POWER

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STEP BY STEP

• WHO CAN CHART AMERICA'S COURSE for the next ten years—or five? Who can chart his own business? Who can say which products will catch the popular fancy of that day? Who can say which business groups will forge ahead or which will drop behind? Nobody can.

• BUSINESS MEN of ten years back had no clearer vision. They only thought they had, as today's events prove. But now, as in the past, it is possible to plan progress without foreseeing the exact course of that progress. Step-by-step modernization is one method.

• IT WORKS THIS WAY: A certain factory, say, starts from scratch with an antiquated power plant. Obsolete, hand-fired, low-pressure boilers. Wasteful auxiliaries. No instruments. Old engines blowing exhaust steam to atmosphere all summer long. Fuel and labor dollars leaking at spigot and bunghole.

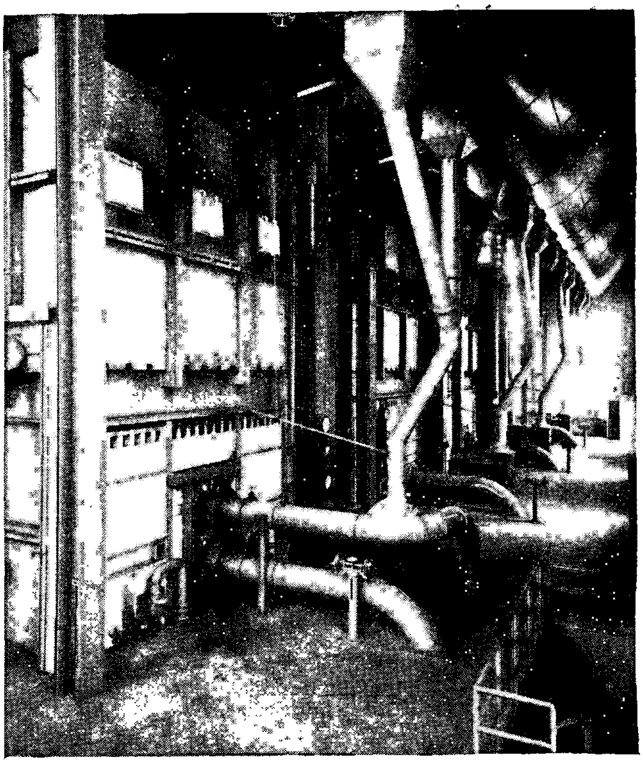
• THE WHOLE PLANT calls aloud for modernization, but the owner hesitates, fears to make such a large investment all at once. He is not quite sure of the business trend or the ultimate future of his product. Yet he knows that inaction is even more dangerous—makes loss certain.

• STEP-BY-STEP MODERNIZATION meets his situation. He avoids heavy plunging, makes first the small, quick-paying investments. Each step pays for the next. At each stage the owner is financially ahead, and at each he is free to adjust his layout to new trends without scrapping the investment already made.

• THE FIRST MODERNIZATION STEP in the case cited is instruments; they cost little, yield a high return immediately, fit any future power set-up. Next, perhaps, several of the small boilers are replaced by a single modern unit, built for higher pressure, but temporarily operated at the old. Its greater efficiency and better design start an immediate saving in coal, labor and maintenance.

• FINALLY COME MODERN GENERATING UNITS and the replacement of the remaining boilers. Plant pressure goes up. Steam waste goes down. More dollars are saved.

• THIS IS JUST A SAMPLE. Each case will differ in general plan and in specific steps. The point is that no plant can afford to delay modernization simply because a complete job may not be practicable at once. Do something now, even if it is no more than the installation of a feed-water meter.



Auxiliary power is furnished by the small turbine-generator set

Ten-month Season and Summer

CENTRAL HEAT

IT HAS long been recognized that the business section of Duluth, Minn., offers an opportunity for profitable operation of a district heating system. The heating season there lasts for ten months, thus giving a better load factor than that usually encountered. Winters are very cold, the number of degree days being about 9,500, and not infrequently steam is required for building heating during the summer.

Duluth Steam Corp., organized to construct a district heating system, started work on a central boiler house of 360,000 lb. per hr. capacity early in 1932, and the plant supplied steam for the 1933 heating steason.

The boiler house, at Lake Ave. and Commerce St., contains four 4-drum boilers, each of 90,000 lb. per hr. steaming capacity and designed for 425 lb. pressure, but actually operating at 230 lb. They are fired with pulverized bituminous coal. The fuel, as received in railroad cars, is sufficiently fine to eliminate the need for coal-crushing equipment.

Coal from the track hopper is fed to a bucket elevator rising vertically outside the boiler-house wall. The elevator discharges to a belt conveyor, which distributes the coal to a 400-ton steel bunker. Three connections are made to the coal bunker for each boiler, making possible a relatively shallow bunker for the live-coal storage secured. The spouts join in a single spout that feeds coal to automatic scales on the operating floor in front of each boiler.

The scales discharge to pulverizers in the basement. Three of these are of 9,000-lb. per hr. capacity and each supplies one boiler. Number 1 boiler is supplied by two pulverizers, each of 4,500-lb. per hr. capacity, making it possible to carry lighter loads on this unit. Coal feed to the pulverizers is controlled from stands on the operating floor at the weight scales. All pulverizers except one smaller unit are driven by steam turbines. One motor drive was provided to permit starting up the plant on purchased current.

Forced-draft fans are integral with the mills and draw air through tubular-type air preheaters having 6,750 sq.ft. of heating surface per boiler. Turbine-driven, induced-draft fans of 60,000-c.f.m. capacity, on the boiler operating floor, draw flue gases down through the air preheaters and through dust chambers below the operating floor. Discharge of the gas is through a common flue at about the boiler drum elevation into a single 13-ft. diameter stack, 250 ft. high. It is of reinforced concrete construction, lined with brick for 40 ft. above the flue gas entrance.

Three boilers have one burner each, Number 1 boiler has two burners, one above the other on the boiler center line. Two oil burners are provided in each boiler for igniting the pulverized coal. They are placed one on each side of the coal burner, at an angle to direct the oil flame under the entering pulverized coal. Fuel oil is stored in a 12,000-gal. tank outside.

Front walls of the furnaces are air cooled, but rear and side walls are water cooled. Inclined sections of the rear water walls are armored, the remainder of the rear wall and the side walls being bare, 3¼-in. tubes set on 6-in. centers. Rear walls are fed from and discharged to the mud drums. Side walls are fed from the mud drum through three downcomers and discharge to the front boiler drum through four risers.

Air for cooling the front wall circulates by gravity, entering the wall just below the operating floor and discharging to the boiler room at about the level of the mud drums.

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.

Water is fed to boilers through feed-water level regulators to a 10¾-in. O.D. header, from which it discharges through a single row of boiler tubes to a boxed-in section in the mud drum. From this closed section two rows of tubes carry the feed water to the upper rear boiler drum, thus forming an economizer section three tubes deep that has considerable effect in reducing flue gas temperature.

No provision has been made in the steam distribution system for the return of condensate, so that except for a relatively small amount of steam condensed in feed-water heating and station drips, feed water is 100 per cent make-up. City water from Lake Superior is normally used for feed water. A well and two 500-g.p.m. motor-operated pumps provide emergency feed-water.

A feature of this plant is the absence of provision for feed-water treatment in spite of 100 per cent city water make-up. A small amount of boiler compound is used,

Heating Demand Combine to Justify

FOR DULUTH

Equipment Data—Duluth Steam Plant

Coal Handling	
Loading conveyor, bucket elevator, distributing belt conveyor, 400-ton steel bunker, coal-handling capacity 75 tons per hour, motor-operated	Brady Conveyors Corp.
Automatic weighing scales, four	Richardson Scale Co.
Pulverizers three 9,000 lb. coal per hr. driven by 150-hp. Elliott Co. turbines, two 4,500 lb. per hour	Strong-Scott Mfg. Co.
High-Low coal burners	Strong-Scott Mfg. Co.
Oil ignition, 2 burners per boiler	Strong-Scott Mfg. Co.
Ash-handling system	United Conveyors Corp.
Boilers and Auxiliaries	
Boilers, four 4-drum, 8,510-sq.ft. heating surface, 425-lb. pressure, operated at 230 lb., 90,000-lb. per hr. Bare and armored water walls	Edge Moor Iron Co.
Front walls, air cooled	M. H. Detrick Co.
Air preheaters, 4-tubular type 6,750 sq.ft.	Edge Moor Iron Co.
Induced-draft fan, 4-double inlet	Green Fuel Economizer Co.
Turbine, 73 hp. for above.....	Elliott Co.
Combustion control	Carrick Engineering Co.
Soot blowers	Diamond Power Specialty Corp.
Water columns	Yarnall-Waring Co.
Safety valves	Consolidated Ashcroft Hancock
Stop valves	Crane Co.
Feed water regulators	Bailey Meter Co.
Blowoff valves	Yarnall-Waring Co.
Feed pumps, two 500-g.p.m. driven by Elliott turbines....	Manistee Iron Works Co.
Cold-water, two 500 g.p.m.....	Manistee Iron Works Co.
General service, 125 g.p.m.....	Manistee Iron Works Co.
House turbine generator, 150-kw., 3-phase, 60-cycle, 220-volt, 0.8 p.f., 1,800-r.p.m. generator; 220-hp., 2-stage turbine	Elliott Co.
Feed-water heaters, two 180,000-lb. per hr.	Worthington Pump & Machry. Corp.
Flow meters, flue-gas recorder.	Bailey Meter Co.
Venturi feed-water meter	Builders Iron Foundry
Draft gages, 3-point	Bailey Meter Co.
Pressure gages, thermometers.	Consolidated Ashcroft Hancock
Pipe, pipe fittings	Crane Co.

and up to date the insides of the boilers are in excellent condition, indicating no need for further treatment.

City water pressure is sufficient to deliver water to a 600-gal. surge, or storage tank just below the boiler house roof. A vertical sump pump also delivers plant drips to the surge tank from a receiver. Under float control, the water flows by gravity to two feed-water heaters, each of 180,000-lb. per hr. capacity. These feed water at 210 deg. to two 500-g.p.m. turbine-driven feed pumps, which discharge to a 6-in. header at the upper rear boiler drum elevations. Provision is also made so that water may be fed to the boilers through the blow-down piping in an emergency.

All auxiliaries, except the one motor-operated mill, coal-handling equipment, emergency make-up pumps and a service water pump, are turbine driven and exhaust to the feed-water heaters.

Electric energy for lighting and the few motor-operated auxiliaries is furnished by a 150-kw. turbine driven alternator. This unit operates at 1,800 r.p.m. and furnishes 3-phase, 60-cycle current at 220 volts. Emergency electricity is from a stand-by utility connection.

Steam is delivered from the center drum of each boiler through an 8-in. line to the 12- and 16-in. station header, just below the boiler operating floor. This location permitted valves in the boiler leads to be placed so that they may be easily operated from the boiler operating floor, and in addition steam leaves the plant at this elevation under an elevated roadway.

The district heating project in Duluth was initiated by J. J. Dwyer, consulting engineer, who made preliminary surveys and plans. Plans were checked and details worked up by the Pillsbury Engineering Co. The Edge Moor Iron Co., as general contractor, furnished the boilers and fuel-burning equipment, and A. R. Robertson, as subcontractor, furnished and installed plant piping and mechanical equipment. Operation of the system is under the management of R. L. Fitzgerald, vice-president and general manager of the Duluth Steam Corp.