FILE NAME: Power Generation (POW)

DATE: 1951 Feb

DOC#: POW018

DOCUMENT DESCRIPTION: Published Article from Trade Journal

Southern Power & Industry
Archive List in Exhibit Order

Exhibit Number	DATE	DESCRIPTION
1	01/01/46	Southern Power & Industry article by N.V. Hendricks titled: INDUSTRIAL HYGIENE-Control of Working Environment is Important
2	04/01/46	Southern Power & Industry article by C.C. Hermann titled: DUST EXHAUST SYSTEMS
3	02/01/51	Southern Power & Industry article by L.W. Cadwallader titled: Potomac Electric Power Company's New Potomac River Station

SOUTHERN POWER AND INDUSTRY

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Annual Subscription—$1.00
Foreign—$10.00

Published monthly at 115 E. Gordon Dalton, Ga.
by W R C SMITH PUB. CO.

Publishers also of: *Textile Industries, Electrical South, Southern Hardware, Southern Automotive Journal, Southern Building Supplies.*

W. J. Rooke, President; R. P. Smith, Executive Vice-President; T. W. McAllister, Vice-President; A. E. C. Smith, Vice-President; O. A. Sharpless, Treasurer; A. F. Roberts, Secretary.

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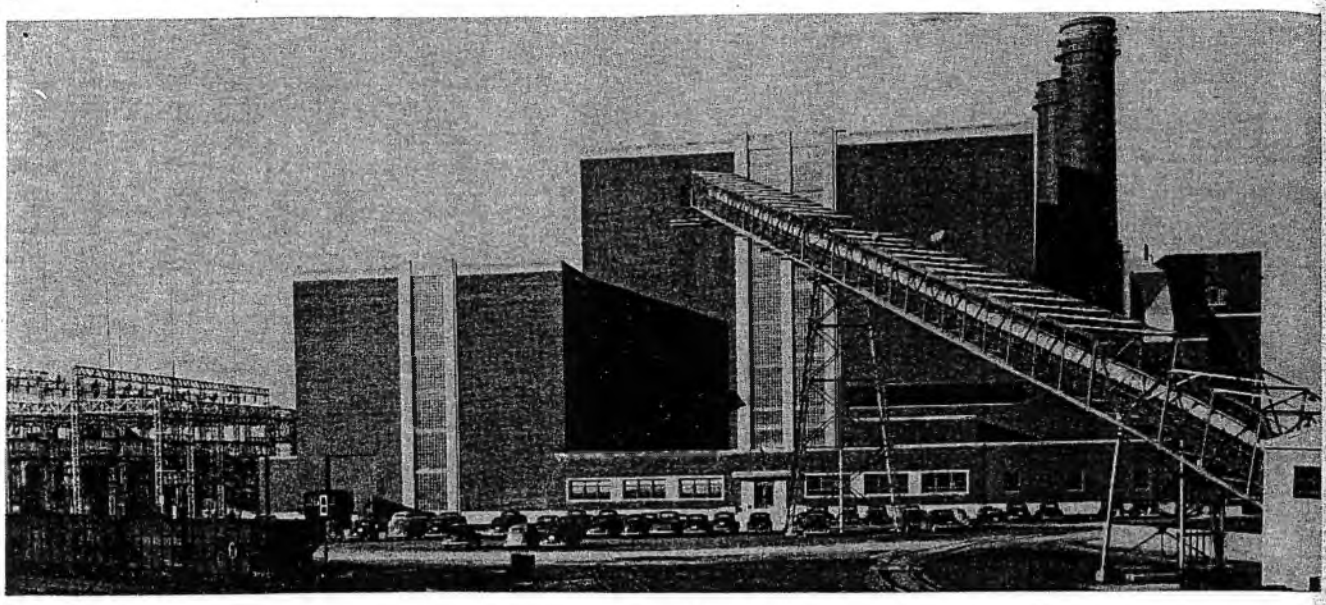
DEPARTMENTS

Contents indexed regularly by Engineering Index, Inc.

Editorial and Executive Offices: SOUTHERN POWER & INDUSTRY, 806 PEACHTREE ST., N. E., ATLANTA 5, GEORGIA



FRONT OF BUILDING WITH 69 KV SWITCHYARD ON LEFT AND COAL HANDLING EQUIPMENT IN FOREGROUND.

Potomac Electric Power Company's New Potomac River Station

Independent 80,000 kw units operated at 850 pounds and 925 F, should give high load factor service with minimum maintenance.

THE new Potomac River Generating Station of the Potomac Electric Power Company is located in Alexandria, Virginia, on the westerly bank of the Potomac River almost opposite the City of Washington and within view of the Nation's Capitol. Planning for this new generating station dates back to 1942, when the site comprising 23 acres was purchased for the construction of a steam power plant to have an ultimate capacity of 400,000 kw in five 80,000 kw nameplate rated turbine-generator units. The first 80,000 kw unit was placed in commercial operation October 1949. The second unit which was a duplicate, was placed in commercial operation in June 1950.

Design Features

It was desired to develop the plant on the basis of conservatively designed and rated equipment suitable for reliable operation for long periods of time with a minimum of maintenance requirments. After careful consideration, it was decided to install initially two 80,000 kw nameplate rated turbine-generator units with throttle steam conditions of 850 psi gage, 925 F, with five points of steam extraction for feedwater heating.

The Company had experienced satisfactory operation with previous unit system installations consisting of one boiler for each turbine-generator and it was decided to continue with this type of installation at the new plant. A single boiler with a continuous rated capacity of 800,000 lb per hr was provided to furnish steam to each 80,000 kw turbine-generator. No cross-connections were provided between the two boilers or turbines.

Particular attention was given to building volume and equipment layout to provide ample space and easy accessibility to equipment for operation and maintenance. And since the location was in a residential area, it was essential that every precaution be taken to prevent smoke or dust nuisance.

Because of the location of the plant with respect to the Washington National Airport, a compromise had to be effected between conflicting requirements of stack height, therefore height of the stacks was reduced 89 ft below that originally planned. The height of the radial brick stacks was limited to a distance above the boiler room roof of about one third the height of the boiler room. It was felt that this was the minimum stack height which would give assurance of proper and safe dispersion of gases and any remaining solids. At the same time increased velocity of gases leaving the stack was provided for by means of a venturi throat or nozzle built within the stack. At full boiler load the velocity of the gases leaving the stacks is approximately 60 miles per hour.

Another consideration was the desirability of harmonizing the external appearance of the station with the general architectural pat-

tern of the area and particularly with that of near-by apartment houses. This was accomplished by the use of red exterior face brick trimmed with gray limestone. The use of glass block windows added materially to the appearance of the building.

Generating Equipment

The turbine-generators are General Electric, single-cylinder, 1800 rpm, 80,000 kw nameplate-rated machines with throttle steam conditions of 850 psi gage, 925 F, steam being extracted at 3rd, 6th, 9th, 12th and 14th stages for feedwater heating. Of the five extraction feedwater heaters, the 14th is a low-pressure closed heater with separate drain cooler, the 12th is a direct-contact heater, the 9th is a low-pressure closed heater, the 6th is a standard tray-type deaerating heater with boiler-feed suction tank, and the 3rd is a high-pressure closed heater.

The generator is hydrogen cooled and has a nameplate rating of 80,000 kw at 0.85 power factor and 0.5 psi gage hydrogen pressure. It is designed for 13,800 volt, 3 phase, 60 cycle service with direct-connected main and pilot exciters. One motor-generator set is provided for emergency excitation of either unit.

Each turbine exhausts into a 75,000 sq ft, two-pass condenser, containing 12,720 Admiralty metal tubes, No. 18 B.W.G. 26 ft long and 7/8 in. O. D., through which cooling water is pumped at the rate of 66,900 gpm.

Condenser air evacuation is performed by two motor-driven, rotary dry vacuum pumps for each unit. Each pump has a capacity of 540 cfm of air-vapor mixture at one in. Hg abs pressure.

Condensing water from the river is supplied by two vertical circulating water pumps per condenser, each pump having a rating of 33,450 gpm at a total head of 49ft. Because of subsoil limitations and the gradient between river bank and the plant, the circulating water pumps were located in a pump house on the river bank and the circulating water pumped through steel pipes to the condensers in the turbine room basement. Inside the station this piping is largely run overhead in order to eliminate foundation difficulties due to subsoil conditions.

Three boiler feed pumps, each driven by an 800 hp, 2300 volt, 3600 rpm squirrel cage induction motor, are provided for each turbine generator unit, any two of the pumps being capable of meeting full load boiler feedwater requirements. No steam-driven boiler feed pumps are provided.

The only steam-driven auxiliaries in the plant are the auxiliary lubricating oil pumps on the main turbines.

The steam generating units are the Combustion Engineering three-drum, bent-tube type with water-cooled furnace, pendant-type superheater, economizer, tubular air preheater, vertically adjustable tangential burners and Combustion Engineering Raymond bowl mills. The furnace is designed for initial operation with pulverized coal, and provision has also been made for possible future use of fuel oil or natural gas. The unit is arranged to burn a wide range of West Virginia and Pennsylvania coals, as follows.

Btu as fired	12500 - 14500
Ash fusion Temp.	2100-2800 F
Ash content, %	4.5-12
Sulfur, %	0.5-3.5
Fixed Carbon, %	53-80
Grindability	60-100

Design pressure for the boilers is 1000 psi gage with operating steam conditions at the superheater outlet of 875 psi gage, 925 F. As indicated in the accompanying cross-section, the furnace has a dry hopper bottom with shaded ashpit. This design of furnace bottom has resulted in a substantially

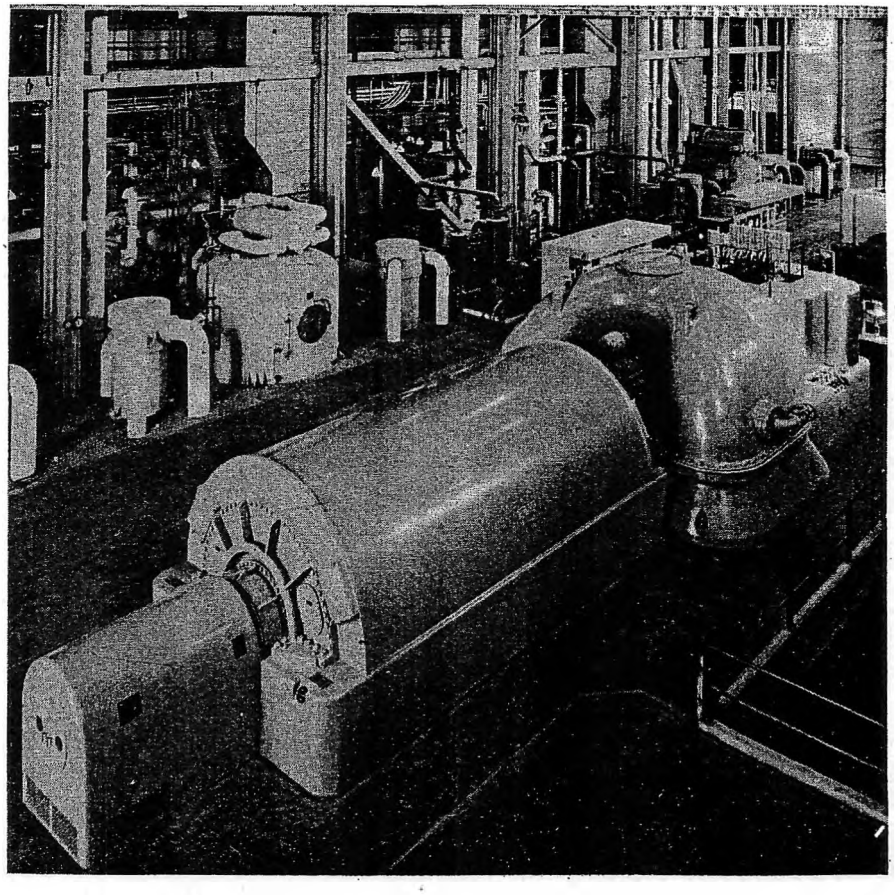
By L .W. Cadwallader

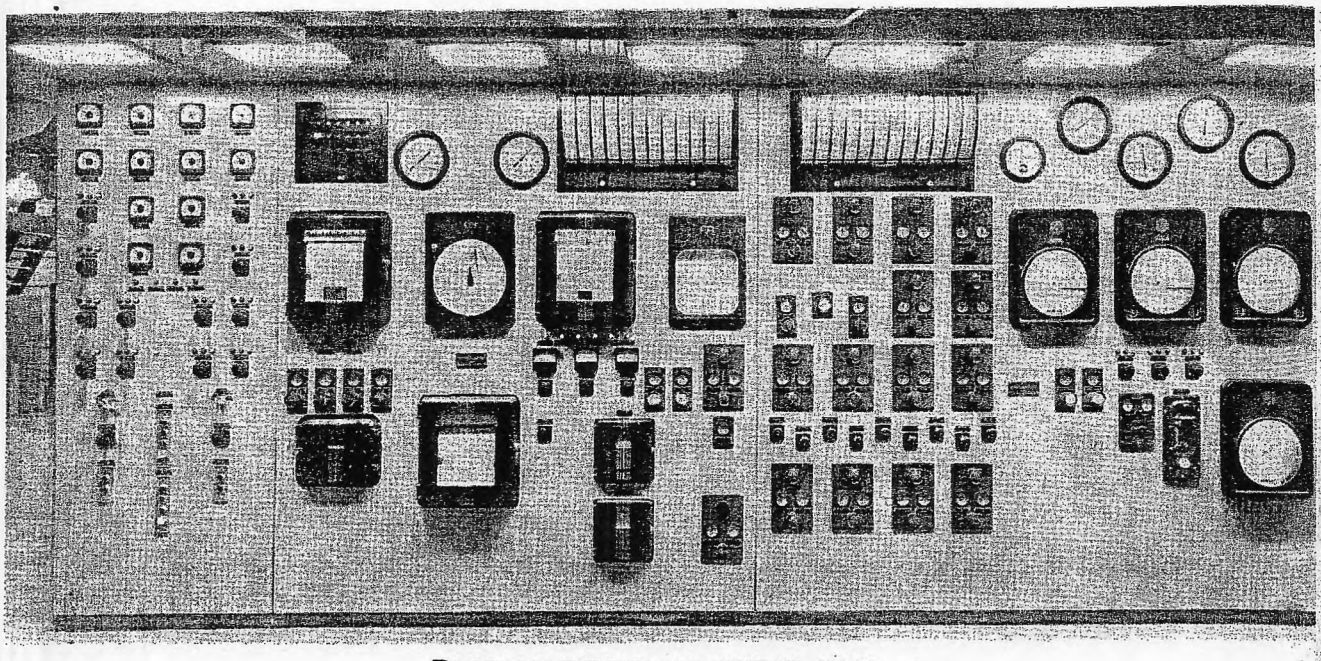
General Superintendent of Generating Stations

Potomac Electric Power Company

Washington, D. C.

TURBINE ROOM AT PEPCO'S NEW $25,000,000 POTOMAC RIVER POWER PLANT. THE 80,000 KILOWATT TURBO-GENERATORS AT THIS PLANT ARE THE LARGEST ON THE PEPCO SYSTEM.





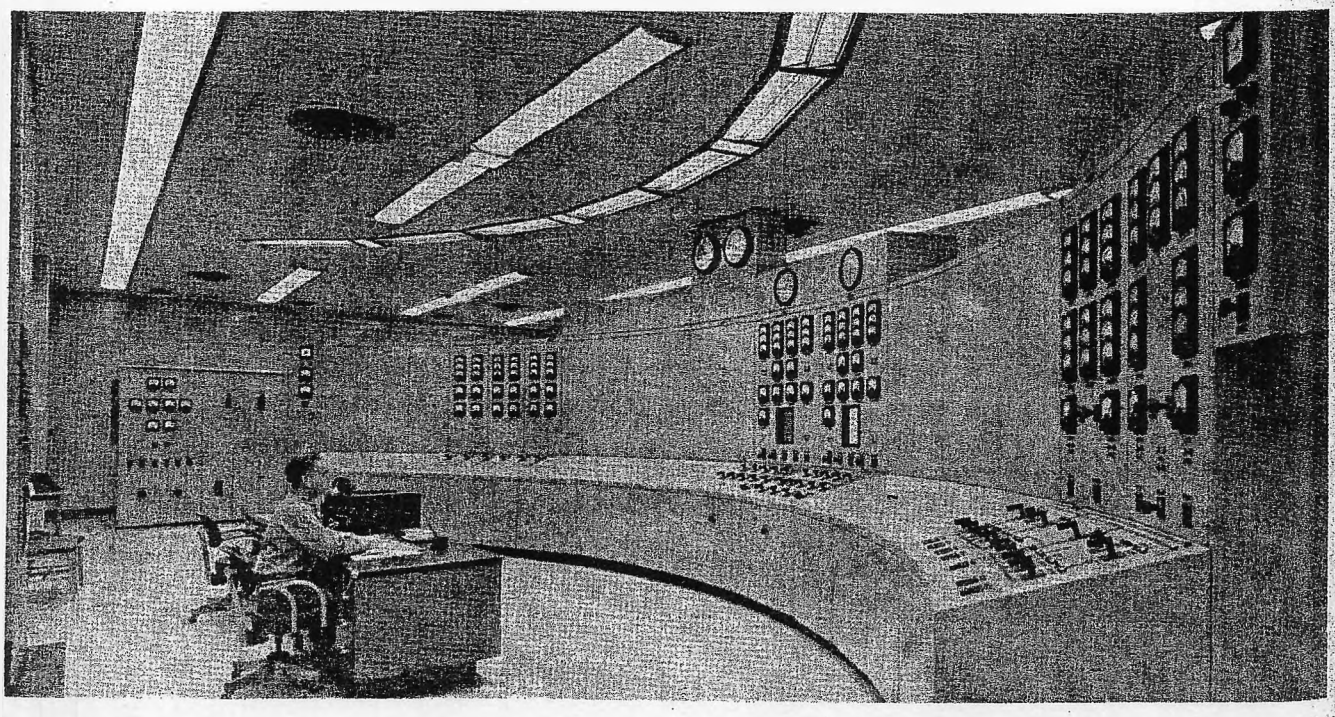
BOILER INSTRUMENT AND CONTROL PANEL.

cooler ashpit than the conventional symmetrical design, and is believed to be the first installation of this type. It is of particular importance in this installation because the furnace bottom ash is removed in a completely dry state by gravity discharge through manually operated gates into a vacuum transport system. It requires the time of one operator for a period of approximately 20 minutes once every 8 hours to remove the dry furnace bottom ash with this vacuum transport system. This is the same system which empties automatically all of the 33 fly-ash hoppers of each boiler unit.

Specifications call for a total steam temperature at superheater outlet of 925 F from 425,000 lb of steam per hour up to the maxium evaporation rate of 800,000 lb per hr. Operating experience indicates that 925 F can be maintained over a wider load range than was specified. While the design provided for primary steam temperature control by means of tilting burners supplemented by bypass dampers, in operating service under normal conditions the superheater bypass dampers remain closed.

The boiler is provided with four bowl mills with sufficient capacity so that any three will carry full boiler load with good quality coal and four will carry full boiler load with the worst coal specified. There are four levels of coal burners or a total of 16 burners. The secondary air dampers for each level of coal burners are remotely positioned from 5-point selector switches mounted on the boiler gage board

CENTRAL SWITCHBOARD ROOM. BLANK PANELS ARE FOR 3 FUTURE UNITS.



and actuating motor drives mounted on burner windboxes. This arrangement of damper control is an innovation and has been quite satisfactory.

The steam generating unit has a maximum continuous rating of 800,000 lb per hr with superheater outlet conditions of 875 psi gage and 925 F, and feedwater temperature of 420 F entering the economizer. Predicted boiler performance when burning coal and operating under above conditions is 88.9 percent. The furnace heat release at 800,000 lb per hr output is 16,900 Btu per cu ft per hr and the net heat available for the entire project radiant surface is 102,000 Btu per sq ft per hr.

Each boiler is equipped with a complete steam soot blowing system for furnace walls, superheater, economizer and tubular air heater. After some experimentation the following schedule of soot blowing was established.

Furnace walls

As needed to remove spotty ash accumulations. A portion of the 12 wall blowers are operated on an average of once every 24 hrs.

Superheater and economizer

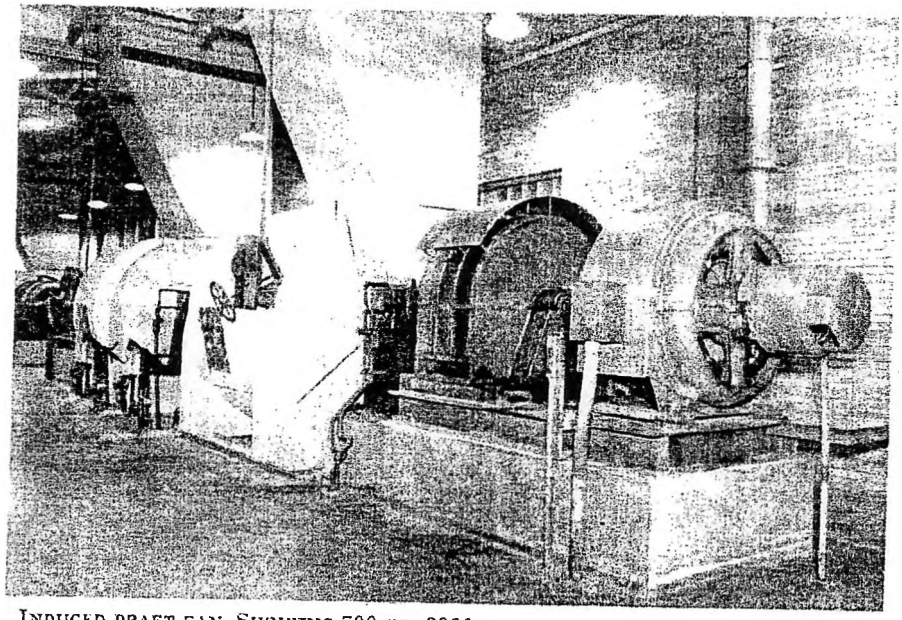
Once every 2 weeks.

Tubular air heater

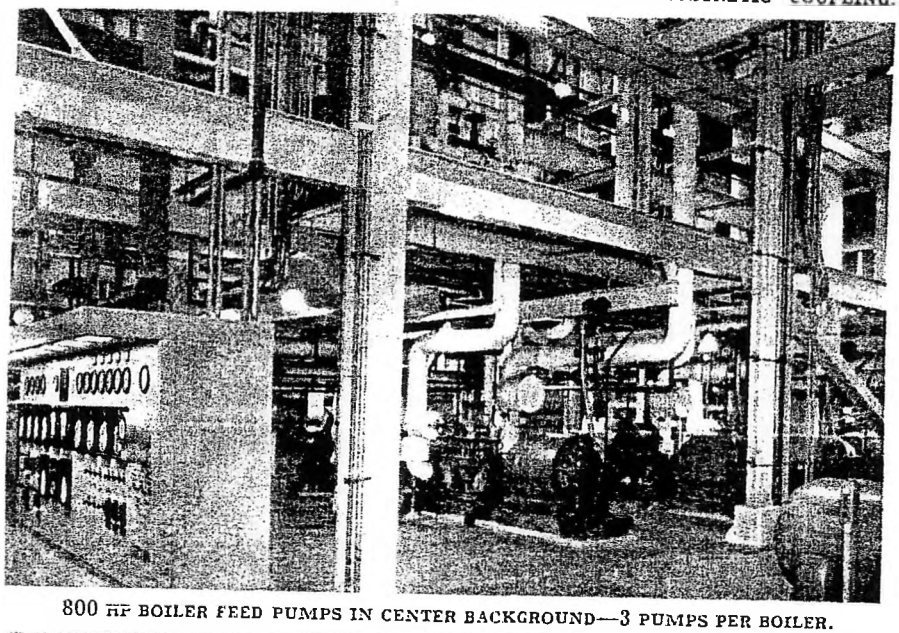
No soot blowing.

FLY-ASH CONTROL

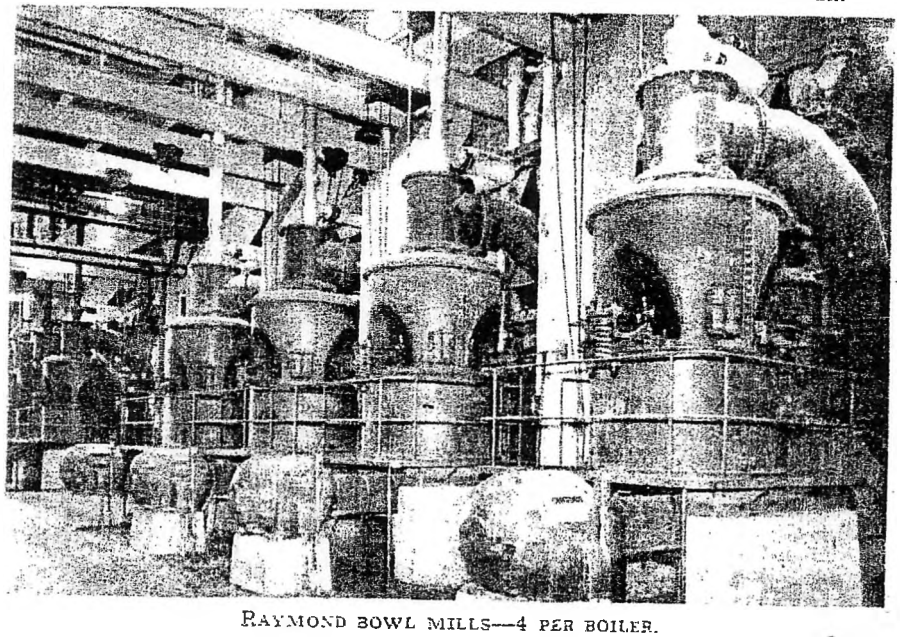
Every effort was made in the design of this station to eliminate any possible nuisance due to dust and stack emission. It was expected that coal would be the primary fuel and to date only coal has been burned. To reduce stack emission to a minimum, it was decided to install in series both a mechanical fly-ash collector and an electrostatic precipitator three sections deep. These are located between the air heater and the stack, the flue gases passing through the mechanical collector first. The air heater, mechanical collector and electrostatic precipitator are divided into four sections across the width of the steam generating unit, with dampers at the inlet to each section so arranged that one fourth of the precipitator at a time can be rapped in still gas. Performance



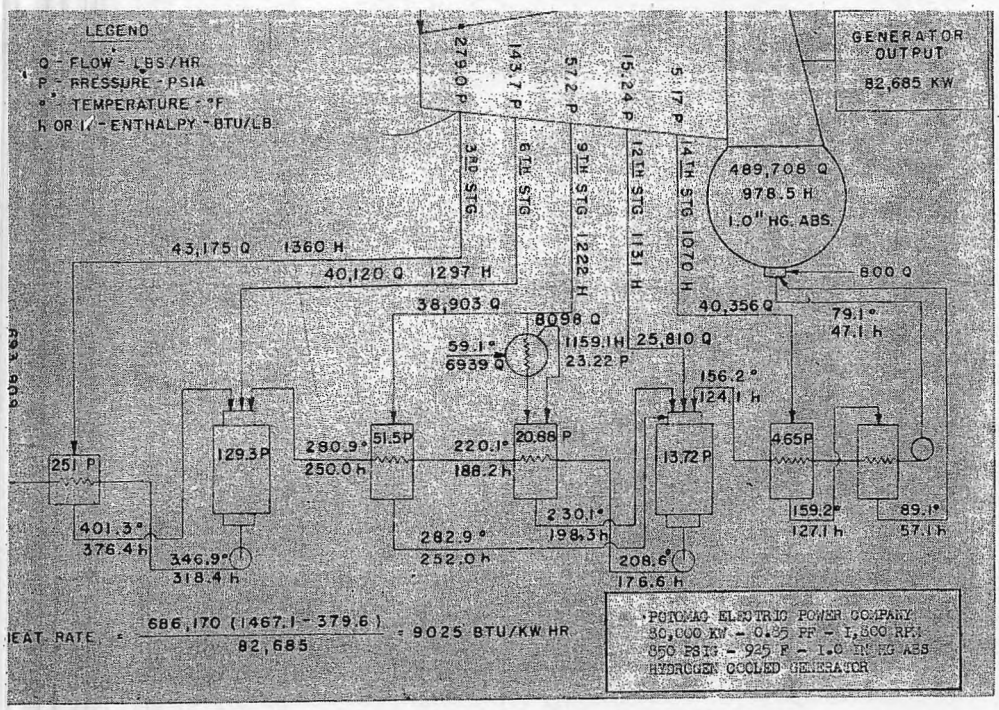
INDUCED DRAFT FAN, SHOWING 700 HP, 2300 VOLT SQUIRREL CAGE INDUCTION MOTOR WITH DIRECT CONNECTED EXCITER FOR VARIABLE SPEED MAGNETIC COUPLING.



800 HP BOILER FEED PUMPS IN CENTER BACKGROUND—3 PUMPS PER BOILER.



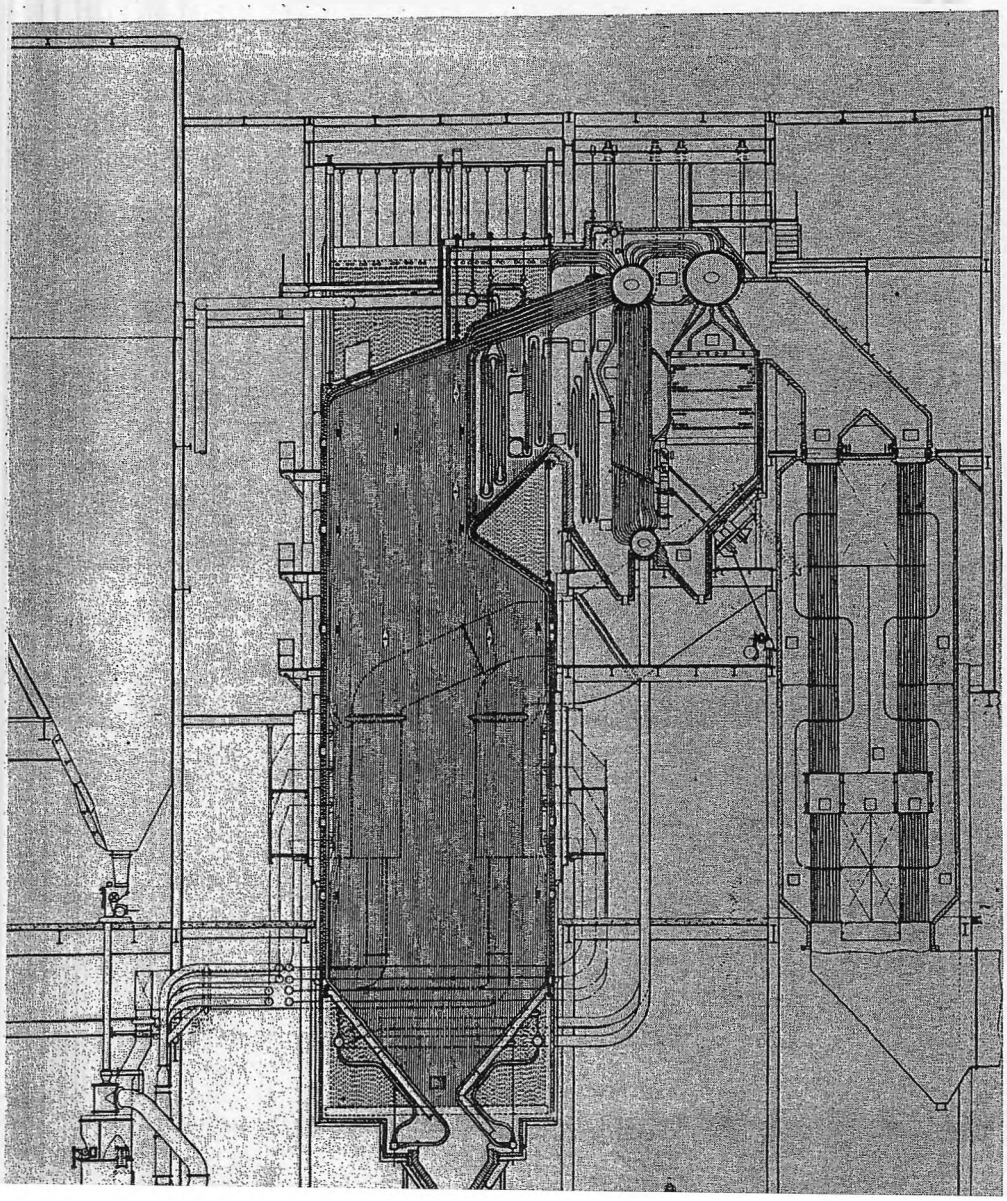
RAYMOND BOWL MILLS—4 PER BOILER.



HEAT BALANCE DIAGRAM

has been gratifying as there is little visible discharge from the stacks. Soot blowing and cleaning of electrostatic precipitator plates have had little or no effect on stack appearance.

COMBUSTION ENGINEERING CO. STEAM GENERATING UNIT.



COAL HANDLING

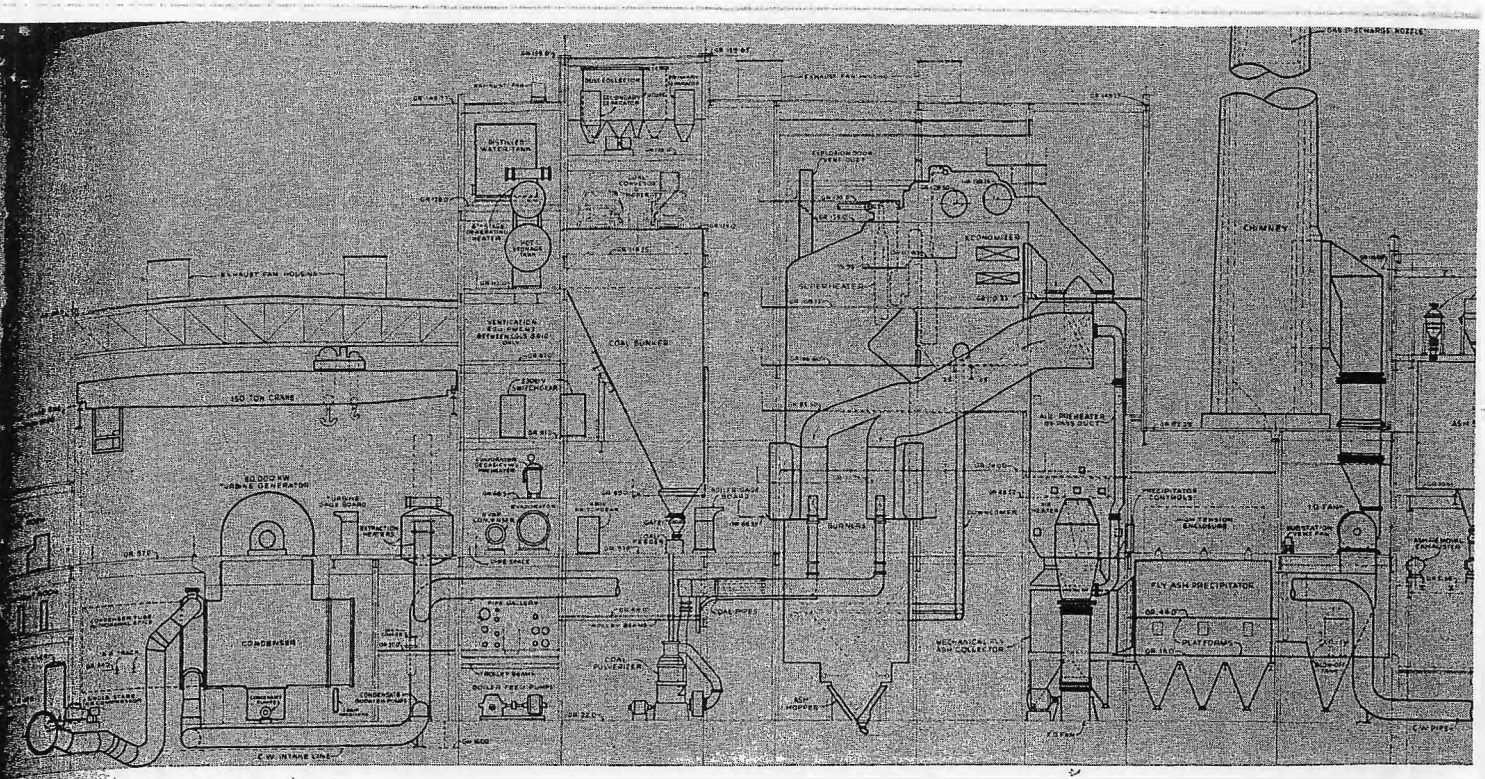
Bituminous coal from Pennsylvania or West Virginia is delivered in railroad cars to the plant yard which has a capacity of approximately 100 coal cars. The cars are weighed on an accurate track scale and then unloaded by a rotary car dumper. With the layout provided, it is possible to weigh, dump and shift one railroad car of coal every six minutes. All shifting in the plant yard is performed by a 50-ton fireless locomotive which is charged once every four hours from the main boilers in the power house. The fireless locomotive has the advantage of cleanliness and low operating and maintenance costs.

Coal from the car dumper pit can be delivered by conveyor belts at the rate of 700 tons per hr to Bradford coal breaker. From this point the coal can be delivered at the rate of 350 tons per hr to both the storage area and to the station bunkers.

When the generating capacity of the plant is increased by the installation of additional units, it is contemplated that the rate of handling coal to the bunkers will be increased to 700 tons per hr by the addition of a duplicate belt conveyor between the Bradford coal breaker and the bunkers.

The coal storage area has a capacity of approximately 175,000 tons when stored to a height of 30 ft. All storing and reclaiming of coal is done with bulldozers. There is one coal bunker per boiler, each bunker having a capacity of 1200 tons. From the bunkers the coal flows through motor-driven coal feeders located on the main operating floor. These feeders regulate the flow of coal to the bowl mills.

The rotary railroad car dumper is totally enclosed, a rolling steel door being installed at either end to permit the shifting of full cars onto the dumper and the removal of cars after they have been unloaded. Elaborate systems of dust collecting equipment have been provided for the rotary-car dumper house, Bradford breaker house, coal bunkers in the station, and all intermediate belt conveyor junc-



PLANT CROSS-SECTION SHOWING ARRANGEMENT OF EQUIPMENT.

tion points where dust could result from coal transfer. The fine dust thereby collected is conveyed to the coal bunkers by a vacuum system which removes the dust from the collectors and discharges it into either coal bunker.

To wet the coal as it is placed in storage, a chemical spraying system is provided. It is also planned to spray the surface of the storage pile with heavy fuel oil to prevent dusting.

ELECTRICAL FEATURES

Each of the 80,000 kw, 85 per cent power-factor generators are directly connected to two 60,000 kva transformers, to step up the energy from 13,800 to 69,000 volts for transmission to the load. Engineering studies showed this to be more economical than tying the generators together at low voltage, and stepping up through transformers tied directly to the 69,000 volt cables. The 13,800 volt generator leads to the transformer terminals are made of the isolated phase construction. These consist of three 20½ in. diameter outer aluminum enclosed, dust and vapor-proofed pipes. Inside of each pipe a 6 in. copper tube is used as a conductor which is securely braced at each 90 degree angle and supported and insulated by porcelain insulators at five to eight feet intervals to withstand the shock of short circuit.

Main step-up transformers are

OPERATING DATA COVERING No. 1 UNIT FROM OCT. 16-'49 TO JULY 31-'50 AND UNIT No. 2 FROM JUNE 12 TO JULY 31-'50.

No.	Description and Source		# 1 Unit	# 2 Unit
1	Total Gross K.W.H. Gen.	(Switchboard)	427,851,000	76,788,000
2	Total K.W.H. Sta. Uses	(Switchboard)	24,976,000	4,163,000
3	Total Net K.W.H. Output.	(1) − (2)	402,875,000	72,625,000
4	Station Service % of Gr.	(2) × 100 ÷ (1)	5.84	5.42
5	Water Fed to Boilers.	(Metered)	3,549,092,000	643,905,000
6	Steam Leaving Boilers.	(Calculated)	3,545,770,000	643,710,000
7	Steam to Turbines.	(Calculated)	3,543,771,000	643,385,000
8	Temp. of Steam	(Av. Weighted Obs.)	921	920
9	Press. of Steam.	(Av. Weighted Obs.)	875	875
10	Temp. of F.W.	(Av. Weighted Obs.)	389	389
11	Net B.T.U. per lb. of Steam.	(Tables)	1,101	1,100
12	Banking Coal.	(Calculated)	—	—
13	Steaming Coal.	(Calculated)	314,366,000	55,628,000
14	Total Coal Burned.	(Scales)	314,366,000	55,628,000
15	B.T.U. per lb. of Coal as Fired.	(Tentative)	13,973	14,249
16	Condenser Back Press.	(Av. Wtd. Obs.)	.95	1.76
17	Circulating Water Temp.	(Av. Wtd. Obs.)	53	80
18	Hours Operation.	(Switchboard)	6,124.5	1,075.2
19	Average Load.	(1) ÷ Rating × (18)	87.3	89.3
20	Capacity Fact.	(1) ÷ Rating × Hrs. Mo.	77.4	80.1
21	Station Water Rate.	(5) ÷ (1)	8.30	8.39
22	Turbine Water Rate.	(7) ÷ (1)	8.28	8.38
23	Act. Turb. B.T.U./Gr. K.W.H.	(22) × (11)	9,116	9,218
24	Stand. Turb. B.T.U./Gr. K.W.H.	(B.P.)	9,020	9,300
25	Stand. Turb. B.T.U./Gr. K.W.H.	(C.W.)	8,990	9,320
26	Boiler Steaming Efficiency	(Calculated)	88.8	89.2
27	Net Boiler Room Efficiency	(Calculated)	88.6	89.1
28	Boiler Standard Efficiency	(Calculated)	89.2	89.4
29	Average Boiler Output	(5) ÷ (31)	579,500	598,900
30	Boiler Use Factor	(31) ÷ Hrs. Mo.	88.6	96.2
31	Hours Steaming	(Boiler Log)	6,124.7	1,075.2
32	Hours on Bank	(Boiler Log)	112.3	15.1
33	Hours on Repair	(Boiler Log)	668.0	73.7
			Operating Over All	Operating Over A
34	Lbs. of Coal/K.W.H. Net*	(Calculated)	782 783	767 768

equipped with fans arranged to blow air on the radiators to permit carrying their rated load without excessive temperature rise. The main 60,000 kva step-up transformers are connected on the 69,000 volt side to the main station buses through pneumatically operated oil circuit-breakers which are capable of opening short circuits of 2,500,000 kva. The transformers, oil circuit-breakers and associated high voltage equipment are located in a switch yard adjacent to the turbine room. Ultimate layout of the station provides for five sections of 69,000 volt bus, each fed by two 60,000 kva transformers from different generators, and each feeding two to three 45,000 kva cables. These cables are connected to the bus by oil circuit-breakers similar to those connecting the transformers.

In case of a short circuit, the proper breakers to disconnect the faulty equipment are opened automatically by relays. Normally, the bus sections will be tied together only through the generator transformers, although they can be tied directly together by means of oil circuit-breakers when a generator is shut down for any reason. The purpose of this bus arrangement is to "cushion" and control the large amount of generated power and to prevent excessive short circuit currents at the generating station.

In spite of the heavy cost involved, it was necessary that all lines transmitting the energy away from the station be underground. Much of the territory between the station and the city of Washington has been carefully landscaped to provide scenic approaches to the city, and the appearance of overhead lines would have been objectionable.

Studies showed that three 600 MCM-conductor, 69,000 volt cables in conduit would be more economical than higher-voltage, single-conductor cables, or cables pulled in pipe. This was the highest voltage three conductor cable available and two such cables furnish sufficient capacity to load one 80,000 kw generator. Conductors and insulation are enclosed in a lead sheath and a nitrogen gas pressure of 35 to 45 lb is maintained inside the cable. This is believed to be the first installation of gas-filled 69,000 volt cable. This so-called "gas-filled" cable was preferred to "oil-filled" cable because of lower installation and maintenance costs. The outside of the lead sheath is reinforced by bronze tapes and the whole cable enclosed in a neoprene jacket for protection against mechanical and chemical damage and electrolysis.

Due to unstable earth conditions over a part of the route between the generating station and Washington National Airport, the cables in this section are of the submarine type covered with metallic armor and no conduit is used. This permits movement of the cables, without damage, when the earth support moves. Many of the features described above are novel but all are based upon sound engineering and the lines should give high-quality service.

Based on a nameplate generator rating of 160,000 kw and including cost of site and everything constructed on it except outgoing feeders and the external distribution system, the cost of the Potomac River Generating Station will approximate $155 per kw. Details on performance and efficiency are given in the accompanying summarized operating report.

Principal Equipment

Generating Station "C", Potomac River, Potomac Electric Power Company

GENERAL DATA

Name of Station ..... Potomac River Generating Station.
Station Site ..... Alexandria, Virginia
Steam Conditions ..... 875 psig, 925 F
Cooling Water Source .... Potomac River
Design and Construction .. Stone & Webster Engineering Corporation.

TURBINE-GENERATORS

Turbines ..... Two—General Electric Company, 80,000 kw, 850 psig, 925 F, 1 in. Hg abs, 5 bleed points, 1800 rpm.
Generators ..... Two—General Electric Company, 1800 rpm, hydrogen cooled, 80,000 kw at 0.5 psig hydrogen pressure, 13,800 volts, 3 phase, 60 cycle, 0.85 pf, 94,117 kva, and direct connected main and pilot exciters.
Main Exciters ..... Two—General Electric Company air cooled, 300 kw, 1800 rpm, 250 volts.
Pilot-Exciters ..... Two—General Electric Company air cooled, 4 kw, 250 volts, 1800 rpm.

CONDENSING EQUIPMENT

Surface Condensers ..... Two—Worthington Pump and Machinery Corp. 75,000 sq ft, 2-pass, inner air coolers and hotwell.
Circulating Water Pumps.. Two per condenser—Worthington Pump and Machinery Corp. vertical, 33,450 gpm, 49 ft total head.
Circulating Pump Drives .. Allis Chalmers Manufacturing Company 600 hp, 590 rpm, 2300 volts, 60 cycle.
Rotary Vacuum Pumps .... Two per condenser—Kinney Manufacturing Company 540 cfm at 1 in. Hg abs, approximately 29 lb per hr water vapor and 16 lb per hr air at 70 F.
Vacuum Pump Drives ..... General Electric Company 40 hp, 350 rpm, 440 volts, 3 phase, 60 cycle.
Circulating Water Valves.. Henry Pratt Company, Inc.
Chlorinating Equipment ... Wallace & Tiernan Products, Inc.
Air Removal Pumps ..... Three—Nash Engineering Company.

STEAM GENERATING EQUIPMENT

Boilers ..... Two—Combustion Engineering-Superheater, Inc. 800,000 lb per hr continuous, 875 psig, 925 F, 36,020 sq ft, three drum, bent tube.
Superheaters ..... Two—Combustion Engineering-Superheater, Inc. 3 stages, low-temp 12,300 sq ft, int-temp 12,300 sq ft, high-temp 4,700 sq ft, bypass control and tilting burners, temperature control range 450,000 to 800,000 lb per hr.
Furnaces ..... Two—Combustion Engineering-Superheater, Inc. completely water cooled, shielded type hopper bottom.
Economizers ..... Two—Combustion Engineering-Superheater, Inc. continuous finned tubed, integral set, split type, 17,650 sq ft.
Pulverizers ..... Four per boiler—Combustion Engineering-Superheater, Inc. Raymond No. 533 bowl mill, 28,400 lb per hr, integral exhauster, variable speed roll type feeder.
Air Preheaters ..... Two—Combustion Engineering-Superheater, Inc. tubular, 4-pass, 122,500 sq ft.
Mechanical Fly Ash Collector One per unit—Aerotec Company multi unit centrifugal fly ash collector, maximum flow 325,000 cfm at 330 F, 85% removal (by weight) of suspended matter.
Electrostatic Precipitators.. One per unit—Research Corporation Cottrell perforated plate type, four units of 15 ducts each, three sections long; normal flow 294,000 cfm at 320 F, efficiency 96%.
Soot Blowers ..... Diamond Power Specialty Corporation.

No. per Boiler:

Furnace Wall	12 Type IS
Economizer	8 Type G9B
Air Heater	8 Type H
Superheater	4 Type IK
Screen Tubes	4 Type IK
Circulating Tubes	4 Type G9B

Combustion Control	Hagan Corporation.
Feedwater Flow and Level	Bailey Meter Company.
Superheat Control	Leeds & Northrup Company.
Blowoff Tank	Missouri Boiler & Sheet Iron Works.
Water Treating Equipment	Infilco Inc.
Safety Valves	Consolidated Div. Manning, Maxwell & Moore
Feed and Check Valves	Edward Valves, Inc.
Blowoff Valves	Yarnall-Waring Company
Water Columns and Gages	Diamond Power Specialty Corp.
Miscellaneous Valves	Hancock Div. Manning, Maxwell & Moore

DRAFT EQUIPMENT

Forced Draft Fans ..... Two per boiler—American Blower Corporation 110,000 cfm, 100 F, 11-in. total head, 1200 rpm, constant speed, inlet-vane control, louvre type damper in fan outlet.

Induced Draft Fans ..... Two per boiler—American Blower Corporation 190,000 cfm, 330 F, 15-in. suction, 720 rpm, variable speed, magnetic coupling control.

Induced Draft Fan Magnetic Coupling ..... Electric Machinery Manufacturing Co.

Forced Draft Fan Drive.... Allis Chalmers Manufacturing Company 250 hp, 1170 rpm, 2300 volts, 3 phase, 60 cycle.

Induced Draft Fan Drive.. Allis Chalmers Manufacturing Company 700 hp, 900 rpm, 2300 volts, 60 cycle, 3-phase.

FEEDWATER SYSTEM

Condensate Booster Pumps.. Ingersoll-Rand Company, 2 per unit, 525 ft head, 1700 gpm, 1750 rpm.

Booster Pump Drives..... Westinghouse Electric Corporation 300 hp, 2300 volts, 3-phase, 60 cycle, 1800 rpm.

Closed Heater 3rd Stage... One per unit—Westinghouse Electric Corporation 3,170 sq ft, quadrant type head, vertical, with U-tube removable bundle. Flow from heater 810,000 lb per hr at 420 F.

Closed Heater, 9th Stage.. One per unit—Westinghouse Electric Corporation 3,000 sq ft, vertical with U-tube removable bundle. Flow from heater 710,000 lb per hr at 291.8 F.

Closed Heater, 14th Stage.. One per unit—Westinghouse Electric Corporation 3-310 sq ft vertical with U-tube removable bundle. Flow from heater 615,000 lb per hr at 163.3 F.

Drain Cooler, 14th Stage.. One per unit—Westinghouse Electric Corporation 320 sq ft, vertical with U-tube removable bundle. Flow from drain cooler 615,000 lb per hr at 104.4 F.

Evaporators ..... One per unit—Westinghouse Electric Corporation 850 sq ft, horizontal, submerged bundle, thermal descaling. Steam flow from evaporator 16,000 lb per hr.

Evaporator Deaerating Preheater ..... One per unit—Worthington Pump and Machinery Corp. Capacity 18,110 lb per hr.

Evaporator Condenser ..... One per unit—Westinghouse Electric Corporation 1,060 sq ft horizontal U-tube removable bundle.

12th Stage Nondeaerating Heater ..... One per unit—Worthington Pump and Machinery Corp. vertical, single shell, tray, 710,000 lb per hr, temp from heater 215 F, 16 psia steam pressure.

6th Stage Deaerating Heater One per unit—Worthington Pump and Machinery Corp. horizontal, two shell, storage, tray deaerator; 810,000 lb per hr, 152 psia steam pressure, temp from deaerator 359 F, 2 vent condensers, 16,275 gal storage tank.

Boiler Feed Pumps ..... Three per unit—Worthington Pump and Machinery Corp. balanced, 6 stage, volute, centrifugal, 1075 gpm at 360 F, 2480 ft total head, 3570 rpm, constant speed.

Boiler Feed Pump Drives.. General Electric Company 300 hp, 3600 rpm, 2300 volts, 60 cycle, squirrel cage.

Extraction Nonreturn Valves ..... Atwood and Morrill Company

COAL AND ASH HANDLING EQUIPMENT

Railroad Track Scale	The Howe Scale Comapny
Rotary Railroad Car Dumper	Link Belt Company, capacity 700 tons per hour.
Coal Bunker Duplex Gates	Stephens-Adamson Manufacturing Co.
Bradford Breaker	Pennsylvania Crusher Company, capacity 700 tons per hour, 1-¼″ openings.
Automatic Coal Scale	Stock Engineering Company
Vacuum-cleaning Equipment	Billmyre Div., Lamson Corporation.
Dust Collecting Equipment	Pangborn Corporation
Windswept Dust Valves	The Allen-Sherman-Hoff Company, hand operated.
Ash Handling Equipment	The Allen-Sherman-Hoff Company.
Coal Spraying Equipment	Johnson-March Corporation
Belt Conveyor Tripper	Robins Conveyors Division
Coal Handling Equipment	Stephens-Adamson Manufacturing Co.
Tractors	Three—Oliver Tractor Company, equipped with Heil bulldozers.

MISCELLANEOUS EQUIPMENT

Gage Boards	Hagan Corporation.
Station Piping	Benjamin F. Shaw Company.
Circulating-water Piping	New York Central Iron Works.
Motor-operated Main Steam Valves	Chapman Valve & Manufacturing Company.
1500-lb Weld Valves	Manning, Maxwell & Moore.
Globe Valves	Manning, Maxwell & Moore.
Electric Traveling Crane	Whiting Corporation, 150 tons.
Automatic Air Filters	American Air Filter Corporation.
Ventilating Fans	Westinghouse Electric Corporation.
Elevators	Otis Elevator Company.
Sewage Ejector Pumps	Chicago Pump & Machine Company.
Tanks	J. E. Hurley Machine & Boiler Works.
Boiler Room Air Supply Fans	Sturtevant Div., Westinghouse Electric Corp.
Service Water Pumps	Two per unit—Ingersoll-Rand Company, vertical, 2 stage, 3250 gpm, 1175 rpm. 134 TDH.
Service Water Pump Drives	U. S. Electrical Motors, Inc., 150 hp, 1200 rpm, vertical hollow shaft, 60 cycle, 2300 volts, 3-phase.
Fire Pumps	Two—DeLaval Steam Turbine Company, horizontal, centrifugal, 1000 gpm, 189 TDH, 1750 rpm.
Fire Pump Drives	General Electric Company 50 hp, 440 volt, 60 amp, 1764 rpm, drip proof, squirrel cage.
Traveling Water Screens	Four—The Link Belt Company.
Hydrostatic Test Pump	Worthington Pump and Machinery Corp.
Miscellaneous Pumps	Yeomans Brothers.
Air Compressors	Two—Ingersoll-Rand Company. One—single stage, 300 cfm, 100 psi discharge. One—two stage, 900 cfm, 100 psi discharge.
Floor Grating	Hendrick Manufacturing Company.
Structural Steel and Bunkers	Bethlehem Steel Company.
Galvanized Substation Steel	American Bridge Company.
Channel-type Roof Slab	Lastek Products Company.
Stair Treads and Platform Plates	American Abrasive Metals Company.
Miscellaneous Iron	Empire City Iron Works.
Railings	A. F. Jorss Iron Works.
Corrugated Asbestos	The Ruberoid Company.
Steel Sash	The William Bayley Company.

ELECTRICAL EQUIPMENT

Main Transformers	
Unit No. 1	Two — Westinghouse Electric Corporation 3-phase, 48,000/60,000 kva, voltages 69,000 wye/13,800 delta.
Unit No. 2	Two—Allis Chalmers Manufacturing Company 3-phase, 48,000/60,000 kva, voltages 69,000 wye/13,800 delta.
Station Service Transformers	
Units 1 and 2	Two—Allis Chalmers Manufacturing Company 3-phase, 6,000/7,500 kva voltage 13,800/2.300 delta connected to generator leads.
.....	One—Allis-Chalmers Manufacturing Company 3-phase, 6,000/7,500 kva, voltage 69,000 wye/13,800 delta.
.....	One — Westinghouse Electric Corporation 3-phase, 6,000/7,500 kva, voltage 69,000 wye/13,800 delta.
.....	Three—Moloney Company 3-phase 750 kva, indoor, dry type voltage 2,300/460.
69 kv Oil Circuit Breakers.	Fourteen — General Electric Company. 2,500,000 kva interrupting capacity.
13 kv Oil Circuit Breakers.	Two—General Electric Company, 1,500,000 kva interrupting capacity.
Insulators	Locke Company; Ohio Brass Company.
Power and Control Cables..	Okonite Company; Simplex Wire & Cable Company.
Distribution Cables	Okonite Co.; Habershaw Cable & Wire Co.; and General Electric Company, 69000 volts, gas-filled.
2300 Volts Switchgear.....	I-T-E Circuit Breaker Company, Multimite indoor with 64 air circuit breakers, 100.000 kva interrupting capacity.
440 Volts Switchgear	Westinghouse Electric Corporation. Low voltage, metal enclosed with 26 drawout air circuit breaker, type DK-25, 600 volts, 25,000 R.M.S. amps.
120/230 Volts Switchgear..	Westinghouse Electric Corporation; Kalek Company.
Coalyard Unit Substation ..	Allis Chalmers Manufacturing Company.
Electric Indicating Instruments	General Electric Company
Relays	Westinghouse Electric Corporation.
Generator Voltage Regulation	General Electric Company, Type GFA-4.
Fire Protective Equipment for Main Transformers..	Grinnell Company, Inc. Automatic, pneumatic, rate-of-rise actuated Mulsifyre (water spray) system.