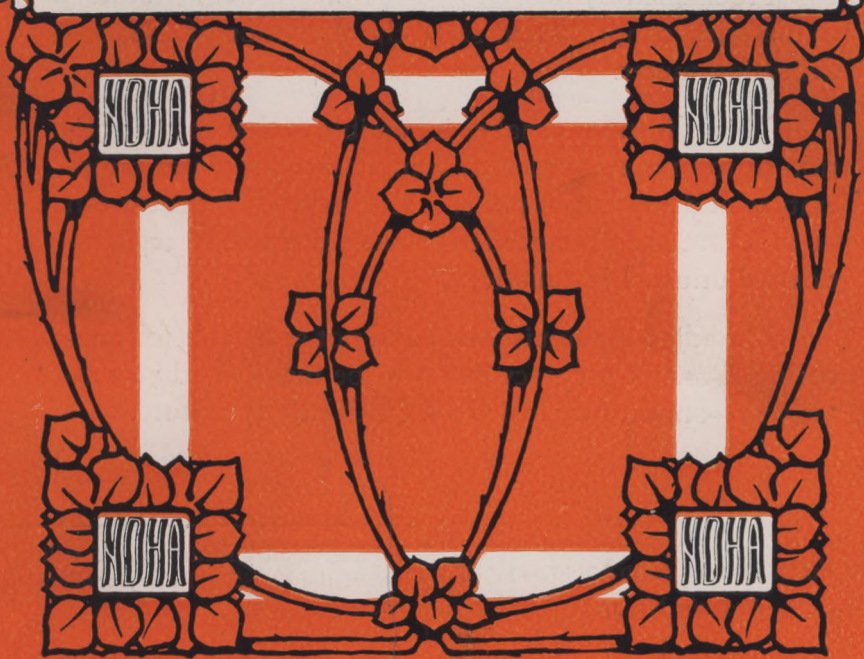


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Central Steam in Duluth, Minnesota

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The city of Duluth, located at the head of navigation on Lake Superior in northern Minnesota, has long been recognized as a perfect location for a prosperous central steam project.

Duluth has an average annual temperature of 38.8 F., the lowest average temperature of any city over 100,000 population in the United States. The annual snowfall is about sixty inches.

The city of Duluth is carved out of a ledge of igneous rock that borders Lake Superior, St. Louis Bay and the St. Louis River. This ledge of rock rises rapidly to a height of a thousand feet or more within a mile of the lake shore. Duluth is frequently described as a city thirty miles long, one mile wide and one mile high, having two seasons, winter and exhibition week.

The business district of the city is a densely built up district, three blocks wide and extending about one mile in length. The commercial activity of the city is concentrated in this district.

The building of a steam system in Duluth was under consideration by different parties for a period of ten years. It was considered as a municipal project, as an extension of the local electrical system, but was finally built as an independent private enterprise in 1932. The project as built was designed to serve the main business section of the city, all of which could be reached with about two and one-half miles of distribution mains.

Adjacent to this distribution system is installed radiation totaling 1,038,000 square feet. Most of the larger buildings use steam twelve months of the year for power purposes.

The steam generating station is located on Lake Avenue and Commerce Street, about nine hundred feet from the load center of the district served. The plant and distribution system were built in the spring and summer of 1932, and placed in operation in September 1932.

THE GENERATING PLANT

The generating plant consists of four 850 H.P. Edge Moor cross drum bent tube boilers, equipped with air cooled front walls and water cooled walls on sides and rear, and air pre-heaters. The boilers are built for 425 pounds steam pressure, but are operated at 250 pounds pressure.

The plant auxiliaries are turbine driven with steam at boiler pressure, but the steam pressure to the distribution system is reduced to 160 pounds before leaving the station.

The boilers are equipped with Strong-Scott Uni-Pulvo coal pulverizers and burners of sufficient capacity to operate the boilers at a rate of 90,000 pounds of steam per hour each. The plant auxiliaries, boiler feed pumps, pulverizer mills, induced draft fans and the 150 Kw. house set are all turbine driven.

One of the four boilers is equipped with two pulverizers, one of which has an electrical drive. This unit is used to start the plant and is also used at other times to assist in obtaining a heat balance for the plant.

All auxiliary turbines exhaust to a deaerating feed water heater.

The coal handling equipment consists of a bucket elevator that lifts the coal from a track hopper to the top of the building, where a belt cross conveyor distributes the coal into a 400 ton overhead steel bunker. No additional outside storage is available at the plant.

Duluth is the upper lake terminal for coal shipped from Pennsylvania, Ohio and West Virginia for distribution to the Northwest. Millions of tons of coal are stored on the big docks during the shipping season, and coal of excellent quality is available in unlimited quantities within three to six miles of the plant.

WATER SUPPLY

The water supply for the city of Duluth is taken from the bottom of Lake Superior, about a mile from the shore. The water supply for the plant is taken direct from the city water mains. Records of the city water department indicate that the average temperature of Lake Superior does not vary over six degrees throughout the year. (32 F. to 38 F.) This lake water is very soft (total hardness 54 parts per million). Just why Lake Superior water is so free of mineral content as

compared with water from the other Great Lakes is not explained, but it is probably due to the igneous rock that forms a large part of the bottom and to the extremely low temperature at which the water remains throughout the year.

In spite of the fact that the only returns to the boilers are the exhaust from the plant auxiliary turbines, there is no provision for feed water conditioning. Only a very modest amount of boiler compound is added and after a year's operation the boilers are in excellent condition and show no need of further treatment.

Ashes are removed from the furnace hoppers, dust-collecting chambers under the air preheaters and stack bottom by a vacuum system. Vacuum is created by a steam jet which exhausts to the stack. Air admitted to the ash line at the hopper from which ash is to be removed carries the refuse to a collecting tank and separator on top of a 25-ton ash-storage bin. The valve controlling steam to the steam jet is motor operated and is closed automatically at 90-sec. intervals and remains closed about 5 sec. When steam is shut off, the vacuum breaks and allows a door in the bottom of the collecting tank to open, discharging the ash to the storage bin.

EQUIPMENT DATA

Coal Handling: Loading conveyor, bucket elevator, distributing belt conveyor, 400 ton steel bunker, coal handling capacity 75 tons per hour, motor operated	Brady Conveyors Corporation.
Automatic weighing scales, four	Richardson Scale Company
Pulverizers three 9,000 lb. Coal per hour, driven by 150 h.p. Elliott Co. turbines, two 4,500 lbs. per hour	Strong, Scott Manufacturing
High-Low coal burners	Strong, Scott Manufacturing
Oil ignition, 2 burners per boiler	Strong, Scott Manufacturing
Ash-handling system	United Conveyors Corporation
Boilers and Auxiliaries: Boilers, four 4-drum, 8,510 sq.ft. heating surface, 425-lb. pressure, operated at 230 lb. 90,000-lb. per hour, bare and armored water-walls	Edge Moor Iron Company
Front walls, air cooled	M. H. Detrick Company
Air preheaters, 4-tubular type 6,750 sq. ft.	Edge Moor Iron Company
Induced-draft fan, 4-double inlet	Green Fuel Economizer Company
Turbine, 73 h.p. for above	Elliott Company
Combustion Control	Garrick Engineering Company

Soot Blowers	Diamond Power Specialty Company
Water columns	Yarnall-Waring Company
Safety Valves	Consolidated Ashcroft Hancock
Stop Valves	Crane Company
Feed water regulators	Bailey Meter Company
Blowoff Valves	Yarnall-Waring Company
Feed pumps, two 500-g.p.m. driven by Elliott Turbines	Manistee Iron Works Company
Cold-water, two 550 g. p. m.	Manistee Iron Works Company
General service, 125 g. p. m.	Manistee Iron Works Company
House turbine generator, 150-kw., 3-phase, 60-cycle, 220-volt, 0.8 p. f., 1,800 r. p. m. generator; 220-h.p., 2-stage turbine	Elliott Company
Feed-water heaters, two 180,000 lb. per hour	Worthington Pump & Machinery Corporation
Flow meters, flue-gas recorder	Bailey Meter Company
Venturi feed-water meter	Builders Iron Foundry
Draft gages, 3-point	Bailey Meter Company
Pressure gages, thermometers	Consolidated Ashcroft Hancock
Pipe, pipe fittings	Crane Company

DISTRIBUTION SYSTEM

The distribution system as originally installed consisted of

1970 feet of 18 inch pipe
434 feet of 16 inch pipe
443 feet of 14 inch pipe
3943 feet of 12 inch pipe
488 feet of 10 inch pipe
1476 feet of 8 inch pipe

The underground pipe is all extra heavy pipe, welded joints, with Badger expansion joints. The conduit is of reinforced concrete, formed on the inside with wooden forms left in place. These distribution lines extend in Superior Street and First Street from Third Avenue East to Sixth Avenue West, with some extensions north to serve buildings on Second Street. This system permits serving all of the central commercial district of the city, and may be extended east and west to nearby industrial customers.

COMMERCIAL DEVELOPMENT

Duluth, like other cities, is suffering from acute shrinkage of real estate values, but in spite of this continuing deplorable situation, the company enters its second winter with 365,000 square feet of radiation connected to its lines. This is about one-third of the available radiation. With an improvement in the local real estate situation and buildings are again rented and rentals are collected, this connected load will undoubtedly increase rapidly.

NEW PROJECT PROPOSED

Just at this time the city of Duluth is preparing plans for a municipal steam project that will extend from the eastern edge of the district now served which is 3rd Ave. East to 31st Ave. East.. It will include twenty miles of pipe lines, 3,000 buildings and residences and about 2,250,000 square feet of radiation. This project is being planned as a Public Works project in anticipation of federal funds for financing. If the project goes through it contemplates purchase of steam from the Duluth Steam Corporation for the first couple years of operation or until such time as its load entirely absorbs the available capacity of the corporation. The load to be served is about one-third in business buildings, apartment houses and institutions, the balance strictly residential. Application for federal funds will be made before the first of January.

A technical description of the Duluth generating station is given in more complete detail, accompanied by photographs and lay-out of the plant, in the issue of POWER for October 1933.