THE PHILO POWER PLANT

By JOHN F. BYRNE, '27

THE Philo plant was the first high pressure high temperature steam plant placed in operation in the United States. Since being placed in operation in 1925, it has maintained an operating thermal efficiency of 24 per cent., that is, the plant consumes only about 14,000 B. T. U., or about one pound of high grade coal for each kiolwatt hour placed on the transmission lines. At the time of completion, it was the most efficient steam plant in the United States, although at the present time this distinction is held by the Columbia Station at Cincinnati, Ohio.

This remarkable efficiency has been obtained by the use of high pressure, high temperature steam, the nominal pressure and temperature being 600 lbs. and 720° F. The steam is admitted to the turbine at about 550 lbs. and passes through seven stages of the turbine where it exhausts at 100 lbs. and 350° F. The steam is then led back to the reheat boiler, which is merely a large superheater, and again the temperature is brought to 720° F. The steam then re-enters the turbine at the eighth stage, passes through fifteen more stages and exhausts from the turbine into a surface condenser, the exhaust pressure being 1 in. mercury absolute. The regenerative cycle is used, that is, steam is bled from three points in the expansion cycle for feed water heating.

Coal for the station is brought in by rail, or by river barge, and a large storage space has been provided. There is provision at this station to store about 50,000 tons of coal in open air, while an under water storage space of 300,000 tons capacity has been provided. The coal entering the station is loaded onto a conveyor by a Gantry crane, and then is taken to bunkers over the boilers. The amount of coal is weighed by a larry as it enters the hoppers in front of the boilers.

The boilers are 1,400 horsepower Babcock and Wilcox, equipped with superheaters, Coxe traveling grate stokers, economizers, and air preheaters. Each boiler has two forced and two induced draft fans, each fan being equipped with a high speed, high horsepower motor, and a lower speed medium horsepower motor for convenience in combustion control. The boilers are arranged in two batteries of four each, with a center firing aisle. The boiler control boards are complete, having all the necessary draft gages, CO and CO_2 recorders, pyrometers, etc., and are so arranged that one man supervises the operation of two boilers. The firing aisle is perpendicular to the turbine room, and as a result the boiler nearest the turbine room in each battery is the reheat boiler. The reheat boiler has only 5,000 sq. ft. of steaming surface, the rest of the boiler capacity being used for reheating at 100 pounds pressure. This boiler is fired according to the reheat requirements, steam generation here being a secondary consideration.

The equipment in the turbine room consists of two General Electric Curtiss turbines, each rated at 40,000 KW—1,000 R.P.M. and coupled to a 41,200 KVA Generator with direct connected exciter. These turbines were the first high pressure, high rating machines ever built and the original name plate rating was 35,000 KW., but they performed so well on test that the rating was raised to 40,000 KW. The generators are three phase V connected having a terminal voltage of 12,800. A 110-ton crane and a large machine

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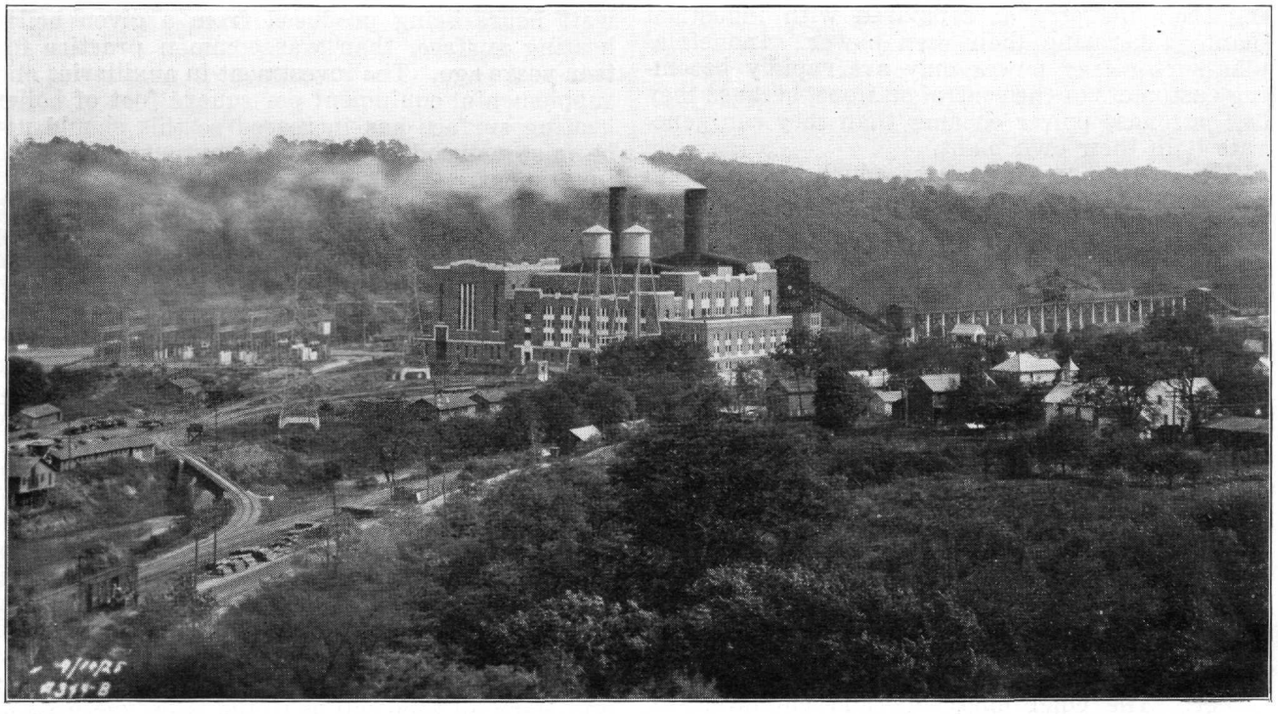

General view of the Philo power plant, showing the switch and transformer yard on the extreme left, the plant in the center and the coal handling equipment and storage on the right.

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shop provide ample facilities for repair of turbine room equipment.

One of the outstanding features of the plant is the arrangement of condensing equipment. Due to the location of the plant just below a dam in the the Muskingum River, water is allowed to flow through the condensers—the intake being above, and the discharge being below the dam. This, of course, makes it unnecessary to pump the circulating water with a consequent saving in auxiliary power. Each turbine has a large 35,000 sq. ft. vertical condenser and both condensers are placed at the bottom of the condenser pit, which is 50 feet deep and about 40 feet in diameter. This pit also contains the condensate pumps (two for each condenser) and the Wheeler jet type air ejectors.

The operating room overlooks the turbine room on one side, and the high tension switch yard on the other. The bench board construction is used and equipment arranged so that the turbine generator control is on the turbine room side of the operating room, and the feeder control is on the switch yard side of the operating room. The generators are direct connected to a 41,200 KVA, 12,800-132,000 volt transformer bank, and all synchronizing is done on the 132,000 volt side of the transformers. The 132,000 volt feeders are arranged on two tower lines, one a north line and the other a south line. House service is obtained by using a small capacity transformer bank, stepping down to 2,300 volts from 132,000 volts.

The Ohio Power Company is the largest power system in the State of Ohio. Its plant at Windsor, West Virginia, has an installed capacity of 180,000 KW. It serves most of southeastern Ohio, West Virginia, and most of northern Ohio not served by the Cleveland and Toledo companies. It is tied in on the east with the West Penn Power Company, and recently when the announcement was made of the direct tie from Boston to Chicago, it served as the connecting link from Pittsburgh to Chicago. Philo was designed by Sargent and Lundy, consulting engineers, and it has a sister station in Twin Branch, in northern Indiana.