

RAINY RIVER WATER POWER PLANTS*

THE plant of the Minnesota & Ontario Power Company and associated companies at International Falls and Fort Frances consists of a power house and paper mill on each side of Rainy River connected by a V-shaped dam pointing upstream. Wasteway capacity for the discharge of the flood waters from Rainy Lake is provided by ten sluices in the Canadian wing of the dam and by six sluices at the head of the old Canadian canal. Each sluice has a width of 10 feet, a sill elevation of 477.5 Public Works, Canada, datum and an arch crown elevation of 490.0. The discharge through these sluices is controlled by two-phase wooden sluice gates, which are raised by means of a motor-driven hoist. In addition to these wasteways there is a 12-foot log sluice with a sill elevation of 487.0.

The dam is of masonry construction, rubble-faced and capped with concrete. The spillway section of the dam is about 450 feet long, with crest at elevation 497, and is provided with flashboard supports and decked to allow passage from one side to the other.

In the American power house, the power developed is used only for the purpose of grinding wood pulp. The installation consists of six units of four 39-inch wheels, each unit direct connected to a battery of four wood-pulp grinders. The wheels are of the "Smith" type, built by the S. Morgan Smith Co., of York, Pennsylvania. At a head of 28 feet, for which the turbines were selected, the manufacturer's rating for each unit of four wheels is 2,011 horse-power, 226 r.p.m. and 782 c.f.s. discharge. The centre of shaft is at elevation 483.0 and the elevation of the bottom of the draft tubes is 461.0. The values of power and discharge given here are 5 per cent. less than those listed on the manufacturer's catalogue, on account of the larger shaft required when four wheels are attached to a single shaft. In operation these wheels generally run at full gate with constant efficiency at all heads, the speed varying with the different heads as given by the manufacturers' catalogue, and the power and discharge being decreased 5 per cent. from the rated values for single turbines. The pressure pumps of each grinder act as governors, since the increasing of the turbine speed increases the pump speed and the pressure against the grinder, with the result of more power being used in grinding the wood. It has been stated that the speed of grinders should not exceed 260 r.p.m. on account of the possibility of the bursting of the grindstones.

On the Canadian side, power is used both for the purpose of grinding wood pulp and for generating electric power. The pulp-grinding installation here consists of five units of four 36-inch wheels, each unit direct connected to a battery of three grinders. The wheels are of the "Smith" type, built by the S. Morgan Smith Co. At a head of 28 feet, the manufacturers' rating for each unit of four wheels is 1,716 horse-power, 244 r.p.m. and 667 c.f.s. discharge. The centre of shaft is at elevation 483.0 and the bottom of draft tube at elevation 460.0. The same conditions of operation as described for the grinders in the American plant are applicable to this installation. The first of the Canadian grinders were operated in June, 1914, the entire present installation being in use by August, 1914.

The hydro-electric portion of the Canadian power house generates electric power principally for the driving of the paper-making machinery and the lighting of the

plant, a small block of power being used in lighting the two adjacent towns. This installation consists of four units of four 36-inch wheels, each unit direct connected to a 1,250-k.v.a., 3-phase, 60-cycle, 6,600-volt generator, regulated by improved Lombard governors. The wheels are of the Holyoke type "C", manufactured by the Holyoke Machine Co., of Holyoke, Massachusetts. The manufacturer's rating for each unit of four wheels at a 28-foot head is 1,700 horse-power and 212 r.p.m. The centre of shaft is at elevation 484.0 and the bottom of draft tube at elevation 460.0. The hydro-electric portion of the Canadian power house, together with the American grinders, has been operated since September, 1910.

WINNIPEG RIVER WATER POWER PLANTS*

The Winnipeg Electric Railway Company's Plant.—The hydro-electric plant of the Winnipeg Electric Railway Company is located on the Pinawa Channel of the Winnipeg River. A very complete account of both the historical and physical features of this plant has been presented in Water Resources Paper No. 3 by Mr. J. T. Johnston, of the Dominion Water Power Branch. This plant was completed in 1906 and during that year furnished the first hydro-electric power used in Winnipeg. The electric power from this plant is used for the purposes of street railway operation, light, heat and power.

The installation at the Winnipeg Electric Railway plant consists of nine main units, each unit consisting of four horizontal inward flow runners mounted in pairs and placed longitudinally in the penstocks. Four of the nine units, each have a manufacturer's rating, at a 39-foot head, of 2,595 horse-power and 200 r.p.m., each unit being direct connected to a 1,000-kw. revolving field, 60-cycle, 3-phase, 2,300-volt generator. The remaining five units each have a manufacturer's rating at a 39-foot head of 4,788 horse-power and 180 r.p.m., each unit being direct connected to a 2,000-kw. revolving field, 60-cycle, 3-phase, 2,300-volt generator. The turbines are equipped with Lombard governors. The generators are guaranteed to operate at full load at 95.5 per cent. efficiency. Excitation is provided by two 100-kw., 125-volt, direct-current machines coupled to two 200-horse-power McCormick turbines, and operating at 600 r.p.m.; and by two 175-kw., 125-volt exciters coupled to 3-phase, 2,300-volt induction motors, operating at 514 r.p.m.

The head available for power purposes at this site varies with the season and the flow, the average head being 39 feet. During the winter, ice conditions have at times caused considerable trouble, resulting in a decrease in available head. A flow of about 8,000 c.f.s. is required to operate this plant under normal head at the full capacity of the present installation.

The power is transmitted to Winnipeg at 60,000 volts, over a 65-mile duplicate transmission line. In Winnipeg this company has an auxiliary plant and storage battery capable of producing 22,000 horse-power, bringing the total power available for distribution in the city up to approximately 45,000 horse-power. During the winter season of peak load, all of the stream and storage battery plant, in addition to the hydro-electric plant, are operated to capacity.

The Winnipeg Municipal Plant.—The hydro-electric plant of the City of Winnipeg is located at the Point du

*From report of Consulting Engineers White and Meyer to International Joint Commission.

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