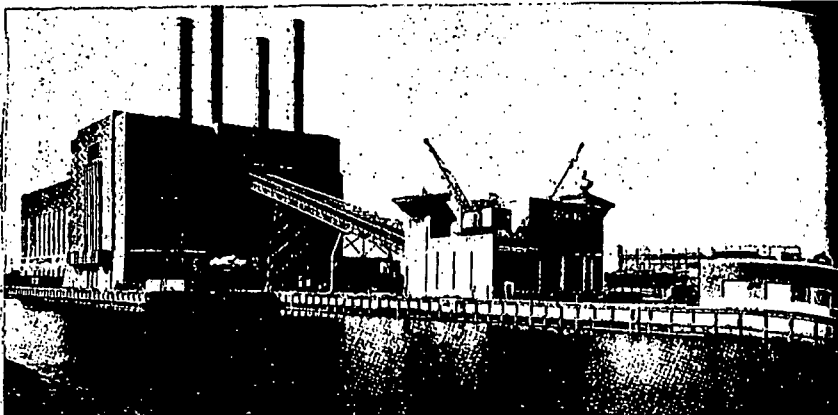




SOUTHWARK STATION NOW HOUSES two units representing one half of the projected ultimate development of 600,000 kw. Each stack serves one 850,000-lb-per-hr boiler operating at 925 psig, 900 F. Coal unloading capacity equals 700 t per hr.

Use of House Turbines Marks Design of Philadelphia's Southwark Station

This plant features largest main turbines to be currently installed. They are arranged on unit system with two boilers per turbine. Low-pressure boiler feed pump partly raises feed pressure before it flows through all heaters at constant head

By A R PETTIT and F W MYERS, Philadelphia Electric Co

THE SOUTHWARK STATION of the Philadelphia Electric Co, in the southeast section of Philadelphia on the Delaware River (2501 South Delaware Ave), has recently been placed in operation. The site, ultimately accommodating four 150,000-kw condensing turbine-generators, has at present only two units. No. 1 went into commercial operation on August 1, 1947, No. 2 will be starting about now.

Main Units. Westinghouse cross-compound double-flow machines are rated at 150,000 kw at 0.8 pf with a 65,000-kw h-p element and a 85,000-kw l-p element. The h-p single-flow 19-stage turbine turns at 3600 rpm, the l-p double-flow 22-stage turbine at 1800

rpm. Generators are totally-enclosed hydrogen-cooled single-winding machines with direct-connected main and pilot exciters. Generation takes place at 13,800 v, 3 phases, and 60 cycles with a 250-v field.

The cross-compound double-flow machine was selected after a study showed it to have the lowest heat rate and the lowest price except for a single-casing machine.

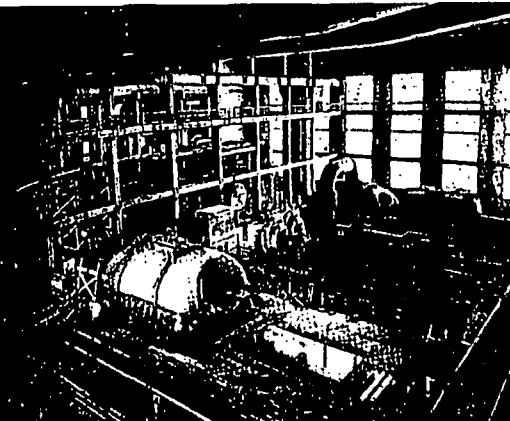
Throttle steam condition of 850 psig, 900 F was selected after cost comparisons with 850 psig-925 F, and 1250 psig-925 F showed that operating cost savings would not be large enough to justify the additional investment. These studies were made in 1940

and construction started in 1941. Because of the war, it was stopped in the summer of 1942 and not resumed until the fall of 1944.

In establishing unit capacity, 150,000 kw was chosen as it was felt that step up to that of the existing 165,000-kw machine at Richmond Station was reasonable with a company installed capacity of over 1,200,000 kw and as interconnected regional system capacity of about 5,000,000 kw. The 150,000-kw units made it possible to provide the most generating capacity in the available space.

House Turbines. An independent auxiliary turbine-generator for each main unit will normally supply power for main station auxiliaries. This will provide maximum reliability for auxiliary power by having its source free from outside system disturbances.

Allis-Chalmers units are 12,500 kw, 3600 rpm, noncondensing steam turbines driving 0.8-pf air-cooled generators with main and pilot exciters. The single flow turbine has one impulse stage and 29 reaction stages and operates with main steam conditions of 850 psig and 900 F at the turbine throttle.



UNIT NO. 1 IN REAR, NOW OPERATING, will be duplicated by Unit No. 2, under construction, in foreground. Feedwater heaters are located beyond the columns

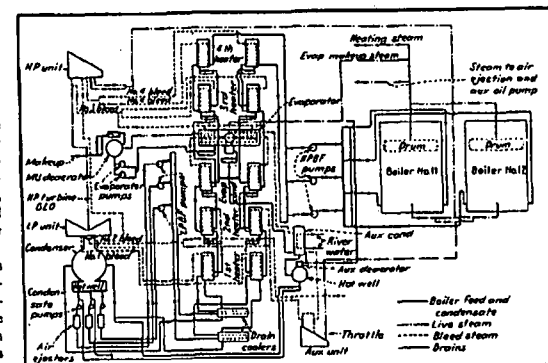
Unit System. This arrangement was chosen for (1) simplicity by omitting tie between units, and (2) reliability by keeping the difficulties of one unit isolated from the others and the elimination of many valves. Unit parts completely separated from the others are main turbine, house turbine, feedwater systems, main steam systems, soot-blower systems, drip systems, draft systems, dust-collector systems, stacks, generator cooling-water systems and circulating-water systems between river and condenser.

Heat Balance. Diagram below shows the heat balance for a station net output of about 150,000 kw, the most efficient load. The scheme makes best use of bleed steam as set by turbine design for producing feedwater temperatures suitable for the boiler design. The auxiliary turbine exhaust discharges into (1) main unit second feedwater heater and bleed point (2) auxiliary condenser and (3) auxiliary deaerator. Normally, with the main unit operating, the exhaust passes to the second heater bleed lines where it furnishes these heater demands and discharges the excess into the main unit turbine after the 5th stage of the low-pressure element. Induction valves protect this bleed point against steam flow from the auxiliary unit after the main unit has tripped out.

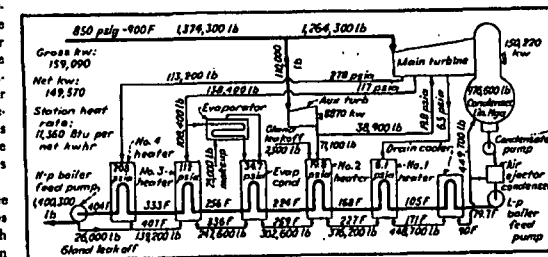
Feedwater System. There are three condensate pumps, three l-p feed pumps and three h-p feed pumps. Two of each set of units are needed for operation under maximum load. From the condenser, condensate flows through the

condensate pumps and l-p feed pumps. Pressure developed delivers the feedwater through the drain cooler and all heaters to the suction of the h-p feed pump without danger of flashing. The two rows of heaters of each unit have connections between them only at the ends, with no valves between heaters in either row. During trouble in either line of heaters, the whole faulty line is taken out of service by closing the valves at both ends. With only one line of heaters in service a maximum load of about 150,000 kw can be carried on the unit. Valving in the ring loop at the h-p feed pump discharge insures water supply to at least one side of each boiler should trouble develop with any pump or the piping.

Steam Piping System. Main-steam-system valving allows isolating either boiler, the main unit or the house tur-



MAIN PIPING DIAGRAM FOR ONE UNIT shows absence of ties with other unit. Parallel feedwater circuits through heaters can be shut off only at feed pumps



AUXILIARY TURBINE EXHAUST DISCHARGES to both No. 2 heater and into the main turbine at 19.8 psig. Note the location of l-p and h-p boiler feed pumps