12.2 × 2.4 × 2.6 m) will be used. A portion of these containers will be designed to allow for top loading of residue and bulky waste.
- *Compactors.* Conventional pre-load compactors will be used. Hydraulic rams will form logs to fit into the standard size intermodal containers. The log will be formed within the compactor and then pushed into one end of an intermodal container. The compactors will have weigh cells for determining the weight and a programmable

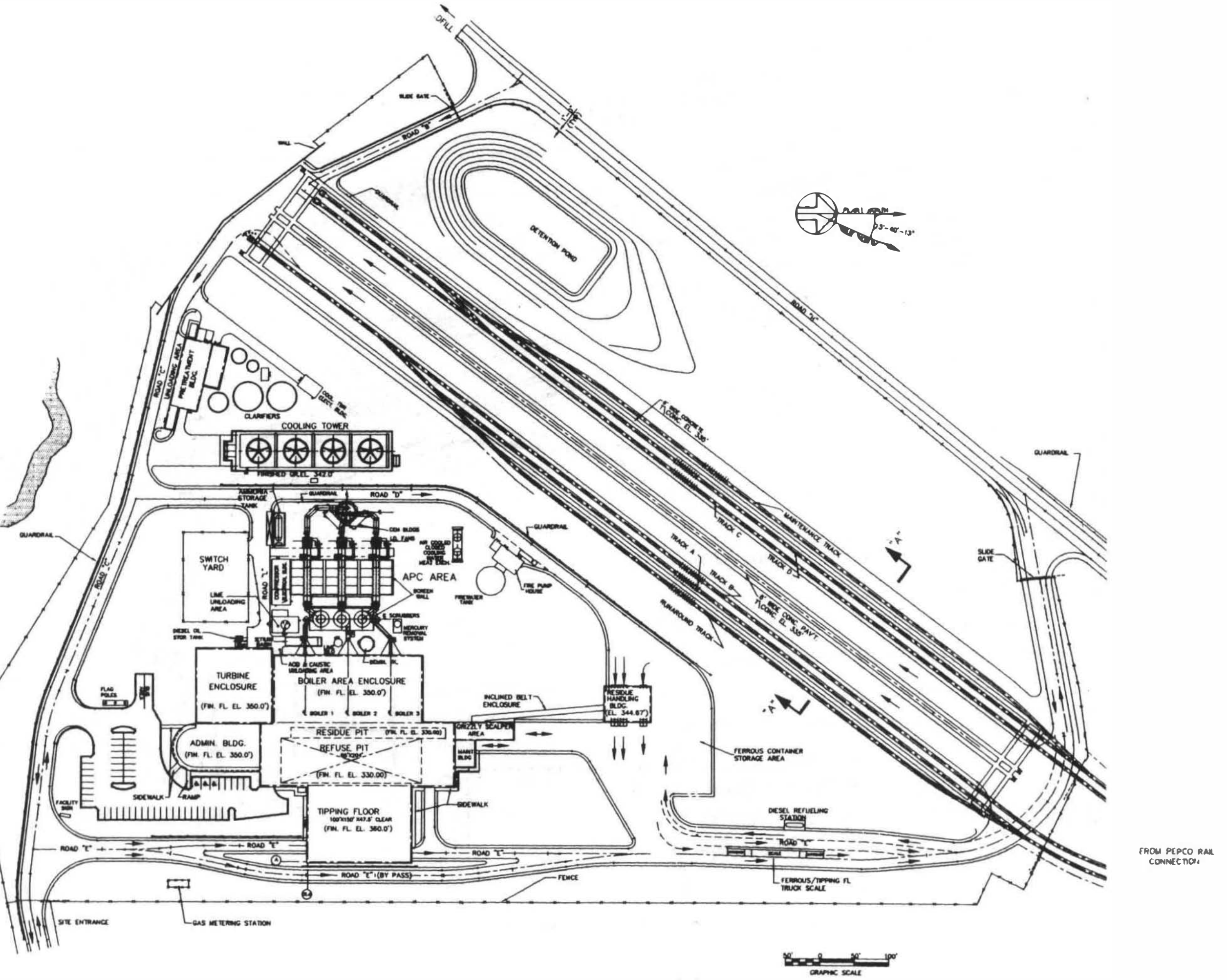


FIG. 3 FACILITY TRACK LAYOUT AND SITE PLAN

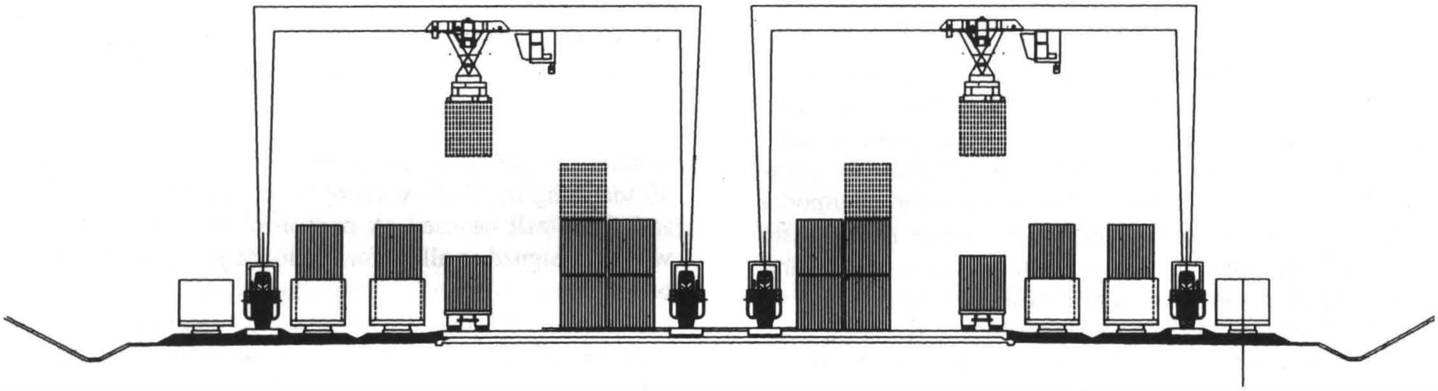


FIG. 4 RAILYARD CROSS SECTION
(Section A-A from Fig. 3)

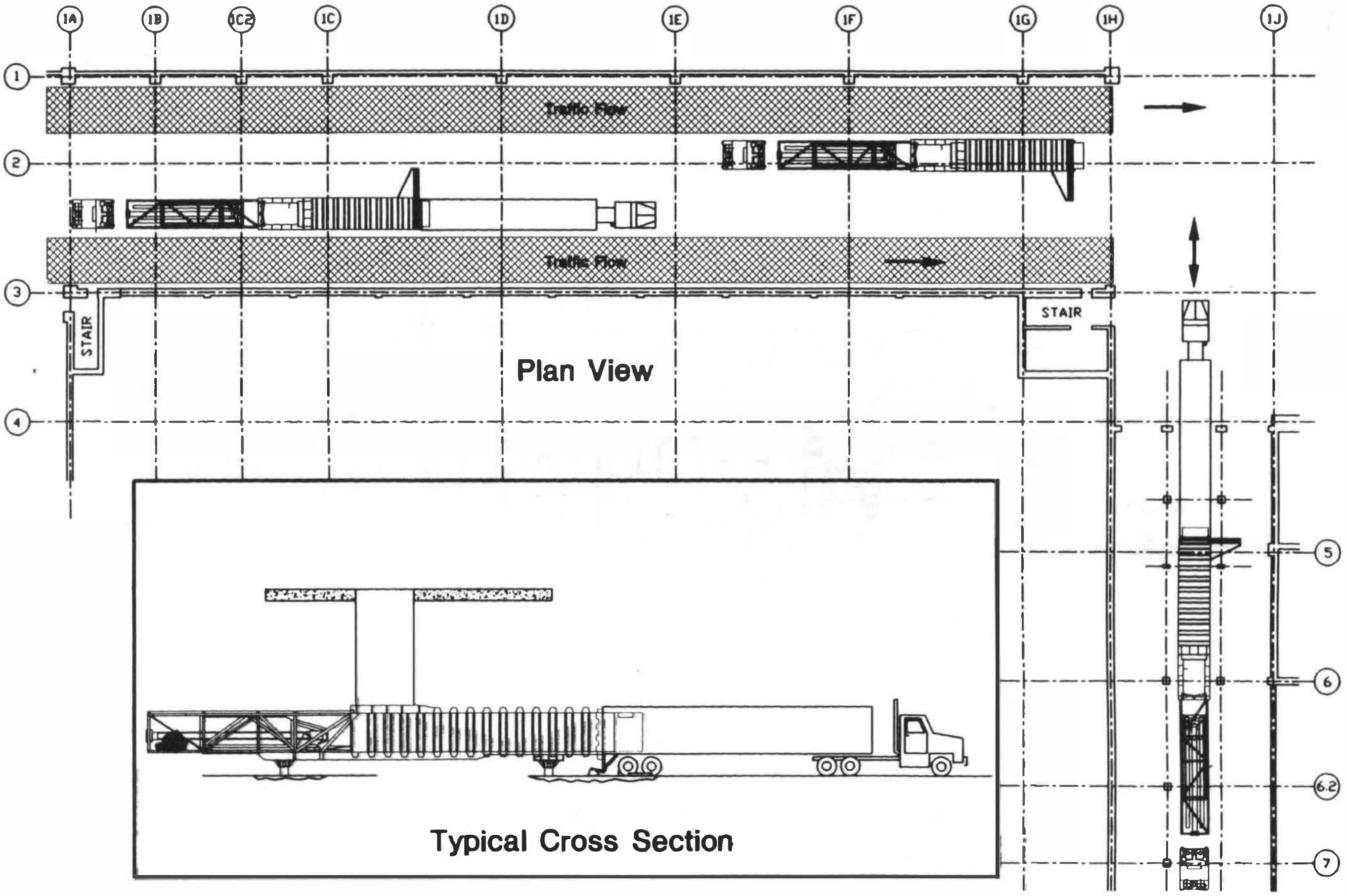


FIG. 5 TRANSFER STATION—FLOOR PLAN

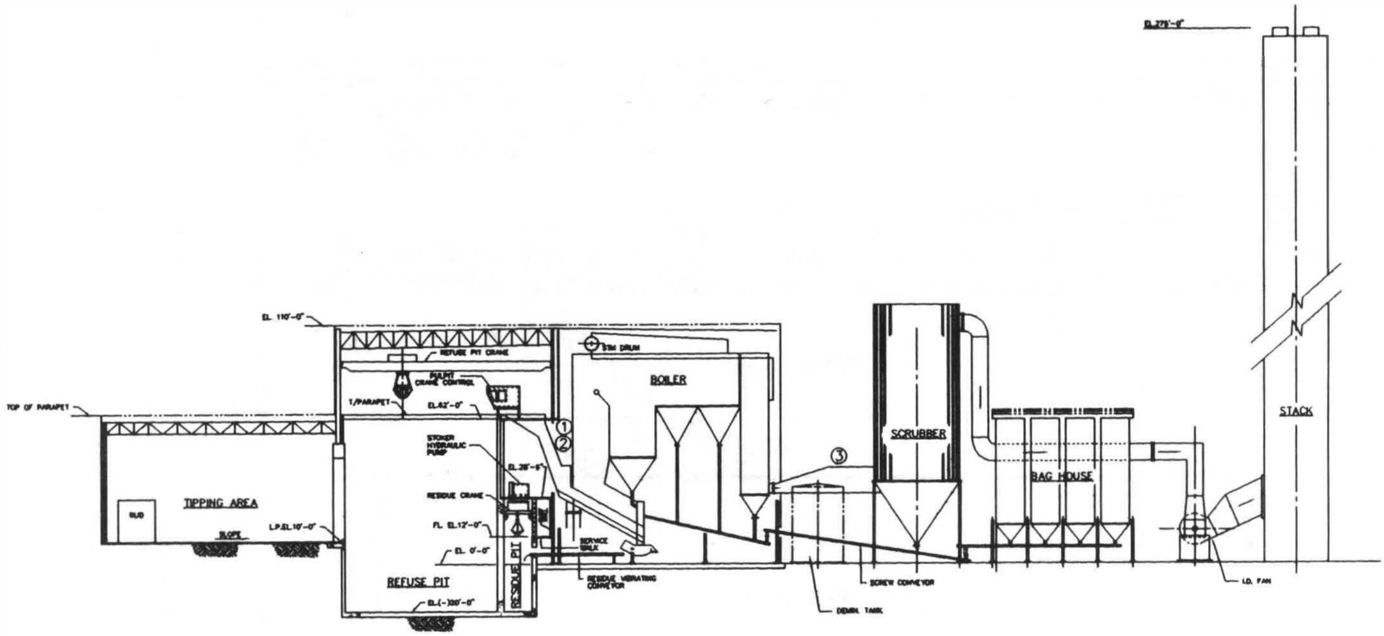
TABLE 1 TRANSPORTATION SYSTEM AND TRANSFER STATION EQUIPMENT LIST

DESCRIPTION	TOTAL QUANTITY	LOCATION
Containers - (40') (Closed Top)	168	TS & F
(40') (Open Top)	20	
Carriers - (Stand-alone Railcars)	48	TS & F
Compactors - (Pre-load)	3	TS
Cranes - (Gantry)	2	TS
	2	F
Tractors and Chassis -		
(Road) (For Residue Containers)	5	TS
(Yard) (For Refuse)	4	TS
(Yard) (For Refuse)	5	F

TS: Transfer Station
F : Facility

controller unit for control and monitoring the compactor operations.

- *Railcars.* Stand-alone intermodal 70-ton (63,600 kg) railcars will be used. The cars will be fitted with bulkheads to hold the containers in place rather than the conventional manually placed inter-box connectors.
- *Cranes.* Conventional rubber-tired container handling gantry cranes (as used in dockside operations) will be used to handle the containers for loading and unloading the train as well as for storing the containers at the railyards (see Figure 4).
- *Tractors and Chassis.* Conventional tractors and chassis will be used to shuttle the containers both at the Transfer Station and at the RRF. The chassis provided at the RRF will allow the containers with refuse to be tipped into the receiving pit. All chassis will be fitted with locating cones in order to hold the containers in place during the transportation and tipping cycle.



1 – AMMONIA INJECTION POINT
2 – DRY LIME INJECTION POINT
3 – CARBON INJECTION POINT

FIG. 6 COMBUSTION FACILITY CROSS SECTION

Operation Cycle

A daily rail operating cycle will be established consisting of a loaded unit train originating at the Transfer Station. The commuter train traffic hours of 6:30–9:30 AM and 4:30–7:30 PM prohibit the refuse train movement during those hours. A train loaded with refuse will leave the Transfer Station early in the morning to be on the main line shortly after 9:30 AM and arrive at the RRF and be ready to be unloaded by approximately noon of that same day.

The system is designed so that one half of the train and its containers are left overnight at the RRF and the other half of the train is immediately unloaded and reloaded, and coupled to the half train left from the previous day. The complete unit-train will be back on the main line at the RRF with empty containers and residue for return to the Transfer Station in the early afternoon and be ready for unloading and reloading at the Transfer Station in the early evening. The train will then be ready to leave for the next cycle early the next morning.

COMBUSTION FACILITY — GENERAL

The RRF site layout is shown in Figure 3. The containerized refuse loaded onto trucks in the railyard is driven to the enclosed tipping floor for discharge into the refuse storage pit in the main process building. A cross-section through the building is shown in Figure 6 and a flow diagram of the combustion facility is included as Figure 7.

Refuse is fed by one of two 10.4 cubic yard (8 cubic meter) orange peel grapples into the feed hoppers of the three 600 TPD boilers. After being charged into the hopper and feed chute, the refuse is metered onto the surface of a Martin stoker from the bottom of the feed chutes by hydraulic feed rams. The feed rams are designed to provide an even distribution of refuse over the entire width of the grate. The reverse-reciprocating action of the stoker grate agitates the fuel bed in a manner which causes the refuse to burn from the bottom of the refuse bed, resulting in thorough burnout of combustible matter.

The stoker grate is shown in Figure 8 and is comprised of five individual grate runs across its width, each grate run having a separate hydraulic feed ram, grate actuation system, residue discharge roller and combustion air distribution system. The entire grate system is inclined downward from the feed end toward the discharge end and consists of alternating rows of fixed and moving grate bars in each run.

Residue remaining from the combustion process flows to two Martin ram ash dischargers per boiler. It is dis-

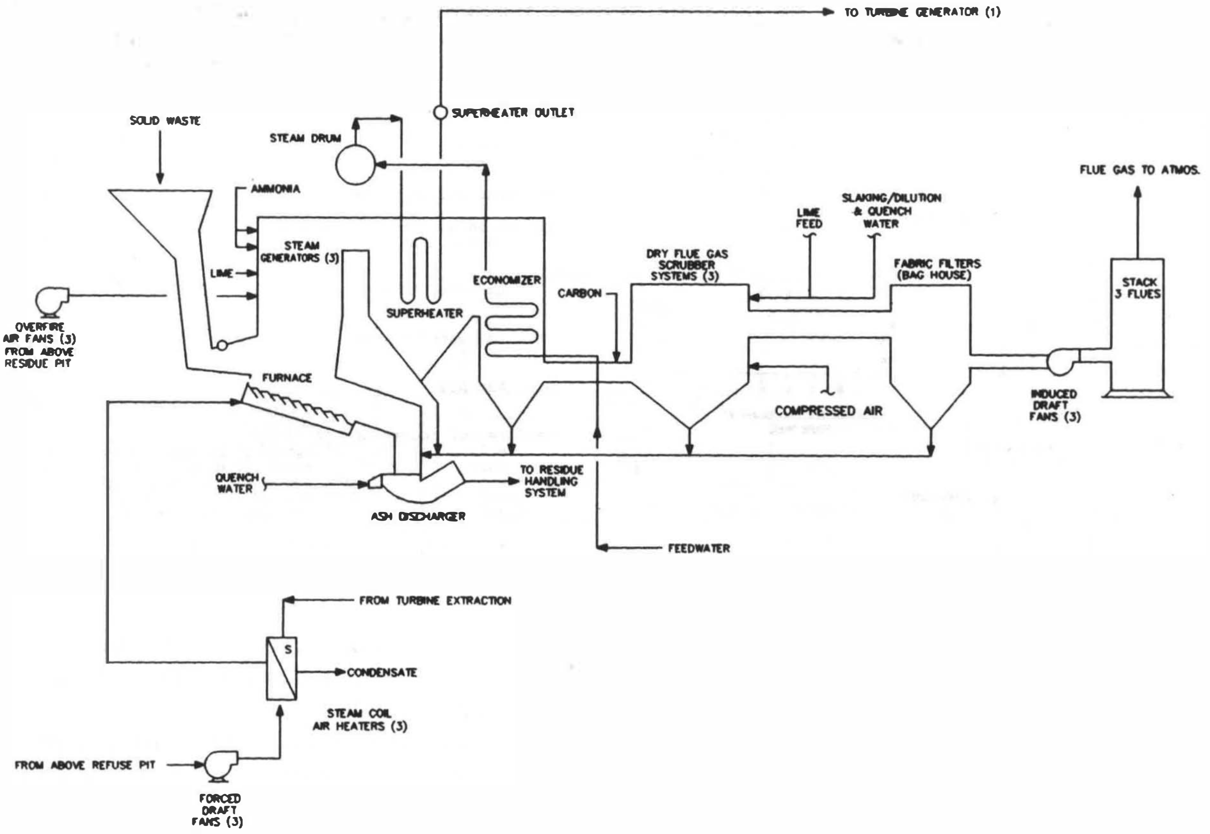
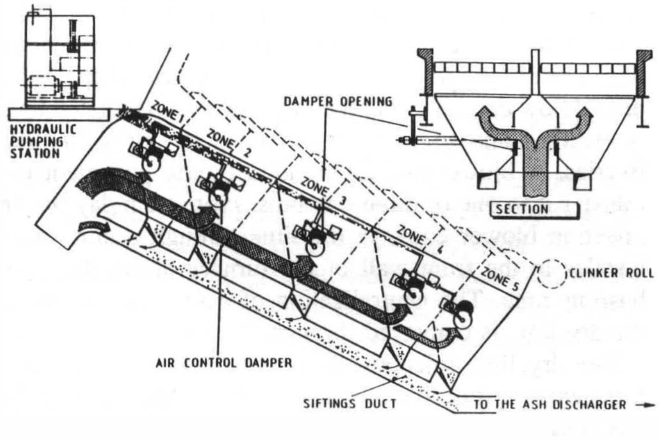


FIG. 7 COMBUSTION FACILITY FLOW DIAGRAM



NOTE ONLY TWO GRATE RUNS ARE SHOWN FOR SIMPLIFICATION OF PRESENTATION

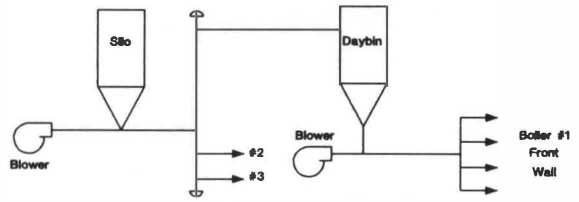
FIG. 8 STOKER GRATE

TABLE 2 MAJOR COMBUSTION FACILITY DATA

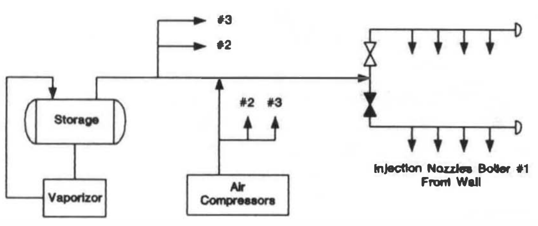
Stoker (1 of 3)	600 TPD of refuse, 5500 btu/lb HHV (5.5×10^5 kg/hr) Reverse reciprocating 33 feet (10.1 m) wide 13 steps
Furnace/Boiler (1 of 3)	171,000 lbs/hr steam (78,000 kg/hr) 275 million btu/hr (290 mill kg/hr) 865 PSIG/850°F outlet (60 Bar/1454C) 300° feedwater (149C)
Turbine (1)	
Throttle Flow	514,000 lbs/hr (234,000 kg/hr)
Design Back pressure	1.5" HgA (5 kPa)
Rating	64 MW
Refuse Pit Capacity (1)	7200 tons (6.5×10^6 kg) 4 days

charged via vibrating conveyors to a residue pit located parallel to the refuse pit. Ash cranes with clam shell grapples outload the residue to a vibrating conveyor. A grizzly scalper then removes +10″ material before an inclined belt transfers the ash to the residue building for ferrous separation and trommeling. One ferrous and two non-ferrous feed points are provided for direct truck loadout.

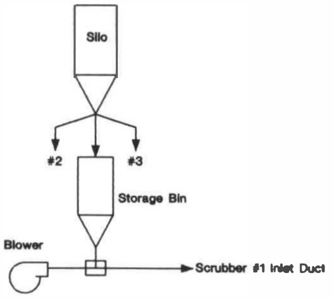
Steam from the boilers drives a single shaft dual exhaust turbine and generator. Power is exported for sale. A water treatment building houses equipment for cooling tower and turbine cycle makeup as detailed further in later sections. Gases from the combustion process are treated by systems in and following the boiler as described in sections below. Major equipment data is provided in Table 2.



A) DRY LIME INJECTION



B) AMMONIA



C) CARBON

FIG. 9 INJECTION SYSTEM SIMPLIFIED FLOW DIAGRAMS

COMBUSTION FACILITY AIR POLLUTION CONTROL SYSTEMS

General

The County, NMWDA, and Ogden Martin took an aggressive position in setting limitations on plant emissions. Design was commenced before the Clean Air Act (CAA) was finalized and the plant was designed to meet or exceed expected requirements.

Five major systems are provided to control and mitigate emissions from the combustion process. Semi-dry scrubber and baghouse trains are provided for acid gas and particulate control. Ammonia, carbon and lime injection systems are provided for NO_x, mercury and supplementary acid gas control respectively. These are described in more detail in the following sections. Major parameters are listed in Table 3.

Scrubber/Baghouse

As shown in Figures 6 and 7, the acid gas scrubber immediately follows the boiler economizer exit. It is a single chamber up flow spray dryer absorber. Lime slurry is injected by eight dual fluid nozzles in parallel flow with the gas stream. Reaction between the lime and acid gases occurs during the evaporation process and on unreacted lime in the baghouse following.

TABLE 3 MAJOR RRF AIR POLLUTION CONTROL SYSTEM PARAMETERS (ALL DATA PER TRAIN)

Boiler Economizer Outlet		
Gas Flow	98,000 SCFM (46.2 cm/s)	
Temp Range	425-500°F (218-260C)	
Scrubber Outlet Temperature Range	285-300°F (141-149C)	
Estimated Reagent Consumptions		
Pebble Lime	400-1000	lb/hr
	182-455	kg/hr
Hydrated Lime	250-500	lb/hr
	113-227	kg/hr
Activated Carbon	10-25	lb/hr
	5-11	kg/hr
Ammonia	40-100	lb/hr
	18-45	kg/hm
Performance (corrected to 7% O_2)		
HCl*	25 ppmdv (1 hr avg) or 95% removal	
SO_2*	30 ppmdv (3 hr avg) or 85% removal	
NO_x	180 ppmdv (24 hr avg)	
Hg	130 ug/NCM or 80% removal	
Particulate	0.01 gr/dscf (.003 gr/NCM)	

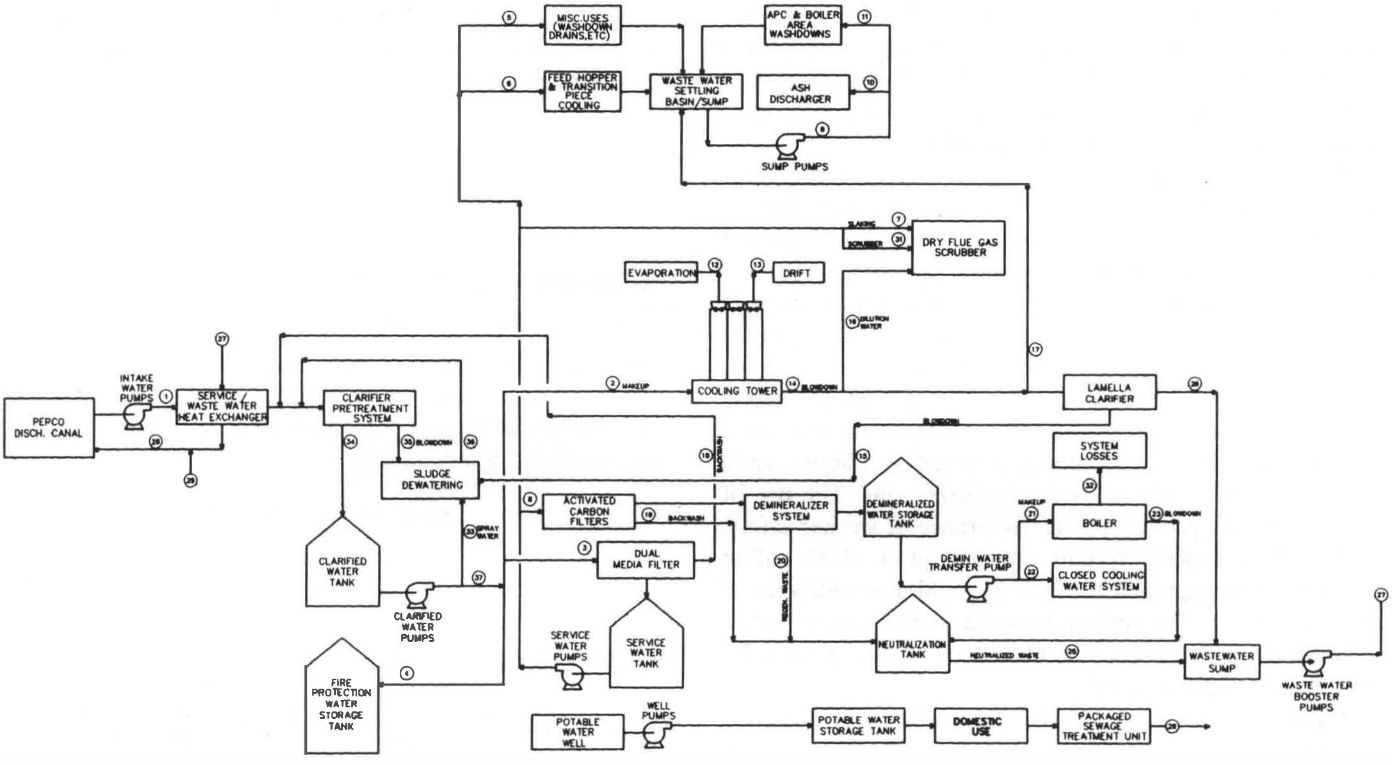
* without credit for dry lime injection

Particulate removal is performed by a reverse air baghouse. The large collection surface area and low velocities of such a design were selected to provide conservatism and design margin. A net air to cloth ratio of 1.8 is achieved through the use of eight modules per baghouse (1 module cleaning). Each module contains approximately 280 25-ft (7.6 m) long bags.

The scrubber baghouse combination is sufficient to meet permit acid gas removal rates. However, to provide capability to meet restrictive future limitations a supplementary furnace dry lime injection system is also provided. A simplified flow diagram is shown in Figure 9A. Hydrated lime is received and stored in a silo sized for truck load deliveries. A blower and distribution piping pneumatically transfer it to one of three day bins. From each day bin an injection blower conveys the lime through a number of nozzles in the front wall of the furnace above the combustion zone. The neutralization of acid gases occurs as the dry lime is conveyed through the boiler.

The dry lime injection design is based on experience from existing installations at two other mass burn facilities. The requirement for this system was site specific in both cases. One facility was a retrofit application with no existing acid gas control. The other had particularly low acid gas limits due to existing pollution levels in the area and the lime injection was supplementary to a spray dryer as it is for the Montgomery County Project.

Ammonia for non-catalytic NO_x removal is injected through the front boiler walls via nozzles in one of two headers at different elevations above the dry lime injection system (Figure 9B). An 18,000 gallon anhydrous ammonia storage tank is provided. Blowers provide carrier air to distribute the vaporized ammonia within the boiler.



NOTES:
1. AVERAGE FLOWS BASED ON OPERATION AT 50° F WET BULB (GUARANTEE CASE).
2. STREAM NUMBERS 24 AND 30 ARE UNASSIGNED.

STREAM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
AVERAGE FLOWS GPM (2)	788.7	636.3	126.2	0	2	0	10	28.4	18	17	1	509	4	123.3	1	6	15	0.8	0

STREAM	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
AVERAGE FLOWS GPM (2)	4.8	23.6	0	14.4	–	19.2	101.3	120.0	127.6	7	–	70	9.2	6.4	787.9	7	14.4	781.5

FIG. 10 WATER BALANCE DIAGRAM

Activated carbon is injected into the flue gas stream upstream of the scrubbers for mercury removal (Figure 9C). While current regulations do not require this system, it is being installed to address the client's goal to incorporate the most advanced pollution control equipment. Handling and distribution is in general similar to that used for the dry lime system. Due to the smaller carbon flows, day bins are not used. The carbon is transferred from a central storage silo via metering screws and blowers for each boiler to its injection point upstream of the acid gas scrubber.

The carbon injection system is sized based on testing performed as part of ongoing R&D. A major set of these tests was performed under EPA sponsorship at the Stanislaus County (California) Resource Recovery Facility in 1991 (Ref. 1).

Water Treatment Systems

The siting of the RRF and utility limitations required the provision of a number of make up water and discharge treatment systems. A water balance diagram is included as Figure 10.

The RRF is sited adjacent to a Potomac Electric Power Company (PEPCO) coal fired generating plant. The PEPCO facility rejects heat to a once through cooling system discharging heated Potomac River water through a flume back to the river. A small fraction of the water in this flume is withdrawn as RRF plant makeup water. The plant discharge is returned to the flume after treatment. The RRF and the flume are connected by approximately a mile of underground piping.

A fairly conventional system treats the intake water. Cooling tower makeup is passed through one of two 100% clarifiers. Water for other processes is also put through gravity filters, carbon filters and a demineralizer depending on final use.

Use of the PEPCO flume was allowed on the condition that there be no net adverse impact on any of the parameters limited by an existing NPDES permit for the flume including temperature. This effectively imposed a requirement that RRF discharge temperature be no greater than intake temperature. Two 100% plate heat exchangers are provided on the facility site to cool plant discharge (primarily cooling tower blowdown) to within one degree

Fahrenheit of the makeup temperature. The discharge and intake pipes are buried together in a common trench for the mile between the RRF site and the flume. This will allow the discharge to further equalize to make-up temperatures or cool to ground temperatures.

The RRF must meet its own NPDES permit limitations. Additional treatment provided includes a lamella clarifier to control suspend solids in cooling tower blowdown and equalization to control pH in process wastewater.

Gaseous chlorination would conventionally be used to control growths in the cooling tower and circulating water system. At the urging of the Montgomery County Department of Environmental Protection, a decision was made to switch to sodium hypochlorite. While material costs are higher, sodium hypochlorite is stored as a liquid while chlorine must be stored as a pressurized gas. The use of the liquid form provides better assurance of worker safety.

The hypochlorite system consists of a 6000 gallon (22,700 L) storage tank for 10% hypochlorite solution and transfer pumps. The sodium hypochlorite is injected at the cooling tower and pretreatment system by mixing into slip streams off these systems.

Finally, it should be noted that, as shown by the flow diagram, waste water is reused extensively within the plant to minimize both intake and discharge of water. This is good design for both environmental protection and plant operational economics.

SUMMARY

This paper has outlined a number of systems that can be considered in a modern mass burn facility. A number of these are project specific and will not be appropriate for all RRF plants. However, they show the variety of options available in ensuring that waste disposal takes place in an environmentally sound manner.

ACKNOWLEDGEMENTS

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REFERENCE

[1] OMSS Field Test Report on Carbon Injection, Radian Corporation, EPA Contract No's. 68-D10010, D90054, and D10031.

KEY WORDS

Resource Recovery, Waste to Energy, Air Pollution Control, Railroad Refuse Transportation, Water Pollution Control