

THE HARRISBURG EXPERIENCE — SUCCESSFULLY OPERATING AN OLD FACILITY

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ABSTRACT

The 720 TPD nameplate waste-to-energy co-generation facility in Harrisburg, Pennsylvania is one of the few remaining municipally-owned, large capacity facilities still in operation. The City credits the success of its 17 year operation to preventive maintenance, well timed modernization, and an efficient and well experienced staff. The IBW-Martin technology uses reverse-reciprocating grates for transfer of refuse through a welded membrane waterwall furnace. The recent addition of an electricity-producing turbine now helps balance the seasonal steam demand loads and significantly enhances the plant's revenue base.

INTRODUCTION

The history of the development of waste-to-energy in the United States has been a long and expensive battle against poor reliability, inefficiency, and negative cash flow. In such a hostile setting, many of the facilities built in the last 15 years have closed their doors. The horror stories associated with both the big waterwalls and the little modular incinerators are too numerous to recount; and the public perception of a waste-to-energy plant's relationship with the surrounding communities has suffered.

The Harrisburg plant is no exception to these ups and downs; however, the Harrisburg experience is ex-

ceptional for several very important and significant reasons:

(a) This facility is one of only three in the entire U.S. that processes a nominal 720 TPD and is also owned and operated by the City rather than a private entity.

(b) This facility is the second oldest waste-to-energy plant still operating in the U.S. Over two and a half million tons have been processed at the facility.

(c) This is the only facility in the U.S. that processes fewer than 1000 TPD that has seen more than two million tons processed.

HISTORY, CAPACITY, AND TECHNICAL INFORMATION

The Harrisburg Facility was the first waste-to-energy plant in the Commonwealth of Pennsylvania and one of the first in the United States when it started initial operations on October 10, 1972. As of December 1987, with the exception of one 50 TPD plant, it is still the only waste-to-energy facility in Pennsylvania. Construction, which began in December of 1969, was completed at a cost of \$10,650,061.

The system is based on the Joseph Martin design which uses reverse-reciprocating grates for transfer of the refuse through an International Boiler Works welded membrane waterwall furnace. The hot

gases make two passes through convective steam generating tubes, then through an economizer, and finally through a two field electrostatic precipitator. There are two such systems in the Harrisburg plant, each rated to process 360 TPD of municipal solid waste, for a total rated capacity of 720 TPD.

Each of the two furnace/boiler trains produces 250 psi, 520°F. superheated steam at the rate of 92,500 lb/hr. The steam is used to generate electricity and the steam is also sold to two customers: the Bethlehem Steel Corporation's Steelton Plant for use in operating their steel manufacturing machinery; and the Harrisburg Steam Work's downtown district heating loop which supplies steam to numerous offices and shops in the downtown Harrisburg area.

Waste is delivered to the facility across a weigh scale and dumped into one of seven pit storage bays, or onto the tipping floor. Heavy equipment pushes the waste from the floor into the pit and one of two overhead bridge cranes picks up the waste and feeds it into the charging hoppers of the two furnaces. After the waste has been thoroughly processed, the residue is transported to an on-site double lined ashfill.

This facility not only processes refuse from Harrisburg and many of the surrounding communities, but also codisposes sewerage sludge at the rate of 50 TPD. The sludge is delivered to the facility and deposited directly from the hauling vehicles into one of two tipping floor level hoppers. Below the hoppers are two holding tanks which can each hold 70 tons. The sludge is then pumped up to special mixing nozzles at each charging hopper and blended with the refuse.

STAFF AND OPERATIONS

Responsible for bringing the Harrisburg facility into its seventeenth year of continuous operation are a staff that is professional, experienced and highly dedicated, a program of comprehensive preventative maintenance, and a well planned capital outlay program for modernization of the machinery and controls.

A staff of 84 (see organizational chart) and a tonnage throughout of 210,000 tons per year provide a ratio of 2500 tons per year per employee. Though this staff may seem large, continuous operation for 16 years has taken the machinery far beyond the effortless reliability of its youth. The frequency of mechanical problems requires the most rapid response possible to minimize time off-line. A well trained and highly experienced crew of mechanics can be at the problem and ready to work within 30 min, regardless of what time or day

it is. The most frequent cause of downtime is waterwall tube leaks (28.3% of all unscheduled downtime in 1986; which is a total of 787 hr down in 1986 due to tube failures), yet a crew can get into the furnace, remove the wasted section and have a new piece welded in and hydroed and the unit lit off within 20 hr of the failure. In 1986, this facility maintained exceptional on line time considering the age of the equipment. Unit #1 was up 82.8% of the year and Unit #2 was up 85.5% of the year (average of 84.2%). Multiplying 1986's average daily throughput (575 TPD) by 84.2% results in a daily throughput of 683 TPD; which is 95% of the original 1968 nameplate rating of 720 TPD.

Another reason for a large staff is the design of the ash removal systems. A retrofit would be very expensive and time consuming; therefore the design inadequacies are compensated for with laborers. The three shift laborers must always be watchful of the operation of the belt, screw, and bucket conveyors. The belt conveyor is especially sensitive to steel objects getting wedged and ripping the rubber belt. The three daylight laborers do plant and grounds house cleaning, clean the various trench drains throughout the facility, and provide landscaping care and snow shoveling.

The facility consumes about 200,000 tons per year of MSW. Tipping Fees at the gate are currently \$37/ton (several long term contracts set lower rates), with income from tipping in 1987 projected to be at about \$3,671,000.

Steam is sold to the Bethlehem Steel Mill for \$7.80 per thousand pounds and to the Downtown District Steam Loop for about \$4.20/1000 lb. Electricity is sold to Pennsylvania Power and Light for \$0.06/kWh. The projected income in 1987 for energy sales is about \$4,194,000. Approximately 12,000 tons per year of Sewerage Sludge is consumed by the facility. The rate of \$50/ton is projected to bring in \$600,000 in 1987. Other minor sources bring the total projected income in 1987 to about \$8,500,000. The difference between costs and revenues (about \$750,000) is used by the City of Harrisburg to support the City's General Fund.

IMPROVEMENTS

The Facility has had a history of not being properly supported by the City. Over the 16 years of operating history, only the last four have been under the guidance of waste-to-energy professionals. The current administration, under the leadership of Mayor Stephen R. Reed, has committed to the required capital outlay necessary to keep the equipment reliable and efficient.

O&M BUDGET (1987)

<u>Personnel</u>	
Salaries Management	\$ 250,000
Salaries Hourly Workers	1,400,000
Overtime	300,000
Fringes	290,000
TOTAL	2,240,000
 <u>Operating Expenses</u>	
Utilities	\$ 600,000
Insurance	300,000
Maintenance and Repairs	250,000
Contracted Services	350,000
Supplies and Expenses	800,000
TOTAL	2,300,000
 <u>Capital Outlay</u>	 1,000,000
 <u>Debt Service</u>	 2,200,000
 <u>TOTAL OPERATING COSTS</u>	 <u>\$7,740,000</u>

Among the improvements are:

(a) Complete overhaul and modernization of both cranes including the addition of solid state, automated, controls.

(b) Complete rebuild of both stoker/grate systems using Martin's latest, proven, developments.

(c) Refurbishment of the columns and beams that support the tipping floor roof and the overhead bridge cranes.

(d) Complete overhaul and modernization of the entire sootblowing systems.

(e) A new scalehouse and a new computerized system for weighing and collecting data for input to the City's mainframe computer to automate the monthly billings.

(f) Programmable controllers and flue gas analyzers for furnace/boiler process control implementing the most advanced logic for improving combustion efficiency.

(g) A new ash handling and hauling system using large 35 ton off road dump vehicles (the City owns and maintains its own lined ash fill with leachate catchment system, located within the complex).

(h) Development of two more ash pits within this 65 acre complex with state-of-the-art leachate systems for 10-15 more years of ash disposal capacity.

(i) A scrap steel bailing system to compress the on site scrap into high density cubes for most cost effective hauling.

(j) Other small, but meaningful, improvements that will allow this facility to reach its 25 year anniversary with a continued record of high percentage on-line and cost-effective operation.

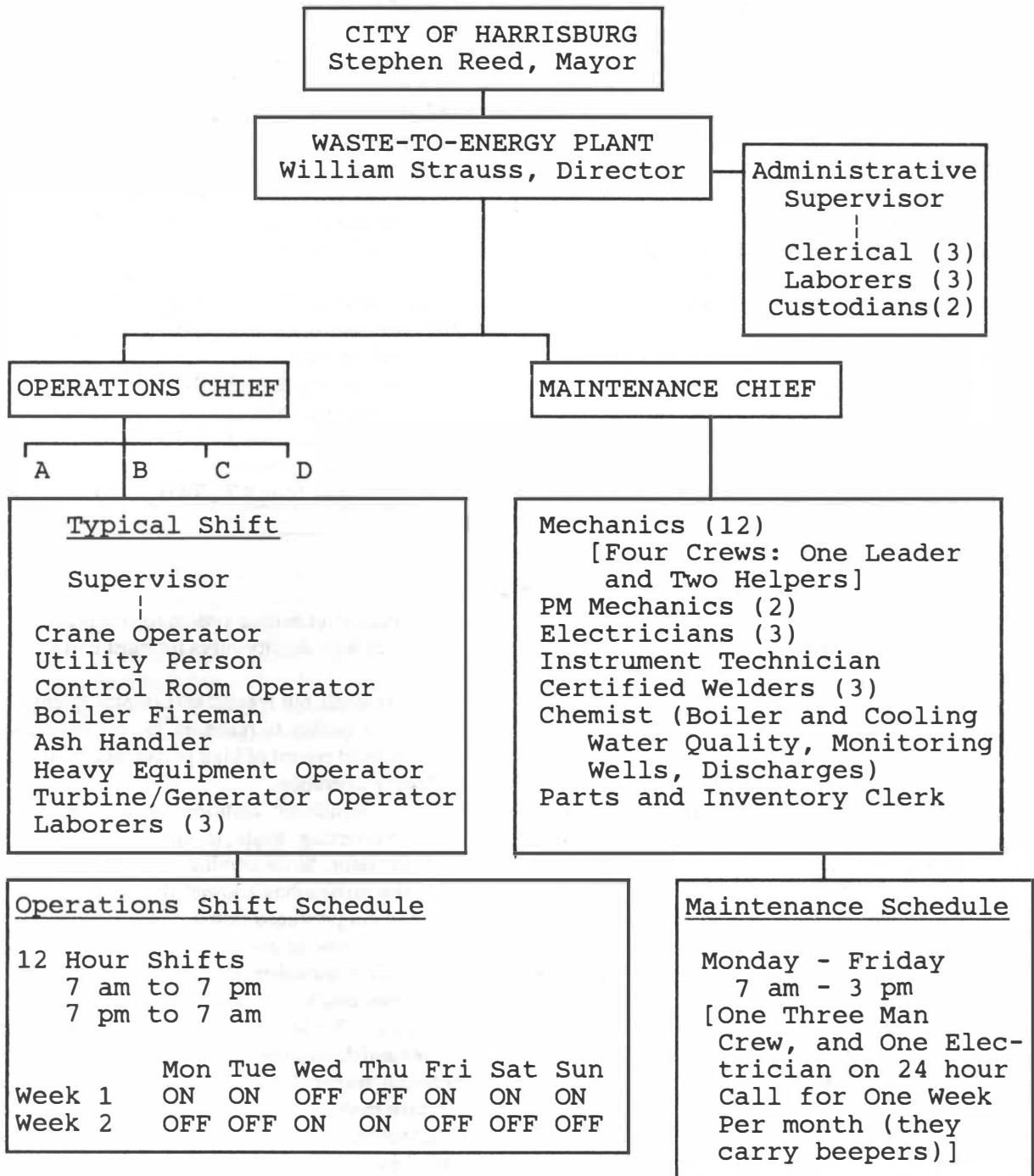
The most significant addition to the operation in terms of converting waste to energy is the 8 MW turbine generator. Since coming on line in November of 1986, the turbine has allowed this plant to convert all of the steam produced into a salable product. Until October 1986, sale of energy from this operation depended on the seasonal swings in energy demand from the two steam customers. During the summer months, as much as 140,000 lb/hr of steam was wasted through a roof mounted, silenced vent.

Increased revenues due to the addition of the generator have made this facility completely self sufficient and enabled the City to invest a million dollars a year in capital improvements.

SUMMARY

There are 47 mass burn plants currently operating in the U.S. (There are only 10 that process more than

TABLE 1 ORGANIZATIONAL STRUCTURE



300 TPD.) Most of those facilities are relatively new. Furthermore, there are 52 mass burn facilities either under construction or in an advanced planning stage.¹ All of these facilities will be facing the unique problems that begin to arise when the equipment starts to age.

The Harrisburg Facility has been a resource center

¹ From the April 1986 issue of *City Currents*, published by the United States Conference of Mayors.

and design model for many engineering firms and incinerator vendors since the early 1970s. Now, entering "old age", it is still a pioneer for the nation. With literally hundreds of years of staff experience and equipment that has been through it all, it serves to lead the way in developing guidelines for staffing and O&M planning for aging facilities. Entering its seventeenth year, Harrisburg begins the task of processing the next million tons.