

guaranteed to deliver rated output with outside-air temperature below 30 F, so it will be necessary to install supplementary gas unit heaters.

Each generator connects through a "unit-system" arrangement, consisting of a 14,000-kva 67,200/12,470-v 3-phase oil-insulated self-cooled transformer and 600-amp 69-kv oil circuit breakers of 1,000,000-kva interrupting capacity, to a 66-kv station bus. To serve auxiliary equipment a 1500-kva 3-phase 13,200/480-v askarel-insulated self-cooled unit transformer is throat-con-

nected to air-blast circuit-breaker switchgear. Auxiliary 440-v power distributes through the load center to motorized units. A transformer similar to the auxiliary draws from the utility's 12.5-kv distribution system by means of a disconnect switch for start-up and standby of all four units. The buses are designed to carry 2000 amp continuously.

Permian Basin design aims at the lowest practicable investment cost consistent with efficient and reliable operation. Another objective has been to

arrange structures and equipment for minimum operating and maintenance labor will be needed. This is promoted by design compactness and care in both general and detailed arrangement.

Ebasco Services Incorporated has rendered engineering and construction services to Texas Electric Service Co. on this Permian Basin project and similar, double-unit turbine-generator and boiler installation at its Wichita Falls Station. Ebasco is designing and contracting four installations of similar units for other utility-company clients.

PRINCIPAL POWER-PLANT EQUIPMENT

Permian Basin, Texas Electric Service Co

Units No. 1, 2, 3 and 4

STEAM GENERATING EQUIPMENT:

Bollers, superheaters, 4.....	Combustion Engineering Co
Two-drum bent-tube VU, 150,000-lb-per-hr steam at 625 psig, 825 F; 10,887 sq ft heating surface in boiler, 1160-sq-ft waterwalls, 2210-sq-ft superheater, 8100-sq-ft furnace volume, 22,100 Btu per hr per cu ft heat release or 112,500 Btu per hr per sq ft projected water-wall surface	
Air heaters, 4.....	Combustion Engineering Co
Ljungstrom type, 20,100 sq ft	
Burners, 4 per boiler.....	Forney Engineering Co
Combustion gas and oil	
Forced-draft fans, 1 per boiler.....	American Blower Co
Motor driven, 25,000 cfm	
Induced-draft fans, 1 per boiler.....	American Blower Co
Motor driven, 90,500 cfm	
Chimneys, 2.....	Mosher Steel Co
Steel with brick lining, 10-ft 8-in. ID, 150 ft high	
Automatic combustion control.....	Republic Flow Meters Co
Air compressor.....	Ingersoll-Rand Co
Fuel-oil burner pumps.....	Worthington Pump & Machinery Co
Fuel-oil heater.....	Graham Manufacturing Co
Fuel-oil strainers.....	Elliott Co

POWER-GENERATING EQUIPMENT:

Turbine-generators, 4.....	Elliott Co
11,500/12,500-kw 1500-rpm, condensing-regenerative turbine, 600 psig, 825 F, 13,625 bhp, 0.8 pf, 13,200 v, 50 cycles, 3 phase, air cooled	
Generator air coolers.....	Schutte-Koerting Co
Lubricating-oil coolers.....	Bell & Gossett Co
Generator air circuit breakers, 4.....	General Electric Co
60-kv 600-amp 1,000,000-kva rating at 13.3 kv	
Turbine generator cranes, 2.....	Colby Steel & Engineering Co

FEEDWATER SYSTEM:

Water-treating equipment.....	Permian Co
Feedwater control.....	Republic Flow Meters Co
Feedwater heaters, 2.....	Lummus Co
Low-pressure, one for each unit; intermediate-pressure, one for unit No. 3 and one for unit No. 4; high-pressure, one for each unit	
Desaerating heaters, 2.....	Elliott Co
Trey type, 300,000 lb per hr, one for two units	
Evaporators, 2.....	Oricom-Russell Co
Horizontal, 7500 lb per hr output	
Evaporator preheaters, 2.....	Elliott Co
Evaporator feed pumps, 2.....	Ingersoll-Rand Co
Boiler feed pumps and accessories, 4.....	Ingersoll-Rand Co
Boiler feed pump turbine, 1.....	Worthington Pump & Machinery Corp
Condensers, 4.....	Elliott Co
11,000 sq ft, 2-pass, air-cooled water box	
Condensate pumps, vertical, 2 per unit.....	Ingersoll-Rand Co
Circulating water pump, 1 per unit.....	Ingersoll-Rand Co
Horizontal, volume, single stage, 29.8 cfs	
Condensate-transfer pumps, 2.....	Turbine Equipment Co

Cooling-towers, induced draft, 2..... Marley Co || 61.3 cfs each, 14-F wet bulb approach, six 50-hp fans each | |

VALVES, PIPING AND JOINTS:

Boiler nonreturn valves.....	Golden Anderson Valve Specialty Co
Safety and relief valves.....	Crosby Steam Gate & Valve Co
Reverse-current valves.....	Manning, Maxwell & Moore
Flow-control valves.....	Riley & Mott
Pressure-reducing valves.....	Manning, Maxwell & Moore
Altitude valves.....	Golden Anderson Valve Specialty Co
Pressure-reducing valves.....	Benjamin F Shaw
Rubber expansion joints.....	U. S. Rubber Co
Steel expansion joints.....	Zellmer Brothers & Johnson

METERS, INDICATORS & REGULATORS:

Pressure gages.....	Crosby Steam Gate & Valve Co
Indicating thermometers.....	Manning, Maxwell & Moore
Boiler meters.....	Bell & Gossett Co
Recording instruments.....	Leeds & Northrup Co
High-water alarm switches.....	Marshall
Temperature regulators, oil heaters.....	Spence Engineering Co
Differential and vacuum gages.....	Manning, Maxwell & Moore
Flow indicators.....	Schutte-Koerting Co

ELECTRICAL EQUIPMENT:

Main transformers, 4.....	Pennsylvania Transformer Co
14,000 kva, 67,200/12,470 v, 3 phase, askarel insulated, self-cooled	
Auxiliary transformers, 5.....	Wagner Electric Co
1400 kva, 13,200/480 v, 3 phase, oil insulated, self-cooled	
Lighting transformers.....	General Electric Co
Switchboards.....	Dayco Electric Co
Forced-draft-fan motors, 4.....	Elliott Co
180 hp, 440 v, 1800 rpm, squirrel cage	
Induced-draft-fan motors, 250 hp, 440 v, 900 rpm.....	Elliott Co
Boiler feed pump motors, 3, 200 hp, 440 v, 3600 rpm.....	Elliott Co
Circulating pump motors, 4.....	Elliott Co
250 hp, 690 rpm, 440 v	
Vertical condensate pump motors, 2.....	U. S. Motors Co
Motors, miscellaneous.....	Westinghouse Electric Co
Surge protection equipment.....	General Electric Co
Battery.....	Electric Storage Battery Co
Cable, power, control and lighting.....	Amesbury Wire & Cable Co
Electric ground cable.....	General Electric Co
Iron conduit.....	General Electric Co
Fibre conduit.....	Westinghouse Electric Co

MISCELLANEOUS:

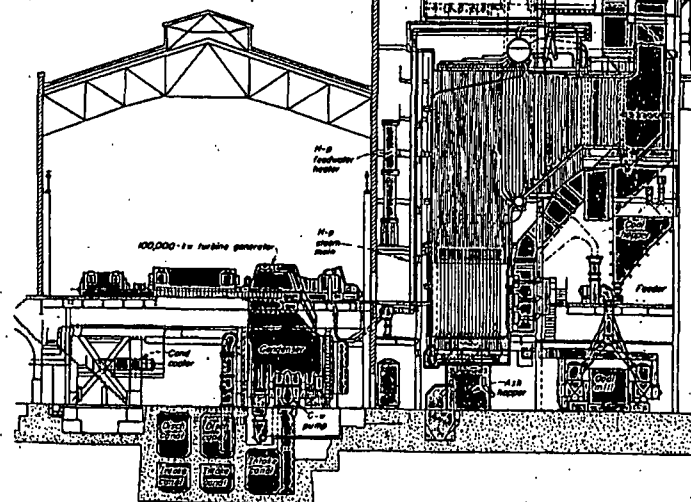
Heat pump.....	Drayer-Hamilton Co
Control air compressor.....	Republic Flow Meters Co
Insulation.....	Johns-Manville

CONSULTING ENGINEERS:

Ebasco Services Incorporated	
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ESSEX: UNIT NO. 1

Public Service Electric and Gas Co., Newark, N. J., has second unit in U. S. A. using 1000-F throttle steam. Many unique features mark installation replacing old unit in existing plant; no auxiliary steam, 8 bleed points, 23-inch turbine blading



COMPACT ARRANGEMENT OF NEW UNIT results from placement of 22,500-kw turbine-generator and four boilers. Most auxiliaries for steam generator are outdoors on boiler-room roof

Dec. 1947, Public Service Electric and Gas Co placed in service its new Unit No. 1, rated at 11,500 kw, 1250 psig, 1000 F. This is the first unit in the country to utilize 1000-F steam, a single-flow high-pressure and double-flow low-pressure turbines driving a 22,500-kw hydrogen-cooled main generator and 7500-kw air-cooled auxiliary generator. A common 500-hp motor drives separate exciters for small and large generators.

With wide-open governor the unit produces a maximum output of 118,000 kw indicating a wide margin between rating and capability.

The unit operates at 3600 rpm despite its size and establishes a record by being the first turbine to use 23-in. blades, in the last stage of the low-pressure double-flow turbine. This factor contributes both to compactness of the machine and efficiency of performance.

No. 1 presents a vivid example of the advance in the art of power engineering. The turbine-generator and its single steam generator capable of 118,000-kw output occupy the same ground area as the predecessor 22,500-kw turbine-generator and four boilers. The unit uses the original turbine-room building but it was necessary to provide a new building for the steam generator. Furthermore, the new unit's con-

denser uses the same circulating water tunnels as the original 22,500-kw unit it replaces, the water requirements being practically identical.

Steam Generator. The radiant boiler has a maximum continuous steam capacity of 900,000 lb per hr at a design pressure of 1500 psig and 1000-F temperature. Three ball mills supply the 12 combination pulverized-coal and mechanical atomizing oil burners that fire the 47,800-cu-ft slag-tap furnace. A center wall divides the furnace into two equal volumes up to the entrance of the boiler convection surface. In the flame area the waterwall tubes forming this wall are twisted to form large-area connecting ports between the two furnace