ft. 8 in. diameter, and ending in a rectangle 9 ft. 5 in. x 21 ft. 9 in. The velocity of the water when the turbine is discharging 1,300 c.f.s. is reduced gradually from 14.6 ft. per sec. at the top of the draft tube to 6.3 ft. per sec. at its outlet.

The governor is of the Escher Wyss hydraulic type operating with oil under a pressure of 300 lbs. per sq. in. The oil is supplied from a central pumping plant through a ring pipe system.

There are two high-pressure three-throw oil pumps, each operated by an impulse wheel. Each pump takes its water from either exciter pipe and is capable of supplying all four turbines. The pump runs continuously, discharging oil through a relief valve into the suction tank when oil is not being taken by the governors, and maintaining a receiver two-thirds full of oil and one-third full of air under pressure ready to provide for sudden large movements of the governors. These are very sensitive and very sure in their action, and acting on a turbine which has so short a penstock and a flywheel provided by the rotor of the dynamo which weighs 65 tons, they give very satisfactory regulation.

The exciters are driven by two 500-h.p. single-runner Francis wheels, with volute cases—taking their water from two 46-inch steel penstocks.

The turbines were built on a guarantee of 83 per cent. efficiency at full load and 110 ft. head. Under 107 ft. head they have developed 10,000 kw. of electric power.

The generators, exciters and transformers were built by the Canadian General Electric Company. The generators are 3-phase, 60-cycle, 4,400-volt machines rated at 8,825 k.v.a., with 40 deg. cent., and 11,031 k.v.a. with 55 deg. cent. temperature rise. There are two exciters of 250 kw. capacity each. There are twelve 3,000 kw. water-cooled oil-insulated transformers arranged in three banks to step up from 4,400 to 60,000 volts. The switchboards consist of 60,000, 4,000 and 12,000-volt oil switch equipment, with a vertical panel control board, and were made by the Canadian Westinghouse Company.

Power House Building.—The power house is a reinforced concrete building which when completed for four units will be 165 ft. long by 70 ft. wide, with a 14-ft. extension at the east end for the control board, and a 28-ft. two-story lean-to along the side for the switches and busbars. Up to the main floor of the turbines the foundations are built of mass concrete with steel rail reinforcement over the tailrace arches. The superstructure consists of a light steel frame, enclosed in reinforced concrete. The transformers are housed in individual concrete vaults accessible to the travelling crane from the top.

A feature of the design of the power house is the ample space around all the machinery, every part of which, including the transformers, are directly under the 60-ton travelling crane which spans the main building.

The 60,000-volt switches and busbars are contained in the lower story of the lean-to building, and all switches and busbars are separated by reinforced concrete barriers which were poured in place. The 4,000-volt switches are contained in the room above the 60,000-volt apparatus, and the lightning arresters are carried on the roof.

Tailrace.—The tailrace channel was excavated by steam shovel in the old river bed. It is 70 ft. wide and 1,500 ft. long. About 75,000 cu. yds. of sand and clay overlain with heavy boulders, and 22,000 cu. yds. of rock were taken out. As the tailrace discharges into a channel with a considerable fall, some provision was necessary to keep the tailwater at the power house at approximately constant level. For this purpose a low V-shaped concrete weir was built in the tailrace about 100 ft. below the power house. The point of the V points to the power house, and the weir is 300 ft. long. This provides for the full discharge of the four turbines with a range in height of the tailwater not exceeding 30 inches.

Penstocks.—The main penstocks are 14 ft. 6 in. inside diameter. The upper ends, which are embedded in the concrete of the intake dam, are belled out to a diameter of 19 ft. The maximum velocity of the water at the entrance of the bellmouth is 4.6 ft. per sec., and in the penstocks it is 8 ft. per sec.

The penstocks were fabricated in Vancouver, the plates being made in Scotland under rigid specifications and shipped to Vancouver via the Suez Canal. The plates at the upper end are ½ in. thick, and at the lower end ¾ in. thick. The rings are 8 ft. wide, and formed of three sheets 16 ft. long. The ring seams are double riveted, longitudinal seams triple riveted. All holes were punched 1/16 in. small, and reamed out after assembling in the shop. Every alternate ring is stiffened by a 5-in. x 5-in. x ½-in. angle riveted to the outside. In the third and fourth penstocks each ring is stiffened by a 6-in. x 4-in. x ½-in. angle.

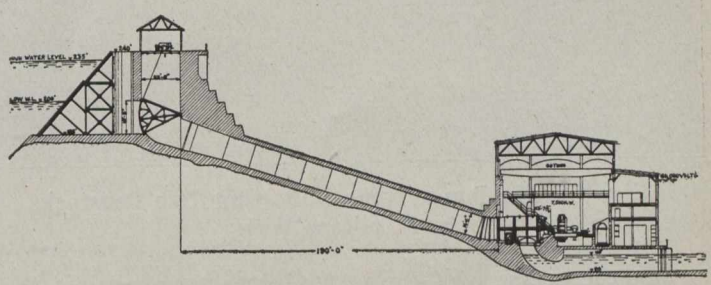

Fig. 2.—Section Through Power House and Intake.

For the greater part of the length the penstocks are supported in concrete up to the centre line, and at the entrance to the power house they are entirely enclosed in a heavy mass of concrete.

There are two separate 46-in. steel penstocks for the exciter and oil pumps.

Intake Dam.—The intake dam is a gravity section concrete dam founded on granite. It is 160 ft. long, and when finished to the full height will be 70 ft. high. There are four main intakes separated from one another by piers 11 ft. wide, projecting upstream from the face of the dam proper, and forming four gate chambers, 19 ft. wide and 24 ft. long. The gate chambers for the exciter pipes are set in the concrete dam to the east of the main gate chambers, and the water reaches them through a short tunnel in the concrete. Across the whole upstream side of the dam there is a screen 120 ft. wide, set on a slope of 45 degrees.

The granite which forms the foundation of the dam, although jointed in all directions, is very impervious. There was only one place found where any water made its way through fissures in the rock, and this was easily taken care of by a 4-in. drain. The surface of the rock was excavated to a considerable depth, and a thoroughly good foundation with plenty of irregularities, to form security against sliding, was secured. As an additional precaution 2-in. steel rods, spaced 5 ft. apart, were set 5 ft. deep all over the foundations. A further point of security lies in the arrangement of the rock abutments, between which the dam sets as a wedge.