

If a power-station were to be designed with a view to utilizing the slack coal produced in the Huntly district it is probable that the best place to locate it would be Auckland, so that it could draw supplies from other sources at the same time. In the second place, the quantity of slack coal now produced in this district over and above that which is sold is in the neighbourhood of 100,000 tons per annum. At a load factor usual in power-supply systems this would only be sufficient for a maximum load of 12,000 h.p., which amount is too restricted for developing the country properly, and is not even sufficient to supply Auckland if all its requirements are to be adequately provided for. In the third place, there would not be any saving in capital expenditure, whilst the working-expenses would be increased.

#### ELECTRICITY IN MINING GENERALLY.

It has already been indicated under the heading of "Electricity and Coal-mines" that collieries are extensive users of electric power derived from bulk supply systems, but the importance of a general supply of power to the mining industry in general is not commonly appreciated. Mining of all kinds is at the best of a temporary character, and the importance of being able to obtain electric power on demand, and discontinue the same when not required, can hardly be overestimated. It would result in the opening and working of mines that would not pay under any other conditions, and numberless works of a prospective and experimental character could be undertaken that would never be entertained under present conditions.

The supply of power for short periods would not cause any difficulty or embarrassment to the power-supply authority, because, firstly, it is presumed that power is available in abundance, and in the second place the power demand over a long period would be fairly even as contracts expire and new contracts are made.

A large extension of electric smelting of ores of various kinds may be anticipated as the result of being able to obtain a supply of electric power in the vicinity of the mines. It is noteworthy that the Tasmanian Government as soon as it established its hydro-electric works was overwhelmed with applications for power for smelting purposes of a kind which had not been previously anticipated; and, although the works were designed on a liberal scale having regard to ordinary requirements of the population and of manufactures, they proved too small to satisfy the demand for power, and immediate steps had to be taken to develop other and supplementary sources of power.

#### GENERAL PRINCIPLES AFFECTING THE GENERATION AND DISTRIBUTION OF POWER.

The distribution of the load throughout the Island, and consequently the most economical distribution of generating-stations and location of main transmission-lines, is dependent largely on the location of the population. The attached map (E 116) showing the distribution of population and consequent probable distribution of load over the Island has been divided into districts, and the probable centres of gravity of the loads of the whole and the various districts have been marked. The centre of gravity of the load over the whole Island is on this basis somewhere in the neighbourhood of Okahukura, on the Main Trunk line, and it would be quite feasible to supply the whole Island from one central generating-station such as Aratiatia or Arapuni, situated not far distant from this point. This, however, is not the best method, and has disadvantages compared with the system adopted.

The question is often asked, How far can electricity be transmitted economically at the present day? The answer depends a good deal on circumstances.

The maximum distance is limited by the highest voltage which may be employed, which to-day stands at 150,000 volts; but this voltage cannot be employed economically unless the power to be transmitted is large enough to justify the use of a certain minimum size of wire, which at this voltage will not cause loss by developing what is known as a "corona."

Under the conditions prevailing in the North Island of New Zealand under the scheme outlined in this report the most appropriate voltage for the primary transmission system is 100,000 volts.

At 100,000 volts the conditions affecting transmission are favourable up to 100 miles, and are not serious up to 150 miles, but above this the difficulties begin to increase. For instance, a transmission-line of certain size of wire and spacing will transmit 17,500 h.p. a distance of 100 miles, 11,000 h.p. 150 miles, and 12,900 h.p. 200 miles, with the same regulation viz., 6 per cent. in each case: that is to say, the capital cost of transmission per horse-power transmitted is increased 87½ per cent. for an increase in distance of 50 per cent., and is increased by 170 per cent. for an increase in distance of 100 per cent. Add to this the extra cost of maintenance and it will be evident that the cost of power increases rapidly with increase of transmission distances.

It is true that the above comparison may be modified if we allow a worse regulation on the longer distances, but there are limits to the regulations, and excess must be compensated for by machinery, which adds to the cost.

Long transmission-lines become a necessity when the nearer sources are inadequate for the requirements of a district, or where the power-stations available are of such a size that their cost per unit would be so much greater than the unit-cost from the larger source as to compensate for the extra cost of transmission. As a general rule it may be taken that under New Zealand conditions, provided the market is available, it will pay to develop any source yielding 20,000 h.p. on a 50-per-cent. load factor at a cost of £20 per h.p. or under, as an alternative to obtaining the power by means of a transmission-line over 130 miles in length from another source.

The capital cost of water-power developments is apt to be high for small or partial development, so that existing loads, by helping to pay the heavy interest and fixed charges during the earliest years of operation whilst the load is growing, have an added value over those which are only prospective and dependent on development.