1950

NEW ZEALAND

STATE HYDRO-ELECTRIC DEPARTMENT

STATEMENT BY THE HON. W. S. GOOSMAN, MINISTER IN CHARGE OF THE STATE HYDRO-ELECTRIC DEPARTMENT

MR. SPEAKER,—

I have the honour to present herewith my first annual statement as Minister in Charge of the State Hydro-electric Department.

Of recent years the shortage of electric power in New Zealand has caused much concern, and as soon as it took office the Government had the position very closely examined. As a result of that investigation the general policy has been determined and was recently made public.

In general terms the policy laid down confirms that the various hydro-electric works already under construction shall be pushed forward to completion and that additional hydro-electric plants for the North Island will be designed and constructed by overseas forces at the same time. This course is necessary in order to secure a margin of supply over demand and so put an end to the recurring periods of shortage in an essential commodity.

While this work is going on it is necessary to look still further to the future, and in this connection an investigation into the possibility of harnessing geo-thermal steam is proceeding very actively. If this source of power proves to be available, then it will have a profound effect upon the future of this country. So far the venture gives promise of success, but beyond that it is too early to make any more definite statement.

We must also face up to the possibility that geo-thermal steam may not be available, and so it is intended to seek out alternative means of augmenting the hydro-electric supply of the North Island. We shall thus be prepared for various eventualities.

In the South Island there are large potential sources of hydro-electric power which offer a ready and economic means of overcoming the power difficulties in that Island, and it is proposed to continue with this type of development as required.

Until the power-supply reaches a stage where there is a margin over demand, it will be recognized that there must be some measure of control so that the conditions shall be as stable as possible. To secure stability requires the active co-operation of the Department, the Electric Supply Authorities, and, above all, of the consumers of electric power.

In the past this co-operation has been readily given, and I must give thanks for this service rendered to the community.

The Government has determined to do all that lies within its means to provide adequate electric power in the future, once the present situation has been overcome.

In the meantime it is necessary to make the best use of the power available, but there are recent signs that consumers are tending to disregard the fact that only their own willing help can serve to make the intervening period as little difficult as possible. Once again I would ask that, in their own best interests, consumers take heed of the requirements of their Supply Authority.

In the North Island it is anticipated that the operation of Maraetai in 1952 will enable the power restrictions to be lifted in that year; while in the South Island every endeavour is being made to bring the Tekapo Power-station into operation before next winter.

Good progress is being made with the construction of the new transmission lines and substations which are essential to distribute energy from the new power-stations, and some comment is made about this work later in the statement.

At the same time work is proceeding ceaselessly on the extension of many substations to keep pace with the growing demand for more power everywhere.

In the early part of this year I visited the major construction works and also as many as possible of the stations in operation.

During this visit I was deeply impressed by the magnitude of the electrical undertaking and by the spirit of enthusiasm and keenness which sustains the industry in these difficult days. It is timely to record my appreciation of the loyal service which is being so readily given.

Especially would I commend the operating and lines staff for the great care which is given to the plant under their control and for the efforts made to make and keep their surroundings beautiful. A fine spirit is also evident in times of trouble, when the members of the staff do their utmost to restore power in the shortest possible time, and I would like to assure them that their efforts are greatly appreciated.

From my own experience I would say that only a visit to the various works can possibly convey an adequate impression of the size of this undertaking, and as many as possible should see for themselves what is being done on their behalf in the field of electric supply.

FINANCIAL RESULTS

The following is a summary of the results (unaudited) for the year ended 31st March, 1950. The audited accounts and balance-sheet will again appear in B–1 [Pt. IV] :—

	£	£
Revenue	3,951,558	
Operating-costs	1,825,677	
Gross profit		£2,125,881
Capital charges—	£	£
Interest	1,144,424	
Depreciation	311,758	
		1,456,182
Taxation reserve	..	224,561
Loans redemption (statutory charge) ..	..	309,382
Balance to general reserve	..	135,756
		£2,125,881

CAPITAL STATEMENT

	£	£
Total capital invested	..	52,827,590
Less—		
Works under construction, surveys and investigations of new schemes	17,335,761	
Plant, motor-vehicles, and stocks	1,938,793	
		19,274,554
Net operating capital	..	
		£33,553,036

In this connection it is desired to draw attention to the report of the General Manager, which report is appended to this statement.

NEW WORKS

In this section a general account is given of the progress on new works being carried out by both the State Hydro-electric Department and the Ministry of Works.

(1) GENERATING PLANTS : NORTH ISLAND

At *Maraetai* steady progress is being maintained and work on the concreting of the main dam is now in full swing. The power-house is well forward and the erection of portions of the hydraulic turbines has commenced. The bridge across the Waikato River giving access to the power-house is nearing completion. The anticipated date for first operation is April, 1952.

At *Whakamaru* very good progress has been made with the diversion channel and the generating plant has already been ordered.

At *Kaitawa* the placing of the sealing material continues and a stage has been reached where the flow fluctuates at about 200 cubic feet per second. It is anticipated that this figure can be greatly reduced by a continuation of the present work.

At *Wairakei* the investigation on sources of geo-thermal steam is concentrated on a line about three and a half miles long, and six drilling rigs are in operation. Steam has already been encountered and the progress to date is very encouraging.

(2) Generating Plants: South Island

At *Cobb* excavating and concreting in the spillway channel is being continued. Excavation for the power-house extension has commenced and preparations are being made for the construction of the new steel penstock. Sufficient man-power is not available on this job to maintain the scheduled rate of construction, and steps are being taken to minimize the effects of any delay occasioned by this factor.

In the *Lake Rotoroa* area investigation work and the construction of access roads is in progress in connection with the proposed Braeburn scheme.

At *Tekapo* the power-house building is practically completed and the steel penstock is well advanced. The construction of the surge chamber has commenced. The tunnel intake work has been hampered by difficulties with the coffer-dam. The erection of the generating unit is well ahead and every endeavour is being made to have this plant ready for operation before the winter of 1951.

At *Pukaki* the main earth dam is practically complete. Concreting of the spillway channel continues and is nearing completion. The temporary storage was of prime importance during the year and has enabled the Waitaki Power-station to carry heavy loads throughout the winter.

At *Waitaki* preparations for adding two new units are well under way and the generating plant is on order.

At *Roxburgh* the excavation of the river diversion channel has proceeded apace, 358,000 cubic yards of material having been removed. The building of the temporary construction village is being pushed ahead, some 114 houses having been built and a further 53 houses are in course of erection. The main generating plant has been ordered.

(3) Transmission Lines

Excellent progress has been maintained in the survey and construction of new transmission lines. With the exception of Australian hardwood poles and cross-arm timber and some items of pole hardware, all materials are now more readily available than they have been for some years. The company which established a transmission-tower factory in New Zealand in 1948, and with which several contracts have been placed, has achieved a steady rate of production.

Construction of the 220 kV. lines in the North Island was maintained at the planned rate in spite of staff shortages and fluctuations in man-power. Three hundred and twenty towers were erected in the year, one hundred of them in March. Improvements in the supply position in regard to steel towers enabled a start to be made late in the year on the construction of the 220 kV. line from Whakamaru to Bunnythorpe with confidence that the work would proceed without interruption.

The survey of the 220 kV. lines from Roxburgh to Christchurch was continued, and tenders will be called shortly for the towers for the first section of this work.

Preliminary work on camp construction, track formation, and route clearing was carried out on the Henderson-Maungatapere 110 kV. line. Materials for this work are coming to hand and it is expected that the line will be ready for service late in 1951. The line will be operated temporarily for a short period at 50 kV. and will give much needed relief to the electricity supply of North Auckland.

Delays in the supply of materials and shortages of man-power have retarded progress on the 66 kV. line linking the Nelson-Marlborough area with the main South Island system. Nevertheless, it is expected that the southern section, taking supply to the Buller Electric-power Board, will be ready in 1952.

Work is in progress on a number of other lines in the North and South Islands to cope with the increasing demand.

(4) Substations

The design work for Otahuhu and Bunnythorpe 220 kV. substations has been completed, and construction work is proceeding as fast as labour conditions will permit. The delay in the completion of the civil engineering works, particularly the building contracts, has seriously held up the installation of the electrical equipment, most of which has been in the country for some time. The non-delivery of the steel switchgear structures ordered from Australia in 1947 is also causing concern.

All major items of equipment for Haywards 220 kV. substation have been on order for some time and some of the material is already here. The design work is well in hand. An area of approximately 8 acres has been levelled, and construction of the other civil engineering works should commence in earnest during the coming summer.

In the South Island, work continued on the main 220 kV. substation near Christchurch. Already tenders have been called for some of the major items of plant, and further tenders will be called shortly.

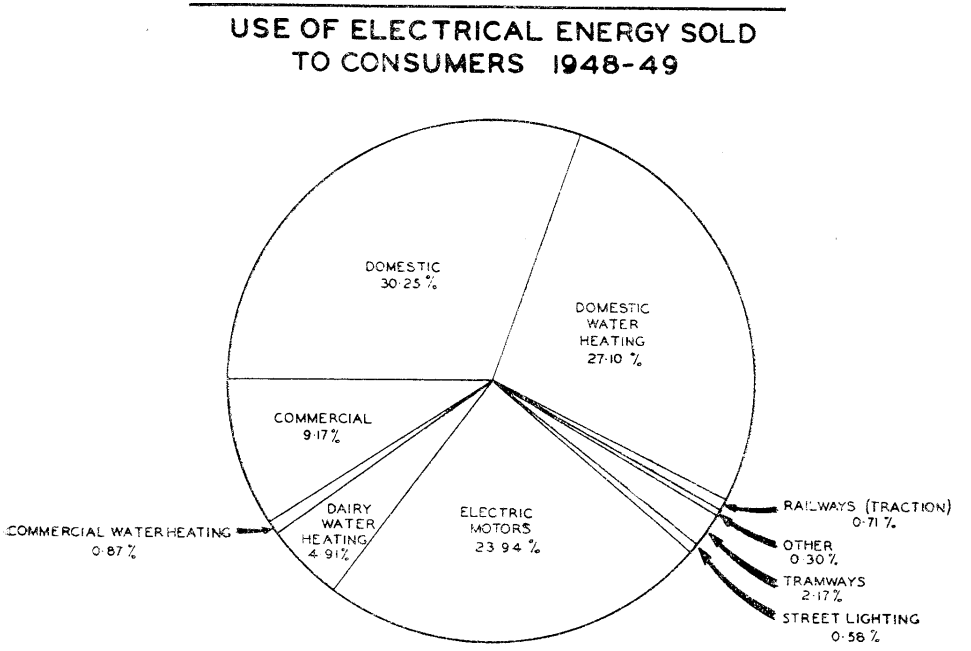
To keep pace with the ever-increasing demand for power, work is proceeding on no less than fifty other substations located throughout the country.

(5) General

The above statement gives a very brief account of the work in hand and an indication of what further work is proposed in the immediate future. The sum total of the requirements of man-power and material necessary to implement the programme is plainly very large, and calls for a sustained and united effort so that the goal may be achieved and the power supply brought to a stage where the unrestricted demands can be met under all conditions.

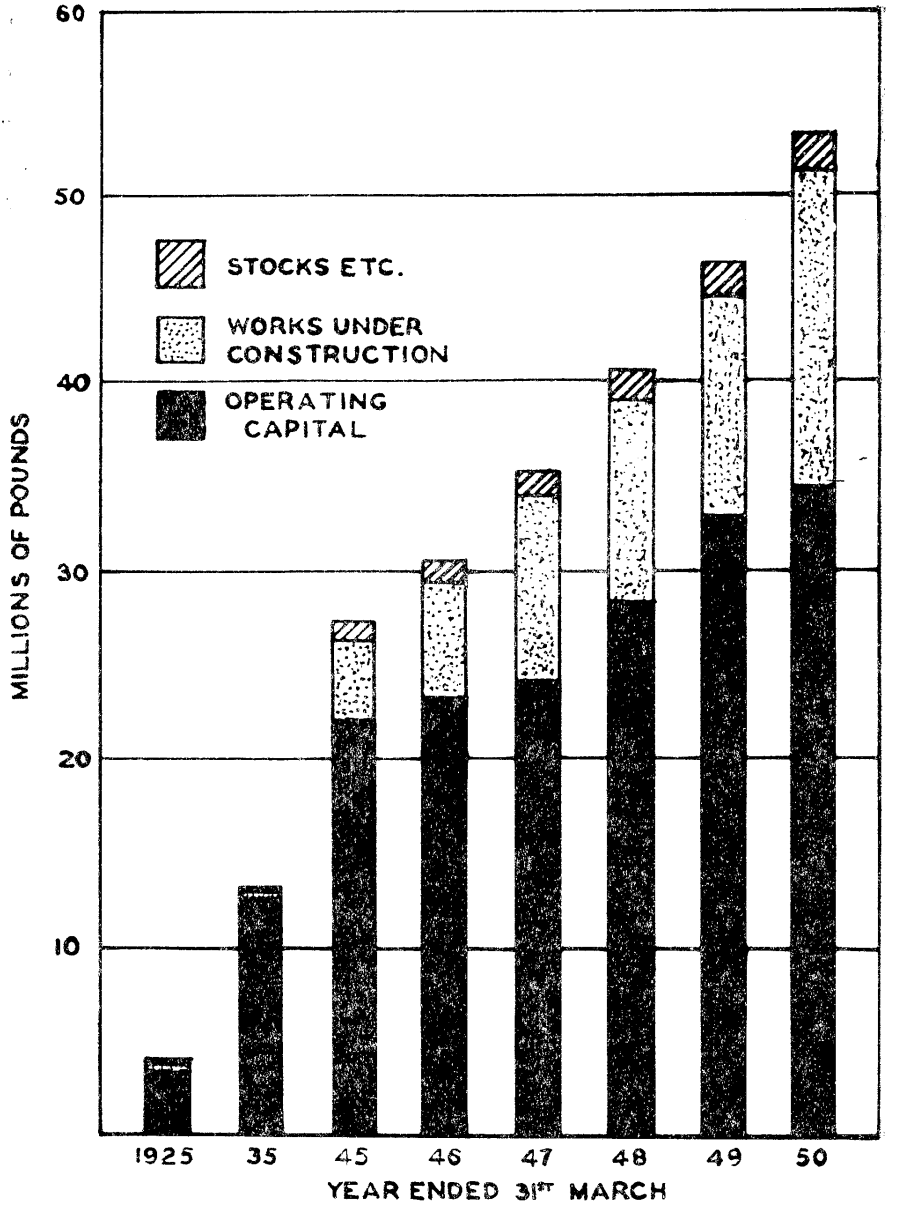
APPENDIX

Further information relating to the past year's working is included in the attached report by the General Manager, while the annual report of the Rural Electrical Reticulation Council is also appended.



CAPITAL OUTLAY

STATE HYDRO-ELECTRIC DEPARTMENT



APPENDICES

APPENDIX A—ANNUAL REPORT OF THE GENERAL MANAGER FOR THE YEAR ENDED 31ST MARCH, 1950

The GENERAL MANAGER to the Honourable MINISTER IN CHARGE.

Wellington, 23rd May, 1950.

SIR,

Pursuant to section 15 of the State Supply of Electrical Energy Act, 1917, I have the honour to present herewith my annual report on all operations of the State Hydro-electric Department for the year ended 31st March, 1950.

Details of the progress of civil engineering works carried out by the Ministry of Works on behalf of this Department will again appear in the Commissioner of Works' report to you and therefore are not specifically commented upon in this report.

The hydraulic conditions were very good for the first six months of the year but thereafter they changed very rapidly, and the period from September, 1949, onwards was very difficult from an operating point of view. This subject is covered in some detail below under the heading "Electricity Control." In spite of the conditions, however, the generation of electric power reached a new high level which is clearly shown in the graph on page 12.

Notwithstanding the reduction in revenue caused by electricity control measures and the costs associated with the necessity for the continued use of auxiliary stations, gross revenue rose from £3,661,405 in 1949 to £3,951,558 this year and the net surplus earned from £11,148 to £135,756. The surpluses from the last two years' operations have been transferred to General Reserve Account which now stands at £146,904.

Increased costs for labour and materials are adding considerably to the costs of works under construction. When the new stations and transmission-lines come into operation from 1951 onwards, interest and other charges on works under construction, which up to that stage are capitalized but which then become payable out of revenue, will be proportionately increased. It had been anticipated, when the new bulk tariff was applied to the power-supply contracts expiring in 1953, that the resultant increase in revenue would, with the aid of surpluses accumulated in General Reserve Account, enable us to carry these increased capital charges and operating-costs until 1953 when a further adjustment in our tariff would become necessary.

Now the unforeseen increase in the price of coal makes it abundantly clear we will not be able to achieve that desirable equilibrium in 1953. Even if steam running remains at the same level as for last year, the extra cost of coal for steam generation will exceed £100,000 this year and a proportionately greater sum for any increase on last year's steam running. Estimates of the financial position for the years 1950–51, 1951–52, and 1952–53 under the conditions now obtaining disclose that we must expect a series of deficiencies for all of these years. It was clear before that in any case an increase in charges for bulk supply of power would be required from 1953 onwards, but now it would appear that some steps will require to be taken at an earlier date if our finances are to be maintained in a healthy position.

It has frequently and truly been said that electricity is one of the cheapest commodities in New Zealand. Until the recent increase in bulk supply of power charges, estimated to give the Department an increase of 7½ per cent. in its revenue, New Zealanders were in the fortunate position that over all there had been a downward trend in the cost of electricity to the consumer, and that even with other increases in distribution costs few Supply Authorities had found it necessary to increase their retail tariffs because of the adjustment in the bulk-supply tariff. Compare this with consumers of the State Electricity Commission of Victoria who, in the past two years, have had tariff increases of 12 per cent. in July, 1948, 9 per cent. in October, 1949, and 6½ per cent. in July, 1950—a total of 27½ per cent. I mention this to give point to the fact that when our charges for bulk supply are adjusted to ensure and maintain financial stability, the increase may be substantially greater than our first increase and will, I think, inevitably call for an adjustment of retail as well as bulk-supply tariffs.

The direct savings in steam-running costs and other purchases of power and the increased revenue that would be derived from the date of operation of Maraetai, let alone the national economic benefits to be gained, are good and sufficient reasons for my emphasizing the desirability of pressing Maraetai and all our subsequently planned expansions to the stage of supplying power with every possible haste.

During the year machine accounting was established throughout the Department. Machines are now utilized for recording the value and movement of stock, the pay procedure has been stream-lined and mechanized, and machine accounting for the financial ledgers is being implemented. The results already demonstrate that a higher standard of efficiency, economy, and expedition is being achieved in accounting work.

ELECTRICITY CONTROL

The Electricity Emergency Regulations 1939 were revoked as at the 31st December, 1949, and were replaced by the Electricity Control Regulations 1949 which came into force on the same date.

By legislation passed last year the functions of the State Hydro-electric Department now include controlling and regulating the supply and use of electrical energy. The Electricity Control Regulations 1949 confer on the General Manager of the Department the powers necessary to carry out these added functions, and also continue in force the Electricity Control Order 1948. However, as the office and title of Electricity Controller no longer exist, all references in the Order to the Electricity Controller are to be read as references to the General Manager.

Before giving details of the restrictions which have applied during the year, it is desired to point out that constant endeavours have been made to ensure that the restrictions on the use of power are as little irksome to consumers as possible. Whatever means are employed to restrict load, it is the consumer who must make the necessary savings. Only for as long as the consumer himself controls his use of power is it possible to provide an uninterrupted service which gives him power when it is really needed. As this means of limiting consumption imposes the least inconvenience and avoids arbitrary measures, the importance of securing and thereafter holding the good will of every consumer has been repeatedly stressed.

Loss of consumer good will, or failure to obtain consumer co-operation, results in power cuts in blocks over wide areas, which seriously interfere with not only domestic consumers but also with specialized industries and organizations which rely upon power being available all the time. Furthermore, this arbitrary means of rationing power does not distinguish between consumers, whether industrial or domestic, who have voluntarily reduced consumption, and those who have made little or no effort to do so.

Each Supply Authority decides how to restrict its load, and this decentralization has made it possible for the savings in power consumption to be made in an orderly manner. For, as power is allocated in bulk among the Electric Supply Authorities according to their essential needs, it follows logically that each consumer should receive a quota from the allocation. Consequently, many of the Supply Authorities are employing quota rationing schemes, whereby the consumer himself effects the necessary savings, and wherever consumer good will and understanding have been obtained the schemes are operating well and power cuts no longer apply.

This also provides the answer to the question often raised regarding what action should be taken against those whose consumption exceeds their allocation or quota. Cutting off power in bulk over wide areas is unjust to the people in the area who have been co-operating. But with the decentralization of load control and the application of quota rationing, any cutting off is confined to the individuals using power to excess. This avoids widespread disruption of the electric supply service.

North Island

During the autumn and winter months of 1949 the combined inflows to lakes Taupo and Waikaremoana were above average. By August both lakes were at the maximum retention level, Taupo being 1½ ft. higher and Waikaremoana 6¼ ft. higher than at the corresponding period the previous year. Consequently it was possible to meet the heavy winter demand without depleting storage. The winter peak was 404,900 kW. compared

with 396,200 kW. for the previous year, and in the twelve months until the end of December the consumption of power was 1,706,000,000 units compared with 1,621,000,000 for the previous year—an increase of 5¼ per cent. This consumption was some 36,000,000 units in excess of the amount allocated.

The prolonged dry period which commenced in September, 1949, resulted in the flows into the Waikato River and Lake Waikaremoana falling considerably below the long-term average. By December it became necessary to draw attention to the fact that for the previous three months the inflows were 20 per cent. below average. The running of the steam stations was increased in October, but even so the level of Taupo fell from 1,177 to 1,175·2 ft. and Waikaremoana from 2,010 to 2,004·1 ft. by the end of December. The excess consumption for the twelve months up to that time was equivalent to a foot of storage at Taupo. It was too early to make an appraisal of the potential generating position for the winter ahead, but it was apparent that a continuation of the dry period and of the excessive rate of consumption would result in storage being drawn down too far by the autumn, and that extra efforts to curtail consumption might be required.

In December, the Power Shortage Advisory Committee decided to extend the twelve-month allocation period which terminated that month until the 31st March, 1950, and this gave those Supply Authorities who were exceeding their allocations a further three months in which to reduce their excessive rate of consumption. During January and in subsequent weeks attention was called to the deteriorating hydraulic conditions. Requests were repeated for the consumption to be restricted to the allocations. Some Supply Authorities were adhering to their allocations, but the savings were being offset by the excess consumption in the areas of the other Supply Authorities, the excess for the fifteen months until the end of March amounting to some 51,000,000 units.

The Advisory Committee again met in March and decided that the Supply Authorities who were rationing their consumers should be allowed to add their savings to the allocations for the ensuing year. On the other hand, a careful study of the reasons given by the Supply Authorities who had exceeded their allocations led to the Committee deciding not to deduct the excess units consumed from those particular Authorities' allocations. The total units finally allocated for the year ending the 31st March, 1951, amount to 1,773,000,000 units, the required generation being based upon average hydraulic conditions and heavy running of the thermal standby plants.

When the Supply Authorities were notified of their allocations for the year ending the 31st March, 1951, they were also informed that the continuation of the dry conditions and of the high rate of excess consumption would lead to a reduction below the allocations becoming unavoidable.

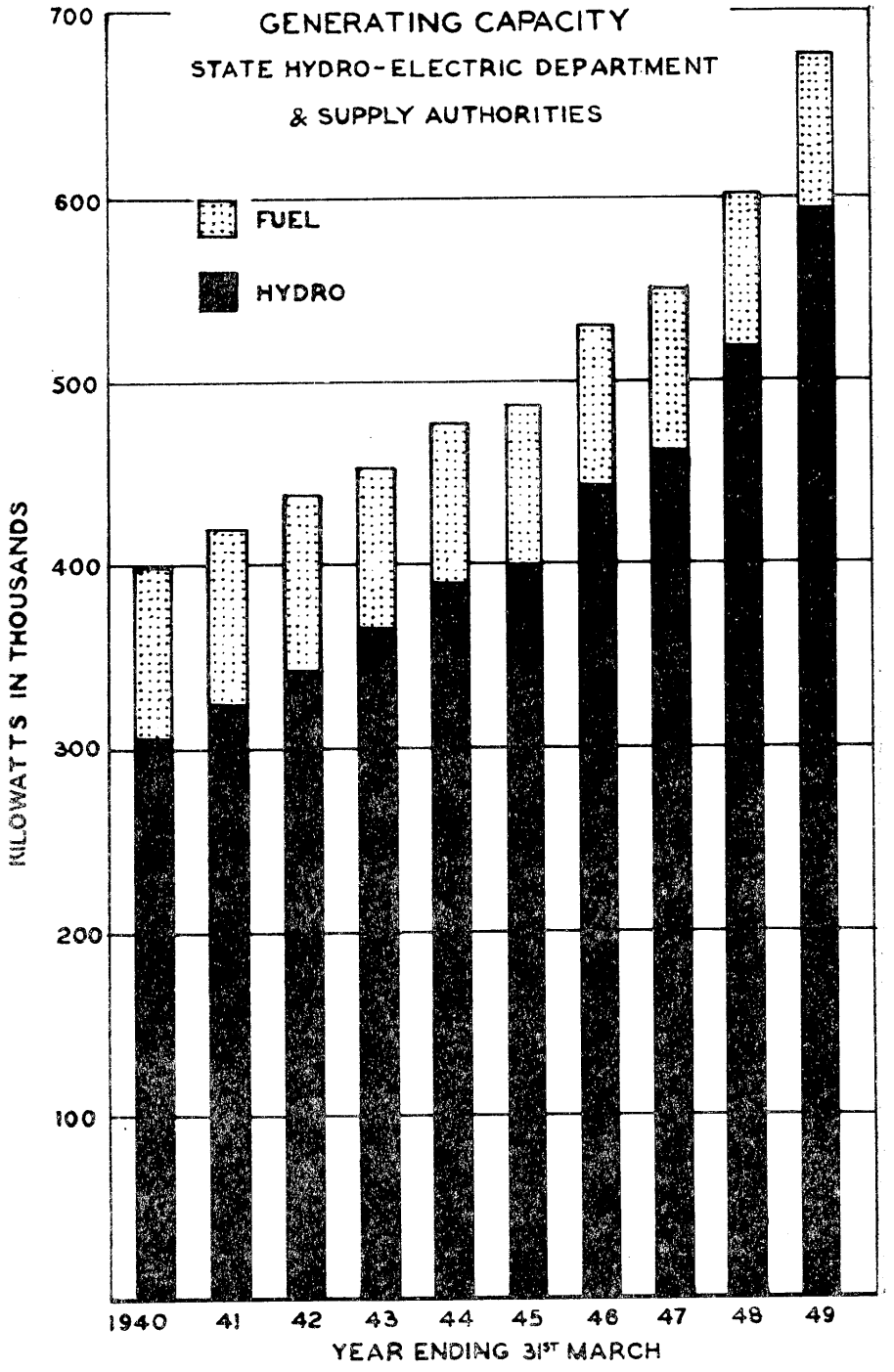
The actual rate of consumption, however, remained high. For the year ended the 31st March, 1950, the units consumed amounted to 1,738,000,000 compared with 1,648,000,000 in the previous year, or an increase of almost 5½ per cent. By the 29th March only 16 in. of controlled storage remained in Taupo, and Waikaremoana was down to level 1,997·6, a reduction of 6½ ft. since the end of December. The Supply Authorities were therefore informed that commencing Monday, 3rd April, consumption should be reduced by 10 per cent. below the allocations.

The effect of this reduction will be felt to differing extents in the various supply areas. Some Supply Authorities have quota rationing schemes operating successfully, and a 10-per-cent. reduction will in many cases cause no serious disturbance to their consumers. In other areas, where the consumption of power has been consistently above the allocations, the reduction which consumers will be called upon to make may be felt severely.

South Island

No special restrictions were imposed throughout the year ended the 31st March, 1950.

It had been anticipated that no more power could be made available than in the previous year, but in view of the favourable hydraulic position in the early part of 1949, the Supply Authorities were advised in April that an average increase of about 5 per cent. should be possible. The actual increase was, however, 11½ per cent., the consumption being 769,000,000 units compared with 689,000,000 in the previous year.


GENERATING CAPACITY
STATE HYDRO-ELECTRIC DEPARTMENT
& SUPPLY AUTHORITIES
FUEL
HYDRO
700
600
500
400
300
200
100
KILOWATTS IN THOUSANDS
1940
41
42
43
44
45
46
47
48
49
YEAR ENDING 31ST MARCH

For the greater part of the year river flows were above the long-term average, but decreased considerably after January, 1950. The Waitaki flows for February and March were 55 per cent. of the average for those months. Storage which should normally be filling at this time of the year was being drawn down. From the beginning of February until the end of March some 26,000,000 units were drawn from storage, and in the absence of adequate rainfall, depletion at this rate called for a reduction in the rate of consumption of power.

In the past two years, consumption in the South Island has increased by approximately 11 per cent. each year. It had been considered that an average increase of 5 per cent. per annum would meet essential needs. However, the actual increase was about double the amount budgeted for.

When hydraulic conditions commenced to deteriorate in February, and as four years' estimated growth in load had taken place in two years and no new generating-plant will be available until 1951, it was decided that a further increase in consumption during the year ended the 31st March, 1951, could not be allowed.

Consequently, the Power Shortage Advisory Committee decided at its meeting held towards the end of March, 1950, that as from the 27th March weekly consumption must be reduced and not allowed to exceed the amount for the corresponding week of the previous year.

Nelson-Marlborough

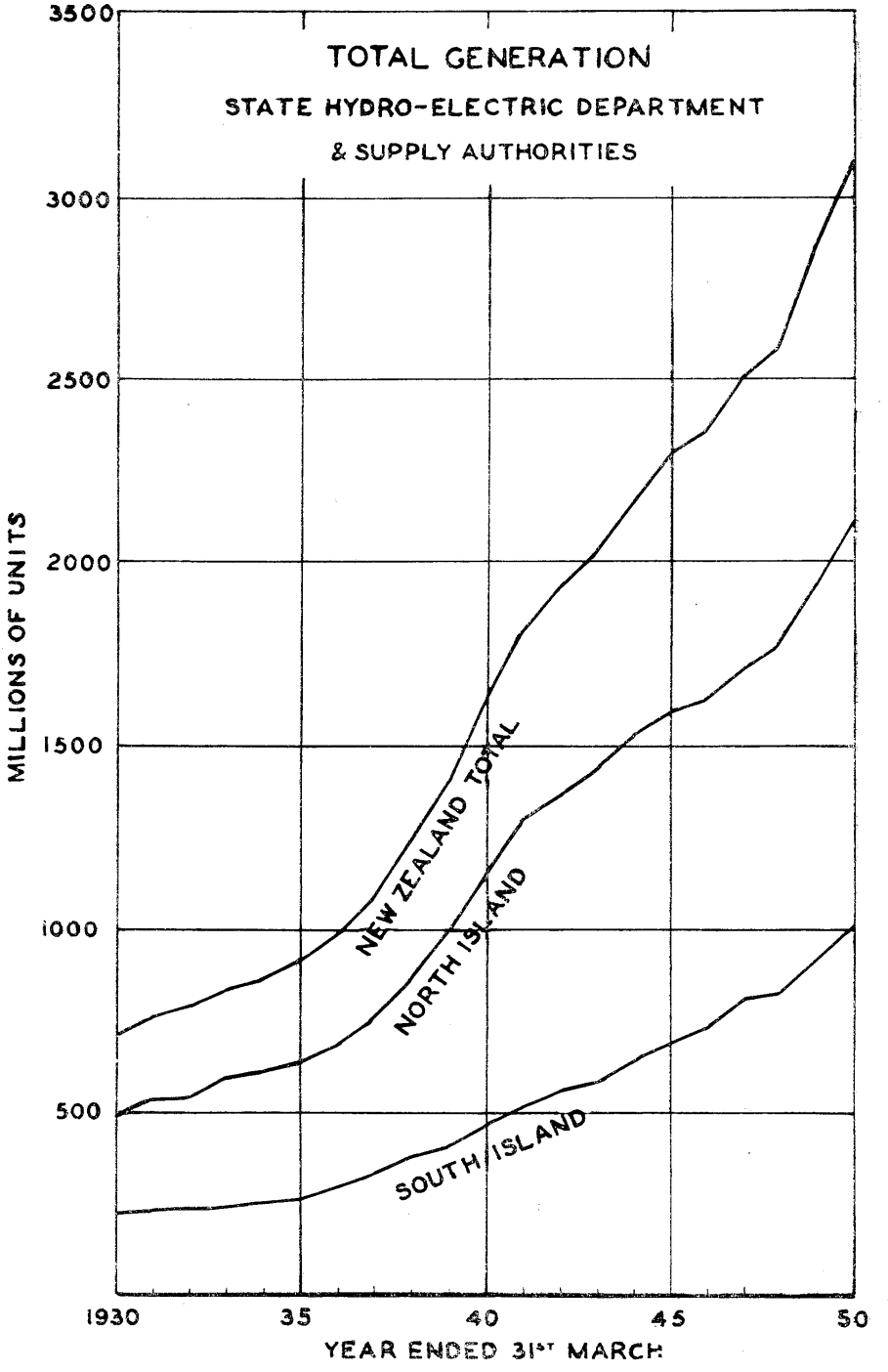
During the year ended the 31st March, 1950, no restrictions were placed upon consumption, but as from August, 1949, certain restrictions were placed upon new connections in order to limit the amount of new load added to the supply system. Following a meeting of the Power Shortage Advisory Committee, the particular measures adopted were decided upon by the Electric Supply Authorities concerned.

As reported last year, until the Cobb extensions come into operation, the average load increase must be limited to about 10 per cent. per annum. Since supply from the Cobb commenced, consumption has increased at a rate averaging about 25 per cent. a year. This unrestricted rate had probably reached a maximum, and indications were that it was tapering off during 1949. The Advisory Committee decided that for the year ending the 31st March, 1950, the consumption should be limited to an increase of 19 per cent. above that for the previous year. To obtain an average increase of 10 per cent. over four years, the per-cent. increases in subsequent years could be further tapered off without creating any serious disturbance to consumers.

Actual consumption for the year was 61,500,000 units compared with 52,400,000 in the previous year, or an increase of 17·4 per cent. The measures adopted by the Supply Authorities have resulted in consumption being below the allocation. This is very satisfactory as the margin of increase available in the remaining years is correspondingly increased.

The extremely dry period which set in early in the new year necessitated a steady draw on storage being commenced on the 15th February, 1950. The thermal generating-plants were started up on the 3rd March, but by the beginning of April only about two weeks' storage remained at the then rate of draw-off. River flows were sufficient to generate only about one-fifth of the total demand.

On the 3rd April the Electric Supply Authorities were requested to reduce consumption by 15 per cent., which, if maintained, would have enabled storage to be eked out until the end of the month. However, this reduction was lifted on the 11th April, as the rains which set in on the preceding day had increased the river flows to more than load requirements.


TOTAL GENERATION
STATE HYDRO-ELECTRIC DEPARTMENT
& SUPPLY AUTHORITIES
MILLIONS OF UNITS
3500
3000
2500
2000
1500
1000
500
NEW ZEALAND TOTAL
NORTH ISLAND
SOUTH ISLAND
1930
35
40
45
50
YEAR ENDED 31ST MARCH

NORTH ISLAND SYSTEM

A. SYSTEM OPERATION AND LOAD DESPATCH

1. Load

The maximum half-hourly load on the system was 404,900 kW. carried between 1700 and 1730 hours on Monday, 20th June, 1949. Last year the half-hourly peak, which was also carried under normal frequency conditions, was 396,200 kW. between 1700 and 1730 hours on Tuesday, 20th July, 1948.

The highest Saturday peak was 344,500 kW. between 1730 and 1800 hours on the 6th August, 1949. Last year the peak was 334,200 kW. between 1730 and 1800 hours on 17th July, 1948.

The highest Sunday peak was 314,800 kW. between 1730 and 1800 hours on the 7th August, 1949, compared with 324,200 kW. between 1130 and 1200 hours on the 22nd August, 1948.

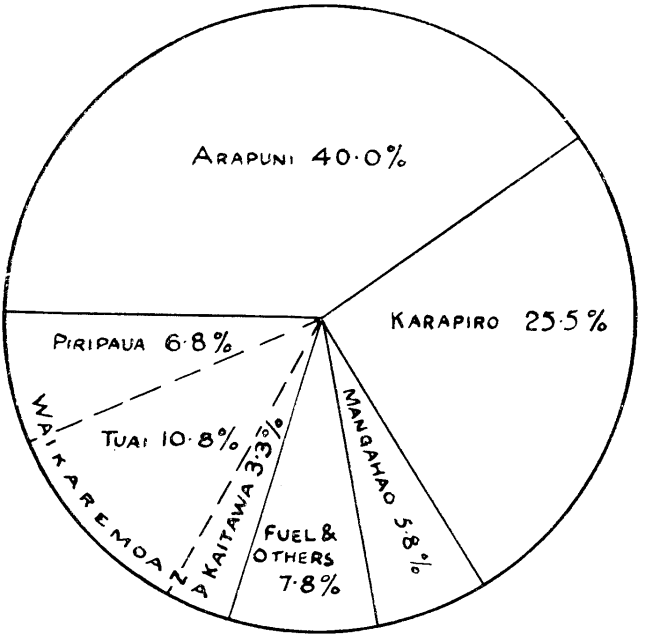
The greatest weekly generation was 43,464,000 units for the week ended Sunday, 14th August, 1949, an increase of 1·9 per cent. on last year's figure of 42,648,800 units. The maximum generation on any one day was 6,588,100 units on Tuesday, 9th August, 1949 (last year 6,430,100 units), an increase of 2·5 per cent. The highest Saturday generation was 5,850,300 units on 6th August, 1949 (last year 5,715,000 units), an increase of 2·4 per cent. The highest Sunday generation was 5,399,100 units on 7th August, 1949 (last year 5,431,500 units), a decrease of 0·6 per cent.

The total generation by all plants in the North Island system for the financial year ended 31st March, 1950, based on provisional returns, was 2,036,000,000, compared with 1,936,000,000 units for the previous year, an increase of 5·2 per cent. The system units generated by Government-owned plants only, plus units purchased from Supply Authorities, were 1,971,000,000 for the year ended 31st March, 1950, compared with 1,868,000,000 units for the previous year, an increase of 5·4 per cent.

Generation details by Government plants plus units purchased for resale (compared with 1948–49) are as follows :—

Station.	Year Ended 31st March, 1950.			Year Ended 31st March, 1949.		
	Maximum Kilowatts.	Units Generated.	Annual Load Factor.	Maximum Kilowatts.	Units Generated.	Annual Load Factor.
			Per Cent.			Per Cent.
Arapuni	161,500	788,277,000	55·7	151,000	742,468,000	56·2
Karapiro	99,600	502,657,000	57·6	96,200	488,667,000	58·0
King's Wharf ..	21,200	47,678,000	25·7	27,600	40,147,000	16·6
Mangahao	21,400	114,779,000	61·1	21,900	114,109,000	59·5
Penrose	..	152,000	..	..	2,011,000	..
Piripaua	134,400	133,853,000	35·0	118,900	131,133,000	35·7*
Tuai		212,416,000			198,627,000	
Kaitawa		65,803,000			40,623,000	
	..	1,865,615,000	..	..	1,757,785,000	..
Auxiliary and standby stations—						
Evans Bay		69,229,000			68,250,000	
Kaouarau		2,872,000			3,371,000	
New Plymouth ..		14,465,000			15,619,000	
Opunake		1,925,000			1,866,000	
South Taranaki ..		1,030,000			1,185,000	
Taumarunui ..		3,572,000			3,567,000	
Tauranga		7,230,000			7,339,000	
Wilson's		2,726,000			1,865,000	
Other miscellaneous ..		1,983,000			7,648,000	
Total units generated and purchased		1,970,647,000			1,868,495,000	

* Kaitawa not in full service until October.



GRAPHICAL ILLUSTRATION OF FOREGOING TABLE

2. Reliability of Supply

There were 163 faults, 61 of which caused no interruption to supply. The following analysis does not include prearranged shut-downs.

Description.	Year Ended 31st March, 1949.	Year Ended 31st March, 1950.	
		Number.	Duration.
			h. m.
1. 110 kV. lines: Defects	15	1	1 26
2. 110 kV. lines: External causes	17	15	3 25
3. 33 kV., 50 kV., or 66 kV. lines: Defects	17	10	55 32
4. 33 kV., 50 kV., or 66 kV. lines: External causes	5	5	3 26
5. 6·6 kV. or 11 kV. lines: Defects	5	2	4 20
6. 6·6 kV. or 11 kV. lines: External causes	1	1	1 08
7. Lightning	72	17	3 45
8. Storms: Nature of trouble not found	..	1	0 28
9. 110 kV. apparatus	2	4	2 56
10. 33 kV., 50 kV., or 66 kV. apparatus	6	5	5 15
11. 5 kV., 6·6 kV., 11 kV., or 22 kV. apparatus	8	13	19 41
12. Generators or synchronous condensers	..	5	9 51
13. Relays	5	5	2 09
14. Control circuits and batteries	..	7	0 31
15. Operation: Mistakes	10	12	2 09
16. Operation: Accidents	9	8	0 21
17. Faults and overloads on consumers' system	..	..	..
18. Other causes	31	22	13 10
19. Cause unknown	20	30	3 05
Totals	223	163	132 38

B. OPERATION AND MAINTENANCE

1. Power-stations

King's Wharf.—The station ran for the whole year except for two weeks in May. All boilers were surveyed. A new turbine rotor was fitted to No. 10 machine, and a new superheater was fitted to No. 15 boiler. Fuel was mainly of indifferent quality which gave rise to many problems in firing and caused a good deal of grit nuisance.

Penrose.—This Diesel station was not on load except for testing purposes until March, when it commenced running for two shifts a day.

Arapuni and Karapiro.—Arapuni: No. 2 generator went out of service on 6th January, 1950, for a major overhaul. Air-coolers have been installed for an enclosed air-cooling system. No. 6 generator was fitted with a new 35,000 b.h.p. turbine runner in April, and a new 24,000 kVA. stator in December. No. 2 auxiliary generating-set was given a complete overhaul. Over two-thirds of the 924 flashboards on the main and extension spillway weirs were renewed. Chlorinating equipment for the village water-supply was installed in July.

Karapiro: No. 3 generating-unit was shut down on several occasions in May, June, and July to inspect and repair a cracked blade on the 42,000 b.h.p. Kaplan type turbine. A new blade was fitted in July.

Generator-running times were:—

Generator No.	Time on Load.		Time Idle.		Time under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
Arapuni							
1	7,773	88·73	895	10·22	92	..	98·95
2	6,042	68·97	750	8·56	1,968	..	77·53
3	7,882	89·98	817	9·33	61	..	99·31
4	7,834	89·43	810	9·25	57	59	98·68
5	7,608	86·85	872	9·95	280	..	96·80
6	6,683	76·29	723	8·25	1,354	..	84·54
7	7,532	85·98	931	10·63	297	..	96·61
8	7,766	88·65	905	10·33	83	6	98·98
Karapiro							
1	7,130	81·39	1,582	18·06	48	..	99·45
2	7,157	81·70	1,585	18·09	18	..	99·79
3	6,141	70·10	1,457	16·63	1,162	..	86·73

Waikaremoana.—The lake-level reached 2009·9 ft. in August, 1949, and fell steadily to 1997·4 ft. at 31st March.

In August, during heavy rains, a slip carried away a chain of the ground supporting the Mangaone Stream deviation pipes, and substantial slips occurred on various roads.

Operation and control of Tuai Nos. 1, 2, and 3 headgates were changed over from D.C. to A.C. The interior of No. 1 pipe-line was sand-blasted and painted, extra manholes being fitted in the lower half. Manholes were also installed in No. 2 pipe-line.

No. 1 generator and governor and No. 5 generator were completely overhauled. Alterations to bearings were made on Nos. 4, 6, and 7 machines to provide better oil usage. Bucholz relays and open-type 11 kV. terminals were fitted on two of the 11/110 kV. transformers.

Generator-running times were :-

Generator No.	Time on Load.		Time Idle.		Time Under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
Tuai							
1	5,041	57·55	723	8·25	2,996	..	65·80
2	7,084	80·87	895	10·22	775	6	91·09
3	7,592	86·67	992	11·32	176	..	97·99
Piripaua							
4	7,997	91·29	418	4·77	338	7	96·06
5	7,672	80·73	271	3·09	1,417	..	83·82
Kaitawa							
6	6,111	69·76	1,713	19·55	935	1	89·31
7	6,356	72·56	1,876	21·42	527	1	93·98

Mangahao.—The rainfall for the year at No. 1 dam was 126·54 in. compared with 123·77 in. and 110·26 in. for the previous two years. At No. 2 dam it was 119·48 in., at No. 3 dam 96·52 in., and at the power-station 54·19 in. Water spilled to waste over No. 2 dam during twenty-three weeks of the year. The annual load factor was 61 per cent. on a maximum load of 21,400 kW.

Generator-running times were :—

Generator No.	Time on Load.		Time Idle.		Time under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	8,500	97·03	98	1·12	162	..	98·15
2	8,496	96·99	78	0·89	186	..	97·88
3	8,538	97·47	59	0·67	163	..	98·14
4	8,365	95·49	73	0·83	322	..	96·32
5	8,380	95·66	87	0·99	293	..	96·65

Early in February, 1950, the wooden sheathing to No. 2 gate at No. 2 dam was badly holed (7 ft. by 3 ft.) by a log in a heavy flood, and was temporarily repaired by a steel-plate patch. The same rain produced a record day's rainfall of 4·65 in. at the power-station, which so filled the tail-race that load had to be reduced. Protective groynes in the tail-race were dangerously undermined and have been repaired.

While each half of the station was shut down in turn, the main turbine valves were overhauled, this being their first overhaul since their installation. Serious damage by explosion and fire was suffered by one of the Horowhenua regulators on 22nd May, 1949, resulting in its tap-changing on load gear being out of service. New ventilation facilities were provided for the control-room.

The power-station completed twenty-five years of service on 3rd November, 1949. This was marked by a celebration at the station on 24th September.

2. Substations

Normal operating conditions obtained and the usual maintenance work continued throughout the year. At both Hawera and Melling a phase of an 110 kV. lightning arrester blew up, and the arresters were taken out of service. A magpie caused a short circuit by getting across transformer bushings at Pahautanui, which resulted in damage to 11 kV. bushings and cable-end boxes. At Takapuna a cat climbed through the protection screen on the Power Board structure and got between phase and earth, which resulted in severe damage to a new 11 kV. switch. 11 kV. cables on 50/11 kV. banks failed at Hamilton, Edgecumbe, and Kerepeehi due to the entry of moisture through a defect in the lead sheathing. Interruptions to supply were caused by accidental tripping of a relay during alterations to a panel at Henderson, the breakdown of an 110/11 kV. transformer unit at Bunnythorpe following a severe Power Board fault, a fault in the 3,500 kVA. induction regulator at Maungatapere, and the burning-out of a starting auto-transformer for a synchronous condenser at Kaitaia. The following details are also recorded regarding specific 110 kV. substations :—

Masterton.—Transformer units of the original 4,500 kVA. bank were overhauled and fitted with Buchholz relays, and a new local service panel and transformer were commissioned.

Mangamaire.—A 1,500 kVA. transformer was overhauled and fitted with Buchholz relays.

Dannevirke.—The 1,500 kVA. transformer returned from Waipawa was put on load. Another 1,500 kVA. transformer overhauled at Napier was assembled and also placed on load, but following fault symptoms, repairs were effected, temporary Buchholz protection was installed, and then it was forwarded to Waverley.

Stratford.—The original corrugated-iron gantry house was dismantled and transferred to Auckland. The synchronous condenser and associated equipment have also been dismantled and are being forwarded to Auckland.

3. Transmission and Distribution

Routine maintenance and inspection work including pole and insulator testing was carried out on the various lines. Repairs were effected, where necessary, when outages were caused by lightning, gorse fires, wind, and normal line defects. On the Napier–Tuai 110 kV. line a conductor had to be repaired when strands were broken 20 ft. from the tower by rifle-fire, whilst four insulators on the 50 kV. Waihou–Paeroa line and two telephone insulators damaged by rifle-fire had to be replaced. Although the usual notices were distributed drawing attention to the danger of moving haystackers near electric lines, one haystacker fouled a 110 kV. line but fortunately no one was injured. The following incidents are also of interest.

(a) 110 kV. Lines

Woodville–Napier.—On the north bank, the Ngaruroro River scoured to within 12 ft. of a 70 ft. tower. Protection work was completed on the upstream side of the tower.

Tuai–Bunnythorpe.—Climbing patrols were instituted and an officer of the Wildlife Branch of the Internal Affairs assisted in an attempt to discover the causes of numerous outages. It is almost certain the outages could be attributed to birds, either shags or magpies, or both.

Bunnythorpe–Ongarue.—The Department of Scientific and Industrial Research found that the cause of excessive rust on underground members in certain sections was due to the combination of very high rainfall and exceptionally acid soil.

Mangahao–Khandallah.—Special investigation was made into the incidence of vibration breaks of conductor strands and of the amount of abrasive wear on line hardware on the tower section.

(*b*) *50 kV. Lines*

Bombay–Kerepeehi.—To prevent insulators from splitting they were removed from their pins and threads smeared with graphite. New cable was spliced in at twelve places where broken strands were found.

Hamilton–Huntly.—The replacing of the original insulators fitted in 1929 was completed. Conductors were examined for vibration breaks and a large number of broken strands were found.

Horahora–Matamata.—The steel towers in service since 1913 were overhauled, about five thousand corroded bolts and five hundred steel members being renewed.

Ngongotaha–Edgecumbe.—About four miles in the sulphur area at Tikitere were rewired with steel-cored aluminium conductors.

Edgecumbe–Waiotahi.—Some original insulators fitted in 1928 have started to crack, and forty-five in rough country were replaced.

(*c*) *11 kV. Lines*

Waikino–Waihi.—Corroded steelwork was renewed on thirty-six towers.

(*d*) *General*

The 1,000 kVA., 11,000/415-volt substation at Frankton was sold to the New Zealand Co-operative Dairy Co., Ltd., Hamilton in March, 1949.

4. Communications

All supervisory and communications equipment has worked satisfactorily. More modern telephone equipment has been installed especially in line huts. The overhaul of the North Auckland line was completed, and the exchange at Bunnythorpe was replaced by a fifty-line manual one. The power-line carrier system on the Bunnythorpe–Napier 110 kV. line has been in continuous service under test conditions.

As the Paekakariki–Khandallah section has deteriorated badly by reason of the blistering of the copperweld conductor, proposals were prepared to renew the line in a new location.

5. Test Department

Installation tests were made on all major new equipment, including switchgear and transformers at substations, and the new stator on No. 6 generator at Arapuni. Routine maintenance tests were carried out on equipment and investigations were made into any faulty operation of equipment. Other work included tests for field time constants of generators at Arapuni and Karapiro, tests on high-speed field reducing on No. 3 generator and open-circuit and short-circuit tests on No. 1 generator at Karapiro, tests on A.C.S.R. compression joints for 220 kV. lines, and relay tests. Experimental contacts were made up and fitted to the tap-changers at Bunnythorpe.

6. Plant and Motor-vehicles

Plant.—The plant position is fairly satisfactory and good service has been given by tractors, cranes, motor mowers, &c. It was found necessary to hire a heavy dozer for roadmaking.

Vehicles.—The supply of new cars and trucks has improved, but new vehicles are still required as the age of the fleet necessitates heavy maintenance. Of some three-hundred vehicles, one hundred and thirty are over ten years old, and seventeen over fifteen years old. Three line maintenance trucks with cabs to accommodate five men were received.

C. CONSTRUCTION

1. POWER-STATIONS

King's Wharf.—A 20 mVA. 22/6·6 kV. transformer bank with its associated switchgear and control gear was commissioned in January. The installation of a second bank is proceeding.

Maraetai and Whakamaru.—For progress on civil engineering construction see Ministry of Works report.

The diversion tunnel at Maraetai was completed in July, and concreting of the power-house was commenced in December. The Mangakino Bridge was completed in August.

An office of the State Hydro-electric Department was established at Mangakino in October to take charge of the electrical construction work. The main transformers for Maraetai have arrived at Tokoroa, and the assembly of oil-storage tanks and low-tension switchboard panels is in hand.

At Whakamaru, excavations for the diversion cut and the power-house bench were commenced in December, and the site of the outdoor station was levelled.

Geo-thermal Investigations.—A camp has been set up at Taupo by the Ministry of Works preparatory to commencing geo-thermal investigations.

Waikaremoana.—See Ministry of Works report for the sealing of the leaks at the main lake and other constructions.

2. SUBSTATIONS

(*a*) *220 kV.*

Otahuhu.—Work completed includes subsoil drains in the outdoor station, installation of an oil interceptor, erection of fifteen permanent and one construction houses, and underground reticulation for electric-power and telephones in the permanent village. The installation of the oil-drains was half completed, a start made with the condenser building contract, and machines installed in the construction workshops. A 30 mVA. 110/22 kV. transformer bank was dried out, placed on a temporary foundation, and filled with oil.

New Bunnythorpe.—Work carried out by the Ministry of Works includes the second oil-interceptor tank, roading, the completion of all but one of the 220 kV. tower foundations, six sets of 220 kV. O.C.B. pads, and turntable pit and laying of the rails on the main traverser track. On the contract for the control and condenser building about 65 per cent. of the boxing and 70 per cent. of the concrete work has been completed.

The nine remaining 110 kV. O.C.B.s were dried out, filled with oil, and bushings with current transformers fitted to seven. Five sets of 220 kV. O.C.B.s have been set on to their pads and bushings installed into four sets.

Haywards.—The Ministry of Works completed the first excavation contract of 135,000 cubic yards in May, 1949. A second contract of 200,000 cubic yards, which will excavate the area down to formation level, was half-completed. The area for the temporary stores building was levelled.

(*b*) *110 kV.*

Mount Roskill.—The 22 kV. bus was extended by a cable to a temporary building outside the switchroom and an extra 22 kV. feeder switch was installed.

Henderson.—The installation of standard control panels and increased rupturing capacity 11 kV. O.C.B.s was completed.

Hamilton No. 2.—The switchroom building was completed in February, and the erection of the new 11 kV. switchgear has started.

Waihou.—The permanent control panels were installed in October, and emergency buswork was erected for the spare transformer of the 110/50 kV. bank.

Woodville.—The installation of high-tension switchgear and the 1,000 kVA. transformer was completed.

Fernhill.—The substation building was completed.

Waverley.—Pending delivery of the transformer and structure, temporary apparatus was installed to give supply in April, 1950.

Longburn.—The main building was about 90 per cent. completed and is available for use.

(*c*) *50 kV.*

Wellsford.—A site was selected for this new substation.

Takapuna.—Increased rupturing capacity 11 kV. O.C.B.s were installed.

Belmont.—The installation of relay panels was completed, and alterations were made to the 50 kV. bus.

Maungatapere.—The installation of a 6,500 kVA. synchronous condenser from Stratford with its building and associated equipment proceeded.

Kaitaia.—No. 2 1,500 kVA. synchronous condenser and its control equipment was commissioned and a 750 kVA. 50/11 kV. transformer bank installed.

Kaikohe.—A 3 mVA. 50/11 kV. transformer bank was installed.

Huntly.—New 11 kV. incoming and local service O.C.B.s and new control panels were installed in March.

Te Awamutu.—The transformer capacity was increased to 4,000 kVA. in May by the addition of two 500 kVA, three-phrase transformers.

Whakamaru.—A 50/11 kV. substation was put into service in February to supply construction works.

Gisborne.—Preliminary steps to the acquiring of the land have been taken.

Tokomaru Bay.—A site was selected for the station.

Te Kiri.—A regulating transformer was installed.

(*d*) *General*

Additional accommodation has been provided for staff at various substations. Work has also been done on the provision or extension of water-supply and sewerage services.

3. Transmission and Distribution

(*a*) *220 kV. Lines*

Whakamaru–Otahuhu.—Foundations have been completed for all but fourteen of the 510 towers on the east line and 291 towers have been erected. Three miles of air-strip matting were laid to provide access in swamp country. Work on access roading and tree-cutting commenced on the west line.

Whakamaru–Maraetai.—Foundations were completed for the twenty-five towers on the west line, and twenty towers were erected. All but one of the twenty-six foundations for the east line also were completed.

Whakamaru–Bunnythorpe.—Construction camps have been built at Tihoi, Kurutau, Turangi, and Hihitahi. A bridge was built over the Mangaonoki Stream, and lateral access tracks to tower sites were formed with the aid of a bulldozer. A start has been made on tower foundations.

Bunnythorpe-Haywards.—The field survey work has been completed. Three miles of roads have been formed in the mountainous bush section behind Paraparaumu. Middle line proclamations covering the routes near Otaki and Waikanae were prepared.

Linton Steel Depot.—5,696 tons of tower steel were received and 3,562 tons despatched to the field. Due to the lack of parts to complete tower sections, 5,082 tons of steel still remain at the depot. Forty-eight tons of aluminium cable steel reinforced were received.

(*b*) *110 kV. Lines*

Otahuhu–Henderson.—A tentative location was made. Parts of this line go through heavily built-up areas.

Henderson–Maungatapere.—Construction camps have been erected at Kaukapakapa, Wellsford, Mangapai, and Maungaturoto, and a start made with tree-cutting and access roads. Steel is being sorted and stacked at Sylvia Park.

Lichfield–Kinleith.—Detailed survey was completed.

Khandallah – Central Park.—The transfer of the western circuit to the new double-circuit towers was completed.

Bunnythorpe–Ongarue.—The six towers required to deviate this line into New Bunnythorpe were erected.

(*c*) *50 kV. Lines*

Maungatapere–Dargaville.—Plans have been made and structure positions pegged.

Te Puke – Tauranga – Aongatete.—Detailed survey was completed and the construction of the Te Puke – Gate Pa section commenced.

Waitomo–Marakopa.—Survey was commenced.

Gisborne – Tokomaru Bay.—A camp was established at Tolaga Bay in September and a start was made on the location of the line.

(*d*) *General*

An 11 kV. line was surveyed from Maraetai to Waipapa. Work was continued on the reticulation of the Mangakino and Whakamaru areas.

4. COMMUNICATIONS

The Maraetai Office was connected to the telephone.

Three new telephone-huts were installed and a lateral line run to Waipapa. The reconstruction of the Woodville–Mangamaire circuit was completed and the thirty-line cordless switchboard at Tuai was installed. Detailed survey for twenty-seven miles of the Bunnythorpe–Whakamaru telephone-line was completed and plans drawn for fourteen miles.

5. GENERAL

The 180 ft. high steel mast for the radio beacon at Wanganui was erected for the Ministry of Works.

At the Napier Depot, previously known as the Taradale Road Depot, the carpenter's shop, a store, another cottage, pump-house, and timber-rack were completed.

SOUTH ISLAND SYSTEM

A. SYSTEM OPERATION AND LOAD DESPATCH

1. LOAD

The maximum half-hourly demand, on the combined interconnected system, which includes the Dunedin City Corporation plants and other auxiliaries, was 185,442 kW. between 11.30 a.m. and noon on Tuesday, 10th May, 1949, an increase of 11·6 per cent. on the previous year's peak of 166,188 kW.

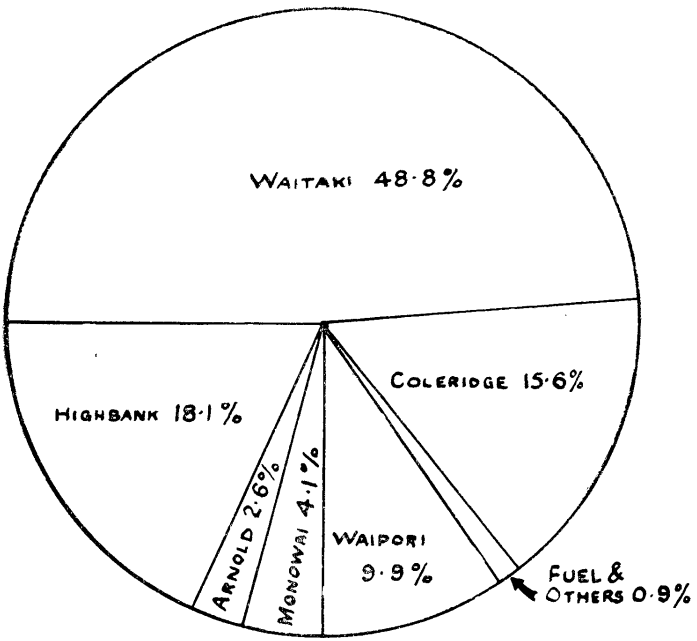
The total generation for the combined system based on provisional returns was 900,000,000 units, an increase of 9·9 per cent. on the previous year's output of 819,000,000 units. The greatest weekly generation was 19,019,564 units (previous year, 16,976,973) during the week ended 7th August, 1949, and the highest daily generation was 2,944,040 units (previous year, 2,683,617) on Tuesday, 2nd August, 1949.

Considerable difficulty was again experienced in obtaining adequate coal supplies for auxiliary stations.

Generation details of the combined interconnected system (compared with 1948–49) are as follows:—

Station.	Year Ended 31st March, 1950.			Year Ended 31st March, 1949.		
	Maximum Kilowatts.	Units Generated.	Annual Load Factor.	Maximum Kilowatts.	Units Generated.	Annual Load Factor.
			Per Cent.			Per Cent.
Arnold	3,300	23,574,800	81·6	3,300	24,913,600	86·2
Coleridge	43,380	140,015,190	36·8	42,440	126,723,510	34·1
Dobson (oil) ..	..	55,130	..	..	443,370	..
Highbank	30,000	162,927,420	62·0	28,000	178,561,650	72·8
Monowai	6,600	37,317,850	64·5	6,500	34,894,650	61·3
Waitaki	83,120	438,795,080	60·3	82,920	370,443,410*	61·4
Departmental totals	..	802,685,470	..	..	735,980,190	..
Dunedin City (all stations) ..		90,159,642			69,782,514	
Kanieri Electric Co.		3,581,925			3,679,000	
Christchurch Tramways		1,088,910			2,769,520	
Others		2,503,420			7,128,446	
Grand total		900,019,367			819,339,670	

* Waitaki No. 5 unit went into service 21st March, 1949.



GRAPHICAL ILLUSTRATION OF ABOVE TABLE

2. Reliability of Supply

Although 242 faults were experienced, there was only one general interruption to the whole system when a bird caused a flashover on the Waitaki-Glenavy 110 kV. line. Some faults caused disturbances or interruptions to one or more supply authorities, but the periods of interruption to consumers were generally shorter than the period of outage of the line or equipment concerned. The following analysis does not include prearranged shutdowns: —

Description.	Year Ended 31st March, 1949.	Year Ended 31st March, 1950.	
		Number.	Duration.
			h. m.
1. 110 kV. lines: Defects	2	1	4 06
2. 110 kV. lines: External causes	5	8	2 38
3. 66 kV. and 33 kV. lines: Defects	12	12	8 14
4. 66 kV. and 33 kV. lines: External causes	8	4	7 14
5. 11 kV. lines: Defects*	79	72	75 18
6. 11 kV. lines: External causes*	42	34	25 00
7. Lightning	7	14	10 47
8. Storms: Nature of trouble not found*	22	36	51 36
9. 110 kV. equipment	1	4	9 44
10. 66 kV. and 33 kV. equipment	8	10	5 56
11. 33 kV., 11 kV., or 6·6 kV. equipment	20	10	15 41
12. Generators	1	..	..
13. Turbines	..	..	..
14. Fires: Scrub	..	1	1 01
15. Relays	..	1	0 07
16. Control circuits and batteries	..	1	1 12
17. Operation: Mistakes	5	1	0 07
18. Operation: Accidents	..	3	0 07
19. Faults and overloads on consumers' system	2	6	1 37
20. Other causes	..	4	0 24
21. Causes unknown*	8	20	16 09
Totals	222	242	236 58

* Includes Southland Electric-power Supply retail distribution.

B. OPERATION AND MAINTENANCE

1. Power Stations

Coleridge.—The year's rainfall was 42·4 in. at the Harper and 27·53 in. at the power-house (previous year 47·01 and 36·07 in.). The lake reached overflow level, 1673·5 ft. in August and January, but was reduced to 1670·38 ft. on 31st March, 1950.

A new record maximum half-hourly demand of 43,380 kW. was recorded from 11.30 a.m. to noon on 27th June, 1949. This was an overload of 25·7 per cent. on the station rated capacity of 34,500 kW.

At the Harper intake, further extensive groyne work was carried out. Steel plates were laid on the intake gate spillways to provide a more permanent surface and reduce maintenance.

Major overhauls were carried out on Nos. 1, 2, 3, 7, and 9 generating-units, and reconditioning of valves was effected on Nos. 4 and 6.

Machine Running Times

Generator No.	Time on Load.		Time Idle.		Time Under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	5,530	63·2	2,196	25·0	1,034	..	88·2
2	5,585	63·8	2,693	30·7	482	..	94·5
3	5,317	60·7	2,980	34·0	463	..	94·7
4	2,376	27·1	6,257	71·4	127	..	98·5
5	2,390	27·3	6,284	71·7	86	..	99·0
6	2,337	26·7	5,981	68·3	442	..	95·0
7	2,326	26·6	5,585	63·7	849	..	90·3
8	3,442	39·3	5,287	60·4	31	..	99·7
9	3,364	38·4	5,023	57·3	373	..	95·7

Waitaki.—The average river flow during the year was 11,700 cusecs, compared with 12,800 cusecs during the previous year.

A turbine gate lower bearing greasing-nipple unscrewed on No. 2 generator, which allowed a jet of water to play up into the generator windings and caused a stator winding failure necessitating the replacement of ten full coils and six half-coils. The unit was out of service from 13th May to 14th June.

In reassembling No. 2 unit after repair, an experiment with dry ice, for shrinking the coupling bolts to enable them to be inserted in the flanges without driving, was very successful.

Machine-running Times

Generator No.	Time on Load.		Time Idle		Time Under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	7,372	84·2	1,388	15·8	..	..	100·0
2	6,777	77·4	1,233	14·1	750	..	91·5
3	6,327	72·2	2,382	27·2	51	..	99·4
4	5,993	68·4	2,674	30·5	93	..	98·9
5	5,747	65·6	2,991	34·1	22	..	99·7

Highbank.—No water was drawn from the race from 28th April till 18th September, but thereafter water was drawn as required for irrigation purposes. The average units generated per hour of running were 18,599 compared with 21,689 the previous year.

Steps were taken to reduce troubles caused by sand getting into the control mechanisms on the main and auxiliary turbines. The station was shut down for general overhaul from 8th to 24th January, 1950.

Three new groynes were built in the Rakaia River by the Ministry of Works to protect the station, and three damaged groynes were repaired.

Machine-running Times

Generator No.	Time on Load.		Time Idle.		Time under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	8,153	93·1	96	1·1	511	..	94·2

Arnold.—During one week low river flow caused a slight reduction in output.

Because of increasing leakage from the tunnel, the station was closed down from 6th February to 18th March, 1950, for extensive repairs to the concrete lining of the tunnel to be carried out by the Ministry of Works. Divers were employed to seal leaks in the headgate structure, overhaul underwater equipment, and remove waterlogged timber from the vicinity of the headgates. During this period the generating-units were overhauled, and the control wiring almost completely renewed.

Machine-running Times

Generator No.	Time on Load.		Time Idle.		Time Under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	7,760	88·6	43	0·5	957	..	89·1
2	7,758	88·6	48	0·5	954	..	89·1

Monowai.—The rainfall for the year was 46·33 in., compared with 57·38 in. last year. Floods occurred in April and February, when water ran to waste.

An inter-turn fault developed in No. 2 generator on Friday, 17th February, 1950. A complete set of new windings was installed, the work being completed by 27th March, 1950.

Machine-running Times

Generator No.	Time on Load.		Time Idle.		Time Under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	7,176	81·9	1,484	16·9	99	1	98·8
2	6,329	72·3	1,408	16·1	1,022	1	88·4
3	6,965	79·5	1,672	19·1	122	1	98·6

Dobson.—Pending the receipt of new crankshafts one engine only was serviceable, and its running was kept to a minimum.

Machine-running Times

Generator No.	Time on Load.		Time Idle.		Time under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1	..	..	..	..	8,760	..	0·0
2	..	..	..	..	8,760	..	0·0
3	56	0·6	8,704	99·4	..	..	100·0
4	..	..	..	..	8,760	..	0·0

2. Substations

Operation was generally satisfactory. Outages were caused by birds dropping a piece of wire across the 110 kV. O.C.B. isolators at Temuka, and by lightning at Oamaru on two occasions, the second causing damage to a switch cubicle. The following particular incidents are recorded :—

(*a*) *110 kV.*

Timaru.—The 11 kV. outgoing feeder cables were rearranged to provide a third feeder for the South Canterbury Electric-power Board supply to Timaru.

Halfway Bush.—Following two outages caused by a switch dropper and a bus conductor breaking on the 110 kV. switching structure, a complete overhaul of No. 1 bay was carried out. New type connections, blades, and fixed contacts were fitted.

Milton.—An 11 kV. voltage regulator was reinstalled.

(*b*) *66 kV.*

Addington.—An 11 kV. cable pothead on one of the main transformer banks failed. As a similar failure occurred last year all of these cable-ends were overhauled and tested and the potheads refilled with hard compound.

Earth leakage and Buchholz relay protection was provided on the four main 20,000 kVA. 66/11 kV. transformer banks, and the substation alarm system was modernized.

Invercargill.—The 11 kV. voltage-regulators gave further trouble.

(*c*) *General*

After a spare 110 kV. bushing failed shortly after being put into service at Timaru, all 110, 66, and 33 kV. bushings were tested and overhauled where necessary, and provision of improved storage arrangements was put in hand.

3. Transmission and Distribution

Routine maintenance and overhaul of lines was carried out, wooden poles being replaced where necessary. Interruptions were caused by storms and gales. The following incidents are recorded :

(*a*) *110 kV. Lines*

Timaru–Glenavy.—The Makikihi River crossings were piled.

(*b*) *66 kV. Lines*

Coleridge–Otira–Arahura.—The earth-wires on Arthur's Pass towers were changed on to strain clamps following failures at the suspension clamps due to vibration.

(*c*) *33 kV.*

Addington–Southbrook.—Part of the Addington–Harewood section of this double-circuit line was strengthened with stub poles to enable an 11 kV. circuit to be carried for the Springs–Ellesmere Power Board. This 11 kV. circuit will replace the existing 33 kV. substation supplying Harewood Aerodrome.

(*d*) *General*

Of a total of 58,548 insulators on 110, 66, and 33 kV. transmission lines tested by buzz-stick, 413 were found defective and replaced.

(*e*) *Distribution*

Approximately fifty-five miles of 11 kV. line extensions were erected, and supply made to a further 748 consumers. The South Invercargill 3·3 to 11 kV. reconversion was completed and that at Riverton is proceeding.

The reticulation of the Moa Flat, Mossburn, Balfour, Waimatua, part Otahu Flat, Greenhills, and Happy Valley were completed. These are extensions under subsidy from the Rural Electrical Reticulation Council.

4. Communications

General maintenance included replacements and additions to lines and equipment. Interruptions to telephone communication were caused by power-line faults, storms, contact with power-lines, fouling of lines by loose wires of adjacent circuits, and other causes.

The north terminal apparatus of the Gore–Invercargill single-channel carrier system was removed from Gore and installed at Halfway Bush, thus providing an additional channel from Halfway Bush to Invercargill.

Further investigation was carried out on the proposed mobile radio-telephone system.

5. Test Department

In addition to the regular testing and servicing of meters, relays, instruments, clocks, rubber gloves, batteries, and cables, &c., relays and meters were installed and commissioning tests carried out on new equipment. This work included the design and installation of metering equipment for a 1,150 kVA. six-phase turbo alternator operated for the Department at the Christchurch Tramway Board's Falsgrave Street Station.

6. Plant and Motor-vehicles

Plant. Good progress was made with the reorganization of the Central Depot facilities at Addington. The mechanical equipment was transferred to the new workshop and the Depot Office nearly completed. At Invercargill the workshop was also completely reorganized to provide more modern facilities.

Vehicles. New trucks and cars were received, but the overall serviceability of the fleet is badly handicapped by age. Of the 163 vehicles in the fleet more than 95 are over ten years of age. The new Land Rover is proving very useful on line-construction work

C. CONSTRUCTION

1. Power-stations

Coleridge.—Three new sets of 66 kV. lightning arresters were installed, completing the provision of individual sets on each of the five main transformer banks.

Waitaki.—The Ministry of Works carried out investigation work in connection with the installation of two additional 15,000 kW. generating-units.

Tekapo. The erection of the single generating-unit was commenced late in the year. For further details see Ministry of Works report.

Roxburgh. Refer to the Ministry of Works report.

Pukaki. The spillway west wall was completed and permanent and coffer-dams raised to permit some storage of water pending availability of full storage when the spillway is completed and spillway gates installed.

For further details refer to the Ministry of Works report.

Benmore.—Refer to the Ministry of Works report.

2. Substations

(*a*) *110 kV.*

Ashburton.—An 18 ft. extension to the switchroom was completed, and installation of a new 10,000 kVA. transformer bank and a new eleven-panel set of 11 kV. switchgear was commenced.

Temuka. A spare transformer for the 5,000 kVA. 110/11 kV. bank was installed in December.

Oamaru.—An 18 ft. extension of the switchroom was completed. Installation of a new 10,000 kVA. transformer bank and a new eight-panel set of 11 kV. switchgear is proceeding.

Halfway Bush.—The installation of the two new 20,000 kVA. 110/33 kV. transformer banks was completed, the first bank going into service on 9th August, 1949, and the second on 2nd November, 1949.

Studholme.—The survey and site plan were completed.

Edendale.—All concrete foundations, footings, and pads were completed, the traverser track formed, and the control panels and equipment were assembled and installed.

(*b*) *66 kV.*

Arahura.—Installation of the new 5,000 kVA. 66/11 kV. automatic tap-changing transformer bank was completed and went into service on 18th September, 1949.

Islington.—Construction of a temporary 12,000 kVA. 66 kV. substation to give supply to the Springs-Ellesmere Power Board was commenced in September. Terminal structures, transformer bank, and store were completed and switchgear is being installed.

Southbrook.—A survey and site plan have been completed for the 66 kV. substation which will replace the present 33 kV. substation supplying the North Canterbury Electric-power Board at Rangiora.

Invercargill.—The contractor made good progress with the switchroom and workshop buildings.

(*c*) *33 kV.*

Waipara.—A second 1,000 kVA. 11 kV. voltage-regulator was installed.

3. Transmission and Distribution

(*a*) *220 kV. Lines*

Roxburgh–Islington.—Preliminary location and fifty-five miles of survey and plans were completed.

(*b*) *110 kV. Lines*

Oamaru–Palmerston–Halfway Bush.—Deviation surveys were carried out to improve the separation from the existing line.

Roxburgh–Dunedin.—Location has been commenced.

Gore–Invercargill.—This line was put into service as a temporary 66 kV. line on 18th December.

Gore–Roxburgh.—Contruction commenced following the completion of the survey.

(*c*) *66 kV. Lines*

Islington–Papanui and Islington–Southbrook.—Surveys have been completed.

Bluff–Invercargill.—A reconnaissance survey was made.

4. Communications

Telephone exchanges were installed at Halfway Bush, Timaru, Tekapo, Gore, and the office at Invercargill. The new Ashburton–Timaru section and the Tekapo–Timaru line were brought into service. Thirty-six miles of line from Ealing to Pareora were constructed, the circuit from Addington on the New Zealand Railways poles was extended to Culverden, and a trunk lateral from Edendale Railway-station to the substation was installed.

Coleridge and Addington radio-stations went into service on 24th June, 1949, and Waitaki in July, 1949. Temporary installations are in use at Hororata and Highbank where receiving stations are being installed. Installation of the Dobson Radio-station is proceeding.

NELSON MARLBOROUGH SECTION

A. SYSTEM OPERATION AND LOAD DESPATCH

1. Load

The maximum half-hourly demand on the system was 13,907 kW. on 16th June, at 1730 hours. This was 10·5 per cent. higher than the previous year's peak of 12,586 kW. The increase in the units generated was 14·6 per cent. The maximum number of units generated in any one week was 1,600,241 for the week ended 19th June, 1949 (last year 1,394,769). The system annual load factor was 61 per cent.

Units generated (compared with those for the previous year) were as follows:—

Station.	Year Ended 31st March, 1950.			Year Ended 31st March, 1949.		
	Maximum Kilowatts.	Units Generated.	Annual Load Factor.	Maximum Kilowatts.	Units Generated.	Annual Load Factor.
			Per Cent.			Per Cent.
Cobb	12,900	68,191,800	60	11,920	60,238,600	58
Auxiliary and standby stations—						
Waihopai		1,883,417			2,749,936	
Other miscellaneous		4,380,829			2,002,296	
Total units generated and purchased		74,456,046			64,990,832	

The units generated by the auxiliary and standby stations represent 8·3 per cent. of the total, compared with 7·3 per cent. during the previous year.

2. Reliability of Supply

A complete blockage of all turbine spears by rocks and gravel occurred at Cobb Power-station during the peak period on 19th May. As stones were thought to be in the pipe-line load was limited to 11,000 kW. until Sunday, 12th June, when the station was taken out of service for 11 hours to enable a screen to be fitted in the stone-trap. On 17th December the station was shut down for 18 hours 28 minutes, commencing at 2302 hours to change over from the old intake to the new.

The following table gives a detailed analysis of faults. Pre-arranged shutdowns are not included.

Description.	Year Ended 31st March, 1949.	Year Ended 31st March, 1950.	
		Number.	Duration.
			h. m.
1. 66 kV. lines: Defects	..	1	0 03
2. 66 kV. lines: External causes	..	1	0 25
3. 11 kV. lines: Defects	..	2	4 03
4. 11 kV. lines: External causes	2	3	7 15
5. Lightning	4	..	..
6. Storms	..	..	..
7. 6·6 kV. apparatus	..	..	..
8. 11 kV. or 33 kV. apparatus	4	1	0 38
9. 66 kV. apparatus	1	1	0 07
10. Turbines	..	3	2 40
11. Relays	4	..	..
12. Control circuits and batteries	..	1	0 39
13. Operation: Mistakes	..	..	..
14. Operation: Accidents	..	..	..
15. Faults and overloads on consumers' systems ..	15	3	0 48
16. Other causes	..	1	0 02
17. Causes unknown	3	4	0 24
Totals	33	21	17 04

B. OPERATION AND MAINTENANCE

1. Power-stations

Cobb.—The peak load carried by the Cobb generators was 12,900 kW. at 1200 hours on 15th June.

To reduce the possibility of flood damage the level of Lake Halley was lowered at various periods.

During February and March water storage fell. Pumping water from Lake Sylvester with a jet-pump commenced on 27th March, which added another 960 kW. to Cobb Station.

The rainfall was 74·17 in., compared with 76·64 in. for 1948–49.

The spears, nozzles, and turbine buckets of all machines were repaired, and the main valves were also overhauled.

Machine-running Times

Generator.	Time on Load.		Time Idle.		Time Under Repair.		Percentage Availability for Service.
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).	
1 ..	7,442	85·0	1,183	13·5	115	20	98·5
2 ..	7,436	84·8	1,213	13·8	91	19	98·7
3 ..	7,513	85·8	1,079	12·3	152	15	98·1
4 ..	7,495	85·6	1,167	13·3	76	21	98·9

Stoke Diesel Station.—The Diesel house was extended and four Diesel-operated alternators of 360 kW. capacity (continuous) were installed and commenced operation on 11th March. The station generated 979,700 units, which was 580 per cent. of last year's generation. The machine-running times were: No. 1 machine, 508 hours; No. 2 machine, 674 hours; No. 3 machine, 516 hours; No. 4 machine, 355 hours; No. 5 machine, 499 hours; No. 6 machine, 379 hours.

2. Substations

66 kV.

All Buchholz relays were replaced at Blenheim and Motupipi owing to oil leaks in the castings. The Nelson City Council cable-box on the terminal structure at Stoke failed on 19th October.

3. Transmission and Distribution

(a) 66 kV.

Two poles struck by lightning on the Upper Takaka Motupipi line were replaced.

(b) 11 kV.

The Motupipi-Tarakohe line was deviated for approximately one mile at the Tarakohe end to allow the Golden Bay Cement Co. to extend its quarry.

4. Communications

Faults were mostly due to high winds, and branches falling on the line in the bush areas. Daily radio communication was used between Nelson, Cobb, and Lake Sylvester for lake-levels during the dry period and to arrange supplies during lake-control work.

5. Testing

New apparatus was tested and usual routine duties carried out.

6. Plant and Motor-vehicles

Transport relies on a fleet of vehicles most of which are over ten years old and have seen hard service in both the Department and the Army. During the year two 15 cwt., one 18 cwt., and one 3-ton chassis were received for work on transmission-line construction. Two cars were received, one of which was a replacement.

C. CONSTRUCTION

1. POWER-STATION

Construction of the main dam at Cobb by the Ministry of Works is proceeding. Lake Little Sylvester was controlled to provide additional storage.

2. SUBSTATIONS

66 kV.

Blenheim. A 5 mVA., 33 kV. voltage regulator was put into service on 22nd July. Reactive metering was installed and came into operation on 1st January.

Motupipi. An automatic earthing switch and restricted earth leakage protection were installed and put into service during October.

3. TRANSMISSION AND DISTRIBUTION

The difficult portion of the 66 kV. Inangahua–Waimangaroa line was located, the profile well advanced, and a camp was established at Denniston. Approximately 60 per cent. of the structures on the Inangahua–Blackwater 66 kV. line have been erected to date, 114 structures being erected, nine miles of track formed, and 30 acres of bush felled this year. Profile plans were rechecked and numerous deviations were made to all lines to improve structure positions.

4. GENERAL

A motor service depot was completed and is in operation.

DESIGN AND PROJECT PLANNING

(*a*) HYDRAULIC AND STRUCTURAL SECTIONS

See report of Ministry of Works.

(*b*) ELECTRICAL SECTION

Power-stations.—Detailed drawings of Maraetai have been continued and are nearing completion. The layout of the permanent village reticulation and lighting was worked out and material ordered.

Generator, transformer, and turbine specifications were prepared and tenders called for Whakamaru. Specifications of the control board for the 220 kV. switching-station were completed and an order placed in New Zealand. Detailed work continued on the cabling and equipment for this switching-station. To allow for the same set being used on all machines, modifications were made to the design of carbon-dioxide fire-protection equipment being bought for Arapuni.

The report on the efficiency tests at Karapiro was completed and further tests made on the high-speed field reducing system.

New governor oil-pumps were ordered for Tuai and work done on the proposal to modify the generator bearing oil-circulating system at Piripaua.

Design work for the Cobb extensions continued and a specification was prepared for the control and relay boards and equipment.

The details of the extensions to the Stoke Diesel Station were completed and the commissioning test supervised.

For Waitaki, drawing alterations necessitated by the installation of No. 5 machine were brought up to date and work was done on alterations for the proposed installation of units Nos. 6 and 7.

A large number of details of cabling and supports, &c., and other equipment for Tekapo, were designed.

The generator, transformer, and turbine specifications were finalized and tenders called for Roxburgh. A start was made on the preparation of specifications for the outdoor switchgear and control gear.

General work included assistance with the layout of proposed schemes and the analysis of both the practice and performance of penstock painting.

Substations.—Co-ordination of the arrangements to meet present needs and the planning for future requirements resulted in the following decisions and arrangements being made.

A second transformer bank is to be installed at Te Awamutu for the winter of 1952 and, by 1954, Hangatiki is to be converted to an 110 kV. substation by tapping off one of the Arapuni–Ongarue 110 kV. lines. As New Zealand Forest Products, Ltd., have decided to erect a pulping-mill near Tokoroa an additional point of supply is to be given to the Thames Valley Electric-power Board at Kinleith and supply will be tapped off near Lichfield. The proposals for Lichfield Substation were consequently modified; the transformer bank and two-bay structure ordered for this substation are now to be installed at Edgecumbe and Tauranga respectively. The transformer bank at Southbrook is to be replaced in 1950, and the substation converted to 66/11 kV. by 1954. Pending the completion of the 220 kV. substation a temporary 66/11 kV. substation is being erected at Islington to supersede Smith's Road and Harewood Substations.

Preliminary investigations were made into the proposal for a new 110/11 kV. substation at Huntly for the winter of 1955, and into the possibilities of a complete reconstruction of Masterton Substation about 1954. Detailed consideration was given to the future requirements of the Gisborne area.

Arrangements were made for the temporary installation of a further transformer bank at Kaitaia, for the temporary transfer to Maungatapere of a synchronous condenser from Stratford to improve voltage conditions until 110 kV. supply is available, to meet switchgear requirements at Dargaville by transfer, for two feeders to supply the Railways Department for traction purposes at Pahautanui, and for a temporary substation at Waverley. It was also agreed to give the South Canterbury Electric-power Board extra feeders at Timaru involving modifications to the existing switchgear and control board.

Contracts were let for indoor switchgear at Maungatapere, Wellsford, Mount Roskill, Hangatiki, Edgecumbe, Tauranga, Hawera, Patutahi, and Gisborne; for outdoor switchgear and structures at Kaikohe (aluminium structures), Te Puke, Aongatete, Pahautanui, and Inangahua; for transformer banks at Wellsford, Mount Roskill, Ngongotaha, Matamata, Tauranga, Gisborne, Stoke, Islington, and Papanui; for O.C.B.s at Edgecumbe, Maungatapere, and Addington; for 220 kV. and 110 kV. aluminium structures, 110 kV. switchgear, 220 and 110 kV. lightning-arresters, and 110 kV. potential transformers at Haywards; for aluminium extensions to 110 kV. switchgear structures and equipment for metering the total Auckland Electric-power Board load from Penrose, Mount Roskill, Otahuhu, and King's Wharf, at Penrose, and for control equipment for the second synchronous condenser at Hororata.

Tenders were called for switchgear structure extensions at Mount Roskill, O.C.B.s at Tauranga, transformer bank at Mangahao, three regulating transformers at Khandallah, 25-ton crane at Gisborne, and for 66 kV. structure switchgear and 45-ton crane at Papanui. The Ministry of Works called for tenders for the new switchroom building at Lichfield.

Design work and detailed drawings were completed or nearly completed for the Otahuhu, Bunnythorpe, Haywards, Studholme, Gore, Edendale, and Invercargill Substations, and for the extensions at Halfway Bush. Detailed design proceeded for Maungatapere and Edgecumbe, and Head Office work was completed for Longburn and Fernhill. The layout of the new 22 kV. switchgear building outdoor extensions, and modifications to the control room at Penrose were well advanced. Drawings were prepared for the 33 kV. structure at Mangahao using steel work from Coleridge, and modifications to the structure at Matamata were planned to accommodate the transformer bank now on order. In conjunction with the Ministry of Works, building drawings were advanced for Papanui, Stoke, Penrose, and Ongarue.

Communications.—Up-to-date telephone switchboards similar to those installed at Bunnythorpe and Penrose Substations were planned for Hamilton, Addington, and Arapuni. Provision for special load dispatch arrangements is being made for Hamilton and Addington.

In the North Island two further single-channel carrier systems are to be installed to provide an extra noise-free channel between Arapuni–Waihou and Penrose–Maungatapere. The Napier–Tuai single-channel carrier system was installed to improve communications in the Napier district, and planning for the communications network for the Waikato projects proceeded.

The installation of the Addington–Waitaki single-channel carrier system should bring the South Island communication network up to the required standard.

The installation of an up-to-date radio network was completed to provide a standby communication system from Addington load dispatch to the main stations in the Christchurch district.

A number of modified "walkie-talkie" sets were made available to facilitate the construction of transmission-lines in difficult country and to provide assistance in other work.

Relay Protection.—Considerable attention has been paid to loading and voltage regulation conditions for the transmission systems in various parts of both the North and South Islands. Calculations are required in connection with present operating conditions and the future planning of transmission systems.

Changing conditions have made necessary short-circuit calculations to determine the rupturing duty for oil circuit-breakers at numerous places. Other short-circuit calculations were made to determine the induced voltages where proposed power-lines will run in proximity to the communication circuits of the Post and Telegraph and New Zealand Railways Departments.

Investigations were made to determine the most suitable protection methods to be employed, in special cases, for large power transformers.

Determination of proposed relay settings and schemes for different districts were worked out and partly implemented, and an alteration to the protection at Arapuni was nearly completed.

Analysis of relay operations continued, and the action taken when incorrect operations occurred resulted in a special investigation into the operation of gas-accumulation relays used for the protection of transformers.

It was decided to conduct in the field a short-circuit test on an old type of 110 kV oil circuit-breaker. This necessitated considerable investigation to determine the best method for conducting the test and interpreting the results.

Further work was done on the D.C. network analyzer and tenders will be called for its manufacture.

(c) Transmission Section

Contracts were placed in New Zealand for the steel towers for the second 220 kV. circuits on the Whakamaru–Otahuhu and Whakamaru–Bunnythorpe lines and for the 66 kV. double circuit line Islington–Papanui, in Great Britain for the steel-cored aluminium conductors for these and other lines, and in Canada for insulators for a number of lines. The placing of a contract in Great Britain for toughened-glass insulators for the Oamaru–Dunedin 110 kV. second circuit will inaugurate the first large scale use in New Zealand of this type of insulator on main transmission-lines.

Regular inspection was continued of steel towers being manufactured by New Zealand contractors for the first 220 kV. circuits from Whakamaru to Otahuhu and to Bunnythorpe and for the 110 kV. double-circuit line from Henderson to Maungatapere. The first-mentioned contract is about 90 per cent. complete, the latter about 20 per cent. Mechanical tests to destruction were carried out on one of each of the four types of towers in the Henderson–Maungatapere contract, the results being highly satisfactory.

Regular inspections were made in all districts of the survey and construction work being carried out. Despite interruptions due to material and man-power shortages excellent progress has been made by the districts concerned in the construction of the major work in hand, the Maraetai – Whakamaru – Otahuhu 220 kV. circuit No. 1. Foundation work was almost completed, 55 per cent. of the towers were erected, and arrangements made for an early start on the stringing of the heavy conductors.

The usual investigations of wire-stringing tension for various loading conditions, insulator deflections, and mechanical loading of supports for various lines were continued, and charts supplied for field use.

Due to increasing difficulty in securing supplies of Australian hardwood poles and crossarms, and following a conference where delegates from the New Zealand Forest Service, various other Government Departments, and local bodies met the Chief Inspector of the New South Wales Forestry Commission and a number of Australian timber suppliers, the specifications for these items were relaxed to permit the supply of a number of species previously excluded. There has been a marked improvement in the supply of these items. Except for the supply of pole hardware which has deteriorated to an alarming extent, all transmission-line material is less difficult to obtain.

REGULATIONS, LINE INSPECTION, ETC.

The electric lines and works of sixty-eight Electrical Supply Authorities were inspected. An inspector visited the Chatham Islands where plant and installations were inspected for the first time.

The Otago Central Electric-power Board and the Taupo Town Board were granted licences authorizing them to use water from the Fraser and the Hinemaiai Rivers respectively for the purpose of generating electricity.

The purchase by the Buller Electric-power Board of the Westport Borough Council's electrical undertaking was confirmed by Order in Council.

The Marlborough Electric-power Board was granted a licence authorizing it to erect and use electric lines in the Borough of Picton, and to change over from D.C. to A.C. supply.

The Auckland Electric-power Board was granted a licence authorizing it to lay a submarine cable in the Hauraki Gulf for the purpose of supplying certain islands.

Boundary adjustments between the North Auckland Electric-power Board and the Whangarei Borough Council and between the King-Country Electric-power Board and the Taumarunui Borough Council were confirmed by Order in Council.

The following licences and permits to use water for the purpose of generating electricity and/or to erect and use electric lines were issued, assigned, or revoked :—

	Supply Authorities.	Private Individuals.
Use of water-power—		
Licences—		
Issued	..	3
Assigned	..	3
Revoked	..	5
Permits—		
Issued	..	2
Revoked	..	1
Grants to drive machinery : Revoked	..	1
Electric lines—		
Licences—		
Issued	11	6
Revoked	2	..
Permits : Issued	..	1
Combined water-power and electric lines licences—		
Issued	2	2
Assigned	..	1
Revoked	..	6
Permits to carry out wiring-work in connection with private plants : Issued	..	270

Sixty-seven Electric Supply Authorities gave notice of their intention to make a total of 707 extensions to their electric lines.

There were 3,301 broken wires and 206 broken poles reported by Authorities. The principal causes of the wires being broken were: trees, 960 (29·1 per cent.); contact, 1,061 (32·2 per cent.); gale, 324 (9·7 per cent.); vibration, 96 (2·9 per cent.); vehicles equipped with cranes, &c., 119 (3·6 per cent.); pole hit by vehicles, 110 (3·3 per cent.); binder failure, 93 (2·8 per cent.).

The following table shows the number of electrical accidents reported compared with the previous year:—

—	Year Ended 31st March, 1950.			Year Ended 31st March, 1949.		
	Fatal.	Non-fatal.	Total.	Fatal.	Non-fatal.	Total.
Child (up to seven years inclusive)	1	1	2	1	3	4
Domestic (includes hotels, boardinghouses, &c.)	2	4	6	4	5	9
Electrical worker (other than linemen)	2	6	8	..	6	6
Electrical linemen	1	10	11	2	13	15
General public	..	..	..	1	1	2
Industrial (factories, workshops, &c.)	..	1	1	1	7	8
Painters	..	2	2	..	1	1
Plumbers	..	1	1	..	1	1
Other trades	..	5	5	2	1	3
Other workers	8	6	14	2	3	5
Suicide	1	..	1	..	..	..
Young person (over seven but not over fifteen years)	..	3	3	2	2	4
Total	15	39	54	15	43	58
Mechanical (fall from pole, &c.)	..	..	..	..	4	4
Stock	3	..	3	1	..	1

The following table shows the number of electrical fires reported compared with the previous year:—

—	Year Ended 31st March, 1950.	Year Ended 31st March, 1949.
Accessories	4	4
Appliances	2	8
Contact between aerial conductors	7	3
Contact between metal conduit and composition gas-pipe	2	2
Fixed wiring (sub-mains and sub-circuits)	2	5
Flexible cables and cords	1	1
Improper use of appliances (irons, radiators, urns, ovens, &c., left switched on)	6	6
Rodents	..	2
Service mains	..	1
Switchboards (wiring behind and accessories on)	6	3
Total	30	35

REGISTRATION OF ELECTRICAL WIREMEN

Examinations were held for electrical wiremen, electrical servicemen, radio servicemen, radio experimenters, cinematograph operators, and luminous-discharge-tube installers. One thousand two hundred and thirty-six sat the wiremen's and 496 the servicemen's examinations, a total of 1,732.

New registrations during the year totalled 372—293 electrical wiremen and 79 limited registrations.

One hundred and twenty-one provisional licences were issued to persons arriving in New Zealand from Great Britain, Australia, and South Africa. Of this number the greater proportion were issued to tradesmen assisted under the immigration scheme. This is the largest number of provisional licences issued in any one year since the Electrical Wiremen's Registration Act came into operation in 1926.

During the current year, 95 names were reinstated on the Registers bringing the total number of reinstatements since the 1947 purging to 283.

The statutory term of office of the four Registration Board members expired on the 31st March, 1950, and on the recommendation of the nominating organizations the sitting members were reappointed for the ensuing term of three years.

PERSONNEL

At the 31st March, 1950, a total of 4,905 employees were engaged on hydro-electric work. Of these 2,530 were directly employed by this Department and the remaining 2,375 were on construction under the immediate control of the Ministry of Works.

The total under the control of the State Hydro-electric Department comprised 1,811 on operation and maintenance and 719 on construction.

From many points of view the past year has been one of great difficulty, and the shortage of staff and the right type of accommodation for them still hamper the great efforts being made to maintain service and to build the new works so urgently required.

In conclusion, I wish to extend my sincere thanks to the members of my own staff and to their associates in the Ministry of Works for their work during the year. They have a full understanding of the many problems which beset us but have not faltered in their efforts, and the progress that has been achieved this year is a measure of their enthusiasm and co-operation. I wish also to accord to the Electric Supply Authorities throughout the Dominion my appreciation for their very real measure of help and understanding.

I have, &c.,

A. E. Davenport, B.E., M.I.E.E.,
General Manager.

APPENDIX B—ANNUAL REPORT OF THE RURAL ELECTRICAL RETICULATION COUNCIL FOR THE YEAR ENDED 31st MARCH, 1950

The CHAIRMAN to the HONOURABLE MINISTER IN CHARGE.

Wellington, 17th April, 1950.

SIR,—

In accordance with the requirements of section 21 of the Electricity Act, 1945, the Rural Electrical Reticulation Council has the honour to submit its fourth annual report for presentation to Parliament.

GENERAL

The new applications for subsidies received during the year substantially added to the number previously dealt with, and included some from several supply authorities who had not previously notified their intention to build lines under the subsidy scheme. Subsidized lines will now be built in the areas of thirty-one supply authorities, and it is encouraging that the benefits of the scheme will be dispersed so widely throughout New Zealand.

To date, subsidies have been approved on 1,336 miles of line which, when completed, will give supply to some 2,372 new consumers. The total annual subsidy provisionally amounts to £36,490, corresponding approximately to the difference between the annual costs to the supply authorities and the annual revenue guaranteed by consumers. The total capital expenditure is estimated to be £713,095. Compared with the average capital expenditure of £60 per consumer incurred by Power Boards prior to the passing of the Electricity Act, 1945, the cost of reticulating the areas included in the applications so far received averages £300 per consumer. The higher cost is, of course, in part due to the rise in costs of materials and labour, but it is also an indication of the sparsely settled and difficult country now being reticulated under the subsidy scheme.

The additional 171 miles completed this year brings the total route-miles of line now operating with the aid of subsidies to 364. This figure allows for corrections made to some returns after the report last year. While the actual amount of new line construction is an improvement on previous years, so far only about a quarter of the total work approved has been completed. This is limiting the scope of the scheme. Subsidies allotted to work which has been unduly delayed could be better allocated to line extensions which would be started immediately. The sooner lines are operating the sooner they will become economically nearer self-supporting, for revenue often increases following the initial provision of supply in the more remote country areas as use of power expands. An increase in revenue correspondingly reduces the amount of the subsidy and the amount so saved becomes available for other line extensions. Consequently there is no doubt that, once a start has been made on new reticulation under the subsidy scheme, it is to the benefit of the scheme for the work to be completed as soon as possible.

The delays in line construction mentioned above can be traced to the limited amount of labour available and to shortages which recur in the supply of line material. New line construction which will return sufficient revenue without the need of subsidies is still being carried out, and naturally this work is taking precedence.

As a year must elapse after the completion of a line before the revenue received is ascertained and the actual amount of the subsidy computed, the small amount of line operated for a full year has resulted in the payment of subsidies being much less than had been anticipated. However, the accumulated surplus in the Rural Reticulation Fund enables the provisional subsidies approved to be in excess of the annual revenue obtained from the present $\frac{1}{4}$-per-cent. levy.

Prior to the commencement of the subsidy scheme it had been customary for many Power Boards to require prospective consumers in the rural areas to guarantee a revenue of 15 per cent. of the capital expenditure incurred. Consequently it has been the Council's policy to limit the return on a subsidized line to 15 per cent., or to such lower percentage required by a Power Board, with the object of ensuring that a rise

in revenue from the consumers would reduce the amount payable by subsidy and so release funds for other necessitous cases. Recently it has been submitted that some Power Boards cannot afford to operate rural line extensions on a return limited to 15 per cent., and that the Council should allow a higher subsidy wherever necessary. In order to be fair to all, the Council is confronted with the difficult task of determining which Power Boards require the extra assistance, and how much it should be in each case selected for preferential treatment. Discussions are now proceeding with the executive of the Supply Authorities' Association in an endeavour to arrive at a solution acceptable to all the Supply Authorities. Naturally, before coming to a decision all Supply Authorities will want to know the amount of the extra levy which would be involved; and this will depend upon the extent to which it is considered the subsidy scheme should be expanded.

APPLICATIONS FOR SUBSIDIES

Eighty-eight applications were received from twenty-three Power Boards, including applications for reconsideration of the provisional subsidies granted last year. Subsidies were approved covering the building of 499·6 miles of line giving supply to 925 new consumers at an estimated capital cost of line construction of £303,396. The subsidies provisionally granted averaged 5·45 per cent. of the estimated capital cost, which is within the 7½ per cent. maximum allowed by the Act. The density of consumers in the districts to be reticulated is about two to every one mile of line. Details of these applications are given in Table I, and the consolidated position for the first four years of the subsidy scheme is given in Table II.

TABLE I.—SUMMARY OF APPLICATIONS APPROVED IN THE YEAR ENDED 31ST MARCH, 1950

Supply Authority.	Number of Applications.	Route-miles of Lines.	Number of Consumers.	Estimated Capital Cost.	Provisional Subsidy, Per Annum.
				£	£
*Banks Peninsula Electric-power Board	2	16·7	14	7,756	573
Bay of Islands Electric-power Board ..	1	5·1	6	2,309	156
*Central Hawke's Bay Electric-power Board	3	48·8	60	59,258	1,874
Dannevirke Electric-power Board ..	2	2·9	4	1,415	50
*Franklin Electric-power Board ..	8	30·1	37	16,333	800
Golden Bay Electric-power Board ..	1	11·2	33	7,153	358
Grey Electric-power Board	1	5·1	6	2,079	109
Horowhenua Electric-power Board ..	1	2·0	7	1,712	47
King Country Electric-power Board ..	2	71·8	98	35,376	2,048
Manawatu-Oroua Electric-power Board	3	17·5	29	12,045	611
*North Auckland Electric-power Board ..	15	52·2	121	24,049	1,729
*North Canterbury Electric-power Board	6	16·3	20	7,178	498
Otago Electric-power Board	1	16·3	14	6,519	277
Rotorua Electric-power Supply ..	1	2·8	4	1,800	112
Southland Electric-power Supply ..	9	15·4	22	8,812	587
Tararua Electric-power Board ..	7	26·0	37	15,016	824
*Tauranga Electric-power Board ..	6	7·7	17	3,918	172
Teviot Electric-power Board	1	1·0	1	280	21
*Waimea Electric-power Board ..	2	87·6	312	76,500	3,044
*Wairarapa Electric-power Board ..	5	33·3	40	28,577	1,854
Wanganui-Rangitikei Electric-power Board	1	11·8	13	6,200	186
*Waitaki Electric-power Board ..	5	5·3	6	2,425	127
*Waitomo Electric-power Board ..	5	12·7	24	6,686	380

* In 1949–50 the following applications were amended: Banks Peninsula, one 1948–49; Central Hawke's Bay, three 1946–47; Franklin, five 1946–47, one 1947–48, two 1948–49; North Auckland, two 1948–49; North Canterbury, two 1946–47; Tauranga, three 1947–48; Waimea, one 1946–47 Wairarapa, one 1948–49; Waitaki, one 1948–49; Waitomo, one 1947–48.

TABLE II.—CONSOLIDATION OF APPLICATIONS APPROVED AS AT 31ST MARCH, 1950

(Combines actual figures for lines built and estimates for lines uncompleted)

Number of Supply Authorities	31
Number of applications	214
Route-miles of line	1,336
Number of consumers	2,372
Capital cost	£713,095
Provisional subsidy per annum	£36,490
Average subsidy (per cent.)	5·1

TABLE III. SUBSIDIZED LINES CONSTRUCTED AND CONSUMERS CONNECTED IN THE YEAR ENDED 31ST MARCH, 1950

Supply Authority.	Number of Applications.	Route-miles of Line.	Number of Consumers Connected.	Actual Capital Cost.
				£
Ashburton Electric-power Board	4	22·18	31	8,988
Dannevirke Electric-power Board	1	1·60	2	967
Franklin Electric-power Board	1	1·25	6	1,013
King Country Electric-power Board	1	51·57	106	22,354
Malvern Electric-power Board	2	1·18	2	562
Manawatu-Oroua Electric-power Board	1	3·61	5	2,875
North Auckland Electric-power Board	5	14·20	27	7,811
North Canterbury Electric-power Board	3	18·59	21	9,009
Springs-Ellesmere Electric-power Board	2	1·10	3	614
Tararua Electric-power Board	9	26·64	37	13,415
Tauranga Electric-power Board	2	5·40	8	2,470
Waitaki Electric-power Board	7	8·00	15	4,001
Waitomo Electric-power Board	4	16·09	39	10,999

Figures in Table III subject to adjustment when final returns are received.

TABLE IV.—CONSOLIDATION OF SUBSIDIZED LINES CONSTRUCTED AS AT 31ST MARCH, 1950

Number of Supply Authorities	18
Number of applications	104
Route-miles of line	364
Number of consumers connected	756
Actual capital cost of lines	£185,753

TABLE V.—SUBSIDIES PAID IN THE YEAR ENDED 31ST MARCH, 1950

	£
Ashburton Electric-power Board	222
Bay of Islands Electric-power Board	447
Central Hawke's Bay Electric-power Board	127
Dannevirke Electric-power Board	393
Franklin Electric-power Board	368
Malvern Electric-power Board	70
North Auckland Electric-power Board	146
North Canterbury Electric-power Board	4
Southland Electric-power Supply	621
Tararua Electric-power Board	90
Wairoa Electric-power Board	73
Waitaki Electric-power Board	83

TABLE VI.—RURAL RETICULATION FUND AS AT 31ST MARCH, 1950

	£	s.	d.	£	s.	d.
Cash balance in Fund as at 1st April, 1949				73,121	6	1
Receipts from annual levy	28,608	19	8			
Interest on investments	1,737	10	0			
				30,346	9	8
				103,467	15	9
Subsidies paid during year	2,644	0	0			
Administration costs and expenses	432	5	10			
				3,076	5	10
Cash balance at 31st March, 1950				100,391	9	11
Sundry creditor—Electric Supply Account: Administration costs and expenses				213	15	2
Net balance in Fund at 31st March, 1950				£100,177	14	9

I have, &c.,

A. E. DAVENPORT, B.E., M.I.E.E.,
Chairman.

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