

Constitution and Objects of Victorian State Power System.

THE State Electricity Commission of Victoria was constituted by Act of Parliament in 1918, for the purpose of developing and pooling Victoria's power resources on a State-wide and State-owned basis, in order to promote electrical progress in a systematic and economic manner, and to obviate the losses and inconvenience which were being caused by frequently-recurring interruptions to imported black coal supplies, due to factors beyond the control of the State.

The following specific duties were imposed upon the Commission by the 1918 Act :---

- (a) The ultimate co-ordination and unification of all State or other electrical undertakings in Victoria, and the adoption of such standards of plant and equipment and system frequency and pressure for the generation, distribution and supply of electricity as will admit of the efficient inter-connection of such undertakings, and inter-change of electricity throughout the same, and, generally, the safe, economical and effective supply of electricity throughout Victoria, and to secure the amalgamation and concentration of such undertakings;
- (b) To encourage and promote the use of electrical energy, and especially the use thereof for industrial and manufacturing purposes;
- (c) To carry out investigations, surveys, explorations and borings to ascertain the existence, nature and extent of coal deposits or of water power suitable for use in connection with the generation of electricity, and to ascertain suitable sites for generating stations;
- (d) To carry out investigations as to the safest, most economical and most effective means of promoting, establishing, extending and improving works for the generation, distribution, supply and use of electricity throughout Victoria, and particularly for industrial and manufacturing purposes;
- (e) To immediately submit as the basis of a State transmission system a scheme for an electrical undertaking utilising brown coal or, alternatively, water power;
- (f) To administer the Electric Light and Power Act governing the operations of municipally and privately-controlled undertakings.

With a view of facilitating the co-ordination and extension of supply, the amalgamation and concentration of undertakings and the standardisation of both supply and tariffs, subsequent Acts have given the State Electricity Commission the power:--

(i) To acquire (to the exclusion of municipal councils) and to operate individual undertakings:

(ii) To control the establishment of new undertakings, whether private or municipal, or the extension of existing undertakings, either in regard to area or plant; and

(iii) To control the tariffs of those undertakers whom it supplies in bulk.

Service Given by Victorian State Power System.

THE duties and obligations of the Commission have been translated into what is now little short of a complete power system for the State, supplying practically the whole of the electrical requirements of the metropolitan area of Melbourne as well as those of 300 country centres, over 200 of which did not previously enjoy the uses and benefits of electricity. In the greater portion of the metropolitan area and in all of its country centres (including the provincial cities of Ballarat, Bendigo and Geelong) it supplies in retail. That portion of the metropolitan area supplied in bulk consists of ten municipal undertakings operating under Orders-in-Council granted before the passing of the Commission's Acts. Bulk supply is also given at sub-stations on the Victorian side of the Murray River to the New South Wales border municipalities of Albury, Corowa, Moama, and Berrigan.

Physical Features of Victorian State Power System.

YALLOURN.—The basis and most interesting feature of Victoria's State Power System is Yallourn, where land dredges for excavating coal and overburden, track-shifters that lift, shift and re-align dredge and transport tracks with amazing rapidity, electric transport of both coal and overburden (including a steep haulage from bottom of the mine to the 1500-ton coal bunker at the power station), and machines for stacking and spreading overburden, form part of the completely mechanised open-cut operations. The open-cut itself is over 250 acres at grass level, and about 200 feet deep. It is on part of the Latrobe Valley brown coal area. The 25 million tons of brown coal already taken from it, and the additional 8 million tons uncovered of overburden ready for excavation, represent a very small fraction of the 6,000

million tons in the Yallourn field, which, again, is but a small fraction of the 27,000 million tons in the Latrobe Valley.

All of the coal in the Yallourn area is capable of being won by the cheap open-cut method, whereby the overburden is first removed by a dredge having a downward reach of 26 feet and an upward reach (by rotating the bucket ladder) of 30 feet, and an output capacity of 3,500 tons in eight hours. The coal thus exposed is excavated by two dredges, each having a downward reach of 90 feet and a normal output capacity of 4,000 tons in eight hours. One is on the surface of the coal, and the other 90 feet down, reaching to the bottom of the deposit. In the open-cut, as at present developed, the overburden is 30 feet thick, and the coal 180 feet thick. For the whole Yallourn field the average thickness of overburden is less than 50 feet, and that of coal over 200 feet. Nowhere in the world is the ratio of coal to overburden so favorable, and the accessibility of the Yallourn lignite is one of its principal advantages.

The daily output of coal from the open-cut is up to 12,000 tons, which is shared by the Power Station and the Briquette Factory. In the dried and compressed form of briquettes, brown coal is a high-grade fuel, its calorific value being increased from roughly 3,000 B.T.U.'s per lb. to 9,500 B.T.U.'s per lb. as fired. The factory produces 1,200 tons a day, and as briquettes are a valuable industrial fuel, they provide a substantial safeguard against interruption to external supplies of black coal. The factory, by permitting the full use of economical coal-winning machinery in large-scale operation, and by spreading the cost of coal over a tonnage that is nearly double the amount which would be required otherwise, has a most favorable effect in lowering the costs of power generation at Yallourn.

The Yallourn Power Station has at present an installed capacity of 150,000 kilowatts. This capacity is to be increased by the winter of 1939 to 175,000 kilowatts, for an effective capacity of 136,000 kilowatts.

The boilers in the Yallourn Power Station use the 65 per cent. moisture coal as it comes from the mine, step and travelling grates and pre-drying devices integral with the boilers enabling a high standard of combustion efficiency to be achieved.

Electricity is generated at 11,000 volts and then stepped up to 132,000 volts for transmission over two steel tower lines to Melbourne receiving stations (one at Richmond and the other at Yarraville).

A SSOCIATED with Yallourn in Victoria's inter-connected transmission system are the following stations:--

NEWPORT "B"-

Effective capacity, 18,000 kilowatts. This is under the same roof as the Newport "A" Power Station of the Victorian Railways, which supplies the requirements of the Melbourne suburban electrified railway system. There is provision for an interchange of energy by means of frequency-changers, the Commission's system being 50-cycle and that of the Railways 25-cycle. Although primarily a peak-load station, Newport "B" preceded Yallourn by over 12 months, its erection being expedited in order that it should form a stop-gap in meeting metropolitan requirements. The effective capacity of the station is to be increased to 48,000 kilowatts by the winter of 1939, and to 90,000 kilowatts by 1948.

RICHMOND_

Effective capacity, 15,000 kilowatts. This was originally the single-phase station of the Melbourne Electric Supply Company Ltd., whose undertakings in Melbourne and Geelong were acquired by the Commission in 1930. The Commission converted Richmond into a three-phase station, primarily for peak-load purposes.

SUGARLOAF-RUBICON HYDRO-ELECTRIC STATIONS-

Total effective capacity, 25,000 kilowatts. The principal station (18,000 h.p.) is on the Eildon Weir of the State Rivers and Water Supply Commission, and utilises the irrigation waters for the generation of electricity. Four other stations, aggregating 18,000 h.p., are on the adjacent Rubicon and Royston mountain streams, and are complementary to that at Sugarloaf, where there is a shut-down period each year to permit the dam to refill. This occurs at a time when the flow in the mountain streams is at its maximum, so a regular minimum output all the year round is assured. The energy from the hydro stations is fed into the main system at 66,000 volts through a terminal station at Thomastown.

The Railways Department's station (Newport "A"), is also inter-linked with the Commission's system.

There are 66,000 volt transmission lines to Bendigo and Geelong; the line to the latter place is operated initially at 22,000 volts. In addition there are local power stations at Ballarat and Geelong.

From Geelong electricity is supplied by means of a 44,000 volt transmission line to the southwestern district of Victoria, which includes such important towns as Colac, Camperdown and Warrnambool, and by a 6,600 volt line to the Bellarine Peninsula.

Rural Electrification.

THE Victorian State system of electricity supply affords one of the most interesting examples in the world of rural electrification, especially when the comparatively sparse and scattered nature of the rural population of the State is considered. In those centres in which the Commission did not initiate supply, existing undertakings were acquired, the local plants (in most cases small, uneconomical and inefficient, and in all cases only capable of serving limited requirements in the towns in which they were situated) closed down, and supply given on the basis of actual generation cost, plus that of transmission and distribution. The development that has taken place in these centres since acquisition by the Commission is indicated by the fact that, while sales have increased by 768 per cent. the average price per unit has been reduced by 6.30d., to 2.45d., the reduction being 72 per cent.

In regard to rural electrification, the acquisition of existing undertakings was in all cases a necessary condition precedent to the formation of homogeneous and economically-operated district supply areas, in which the smaller centres and farms could be brought within economic range of supply. In the cases of small and remote rural extensions, a five years' guarantee of revenue sufficient to cover annual costs is required by the Commission. The guarantees have advantages, inasmuch as consumers as a rule ensure that at least they use energy up to the full amount of their guarantee; consequently they quickly discover the value of electricity for the many and varied purposes to which it is so admirably adapted in the home and on the farm. There are nearly 3,000 farms receiving supply from the Commission. There are using electricity for a variety of purposes, such as milking, separating, hot-water systems, wood-sawing, chaff-cutting, corn-grinding, elevating, etc., besides finding it a positive boon in the home and for lighting yards, barns, etc., at a cost of about 7/6 a week. Practically all of the rural industries within range of the Commission's system are electrified, and charges for the service are showing a consistently downward tendency. For instance, well designed and operated butter factories spend only 10/- for electrical power for each ton of butter manufactured and sold for £100.

A special section of the Commission's Electricity Supply Department gives close and continuous study to every possible measure which can be adopted to enable electricity to be used to improve farm products, increase production, reduce production costs and eliminate drudgery.

Growth of the Victorian State Power System.

THE first of the five 12,500 kilowatt turbo-alternators forming the original installation at the Yallourn Power Station came into operation on the 24th June, 1924, and in the financial year 1924-25 the sales of electricity actually generated by the Commission's own plants at the Yallourn and Newport "B" Power Stations amounted to 101 million units. In that year the number of centres directly served by the Commission was 55, including one retail district in the metropolitan area. In the 1936-37 financial year the number of centres directly served by the Commission, including 20 suburbs in Melbourne (the remaining ten being served in bulk) was 303, and the sales of electricity generated by the Commission amounted to 627,000,000 units. This is an increase of 49 million units over sales in 1935-36.

Revenue from electricity supply in 1924-25 (including that from energy purchased and re-sold) was about £670,000, against £3,340,000 in 1936-37. The effective capacity of the Commission's generating plant in 1924-25 was roughly 90,000 horse-power, compared with about a quarter of a million horse-power in 1936-37.

The progressive growth in the demand for power has been forecasted and provided for in an economical manner, with a diversity of supply source that adds to the security and flexibility of the system. While accurate forecasting of the growth of the public demand for power requires constant analysis of the most complete records, so that new plant provisions shall be neither premature nor belated, the Commission has also to be ready whenever the need arises to indicate to Parliament the most economical of the alternative power sources available for development, with particular regard for the characteristics of any new loading that requires to be catered for. This entails constant research and systematic power surveys, which have advanced to such a stage that schemes aggregating a quarter of a million horse-power have been tabulated ready for consideration. This represents one of the Commission's most important duties, and is one of the advantages of an organised system of supply, concerned with the development of Victoria's power resources for the benefit of the people as a whole.

To meet the estimated growth of load on the Commission's system up to and including the winter of 1951, Parliament has approved of a hydro-electric scheme on the Kiewa River, which has its source on the Bogong High Plains, an extensive plateau 5,500 feet above sea level, lying between Mounts Bogong and Hotham, in the highest mountain system in Victoria. The main storage reservoir for the Kiewa undertaking will be 95,000 acre feet of water in Pretty Valley, at an altitude of 5,500 feet, while a second storage of 13,000 acre feet will be provided in Rocky Valley, at about 5,300 feet altitude. A feature of the scheme will be rock tunnels, in lieu of open water races, for the conveyance of water to the pipe heads of the power stations. There will be four power stations, one (21,000 kilowatts) at an elevation of 4,000 feet; one (33,000 kilowatts) at an elevation of 3,700 feet; one (24,000 kilowatts) at an elevation of 1,840 feet; and the lowest (39,000 kilowatts) on the river flats near Tawonga, at an elevation of 1,200 feet. After allowing for spare plant, the ultimate effective capacity of the scheme will be 104,000 kilowatts. The generating pressure of 11,000 volts will be stepped up to 66,000 volts up to the stage where there will be an output of 50,000 kilowatts, and to the ultimate transmission voltage of 165,000 volts when Kiewa's capacity has reached 76,000 kilowatts. The transmission line, from Tawonga to Melbourne, will be 158 miles long, and terminate at a receiving station in Brunswick, this location being in conformity with the needs of the main metropolitan distributing system and of the main country feeders radiating therefrom. The received output at Brunswick will be 92,500 kilowatts.

Included in the major extension plan is the enlargement of the Newport "B" (metropolitan peak load) station to an effective capacity of 90,000 kilowatts by 1948.

The total estimated cost of the major extension scheme is £8,783,000.

The Kiewa scheme lends itself conveniently to development in stages, of such size that the completion of each stage, together with the completion of portion of the Newport installation, will deal most suitably with the regular increase of system load, with the result that the capital outlay on each successive stage will be immediately productive.

Tariffs of the Victorian State Power System.

THE Tariffs of the Victorian State Power System are designed to do two things—(1) To permit the various classes of consumers to use electricity extensively on an economical basis, and (2) to preserve the financial stability of the scheme, so that while the benefits of increasing use of electricity shall be passed

on to consumers in the form of a decreasing unit charge, there shall be just sufficient growth of revenue as the result of increasing use of electricity to take care of the capital and operating charges on the extra provisions for generation, transmission and distribution that this greater use of electricity renders necessary. In short, the principle that electricity is an essential public utility, and should be no more than self-supporting, has been given effect to through a policy of service at cost.

One of the statutory duties of the Commission is to promote the use of electricity, especially for manufacturing purposes. As evidence of the manner in which the State system has stimulated and catered for the growth of manufacture by providing plentiful supplies of power at suitable tariffs, it may be pointed out that whereas in 1917-18 the total electric horse-power installed in factories in Victoria was only 37 per cent. of the whole, to-day it is over 80 per cent. of the whole.

In the metropolitan area the standard power and heating tariff commences at 2d. per unit for consumption up to and including 500 units per month, stepping down progressively until it reaches 0.75d. for the largest block in the schedule. There is also an all-purposes tariff (power, heating and lighting), which commences at 4d. per unit for consumption up to and including 100 units per month, stepping down progressively until it reaches 0.75d. for the largest block in the schedule. An off-peak tariff of 0.3d. per unit is prescribed for electricity used between the hours of 11 p.m. and 7 a.m. In the provincial cities of Ballarat, Bendigo and Geelong there are similar industrial tariffs, but on a slightly higher level to cover the extra costs of supply. The same principle applies in the smaller rural centres.

The standard domestic tariff in the metropolitan area is in two parts—a fixed charge of 1/- per room per month, plus 1d. per unit for the energy actually consumed. Provision is made that the average charge per unit to be made to any consumer at quarterly meter readings shall not exceed 6d. per unit, but that if the monthly consumption is so negligible as not to amount to five units, a minimum charge at the rate of 2/6d. per month shall apply. An off-peak water-heating tariff of 0.375d. per unit is prescribed. The tariff therefore allows any consumer to use electricity extensively for all household purposes on an economic basis, while safeguarding the very small consumer against what he might regard as a burdensome charge for the amount of electricity he actually uses. A similar form of domestic two-part tariff, with slight variations in the rates to meet the differing costs of establishing and maintaining supply, is also standard throughout the Commission's country districts. The two-part domestic tariff has greatly stimulated the use of electricity in the home, by reducing the average unit cost as consumption increases. It is possible to have an all-electric home in Melbourne at an average cost per unit of about 1d., after counting in the service charge. The incidence of the Commission's forms of tariffs in the areas served by it is shown by the fact that while sales of electricity have increased by 226% since 1924-25, the increase in revenue has been only 102%, while the average revenue received per unit sold has decreased by 1d., or by 38 per cent. This represents an annual benefit to consumers of £1,685,000. Direct reductions as affecting all centres, but principally felt in the metropolitan area (which uses about ten times as much electricity as the remainder of the State) have contributed £292,000 per annum to the foregoing result, based on the consumption of the different classes of consumers benefited at the times the reductions were made. In the domestic field specifically and embracing all centres served by the Commission, sales of electricity since 1924-25 have increased by 280\%, for an increase in revenue of only 85%, giving a decrease in the average unit charge (now 2.63d.) of 2.79d., or 51 per cent.

The policy of the Commission is to make direct reductions in its scheduled charges as opportunity offers, and independent of the automatic reductions which accrue from increased consumption under its form of tariffs.

Financial Stability of the Victorian State Power System.

- - Certainty and continuity of supply. The system has a splendid record in these respects, from the points of view of the adequacy of the power sources so far developed, freedom from industrial troubles, and the technical soundness of the whole system.
 - (2) Capability of expansion. Complete data exist in regard to economic power resources for future requirements amounting to about a quarter of a million kilowatts.
 - (3) Independence of sources outside Victoria. The State has been made perfectly self-contained in regard to electricity supply, while the associated industry of briquetting at Yallourn has supplemented Victoria's internal fuel supplies in a substantial, reliable and valuable way.
 - (4) Economic soundness. Economic soundness is shown by the fact that the system is meeting all its commitments, including full interest, depreciation and sinking fund charges, with substantial provision for contingencies, the while that the average price of electricity supplied has shown a progressive and material decline.

The Commission's loan indebtedness at the close of the 1936-37 financial year, including its liability for debentures of municipal councils transferred to the Commission as part of the consideration for the purchase of their undertakings, amounted to £18,682,414. Of this amount the liability to the State of Victoria is £17,452,464. That on account of State Electricity Commission loans raised under the specific borrowing powers conferred upon the Commission by Parliament in 1933 is £1,055,360, and that on account of municipal debentures is £74,091.

The total loan indebtedness compared with the previous year shows a net decrease of $\pounds 124,334$. The fixed capital of the Commission (roundly $\pounds 21,600,000$) is made up as follows: —

*Coal Supply Works				£982,000
Power Stations				£6,752,000
Transmission Lines	1120401.010			£2,552,000
Terminal Stations and Transformer	Sub-stations			£1,727,000
Distributing Systems		1.1	1	£5,821,000
*Briquette Factory		Sectional		£1,275,000
*Town of Yallourn				£601,000
Tramway Systems	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	2	1.151	£328,000
Office buildings, workshops, stores,	etc			£1,637,000

*These items are not usually associated with electrical undertakings, and to that extent the Victorian State undertaking is not comparable with other large undertakings elsewhere. But they add real value and strength to the Victorian system.

The Commission's reserves stood at £4,663,109 at the 30th June, 1937, of which £757,082 was to the credit of the National Debt Sinking Fund, and £26,640 to the credit of the State Electricity Commission Sinking Fund, leaving £879,387 to the credit of the Depreciation Fund, which is invested in the business. The increase in the Depreciation and Sinking Funds during the year was £529,851 including £132,566 interest on the Depreciation Fund.

Contingency and other funds amounted to £344,918 at the same date.

After making the necessary provisions for meeting all commitments the Commission's profit for the year amounted to £38,901.

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