

# ELECTRIC GENERATION AND DISTRIBUTION

Commission of Conservation Report shows over 752 Plants with an aggregate Capacity of over Two Million Horse Power, 270 of which are Hydraulic and 201 Steam Plants.

That there is a total of 565 electric generating plants in Canada, with an aggregate capacity of 2,107,743 horse-power, and supplying not less than 753 distributing systems of varying importance, which cover some 973 places, is stated in a report on "Electric Generation and Distribution in Canada," prepared by Leo G. Denis, B.Sc., E.E., Hydro-Electric Engineer, Commission of Conservation, and published recently by the Commission. The report groups the plants according to the kinds of prime movers, as follows:—

| Horse-power.                                      |           |
|---------------------------------------------------|-----------|
| 270 hydro-electric plants, aggregating.....       | 1,806,618 |
| 201 steam plants, aggregating.....                | 288,202   |
| 49 gas plants, aggregating.....                   | 8,157     |
| 45 oil or gasoline engine plants, aggregating.... | 4,766     |

Total..... 2,107,743

The ownership of these various plants is divided into 207 municipal or publicly owned plants of 452,508 h.p. total capacity, and 358 privately owned plants of 1,655,295 h.p. total capacity.

## SIZE OF PLANTS.

The plants, as shown in the report, vary greatly in size. The largest Canadian hydro-electric development is 488,800 h.p., in the three large power plants at Niagara. Other large installations are five plants of over 100,000 h.p. and thirty-six of over 10,000. The largest single plant is the Ontario Power Company, now operated by the Ontario Hydro-Electric Power Commission at Niagara, with a total capacity of 211,300 h.p., while the largest single unit is 20,000 at Grand'mere, Que. "The average head of water utilized is not exceedingly high," says the report, "but many of our large hydro-electric plants operate under fairly high heads, such as 140 to 180 feet at Niagara, 145 at Shawinigan, 83 at Grand'mere, and 400 feet at the Coquitlam - Buntzen plants near Vancouver. The highest head in Eastern Canada is 540 feet, at the 8,000 h.p. plant at Eugenia Falls, Ont., while in the West we have a head of 1,820 feet, for hydro-electric purposes at Britannia Beach, B.C., where the development also provides a total head of 3,530 feet in two steps of 1,450 feet and 2,080 feet for the direct operation of other machinery. On the other hand, one of our largest plants, recently installed at Cedars, Que., operates under a head of 30 feet.

The plant at Hamilton, Ont., 26,667 h.p., is the largest steam-power plant in Canada, and is used as an auxiliary, while the plant at Edmonton, Alta., 14,234 h.p., is the largest steam plant operated continuously.

## POWER RESOURCES.

The report points out that Canada is well provided with primary power resources, and that, except for a part of the Middle West, either water-power or coal is found in abundance, while in

British Columbia both are available. In Quebec, Ontario, and eastern Manitoba water-power is the largest source of energy by far, and in British Columbia and western Alberta water-power is also the predominating source of energy. In the Maritime Provinces both steam and hydro energy are used, but steam is the largest source of power. In the Middle West large plants are operated by steam and smaller ones by oil or gasoline engines.

"We have reason to congratulate ourselves," the report states, "on the type of plants found in our large hydro-electric installations. Usually the works are of the most substantial construction, and the most expert engineering advice has been obtained, while the equipment is in keeping, and comprises both hydraulic and electrical machinery of the most efficient type. The same, unfortunately, cannot be said of many of our small plants, and particularly in the older ones there is great room for improvement. The old wooden dams are usually very leaky and, especially on small streams, a considerable proportion of the flow is wasted, while the remaining water is often lost in a vain effort to operate an obsolete and inefficient water-wheel installed years ago and never properly repaired or adjusted." The same comment is made by the report in regard to steam plants.

## TYPES OF GENERATORS AND FREQUENCIES.

The types of generators used are described in the report as follows: "Practically all energy for distribution is generated as alternating current. The types of generators comprise various phases, frequencies, and voltages. All large plants, and a great many of the smaller plants, operate at three-phase; a number of the older plants, some of a fair size, still use the two-phase; while the single-phase systems are confined to small plants which have also been installed for some time. The principal frequencies used are 60, 30 and 25 cycles, while frequencies of over 100 cycles are still found in the older plants of small size. There is naturally a great variety of generator voltages, these being adapted to suit the most economic power plant design. In plants supplying distribution systems direct at the generator voltage we find 2,200 volts predominating; also 550 volts where a large amount of motive power is supplied near the plant; also 12,000 volts in plants where all or a portion of the energy is transmitted a certain distance at this voltage. With the exception of electric railway service, and in a few places for a portion of the industrial power service, direct current generation is practically confined to very small plants. Such plants sometimes use storage batteries to provide continuous service while the generating units operate only a portion of the time."

Referring to the character of the loads, the report continues: "The aggregate maximum demand on the plants is 1,078,298 k.w., of which 1,003,955 k.w. is on hydro-electric, 69,924 on steam, and 4,419 k.w. on internal combustion engine plants. The division between the various services, such as lighting and power, could not be obtained from all plants and systems, but available data indicate that 31 per cent is used for lighting, 59 per cent for power, and 10 per cent for miscellaneous."

Of the various plants, 274 give a continuous service, night and day, while 220 give only a night service. The remaining 71 plants are used as auxiliaries.

## COST OF GENERATION.

The cost of generation for hydro-electric plants, usually given in dollars per h.p.-year, is estimated in the report

## NUMBER, OWNERSHIP AND CAPACITY OF ELECTRIC PLANTS IN CANADA.

| Province.                 | Ownership.        |                      |                   |                      |               |                 |
|---------------------------|-------------------|----------------------|-------------------|----------------------|---------------|-----------------|
|                           | Private.          |                      | Public.           |                      | Totals.       |                 |
|                           | Number of plants. | Total capacity, h.p. | Number of plants. | Total capacity, h.p. | Total plants. | Total capacity. |
| Nova Scotia.....          | 24                | 23,064               | 14                | 4,113                | 38            | 27,177          |
| Prince Edward Island..... | 9                 | 1,314                | .....             | .....                | 9             | 1,314           |
| New Brunswick.....        | 16                | 16,212               | 7                 | 2,395                | 23            | 18,607          |
| Quebec.....               | 99                | 604,903              | 20                | 20,158               | 119           | 625,061         |
| Ontario.....              | 105               | 609,658              | 68                | 290,198              | 173           | 899,856         |
| Manitoba.....             | 8                 | 53,706               | 15                | 49,309               | 23            | 103,015         |
| Saskatchewan.....         | 26                | 2,682                | 36                | 27,911               | 62            | 30,593          |
| Alberta.....              | 27                | 43,235               | 25                | 41,882               | 52            | 85,117          |
| British Columbia.....     | 41                | 290,234              | 22                | 16,542               | 63            | 306,776         |
| Yukon.....                | 3                 | 10,227               | .....             | .....                | 3             | 10,227          |
| Canada.....               | 358               | 1,655,295            | 207               | 452,508              | 565           | 2,107,743       |

to run from \$8.50 to \$15 per h.p.-year or lower for very large plants, while for smaller hydro-electric plants from \$30 to \$40 per h.p.-year. Steam plant costs, usually expressed in cents per k.w.h., are reported as varying from 0.7 to 5 cents per k.w.h. in large plants and from 3 to 15 cents per k.w.h. in smaller plants.

## TRANSMISSION LINES.

Transmission lines in Canada, according to the report, operate under many different voltages up to 110,000 volts. "There are only three systems," it is stated, "using over 100,000 volts, namely, the Niagara system of the Ontario Hydro-Electric Commission, the Shawinigan Water and Power Company, and the Montreal Light, Heat, and Power Consolidated, on the line from its Cedars plant to Massena, N.Y." Lines of various voltages from 10,000 upward aggregate 5,490 miles, and are as follows: 10,000 to 30,000 volts aggregate 2,428 miles; 30,000 to 99,000 volts aggregate 2,485 miles; 100,000 volts and upwards aggregate 577 miles.

The cost per mile of the different lines naturally varies with the mode of construction, size, and number of conductors and voltage for which constructed. For voltages of from 10,000 to 50,000 the figures given show a wide variation of from \$600 to \$11,000 per mile, while on 100,000-volt lines and over we have from \$7,500 to \$14,000 per mile.

Iron transmission lines have been used in many instances lately, owing to the high price of copper and aluminum.

Of the 752 distribution systems in Canada, 389 are municipal or publicly owned and 363 under private ownership. The systems included cover a total of 11,852 miles of streets, and supply 730,697 consumers with an estimated connected load 497,846 kilowatts for lighting and appliances and 970,505 h.p. for power.

## RATES.

The report makes the following comment on rates: "As probably the question of rates charged to consumers will be one of great interest, a word of warning is necessary to prevent the drawing of hasty conclusions when establishing comparisons in this connection. As might be expected, low rates are generally found where hydro-electric energy is available, but rates are influenced by many extraneous circumstances. Naturally there may be a fairly large margin between rates charged and the cost of energy at the power plant or substation, due to features of the distribution system. In some cases it costs almost as much to distribute as it does to generate. In other instances, where the distribution system is restricted and the load confined to a small area, distribution cost may be a very small item. It is also often difficult to establish a fair comparison between various rates on account of the different systems of charging used in various places. For instance, the Hydro-Electric Power Commission has adopted a system of rates based on a fixed charge plus a meter

rate varying with the consumption. In other words, a combination flat and meter rate and a comparison with a straight flat or a straight meter rate can only hold for a specific example with stated conditions and consumption. The working out of proper rates is one of the most important and intricate problems facing an electric distribution organization, and there are doubtless a number of cases, particularly in some of the smaller systems, where a proper policy with regard to the sale of current has not been adopted. Frequently, as a result of such mistaken policy, the maximum revenue possible is not derived from the plant."

Incandescent lamps, particularly since the advent of gas-filled lamps, have been replacing enclosed arc lamps for street lighting, the report states. The prevailing size of incandescent lamps is 100-w., while lamps of from 25 watts to 1,000 candle-power, both tungsten and gas-filled, cover the range found in use.

"The rates or charges allowed for street lighting show much variation in different places," the report continues. "Some of the higher rates per lamp per year are: Luminous or magnetite arc, \$95; enclosed arc, \$90 to \$125; 100-w. lamp, \$48; 300-w. lamp, \$75. Some of the lower rates per lamp per year are: Luminous or magnetite arc, \$46.50; enclosed arc, \$40; 100-w. lamp, \$3.30; 400-c.p. lamp, \$8.40; 1,000-c.p. lamp, \$50. In a number of places the street lighting service is charged on the meter rate at so much per k.w.h."

The report contains descriptions of the various plants and systems for electric generation and distribution throughout Canada, and is fully illustrated with maps, charts, and half-tone reproductions of photographs of many of the most important plants.

## DECLARATION FOR EXPORT.

Canadian exporters desiring to take advantage of the preference granted goods of Empire origin imported into the United Kingdom must make a sworn declaration on invoice in the following form definitely prescribed by the Commissioner of Customs:—

"I, exporter of the goods described in this invoice, hereby declare that all the said goods are bona fide the produce or manufacture of one or more of the British dominions."

Details of shipment will follow, with signature. Customs collectors have been instructed that the declaration may be sworn before them. In making the announcement, the Canadian Trade Commission, Ottawa, suggests that correspondence should be addressed to them regarding classes of goods affected by the British restriction and for which the declaration is required.

## TIMBER BUSINESS LIKELY.

Recent advices from Canadian Mission in London are to the effect that the timber control will soon be lifted, and Canadian lumbermen are advised by the Mission to get in touch with the ordinary trade channels, as the volume of business will likely be limited only by the ocean tonnage.