

of our roads must be of that nature, but with the motor car coming into use by nearly every farmer in the country, the value of the smooth road is being realized more widely, and the time is probably not far distant when the people will ask—and will be willing to pay, which is the big thing—for more permanent forms of construction, at least on main highways. Permanent highways cost considerable money, however, and the community must first be educated up to a willingness to bear this increased cost.

If one goes into figures it seems that it should be easy to convince the most pessimistic, for when one considers the saving in cost of hauling farm products, the saving in the cost of operation of motor cars, the saving on depreciation in value of vehicles of all kinds, and the lengthening of the effective life of horses, and the increase in the value of lands, there is without question splendid return for the investment in good roads, without taking into consideration their moral, civic and educational value.

## "Hydro" Calls For Tenders on Four 52,500 H.P. Turbines

First Units For Chippawa-Queenston Power Development—Summary of the Specified Requirements—Thoroughly Modern Governor Equipment

**T**ENDERS are being called until 4 p.m., October 1st, by the Hydro-Electric Power Commission of Ontario, for the initial hydraulic equipment of the Chippawa-Queenston power development. The work required consists of the design, fabrication, delivery, erection and test; ready for operation, of four single-runner vertical turbines, with spiral casings, arranged for direct connection to electric generators; also the supply and erection of the distributors or supply pipes, governors, governor pressure systems and all other accessories and attachments necessary for the generation, regulation and control of the required amount of power.

The site of the power house, as stated in *The Canadian Engineer*, issue of June 20th, 1918, in the article descriptive of this development, is at Smeaton's Curve on the Niagara River, about one mile south of the village of Queenston.

Each turbine is intended to drive at full gate one 3-phase, 25-cycle, 12,000 volt, internal revolving field generator of 43,900 k.v.a., 85 per cent. power factor, maximum rating. The generators will be arranged for parallel operation and will supply the Commission's Niagara system over a 110,000-volt transmission line.

The water will reach the turbines through riveted steel penstocks 14 feet in diameter and approximately 500 feet in length. The specifications for the turbines state that the normal net head available shall be taken to be 305 feet, the maximum gross head 323 feet, and minimum gross head 300 feet. This gross head is the total head between the forebay water level outside the gate house wall and the water level in the tailrace immediately outside the power house wall.

The constant speed of each unit will be 187.5 revolutions per minute. Each unit will have a full gate capacity of 52,500 mechanical horse-power at the generator coupling when operating under a net effective head of 305 feet, and at the above-mentioned speed.

### Normal Load 47,000 H.P.

The generators will normally be operated at from 50 per cent. to 60 per cent. of full rated load. It is desired that the size and type of wheels be so selected that the best efficiency will be obtained at the normal load of approximately 47,000 horse-power on the turbine. Each runner will be a solid one-piece steel casting, the vanes being cast integrally with the crown and band. Alternative tenders will be received for the supply of cast iron or bronze in place of cast steel for the runners.

Alternative propositions are also desired on the basis of provision for the removal of the runners from below,

through the draft tubes by lowering the runners from position by means of tackle passed through the hollow shafts, and removing them through the foundations by lowering the upper sections of the draft tubes.

Each speed ring will be made of cast steel in two sections, and will consist of upper and lower flanges on crowns, connected by approximately twelve stationary vanes, cast integrally with the flanges. These vanes will be formed in such manner as to direct the water efficiently through the casing of the guide vanes and will also act as stays to tie the upper and lower flanges together, to resist hydrostatic pressure acting upon the casing and to support all superimposed weight.

### Tested at 260 lbs. per Square Inch

Each casing will be of spiral or volute type, of circular cross-section and made of cast steel. Its form will be such that the area of the water passages will be decreased in proportion to the discharge, so that the velocity will remain constant while producing a minimum of hydraulic loss. The casings will be tested in the contractor's shops hydrostatically to a pressure of 260 lbs. per square inch.

Alternative tenders will be received based on the supply of plate steel casing, the specified material for which is open hearth steel with maximum phosphorus .04 per cent., if made by basic process; .06 per cent., if made by acid process; sulphur shall not be over .05 per cent., and manganese between .3 and .6 per cent. The casings must be amply strong to withstand the strain due to sudden variations in hydraulic pressure due to governor operation or other causes, and will be designed to withstand twice the normal static head under working conditions due to sudden closing of the gates by the governors.

The upper portions of each draft tube will be made of cast iron, so designed that it may be set in exact conformity with the alignment of the shaft. It will be embedded in the concrete and will support the lower distributor plate. As mentioned above, alternative propositions will be received based on a telescopic draft tube, in which case the tube will be made in two sections, the upper conical section telescoping into the lower in order to permit the removal of the runner.

The cast iron split guide bearings will be of the water lubricated lignum vitae type. The piping connections will be such that water may be fed under ordinary conditions from each turbine casing to the lignum vitae bearing. Two filters will be provided, so arranged that cleaning or flushing may be accomplished without cutting off the bearing lubrication.