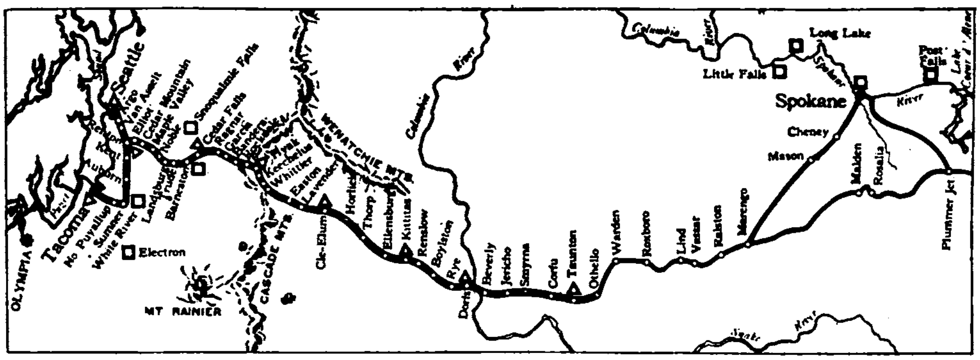
New Power Supply for the St. Paul

Water Power Plants at Long Lake and Snoqualmie Falls Supply Electrical Energy at 100,000 Volts to Eight Motor-Generator Substations

THE formal inauguration of electric service on the coast division of the Chicago, Milwaukee & St. Paul Railroad was scheduled for March 5, the day on which this issue of the ELECTRIC RAILWAY JOURNAL goes to press. An account of the inauguration will be given in a later issue. Readers of the paper are familiar with the details of the line and the locomotives from the several articles which have appeared in it during the past three years. Two pictures of one of the substations have just come to hand and are reproduced herewith. They were furnished by the General Electric Company. An outline map of the line is reproduced from the January, 1920, issue of the *Electric Journal*, from which a part of the following information is abstracted:

The electrification of the coast division adds 207.4 miles to the 440 previously electrified in Montana on the Rocky Mountain and Missoula divisions, and it extends from Othello in central Washington to the shops in Tacoma at the Puget Sound end. There is still a 212-mile gap between the Montana and Washington sections to be electrified.

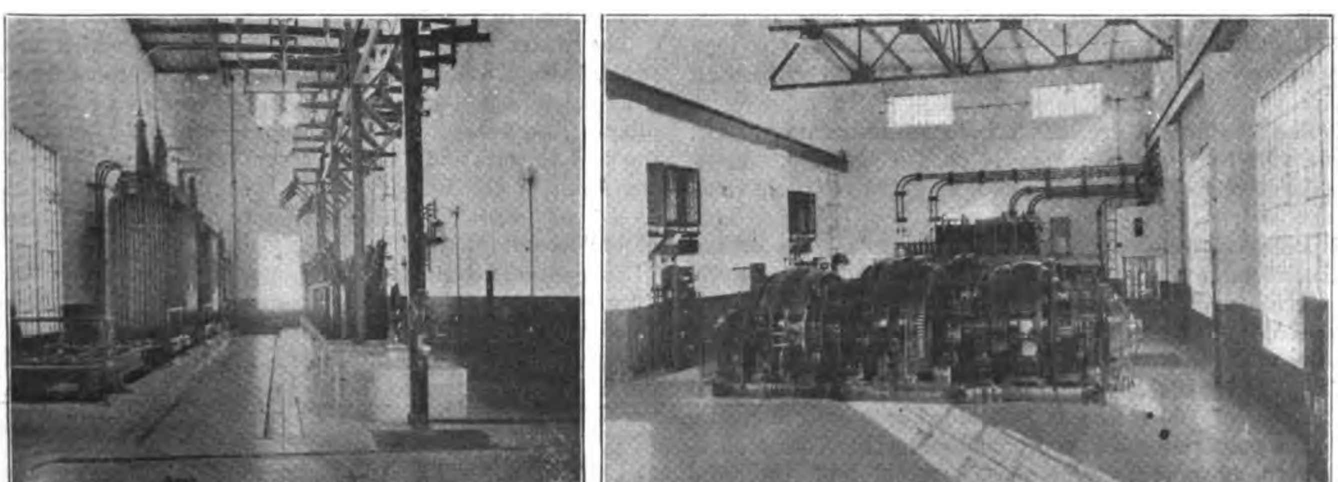


MAP OF PART OF C., M. & ST. P. R.R. SHOWING NEWLY ELECTRIFIED SECTION

All of the energy used on the new electrification is developed from water power, by the Washington Water Power Company and the Puget Sound Traction, Light & Power Company, through an organization known as the Intermountain Power Company. The Long Lake plant of the Washington Company and the Snoqualmie plant of the Puget Sound Company are the chief sources of power. This is delivered at 100,000 volts along the railroad's right-of-way, to eight substations as indicated by triangles on the map.

The contract between the Intermountain Power Company and the Chicago, Milwaukee & St. Paul Railroad specifies that the total demand of the railway company must not exceed a stated amount when integrated over a period of five minutes, and that the power payment be based upon this amount, with a maximum load factor of 60 per cent. For instance, if the denominated maximum is 10,000 kw., the railway company will pay for 6,000 kw. integrated over the month, whether this amount is used or not, and for amounts in excess of 6,000 kw., will pay at the same rate per kilowatt-hour. This requirement gives the railway company the benefits in cost of power generation that accrue because of high load factor. In order to meet the conditions of the contract it becomes necessary to totalize at every instant the whole load being taken into the railway system at the substations located at Taunton, Cedar Falls, Renton and eventually Tacoma. This load must be totalized in such manner that it can be measured by a maximum demand meter with a five-minute interval, as well as indicated and recorded. Also, in order to prevent the peaks of load usual to railway service from penalizing the road in additional power cost, the voltage generated at the substations is reduced automatically when the total load reaches such proportions that the nominated maximum demand is in danger of being exceeded. The result is a smoothing out of the load curve of the system by slowing down trains during the peak and spreading some of this load over the valleys of the curve.

Equipment for the substations is being supplied by the Westinghouse Electric & Manufacturing Company and the General Electric Company. Each of these companies has taken special precautions to guard against the occurrence of flash-overs on the direct-current generators at times of short-circuit on the 3,000-volt system. The substations whose equipment is supplied by the General Electric Company are provided with high-



AT LEFT, HIGH-TENSION ROOM IN CEDAR FALLS SUBSTATION. AT RIGHT, MOTOR GENERATOR ROOM speed circuit breakers with a view to opening the circuit before the current has had opportunity to build up. The machines furnished by the Westinghouse Company are protected by the "flash suppressor," a device developed especially for this electrification.

Powered Coal Plant at Seattle

Following Extensive Experiments the Puget Sound Company Installed 4,100-b.-hp. Plant — Well Arranged Equipment Increases Economy and Efficiency

THE Puget Sound Traction, Light & Power Company, Seattle, Wash., installed in one of its boiler plants, used for steam heating purposes, a complete equipment for burning pulverized coal, following the experiments described in the issue of the ELECTRIC RAILWAY JOURNAL for May 19, 1917. Fuel oil was previously burned in this plant, but the presence of a 225,000-ton culm heap near by, and the possibility of effecting considerable economy by utilizing it, induced the company to install a pulverizing and drying plant. The culm is from Washington lignite coal which has a fuel value of about 9,000 B.t.u. with 18 per cent moisture and 16 per cent ash. The culm itself contains 7,300 B.t.u. with moisture of 25 per cent, volatile matter 28 per cent, fixed carbon 26 per cent and ash 20 per cent. It costs $1.80 per ton f.o.b. the raw-coal bunkers.

Briefly the equipment may be divided into several parts, namely, that for handling raw coal, that for drying, that for pulverizing, that for burning and that for handling the ashes.

There are three wooden raw-coal bunkers, lined with galvanized iron, of a total capacity of 725 tons. The raw coal passes first through a gate and an auxiliary hopper (provided to prevent clogging) to a Mead-Morrison crusher, next by way of a belt conveyor to a bucket elevator, thence to a raw-coal flight conveyor, which distributes it over the bin provided for raw crushed coal. The capacity of the plant to this point is 75 tons per hour.

The 325-ton crushed coal bunker is of reinforced concrete. It branches into two hoppers with 10 in. x 5 ft. discharge openings in the bottom. From these 30-in. apron feeders convey the coal to dryers through 10-in. pipes, so arranged that either or both of the two dryers can be used. In these pipes are lines of paddles, motor-driven, to insure continuous flow. One horsepower is required for the set of paddles in each pipe.

The two dryers are of the indirect-fired rotary type, one of 7 tons and the other 10 tons capacity per hour. Induced draft for these is provided by two Sirocco fans, each driven by a Terry steam turbine. These fans discharge through cyclone separator heads. The dryers discharge into a dry-coal elevator, through magnetic separators which take out iron scrap. Thence the coal is distributed by means of a 12-in. screw conveyor over a dry coal bin through eight steel extension spouts. The dry-coal bunker is of reinforced concrete, with a total capacity of 160 tons. It is divided into four hoppers.

The pulverizing mill equipment comprises four Fuller-Lehigh 42-in. mills and one Raymond mill, the total capacity being 16 tons per hour. Each mill requires a 75-hp. motor. From the mills the spouts lead to a 12-in. screw conveyor and the powdered coal passes over an elevator to another 12-in. screw conveyor, leading to the bins above the boilers.

No cyclone separators or dust collectors are used with the Fuller mills, but the excess air is removed by a small induced draft fan, and is fed directly to the furnace. From the Raymond mill a large exhaust fan, driven by a 30-hp. motor, drives the air through a cyclone separator, from which the discharge leads to the above mentioned screw conveyor. There is also a small pressure relief fan connected to the separator to prevent accumulation of pressure.

As previously mentioned, a screw conveyor leads to the bins over the boilers, and across this are four 12-in. conveyors, each driven by a 5-hp. motor, feeding a bin of 16 tons capacity. Connecting with the bins are twenty-two screw-conveyor feeders. After experiments with several types of feeder, it was found that for the local conditions the Santmyer feeder was best and this is now used throughout.

Air for the feeders comes from two 50,000-cu.ft. Sirocco fans and two 3,000-cu.ft. Sturtevant fans, the latter being used for individual feeders. The feeders are driven by 1½-hp. Crocker-Wheeler motors.

The burners are especially designed elbows with three openings, one for the fuel, a smaller one for the air feed and a third for the discharge.

In adapting the boilers for the new fuel supply, Dutch ovens were added so as to give ample combustion chamber space. Ash crushers were installed also and a drag-chain conveyor was provided to transfer the ashes to an elevator which raises them to the ash bin.

The culm is loaded at the mines directly into coal cars by means of a Bagley scraper. It is delivered to the storage bunkers at night, two additional men being furnished to help the train crew in unloading the cars. One man takes care of the raw coal equipment, coal being transferred from the storage bunkers to the crushed coal bunkers sufficient for the twenty-four-hour run during an eight-hour shift. One man looks after the feeders supplying the dryers which, owing to the higher temperatures of the discharge, tend to clog up. Another man operates the dryers and mills. He has an assistant to look after the distribution of the dry coal and pulverized coal in the bunkers above.

Both mills and dryers are operated continuously. Pulverized coal is used as a fuel for drying, approximately one ton of pulverized coal being burned to dry twenty tons of raw coal.

The water tender takes care of feeders, which are regulated by controllers located on the boiler room floor. The machinery is kept in operating condition by an oiler. Two helpers keep the tubes clean by operating the soot blowers and a special steam jet inserted through the front of the setting. This operation is performed at 4-hour intervals. In addition to this the men also blow down the tubes.

Three additional helpers remove the ashes from the dryer settings, clean the combustion chambers when necessary and remove the ash deposits back of the bridge wall at regular intervals. This deposit is wetted down in the setting to facilitate handling and to avoid spreading of the dust. One cleaning a week is sufficient to take care of this deposit. The slag accumulating on the sides of the combustion chamber is removed at intervals varying from six to ten weeks.

The ash falling into the pit below is removed with