

F steam, Fig. 6, feeds three 500-kw turbine-generators, Fig. 1, the i-d fan drives, and two of the three boiler-feed pumps, plus the two major pressure-reducing stations, Fig. 7, operating in series for institution process and laundry needs.

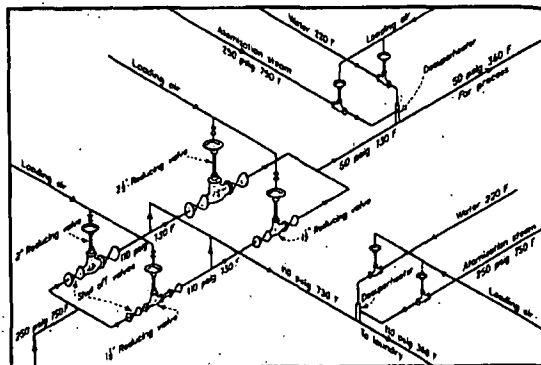
Two turbine-generators are noncondensing, one is condensing, with space for a later condensing unit. Turbines are all multi-stage (see equipment table, p. 83) and multivalve design for throttle conditions of 250-psig pressure and 750-F temperature. The noncondensing units discharge directly into the 50-psig process header and the condensing unit into a surface condenser, Fig. 4, at 1 psia. An i-d cooling tower, Fig. 5, supplies the cooling water for the 2-pass, nondivided condenser.

Electric energy, generated at 2400 v, feeds into metal-clad switchgear onto the station bus for distribution. A double-ended indoor substation, 2400-480 v, supplies station power through two 300-kva transformers. A 2-section 480-v motor-control center contains breakers and motor starters for all power-plant motors. Station lighting comes from two 25-kva, 480-120/240-v, single-phase, 60-cycle transformers.

Daily peak electrical loads occur when laundry and kitchen stores are on the line. Greatest loads develop in winter when heating-system ventilating fans add their demands to laundry and kitchen peaks. In spring and fall one condensing and one noncondensing turbine-generator in parallel balance process steam, electrical loads.

Power Auxiliaries. To get the desired reliability and continuity of services we installed duplicate power-plant auxiliaries, including turbine-driven auxiliary drives on equipment needed for emergency start-up. The i-d fan and its turbine drive, as mentioned, are built to give full-rated output under stoker and dust-collector operation.

Pressure-reducing stations, Fig. 7, employ two air-operated diaphragm-reducing valves in parallel with a single pressure controller. Smaller valve opens first, gives more accurate control during low-load flows. The two desuperheaters, jet design, use a small amount of high-pressure-steam fan atomization. Desuperheating water comes from boiler feed-water discharge headers under control of air-operated diaphragm-type valves. Atomization steam is controlled in like fashion by the same type valve except it does not modulate for the different steam-flow rates. Pressure-reducing and desuperheater stations operate automatically with any instrument setting for



7 Pressure-reducing stations have two air-operated reducing valves running in parallel with one pressure controller. Desuperheaters use atomized steam

desired pressure and temperature, or can be controlled manually from the centralized control panels.

Operation. Centralized control panels, just mentioned, stand on the operating floor for the steam- and electrical-generating equipment. They carry the necessary controls for these major elements, the pressure-reducing stations, building lighting, heating, ventilating and motor-driven auxiliaries. In addition, the boiler feed pump and feedwater piping system are operated on this same floor level. An annunciator notifies the 2-man crew of any irregularities.

With about a year and a half of operation under our belts results have proved good. All services—steam, electrical, energy, hot and cold water, compressed air—vary in demand from season to season and from hour to hour. The laundry, for example, pulls steam and electricity daily from 8:00 am to 4:00 pm except Sunday. During start-up the laundry takes a very heavy hot-water draw. When you add the heating season demands both boilers have to run to meet peaks. In summer at lowest loads one boiler alone can handle the demand at 50% of its rated output.

CORRECTION

In the article, "Hospitals Need Mechanical Know-How" (May 1959, pp. 77-79) Tables I and II, columns 4 and 5 should both be labeled, "Power, Light & Heat Cost," not broken down as shown.

Steam-distribution mains, electric service, 110-F water from two hot-water storage tanks in the power plant, cold softened water from three zeolite water-softeners, compressed air and condensate return mains reach the major buildings through underground tunnels. These tunnels also serve for employee traffic and food transportation.

Troubles have been few, relatively light. At the start, condensate, returned from part of heating system, was contaminated with oil, which had accumulated from using steam engines in the old plant. This condensate we bypassed to the sewer the first few weeks, but now we filter it for feed.

In summer, the condensing turbine-generator meets the electrical energy needs. Exhaust steam from auxiliary-drive turbines, evaporators and pressure-reducing and desuperheating stations supplies 50-psig process steam.

This same condensing turbine plus one noncondensing unit takes care of the fall season load. Machines run in parallel and electrical load is proportioned by manual regulation of the turbine speeds on the switchboard, so nearly all 50-psig process steam comes from the noncondensing unit.

Winter, however, presents a different picture. The 50-psig steam load is greater than the electrical. Then the noncondensing turbines carry the electrical energy part of the load and provide some of 50-psig demand. Turbine-driven auxiliaries and evaporators meet remainder of this process-steam demand with pressure-reducing and desuperheating stations ready for makeup so the steam cycle is highly flexible.

PRINCIPAL POWER-PLANT EQUIPMENT

Rochester State Hospital, Rochester, Minn.

Steam-Generating Equipment:

Boilers, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Wm Brow Boiler Mfg Co
Superheaters, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Wm Brow Boiler Mfg Co
Burners, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Peabody Engineering Co
Combustion, oil and gas, ring-type high pressure gas burners, mechanical-stationing oil burners	Combustion Engineering Co
Refractory, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Phibco Co
Insulation and steel casing	Pratt-Daniel Corp
Induced-draft fans, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	De Laval Steam Turbine Co
Steam turbine, 40 hp, and reduction gear, 150 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	De Laval Steam Turbine Co
Forward-draft fans, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Clange Fan Co
Vane controlled, inlet damper, 48,200-lb air per hr, 7.4-in. wg	General Electric Co
Forced-draft fan drives, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	General Electric Co
Induction motor, 25 hp, 440 v, 3 phase, 60 cycle	Lashy Mfg Co
Oil-pumping assembly	Worthington Corp
Oil pump, 1, duplex, steam driven, 15 gpm	De Laval Steam Turbine Co
Screw type, motor driven, 15 gpm	Lashy Mfg Co
Oil heater	Minnesota Tank & Mfg Co
Blowdown tank, 1	Yarnall-Waring Co
Flash tank, 1	Yarnall-Waring Co
Relief valves	Parish Engineering Corp
Safety valves	Centrifugal Corp
Steam purifier	Permuli Co
Steam CO ₂	

Power-Generating Equipment:

Turbines, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Worthington Corp
Two pass, surface type, 800 sq ft, tube length 12 ft supported from turbine exhaust nozzle, twin-tangent 3-stage air ejector with inter- and after-condenser	Electric Machinery Mfg Co
Reduction gear, 930 hp, double-helical type	Electric Machinery Mfg Co
Generator, 1, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Electric Machinery Mfg Co
Condenser, 1, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Condenser Service and Rings Co
Two pass, surface type, 800 sq ft, tube length 12 ft supported from turbine exhaust nozzle, twin-tangent 3-stage air ejector with inter- and after-condenser	Ingersoll-Rand Co
Cooling tower, 1, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Lilla-Hoffman Cooling Towers, Inc
Induced-draft type, capacity 1200 gpm, from 93 to 80 F; wet bulb 73 F, 1 fan, total capacity 220,000 cfm air, 218 rpm, each driven through Cleveland reduction gear by 18-hp 1750-rpm totally-enclosed fan-cooled 440-v 3-phase 60 cycle Louis Allis Co induction motor	Food Machinery & Chemical Corp
Horizontal centrifugal, capacity 1800 gpm, each 45-ft head, direct-connected to 30-hp, Ideal Electric Co, splash-proof, induction motor, 440 v, 3 phase, 60 cycle, 1750 rpm	Food Machinery & Chemical Corp

Feedwater Equipment:

Desuperheater, 1, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Worthington Corp
Tray type, flow capacity 70,000 lb per hr, storage capacity 6000 lb, heating section vertical with surface-type vent condenser, horizontal storage section	Warren Steam Pump Co
Boiler feed pumps, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Warren Steam Pump Co
4-stage, horizontal, centrifugal pump; capacity, each unit, 90 gpm, discharge head, 970 ft, direct-connected to 40-hp steam turbine, 3550-rpm, 150-psig, 750-F back-pressure, 30-psig	Whitton Machine Co
Boiler feed pumps, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Byron Jackson Co
10-stage, hydroplex, vertical, centrifugal pump; capacity, 40 gpm; discharge head, 990 ft; direct-connected to 30-hp induction motor, 3600 rpm, 440 v, 3 phase, 60 cycle, Louis Allis Co	Byron Jackson Co
Evaporators, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	The Sling Co
Horizontal submerged-tube, bundle capacity, each unit, 3500 lb per hr at 110 psig when supplied with steam at 230 psig, 750 F, and feedwater at 110 psig, heating surface 100 sq ft	Aurora Pump Co
Evaporator feed pumps, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Aurora Pump Co
Horizontal turbine type, capacity, each unit, 8.4 gpm, discharge head, 160 ft, suction head, 100 ft, direct-connected to 1/4-hp, 1750-rpm, Louis Allis Co, splashproof induction motor 440 v, 3 phase, 60 cycle	Food Machinery & Chemical Corp
Condensate-transfer pumps, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Food Machinery & Chemical Corp
Horizontal centrifugal, each 120 gpm, 201-ft head, direct-connected to 5-hp, 1750-rpm, Ideal Electric Co splashproof induction motor, 440 v, 3 phase, 60 cycle	Minnesota Tank & Mfg Co
Condensate-storage tank, 1, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Minnesota Tank & Mfg Co

Air compressors, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Quincy Compressor Co
Two-stage capacity, each unit 92 cfm, 900 rpm, 90-100 psig, dual control for continuous or intermittent operation, driven with V-belt by 15-hp 1725-rpm induction motor, 440 v, 3 phase, 60 cycle	Moorehead Machinery & Boiler Co
Air-receiver tanks, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Moorehead Machinery & Boiler Co
36 in. dia x 8 ft high, ASME Code, welded steel tanks	

Control & Metering Equipment:

Pressure-reducing stations, 750-110 psig and 110-50 psig	Republic Flow Meters Co
Pressure-reducing stations, 50-6 psig	Fisher Governor Co
Desuperheater stations	Taylor Instrument Co
Steam flowmeters:	
Steam generators	Balloy Meter Co
Turbine generators	Republic Flow Meters Co
Process steam	Republic Flow Meters Co
Gas-flow meters	Republic Flow Meters Co
Hot-water storage heaters	Leila Co
Water meters	Worthington Corp
Oil meters	Worthington Corp
Pressure and temperature recorders:	
Steam generators	Balloy Meter Co
Process steam	Republic Flow Meters Co

Electrical Equipment:

Metal-clad Switchgear, indoor	Westinghouse Electric Corp
3 kv, 2400 v, 3 phase, 3 wks, 60 cycle, 1200 amp, 3-pole, removable type	Westinghouse Electric Corp
Control switchboard, duplex	Westinghouse Electric Corp
Tunnel type with all relays on rear	Westinghouse Electric Corp
Circuit breaker	Westinghouse Electric Corp
Generator field, 150-v dc, nonautomatic, 2 pole, single throw	Westinghouse Electric Corp
Power center, indoor, 600 kva, double ended	Westinghouse Electric Corp
Transformers: 300 kva, 3 phase, 60 cycle; high voltage, 2400, delta-connected; low-voltage, 480, delta-connected	Westinghouse Electric Corp
Switchgear: low voltage, metal enclosed, 480 v, 3 phase, 3 wks, 60 cycle	Westinghouse Electric Corp
Power breakers: removable, type DD-35, 600 v, 600 amp, 3 pole, single throw, 2500 ac, electrically operated with adjustable time overcurrent protection and instantaneous trip	Westinghouse Electric Corp
Lighting breaker: removable type, 600 v, 100 amp	Westinghouse Electric Corp
Indoor motor-control center	Westinghouse Electric Corp
Lighting panelboards	Westinghouse Electric Corp

Other Equipment:

Water softening:	
Sodium-zeolite-softener tanks, 3, 7 ft dia x 6 ft high, vertical, flow capacity of each 200 gpm, 70,000 gal between regenerations	Water Softening Service Co
Brine-measuring tank, 1, 36 in. dia x 48 in. high, vertical	Jeffrey Mfg Co
Salt-handling equipment:	
One bucket elevator and screw conveyor, 7 tons per hr	Jeffrey Mfg Co
Bump pumps:	
Duplex unit, each 100 gpm, 18-ft head, direct connected to 1-hp, 1750-rpm induction motor, 440 v, 3 phase, 60 cycle	Aurora Pump Co
Hot-water storage heaters, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Leila Co
Unit, each 48 sq ft heating surface, Bell & Gossett Co, flow capacity, 4000 gph, storage 2000 gal	Leila Co
Oil storage, 4, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Wm Brow Boiler Mfg Co
11-ft-dia x 21-ft-long, horizontal, welded-steel tanks, submerged heating unit, Rose Heater Co	Wm Brow Boiler Mfg Co
Ventilating fans, 3, 10,000 lb per hr, 270 psig, 750 F, 3 drum, bent tube, 3953 sq ft boiler surface, 975 sq ft waterwall surface, 3100 cu ft furnace volume	Westinghouse Electric Corp
Axial duct-type fans, each 12,000 cfm at 70 F, 900 rpm, V-belt driven by 3-hp 1750-rpm induction motor, 440 v, 3 phase, 60 cycle	Sturtevant Div
Heating units:	
3 sections capable of raising temperature of air from -20 to 30 F when supplied with steam at 5 psig, 450 F	McQuay, Inc
Filter bank	American Air Filter Co
Unit heaters	McQuay, Inc
Piping fabrication & erection	Reuben L. Anderson Co
High-pressure valves	Henry Vogt Machine Co
Low-pressure valves	Wm Powell Co
Welding fittings	Ladish Co
Expansion joints	Chicago Metal Hose Div, Flexlines Corp
Pressure-reducing valves	Fisher Governor Co
Flow-control valves	Minnesota-Honeywell Regulator Co
Steam traps	Key & MacDonald, Inc
Safety valves	Parish Engineering Corp
Backpressure relief valve	Cochran Corp
Atmospheric exhaust valve	Atwood Merrill Co
Drainers	Fisher Governor Co

Major Contractors:

Building	Benicks Co
Electrical	Southwest Electric Corp
Architects and Engineers	Ellerbe & Co