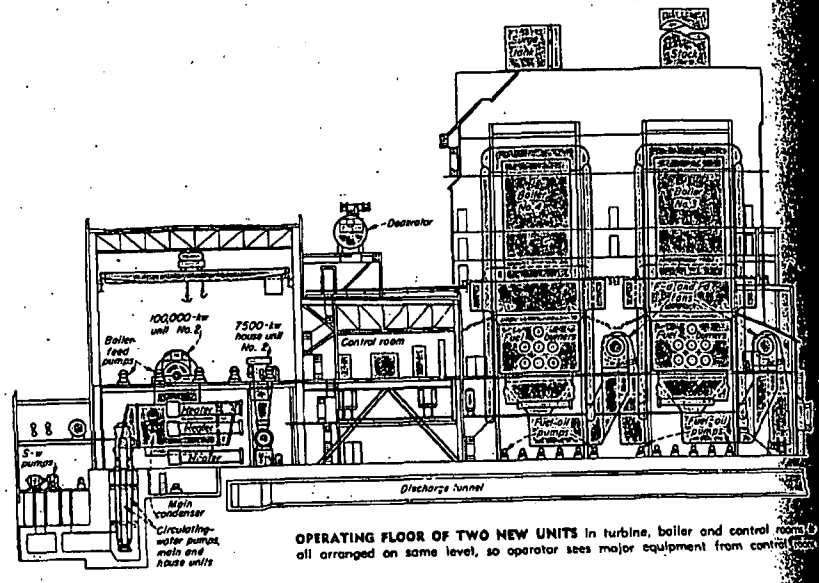
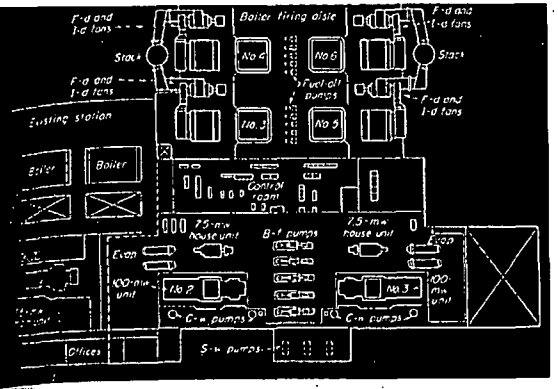
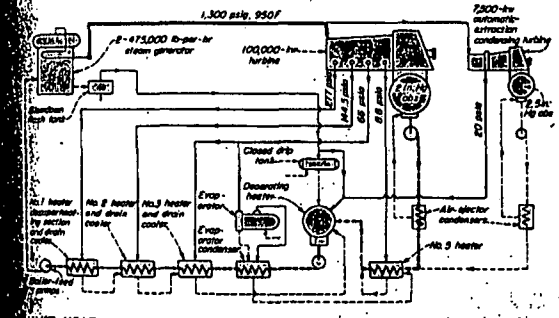


OPERATING FLOOR OF TWO NEW UNITS in turbine, boiler and control rooms all arranged on same level, so operator sees major equipment from control floor



MAJOR APPARATUS OF TWO NEW UNITS face each other about a center line running through boiler firing aisle. Boilers are semi outdoor; most of plant is housed



UNIT HEAT BALANCE INCLUDES automatic-extraction condensing house turbine that supplies the bulk of deaerating steam, absorbs excess l-p steam at low loads

STATION P

Pacific Gas and Electric Co erects extension in San Francisco that overshadows existing plant. Fast load-pickup needs dictate many design features of two new units

▶ AS PART OF THE VAST SYSTEM that serves much of the state of California, with hydro stations as the predominant energy source, the duties of the new units at Station P differ from most steam plants. The 215,000-kw extension, scheduled to go into operation in late 1948, will at times run at low loads, and yet may be called on to develop full load in a matter of 20 to 30 seconds. Equipment must be properly selected for this service; for instance, four steam generators are better than two; fairly high steam pressure of 1380 psig proves more favorable than the lower pressures; the seven oil burners serving each boiler furnace have a 20:1 load ratio. Attemperators in the lower boiler drums serve to prevent excessive thermal shock on the turbines during periods of quick pickup.

The forced- and induced-draft fans and four of the boiler-feed pumps will operate at all times at full speed, ready for full-capacity demands. Automatic controls provided wherever possible insure rapid functioning of all unit elements.

Centralized Control. The control room features the general layout; it puts the operator at the key point close to house turbines, boiler feed pumps and main turbines on one hand, and the boiler-room firing aisle on the other. The fundamental plan places the main turbine-generators lengthwise in the turbine room with the steam ends facing one another. This permits a convenient symmetrical arrangement of main steam piping from the steam generators.

Auxiliary equipment is divided between two levels. Boiler-feed pump units and feedwater evaporators are in the turbine room on the operating floor, while all other auxiliaries are on the ground floor between the condensers and the boilers. Salt-water cooling pumps are in a pump house adjacent to the wall of the condenser area.

Turbine Room. Two 100,000-kw units with corresponding 7500-kw house turbines are being installed. The tandem compound double-flow main turbines as well as the automatic-extraction condensing house turbines, use steam at 1300 psig and 950 F. Four bleed points supply steam to four closed feedwater heaters and an evaporator.

The house units provide an independent electric supply for station auxiliaries, and will always be in operation supplying extraction steam at about 5-psig pressure to the deaerating feedwater heaters. Normally, the evaporator takes its steam from the house unit of the corresponding main unit. Whenever moderate amounts of extra 5-psig steam become available it can be inducted in the bleed opening of the house unit.

The single-pass main condensers have 40,000 sq ft of surface in aluminum-brass tubes arranged in divided water boxes. Steam-jet air ejectors serve the condensers, which have deaerating storage-type hotwells. Each main unit has two 1500-gpm condensate pumps.

Two gravity tunnels supply circulating water from San Francisco Bay and are sectionalized so any portion may be cleaned with only one main unit out of service. Condenser water discharges through concrete tunnels. Two vertical circulating-water pumps serve each main condenser at the rate of 40,000 gpm each when operating in parallel at 595 rpm against a total head of 31 ft. The single-pass house unit condensers have divided water-boxes. Each condenser contains 4000 sq ft of aluminum-brass tubes, the circulating water being supplied by one vertical 9000-gpm pump. Two 170-gpm condensate pumps serve the house units.

The original intake tunnel has been widened to the screen-well entrance. Two larger wells have been added to the existing four wells. Traveling screens operate automatically in response to water differential controls. Both intake tunnels can be used for all units.

Steam Generators. Two radiant boilers with 475,000-lb-per-hr steam rating and 517,500-lb-per-hr steam capability serve each of the two main turbines and their corresponding house units. Steam generators located outdoors have an umbrella roof, but the firing aisle is completely enclosed. This was considered necessary in view of the fog and temperature range prevailing in this area. Each steam generator has a 2-section superheater with intermediate drum-type attemperator, an economizer and a tubular air heater.

Each of the steam generators has one draft-fan unit consisting of one overhung single-inlet forced-draft fan, one double-inlet induced-draft fan and a 2000-hp 4160-v driving motor on a single shaft. These units are on the east side of each boiler at the operating-floor level. The two boilers of each unit are served by a single gunite-lined steel stack, 15 ft 4 in. dia by 200 ft high. Stacks are self-supporting from the ground.

Structure. Steps had to be taken to guard against the effects of earthquake shocks. In the boiler area the footings are tied together by reinforced concrete beams. The building was designed to resist shocks with a seismic factor of 0.2 G, including half of the live loads.

While boilers and fans are essentially outdoors, the remainder of the equipment is fully housed in more or less conventional fashion.

Electrical System. Each of the 13.8-kv 3-phase 60-cycle main generators connects to a step-up transformer bank of three 29,800/37,250-kva single-phase 115-13.8-kv transformers. Each 13.8-kv generator lead is tapped to supply a station-service transformer bank of three 3,334/4,444-kva single-phase 13.8-4.16-kv transformers.

Each main generator has a 300-kw motor-generator set for excitation with direct-connected amplidyne; in addition, there is a spare set for emergency.

The motor-driven station auxiliaries are supplied at 4160 and 480 v. Motors larger than 125 hp are rated 4160 v, the smaller motors 480 v. Two transformer banks and the two house units supply the station auxiliary power. These sources connect to the 4160-v switchgear on the ground floor under the control room. From this same location four metalclad unit substations supply the circuits running to 480-v load-center switchgear at strategic points throughout the plant. Dry-type transformers operating at 480-208/120 v supply the plant lighting system.

A 60-cell 125-v storage battery and two 25-kw battery-charging generator sets provide for circuit-breaker-control circuits, for valve operation and emergency lighting. Distribution switchboard is in the central control room.

A special annunciator signal system consists of banks of large light-type indicators mounted above the various control boards and in the control-room walls between turbine and boiler rooms. These will prove valuable under emergency conditions.

Table of principal power-plant equipment is given on following page.

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