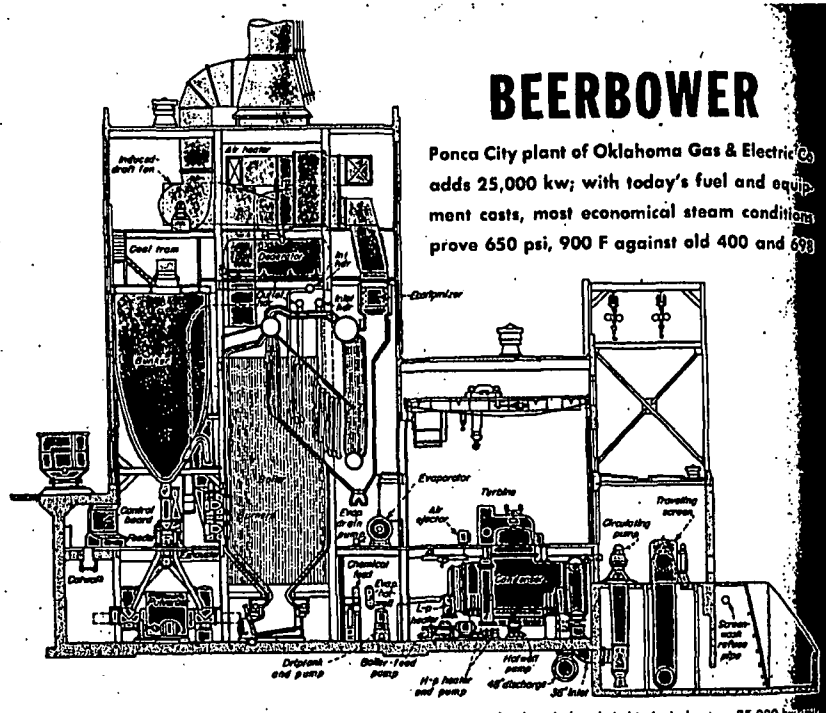
BEERBOWER

Ponca City plant of Oklahoma Gas & Electric Co. adds 25,000 kw; with today's fuel and equipment costs, most economical steam conditions prove 650 psi, 900 F against old 400 and 698



CROSS SECTION shows new 3-drum radiant boiler No. 3 with economizer and regenerative air heater. Forced-draft fan is on same level as induced, behind air heater; 25,000-kw No. 2 has condenser across its axis. Note vertical cir

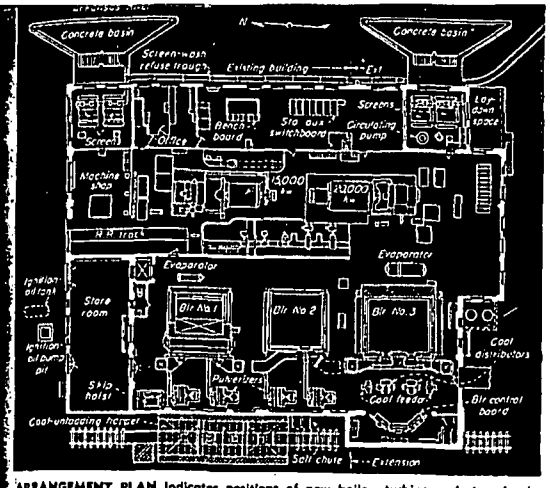
▶ **Located near Ponca City**, center of western Oklahoma's petroleum industry, Lincoln Beerbower Station was originally designed to burn petroleum coke from a local refinery, with coal and gas as supplementary fuels. Later, gas became available and petroleum coke was the standby fuel. In the initial installation, made in 1929, two 150,000-lb-per-hr steam generators supplied a 15,000-kw turbine-generator. Provisions were made for handling and firing both solid and gaseous fuels, and the problems of burning fuels of such different characteristics were solved by suitable furnace design. With relatively low-cost fuels, and at the then-existing state of the art, most economical steam conditions for the first unit worked out to be 400 psi and 698 F.

Changed Conditions. Since then, importance of petroleum coke as a fuel for this plant has declined. Costs of coal and gas have risen. Thus, when postwar extension of this plant was studied, higher pressure and temperature were indicated. When extension was authorized, economical balance between fuel and investment costs dictated relatively modest pressure increase, to 650 psi, and going to 900 F.

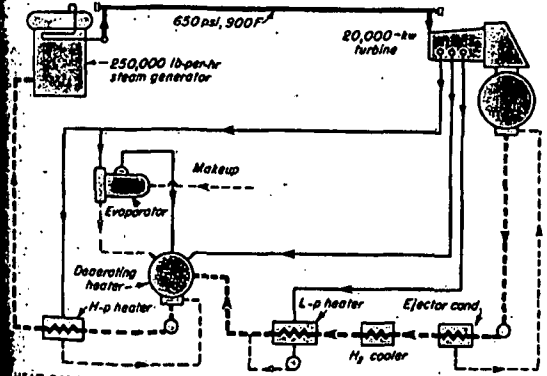
The extension, which goes into operation some time this fall, consists of a single 250,000-lb-per-hr steam generator and a 25,000-kw turbine-generator. The existing building was extended approximately 60 ft. Operated essentially as a unit installation, the new steam generator and turbine make use of water-treatment and fuel-handling facilities installed for the first unit. The section above shows the general arrangement of the new unit, while the plan on the facing page indicates relation of new equipment to old.

Steam Generator. No. 3 steam generator is a 3-drum radiant design, with pendant superheaters having condenser temperature control. Tube bundles in superheater inlet header receive cooling water from the boiler-feed discharge line, ahead of the economizer. Cooling action condenses part of the steam controlling quality of steam entering superheater as a means of maintaining desired temperature at the superheater outlet. Because water flow through tube bundles may, under some operations, represent a substantial percentage of total feedwater flow, two regulating valves are installed: one in the line to the tube bundles and one in main feed line just ahead of economizer.

The fully watercooled furnace has hopper bottom, from which ash is sluiced by a hydraulic system. This also serves the soot hopper. The furnace volume of 17,000 cu ft yields a corresponding heat release of 18,850 Btu per cu ft per hr. Two ball-mill pulverizers supply four burners, which also fire natural gas. Draft system consists of two forced- and induced-draft fans for the boiler at the level of the hot-air tal regenerative air heater. Hydraulic couplings provide volume control for constant-speed-motor drives. Automatic combustion control is air actuated



ARRANGEMENT PLAN indicates positions of new boiler, turbine and river intake relative to existing equipment. Note new boiler control room for all three units



HEAT BALANCE: New turbine has three bleed points supplying low-pressure closed heater, deaerator and high-pressure heater. Note simplified hookup of evaporator

Control Room. The extension houses a new boiler control room for all three steam generators. Three dust-tight bench panels carry indicators, recorders and controls for each steam generator. On the panel for No. 3, the upper vertical section mounts the various operating meters, the top bench slope ammeters, and the main bench slope selector valves and switches. Relays and other auxiliary devices are under the bench. The full complement of operating instruments includes a steam-temperature recorder and indicator with high-temperature alarms and a boiler-drum-level recorder and controller provided with high- and low-level alarms.

Coal from Oklahoma fields, and the local petroleum coke, come to the plant by rail. Cars discharge into a track hopper. Coal is crushed and raised by skip hoist to a tramway running over the suspended steel bunkers (see section). The tramway was extended for the new unit.

Feedheating Cycle. Turbine-generator No. 2 has three bleed points and the feedwater-heating cycle (see diagram) is relatively simple and straightforward. A vertical hotwell pump discharges condensate through an ejector condenser and generator hydrogen cooler to the low-pressure closed heater, which receives steam from the lowest bleed point —12.8 psia at full load. The middle bleed point—45 psia—supplies the deaerator. The three motor-driven boiler-feed pumps take suction from the deaerator hotwell and discharge through the high-pressure closed heater. The deaerator receives drains from both closed heaters; ejector drains go back to the condenser hotwell. Boiler steam, through a pressure-reducing valve, holds deaerator at 2 psi minimum.

In the simplified evaporator hookup, both drains and evaporation go to the deaerator. Steam supply comes from the top bleed point (154 psia), which also serves the high-pressure heater. Continuous blowdown is automatically controlled by a conductivity cell. Sample water flow goes through a cooling unit, which is thermostatically controlled, and thence to the conductivity cell, which actuates the blowdown valve. Concentration in the evaporator thus regulates rate of blowdown.

Water Treatment. Makeup for the evaporator comes from filters and softeners installed for boilers 1 and 2. Wells and springs supply raw water. For internal treatment in boiler 3, a portable air-motor-driven mixer and dissolving tank discharge into a feed tank supplied with water from the main boiler-feed line ahead of the regulating valve. Sufficient pressure differential is thus available to inject chemical feed into the boiler drum. A complete sampling system is provided for main steam line, superheater inlet header, front and mud drums, condenser hotwell, boiler-feed-suction line and evaporator vapor line. Degassers and conductivity cells are installed for main-steam, evaporator-vapor and boiler-feed-suction samples; a pH cell is also provided for the boiler-feed-suction samples. Cooling-water valves are all thermostatically controlled.

Intake System. Circulating water for the horizontal cross-flow 2-pass condenser comes from the Arkansas River. The new unit has its own intake, a concrete basin having a trash rack. Stop logs precede and follow the traveling screen. Monorail hoists, on steelwork above the building section housing the circulator and screens, serve to lift out equipment for servicing. Roof hatches give access.

The vertical propeller-type circulating pump discharges into a 36-in. condenser-inlet line. Located across the turbine axis, the condenser discharges into a 48-in. line, which is joined by a line from No. 1 condenser. Discharge is downstream from the plant.