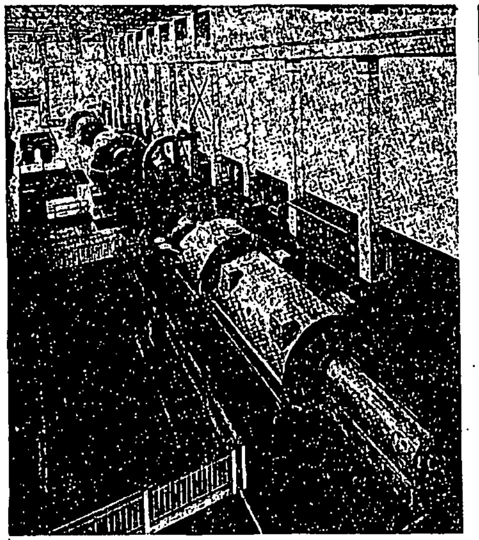
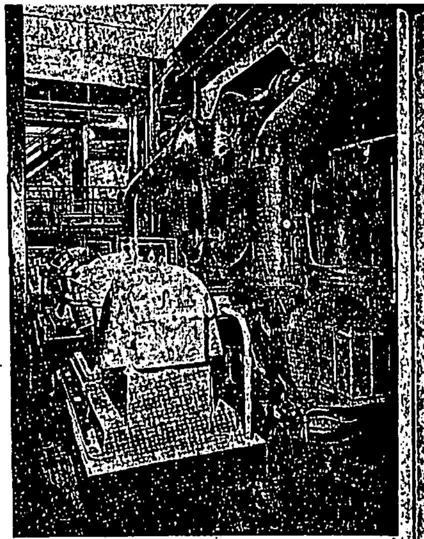
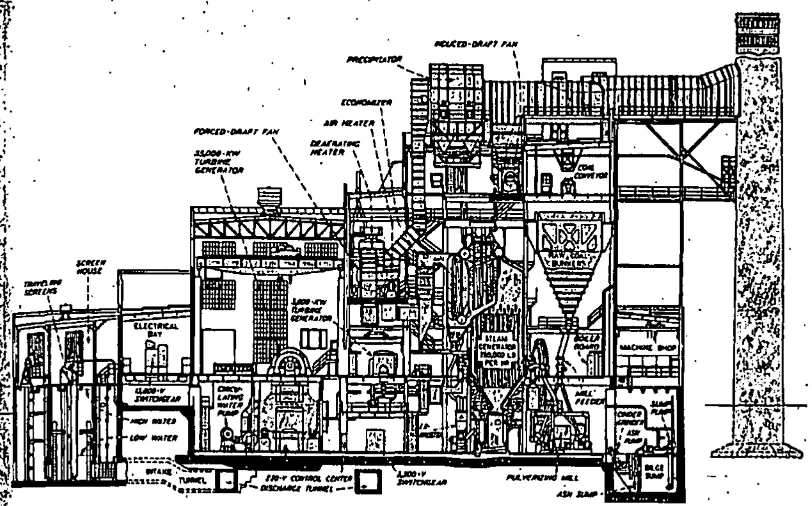


NEW NO. 3 UNIT RATED 35,000 KW. In foreground, can produce a maximum of 43,750 kw with 850-psig 900-F steam



MAIN CONDENSER COOLING-WATER CIRCUIT is fitted with reversing valve for backwashing unit while carrying generation



TWO STEAM GENERATORS, No. 7 and 8, serve the new condensing and backpressure turbines. Condensers in the saturated steam header of the superheater, using feedwater for cooling, control outlet-steam temperature. Pulverized coal is the fuel

High-Pressure Boilers Serve New Condensing and Topping Turbines

New high-pressure unit generates enough steam to help develop full load on existing low-pressure units using topping turbine to reduce pressure. Station name was changed to honor operating superintendent who has run plant since first constructed

By THOMAS Y MULLEN, *Sponsor Engineer, Gilbert Associates, Inc.*

▶ ON JUNE 25, 1948, the former Middletown Station of the Metropolitan Edison Co in Middletown, Pa. was renamed the Crawford Station in honor of Harold J Crawford, plant superintendent of the station since the first unit was placed in operation. This station, on the west shore of the Susquehanna River, was the first central station in this country to use all pulverized-bituminous coal-fired boilers. Crawford Station is known for its early experiments in pulverizing and burning anthracite coal dredged from the bottom of the river adjacent to the station.

The "fishtail" burners and air-cooled refractory walls, which were in the original boilers here, have been largely displaced by turbulent burners and watercooled furnace walls in recent pulverized-bituminous-fired boiler installations. Burners like those included in the original Middletown installations and similar air-cooled refractory walls, or sections of furnace walls, are, however, used in some of the most recent anthracite installations to maintain ignition.

New Unit. Design of the latest Crawford extension started in 1941 when the Metropolitan Edison Co., foreseeing need for added generating capacity in this area, contracted with The Atlantic Utility Service Corp (predecessors of Gilbert Associates, Inc) for engineering and design of a plant extension incorporating one 35,000-kw turbine-generator and two 200,000-lb-per-hr steam-generating units and all associated equipment.

Engineering and design work proceeded on this basis until 1942 when the federal government refused to grant priority for continuation of this project. The Edison Co realized that the need for this extension would be increased by this delay, and also excessive cancellation charges would be encountered if the project were dropped. Hence, hold orders were placed on all equipment contracted for, and engineering and design suspended until priorities could be secured.

In June 1945, when priorities were finally obtained, work was resumed. Alterations to existing No. 2 turbine had increased its capacity from 30,000 to 35,000 kw. But the poorer-quality coals, which were now being burned as a result of the war, made it impossible for the existing boilers to produce sufficient steam to operate the turbines at full capacity, which was desirable.

Consultation with the Foster Wheeler Corp revealed that steam-generator design had not proceeded so far that it was impracticable to change their capacity. Accordingly, these units were increased from 200,000 to 250,000 lb per hr each. In addition to the 35,000-kw (43,750-kw maximum) turbine-generator, a 3000-kw (3750-kw maximum) pressure-reducing turbine-generator exhausting to the old plant's main steam header was purchased.

Steam generators were designed for 1000-psig maximum allowable working pressure to deliver steam at the superheater outlet at a pressure of 875 psig and 910 F temperature.

The 35,000-kw turbine was designed for throttle steam at 850 psig and 900 F, exhaust to a condenser, and with bleed points in the 7th, 10th, 14th and 18th stages. The 3000-kw turbine was designed to receive steam at 850 psig, 900 F, and to exhaust at a backpressure of 330 psig. Since the exhaust from this unit has a temperature of about 705 F at rated load, condensate is used to desuperheat it to a temperature of 650 F before entering the steam header serving No. 1 and 2 turbines at a pressure of 325 psig.

The small turbine will normally operate at a throttle flow of 100,000 lb per hr but the stage heaters, pumps, desuperheating station, piping, etc, have been designed to accommodate flows up to 150,000 lb per hr during periods when one boiler is out of service in the low-pressure section of the plant, or when peak loads occur.

Heat Balance. The heat-balance diagram, page 66, shows the major cycle conditions with full capability developed on the large turbine and 150,000-lb-per-hr steam flowing through the small topping unit on its way to units No. 1 and 2.

Condensate leaving the hotwell passes through a low-head condensate pump, inter- and after-condensers of the evactor, the 18th-stage closed heater, and discharges into a tray-type deaerating heater. The deaerating heater, operating at constant pressure of about 2 psig, serves as evaporator condenser for all makeup to the new extension. Supplementary steam to maintain constant deaerator pressure bleeds from the 14th stage at full load and from the 10th stage at light loads. A diaphragm-operated valve controls this steam flow from the turbine. When evaporator vapor exceeds that needed for constant deaerator pressure the diaphragm valve closes completely and a bypass valve around the 18th-stage heater automatically opens to the extent needed to maintain constant deaerator pressure by admitting cooler condensate.

Choice of a fixed-pressure deaerator instead of a "floating" deaerator was based on (1) keeping water flow to the boiler feed pumps at a constant low temperature (2) preference for a loop seal for the deaerator, thus eliminating possibility of flooding 14th or 10th stage bleed lines because of overflow valve failure (3) simplifying condensate-return system from existing station, which is equipped with constant-pressure deaerators (4) eliminating venting and boiler-feed-pump turbine-shaft sealing problems that would be encountered when pressure within a floating-type deaerating heater would be below atmospheric pressure.

The deaerator discharges to three boiler feed pumps, 300,000-lb-per-hr capacity each, connected in parallel.