# "Hydro's" Queenston Generator Specifications

## Tenders Called on Several 45,000 K.V.A. Machines—Ventilation and Insulation are the Main Problems in Design—Commission Says that Ultimate Capacity of the Station May Be a Million Horse-Power

SPECIFICATIONS have been issued by the Hydro-Electric Power Commission of Ontario for the big generators needed for the initial installation at Queenston, which will probably total 200,000 h.p. It is recognized, however by the engineers of the Commission that these specifications are tentative, and alternatives to be submitted by the tenderers will receive consideration.

As each generator will have an output capacity of 45,000 k.v.a. at the terminals (at a power factor of 80%, current lagging) the main problem is ventilation.

"Give me a method by which to get the heat away, and I could build a generator of 1,000,000 k.v.a.," says the chief engineer of a prominent electrical firm.

### Ventilation

Various schemes have been proposed for the ventilation of these big generators, and it is expected that each of the bidders will submit plans of their own in this regard, as each of them has a ventilating engineer at work upon the subject. The Commission tentatively proposes that each generator be completely enclosed, cooling to be effected by air either forced in or exhausted by suitable fans.

It is the intention to draw the air from the gorge through the east wall of the station, above the flood level (elevation 296), and supply it direct (without treatment) through ducts to the generator, either at the bottom or at the bottom and top. The heated air will pass through ducts into the atmosphere at the rear of the station, at or near the roof.

If possible, the Commission desire the generator to ventilate itself by means of suitable fans located on the rotor, as it is thought advisable to dispense with external fans if at all practical to do so, the idea being to have the units as nearly self-contained as possible, and not dependent upon auxiliary equipment.

It is intended that the design of the ventilating system be withheld until full information is received from the generator manufacturers. The tenders will contain recommendations as to whether the fans, if any, should be located in the supply or exhaust ducts, and they will state the quantity of air required, and the pressure or supply or vacuum in exhaust ducts which it will be necessary to maintain; also the maximum velocity of air which will obtain in any part of the unit under operating conditions.

### Temperature Rise

The specifications limit the temperature to any part of the generator to 100° C. with the cooling air at 40° C. This is with the use of mica and cambric insulation. With an all-mica insulation, the Commission may allow a slightly higher temperature.

"The above maximum temperature rise," states the tentative specification, "is below that allowed by the A.I. E.E. rules for class A insulation, but whether this class of insulation is used or not, it is the intention of these specifications to cover a unit which is conservative in heating.

"If, however, the tenderer is prepared to supply a different class of insulation and to recommend a higher maximum temperature, the Commission may consider such recommendation as an alternative, but in no event will the Commission consider temperatures of any part of the unit in excess of 90° C by thermometer and 110° C by embedded temperature detectors."

At least twenty-four embedded detectors are to be placed in different parts of each generator.

### Mechanical Requirements

Each machine will have a vertical shaft, revolving field with thrust bearing, and possibly a direct-connected exciter. Each generator will be mechanically capable of delivering the rated capacity of each water turbine, namely, 52,500 h.p., and will be capable of carrying any momentary overloads to which it may be subjected.

The normal speed will be 187.5 r.p.m., and the frequency, 25 cycles per second. The machines must be designed so they will run continuously without load but with normal field current at 347 r.p.m. without stressing any part to the elastic limit of any of the material, or in any other way injuring the unit.

The rated capacity is to be delivered at a normal potential of 12,000 volts, but the design must permit variation of the voltage to 13,200 for several hours at a time.

The voltage of the unit will be under the control of an automatic regulator.

The potential wave form of each generator must not deviate from a sine wave by more than 10% at any load from zero to the rated load.

The main shaft will be of forged steel. The Commission reserve the right to adopt the design of coupling submitted by the generator contractor or by the turbine contractor.

### Brake Device

The brake device required for stopping the rotor after the turbine gates have been closed, consists of a number of brake cylinders and plungers secured directly to the foundation, the plungers bearing on a surface forming part of the rotor. It is intended that the brakes should bring the rotor to rest from normal speed within five minutes.

The armature of each generator must withstand for one minute a potential of 30,000 volts applied between all windings and ground, and between phases windings; and the field a potential of ten times the rated exciter voltage to ground for one minute. Wherever possible, the insulation of conductors and bracings will be covered with fire-proof material to prevent the spread of fire.

Each generator will be direct-connected to a single runner, vertical shaft hydraulic turbine, the tenders for which are now being considered by the Commission. An outline of the specifications for these turbines was published in the September 26th issue of *The Canadian Engineer*.

While it is not likely that the initial installation will comprise more than four units, it is intended to instal additional units from time to time as the power situation