OFFICIAL PROCEEDINGS

SIXTY-FIFTH ANNUAL MEETING

OF THE

INTERNATIONAL DISTRICT HEATING ASSOCIATION

HELD AT

THE OTESAGA HOTEL

COOPERSTOWN, NEW YORK

JUNE 24, 25, 26, 1974

VOLUME LXV

Published By The

INTERNATIONAL DISTRICT HEATING ASSOCIATION
5940 BAUM SQUARE, PITTSBURGH, PENNSYLVANIA

The study concluded that the latter system will be eliminated by the construction of Metro Centre, a large urban renewal project. The remaining five systems come within a city block of one another, and the Study has recommended that they be integrated into one large district heating system, and expanded to heat all existing buildings in the city core.

The existing Pearl Street Plant of the Toronto Hydro District Heating System would be dismantled, because of chimney effluent impingement upon nearby tall buildings and the 1800-ft high CN Tower presently under construction 2200 ft south of the heating plant. It is interesting to note that, when this Study was authorized in 1969, replacement of the 250-ft Pearl Street stack with an economically possible 700-ft stack would have eliminated the impingement problems. By 1972, a 1000-ft stack would have been required to avoid interference with the proposed 926-ft Bank of Montreal building, and by 1973 an impossibly high stack was required to clear the CN Tower—the world's tallest self-supporting structure.

The replacement for the Pearl Street Heating Plant will be a 600 M lb per hr conventional gas and oil-fired steam plant, combined with a heat recovery incinerator consuming 1200 tons of city garbage daily, and with a firm sendout capacity of 200 M lb per hr. Located approximately one and a half miles from the load centre, the new plant will supply 27 per cent of the annual system sendout from the base load refuse-fired component.

The five plants of the integrated system will have a firm sendout capacity of 2065 M lb per hr. The estimated peak steam demand is 1990 M lb per hr.

DISTRICT HEATING AND COOLING WITH A SOLID WASTE FUELED PLANT

CARL E. AVERS, *General Manager and Chief Engineer*
Nashville Thermal Transfer Corp., Nashville, Tenn.

Now operating in Nashville, Tennessee is a $16.5 million facility which uses a free and constantly expanding energy source, while similar systems in other cities struggle in the face of fuel shortages.

Solid waste—garbage and trash historically disposed of in dumps and landfills—is utilized as a primary fuel in an efficient, modern and economical central energy plant to heat and cool state, municipal and private buildings in the downtown community.

In 1974, the first year of operation for the pioneering Nashville Thermal Transfer Corporation (Thermal), heating and cooling customers will include at least 42 state, municipal and private buildings. These original contracts have been executed for 30-year terms commencing with the initial delivery of service, and contracts with additional customers are being negotiated.

The State of Tennessee will be the largest single user, with the Metropolitan Government a close second. A complex of Federal buildings is expected to join the lengthening list of users, and private buildings already account for over half of the total service consumption.

Projections by the engineers for the Thermal project show first year revenues of $1,600,000. Revenues are estimated to exceed $2,600,000 by 1978. The revenue projections reflect the distinct advantage that Thermal has over individually-owned and operated cooling and heating systems. Thermal can produce steam for about 30 per cent of the cost of using fossil fuels, and chilled water for about 40 per cent. The district plant replaces at least 27 individual cooling and heating systems in its first phase alone, and will save some 20 million kilowatt hours in electrical usage. When the plant is completed and fully operative, it will conserve more than 71 million kwh per year, or roughly the electric power consumption of a residential area of 15,000 people.

The Corporation's rates for cooling, heating and incineration service will be the lowest in the United States for a system of comparable size. The use of no-cost fuel supplied by Nashville will enable the Corporation's customers to purchase heating and cooling for a price at least 25 per cent less than their alternate cost of owning, maintaining and operating their own in-building boilers and chillers. Some will save over 50 per cent.

Under the Thermal-Nashville contract, Nashville retains title to all solid waste delivered to Thermal both before and after incineration. A recent study by the U. S. Bureau of Mines reveals that the recovery value of incinerator ash can equal $2 to $3 per ton of solid waste. Sale of this residue may result in substantial profits to Nashville. Also, this new system reduces Nashville's future cost for solid waste disposal by about $3 per ton. This savings amounts to over $1,250,000 annually through reductions in the estimated cost of transportation and future sanitary landfill operations.

The initial consumption and production capacity of the Thermal plant is 720 tons of solid waste per day, producing about 395,000 pounds of steam per hour and approximately 14,000 tons of air conditioning. Ultimately, the plant will consume 1440 tons of solid waste per day (equivalent to the estimated total county-wide daily refuse collection by 1976) to produce a steam output in excess of 500,000 lb per hr and over 30,000 tons of refrigeration.

The Thermal system begins with local garbage and trash route trucks operating throughout the county. These trucks deliver their solid waste to strategically located transfer stations where the solid waste is placed in 65 to 75 cubic yard trailers. The solid waste is then delivered to the plant in these large, fully enclosed semi-trailer trucks and dumped into a refuse pit large enough to permit weekday and weekend operation on weekday deliveries. One or two deliveries per hour are made to the central plant. The transfer station process significantly reduces annual travel, keeping local trucks off the main roads and permitting them to return to their routes more quickly.

An overhead crane picks up the solid waste in one-ton bites and feeds it into multi-level incinerator boilers. The plant includes two 360-ton-per-day steam generators, manufactured by Babcock & Wilcox Company, and eventually may be expanded to include about three additional 360-ton units. These units can also operate on natural gas or fuel oil. The solid waste is continuously fed into the steam generator by reciprocation grates, manufactured by the Detroit Stoker Company.

Ash from the incinerator is dropped into an ash hopper and sprayed with water from the scrubber tank. Spraying cools the ash and eliminates dust during the

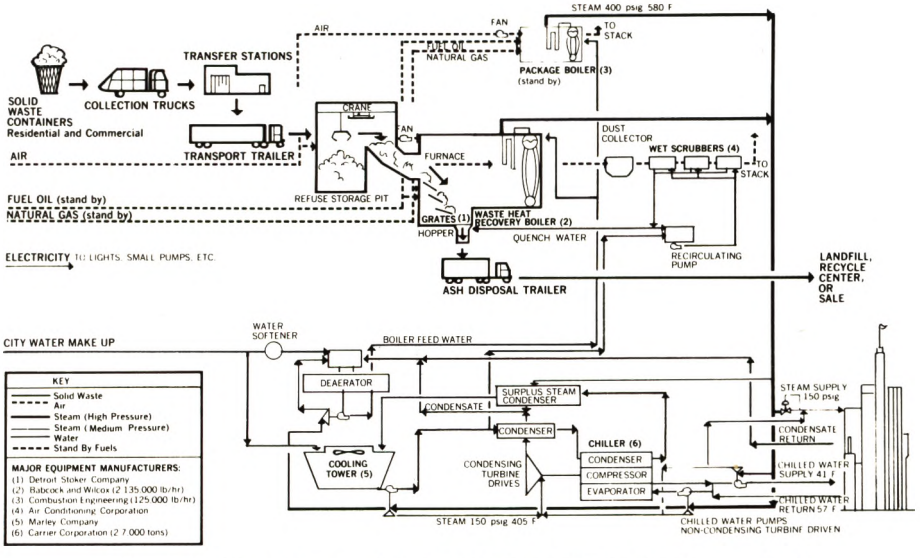
removal process. Trucks haul ash from the plant, and the sterile residue ash provides a dense fill or building block material where desirable. If trucked to landfills, it does not require earth cover.

Combustion air, drawn into the plant through the solid waste storage room, promotes burning of odors in the boiler-incinerator, thus eliminating any potential odor problems in the plant area. The furnace is sealed and operated under a slight negative pressure to prevent escape of dust and odors. The 1800 F heat in the furnace explodes glass into fragments much like sand. Metals are sterilized and can be easily removed from the ash for reclamation.

For maximum heat recovery, the flue gases exit from the boiler sections through an economizer bank wherein the temperature of the gases is reduced to approximately 500 F. These gases then go through sophisticated particulate and gas collection devices in order to meet emission criteria. The gases first are subjected to a dry "cyclone" to remove the remaining particulates and water soluble gaseous constituents. The cleaned gases leave the scrubbers at about 140 F and then discharge into the atmosphere through low-profile stacks.

Pollution control is a very important part of the project. Particulate matter and sulfur dioxide emission control are accomplished with the combination of dust collectors and the series of wet scrubbers built by the Air Conditioning Corporation of Greensboro, N.C. The current level of particulate and sulfur dioxide emissions will be reduced by 75 and 90 per cent respectively, over the existing in-building systems that are being replaced by the Thermal plant.

For heating purposes, steam goes directly from the boilers into the distribution network. For cooling, steam generated in the boilers is piped at 400 lb pressure and 600 F, to the cooling building which contains two steam turbine-driven Carrier Corporation centrifugal chillers rated at 14,000 tons of cooling capacity. The condensing turbines on the chillers receive steam from the non-condensing turbines which drive primary pumps.



Simplified flow diagram of Nashville Thermal Transfer Corporation's central heating and cooling plant fueled by solid waste.

Two cooling towers reject heat from the refrigeration cycle. Each Marley Company tower has a water capacity of 90,000 gallons and a recirculating water rate of 17,000 gal per minute. At full load, when both chillers and boilers are operating at capacity, the plant has a make-up water requirement of approximately 1,500,000 gal per day, which will be entirely supplied by the Nashville city water system. This exceptionally high water requirement is less than the demand by plants replaced by the Thermal operation. Less than two per cent of the total water used by the plant is fed back into the Nashville sewer system. No water directly from the Cumberland River is used or returned directly to the river.

Steam at 150 psig and 41 F chilled water are piped under city streets through a four-pipe distribution system which is 15,000 trench ft in length. The condensed steam and 57 F chilled water is returned to the district plant in closed recirculatory cycles. Each customer is billed according to the quantity of cooling and heating utilized. This four-pipe distribution system consists of a chilled water supply line, a chilled water return line, a steam feed line and a condensate return line. The normal operating pressure of the chilled water lines is about 220 lb. Both chilled water and steam service supply lines terminate at meters installed on the customer's premises.

Although solid waste is the principal fuel for steam production, each incinerator is equipped with auxiliary gas and oil burners. The auxiliary fuels are deemed necessary by systems engineers for the maintenance of consistent steam pressure in the event of an unusually high moisture content of wet solid waste. In addition, a 125,000 lb per hr stand-by and supplemental package boiler fired by gas or waste oil is also available, to increase the overall plant reliability and operational flexibility during maintenance periods. Engineers estimate average auxiliary fuel usage will be less than ten per cent of the fuel required.

In addition to heating and cooling services, Thermal generates electricity for its own use. Also, by utilizing waste oil (primarily from automobile crankcases) for stand-by reserve, the system relieves a secondary waste problem.

The contemporary buildings and landscaped grounds of the Thermal plant are on property which was once the site of the historic Tennessee Central Railway terminal. The location is at the end of a section of the riverbank extending north to the Courthouse Square which will soon be developed as a scenic riverbank park and garden.

The future prospects and potential for Thermal's pioneering program are inevitably linked to the bright and burgeoning potential of Tennessee's capitol city.