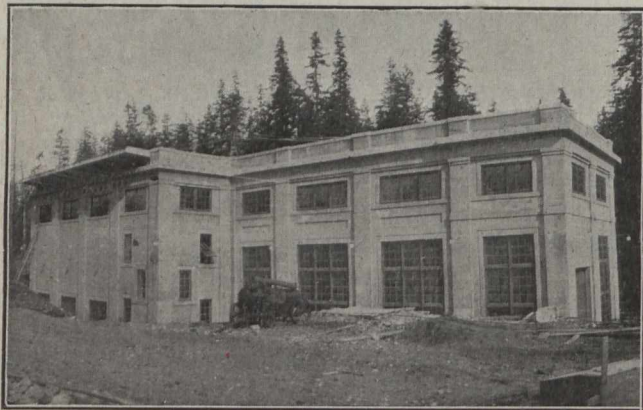


of flow in the penstock as to prevent the pressure rises due to governor throttling to exceed a nominal percentage of the pressure due to the active head. This relief-valve gear is adjustable to close in any desired length of time so that the water waste need be no more than sufficient to diminish the penstock flow at a proper safe rate. The general arrangement as designed includes, in addition to the governor-actuated relief valve, an independent direct-pressure relief valve which would open in the event of extraordinary rise in pressure caused, for instance, by any trouble occurring to the governor gear. In addition to the valves described, there is a safety relief—a bursting plate closing the end of a nozzle which terminates each penstock in the power house, so that in the event of accident to the governor gear and relief valves, any abnormal or dangerous rise in pressure in the penstocks would be prevented.

The present installation consists of one-half of the ultimate plant contemplated. The turbines are of the Francis reaction type with single runner on horizontal axis. The specified rating of these turbines is 4,700 h.p. when operating under 272 ft. of head, but with the plant



Exterior View of Power House.

only partially installed, as stated, that is, with only two units to operate while the upper part of the penstock system is constructed for four, the available horse-power for one turbine running alone is approximately 6,000. With the two turbines running the combined available horse-power is approximately 10,000. When the plant is completed, as contemplated by the addition of two more similar units, the total available horse-power of the four turbines operated at one time will be approximately 19,000.

The machines are placed with the shaft parallel with the longitudinal axis of the building. The floor space required for each unit is 32 x 50 ft. and the floor space of the ultimate power house as designed is 34 x 214 ft. The main building, as far as constructed for the present, is 34 x 117 ft.

The generators are 4,400-k.v.a., 13,200-volt, 3-phase, 25-cycle, 500-r.p.m. machines supplied by the Canadian General Electric Company. They have the lower portion suspended from the foundation piers within the foundation pit. These machines are designed for a 25% continuous overload. Each machine has its exciter direct connected but the capacity of one exciter is sufficient for two machines when operating at 80% power factor.

The electrical conductors from the generator pits are laid in the concrete floor and foundations and the leads are accessible at numerous points in manholes and tunnels. The grouping of the leads from the switchboard and

switching apparatus is effected in a central tunnel. The switchboard and control station are placed on an extension of the second floor of the annex, projecting as a gallery within the main portion of the building, from which the full interior of the power house proper is visible to the operator. The switching apparatus is located on the annex second floor and is contained in a series of reinforced concrete cells. Six lightning arresters are located on the upper floor and from these the transmission lines pass out through the side of the building with the usual insulated wall entrances and attachments, which are protected by a 6-ft. awning extension of the roof.

It will be noted that there are no step-up transformers for the transmission lines. On account of the short runs no such apparatus was required, the longest line being under six miles. Most of the current is used at transmission line voltage but step-down transformers are used in various places where the lower voltages are required.

The plant above described is now in operation and its performance is meeting all expectations. It should be noted that the storage and diversion works, water conduit, forebay, waterway and the upper third of the penstock system are completed for the full capacity of four units, while the lower two-thirds of the penstocks are completed only for supply to the two of these units now in operation. The cost as now constructed, figured on the basis of the normal output capacity of the two units now installed, is less than \$70 per h.p. at the power house switchboard; the corresponding cost will be reduced to less than \$60 when the plant is ultimately complete. Considering the permanent character of the work throughout, the isolated location of the plant in relation to material and labor markets and the fact that a great deal of material and many appliances required for its construction had to be imported and were subject to heavy customs duties, these low costs are noteworthy and reflect efficient design and particularly neat and workmanlike construction.

The water-wheels, with governor equipment, relief valves, etc., were supplied by Escher Wyss & Co. Generators and all electrical apparatus were installed by the Canadian General Electric Co. The gate valves, air valves, etc., were installed by the Crane Company of Chicago. Messrs. Grant, Smith & Co., Seattle, were the general contractors. Messrs. H. K. Owens and A. V. Bouillon, Seattle, were the consulting engineers for the work. Mr. L. Netland was resident engineer for the Canadian Collieries (Dunsmuir), Limited, during the construction. Mr. Joseph Hunter is the company's chief engineer.

RECORD AMERICAN ZINC EXPORTS.

All previous records in exports of zinc from the United States were surpassed by those of the three months ended with November, which rose to the unprecedented total of 65,504,574 lbs., as compared with 1,346,877 lbs., in the corresponding period a year ago. During the last four fiscal years, zinc exports have averaged 12,800,000 lbs. per annum. In 1897, the former high record year in exports of zinc, the total was 35,869,987 lbs. That figure, however, was surpassed by the single month of September last with an export total of 38,090,144 lbs. of zinc pigs, ingots, etc. The unusually large exports of zinc in recent months were sent chiefly to Europe. In September, when the exports of zinc pigs, etc., rose to the highest point ever known, 28,000,000 lbs. were sent to England, 3,000,000 lbs. each to Scotland and France 333,300 lbs. each to Denmark and Italy, while 1,250,000 lbs. went to British Africa, and 250,000 lbs. to Australia.