1946

NEW ZEALAND

STATE HYDRO-ELECTRIC DEPARTMENT

STATEMENT BY THE HON. R. SEMPLE, MINISTER IN CHARGE OF THE STATE HYDRO-ELECTRIC DEPARTMENT

MR. SPEAKER,—

As I indicated in my Public Works Statement of 1945, steps were taken during the year to establish the former Hydro-electric Branch of the Public Works Department as a separate Department of State. The Electricity Act, 1945, passed towards the end of the last session of Parliament, made provision for this, and the State Hydro-electric Department was duly established.

As Minister in Charge, I have the honour of presenting its first annual report.

FUNCTIONS OF DEPARTMENT

The new Department is charged with the administration and control of the State Supply of Electrical Energy Act, 1917; the Electric Power-Boards Act, 1925; the Electrical Wiremen's Registration Act, 1925; the sections of the Public Works Act dealing with water-power and erection of electric lines; and sections of such other Acts as deal with the supply and use of electricity. It will continue to operate and manage the whole of the various hydro-electric undertakings previously completed; it will carry on surveys and investigations of future extensions, so as to be in a position to make recommendations as to future requirements; it will design the various works required for new developments, and will construct and erect such sections of them as transmission-lines, substations, power-house-plant machinery, as was previously carried out by the Hydro-electric Branch. Major civil engineering works, such as dams, tunnels, roading, housing, &c., for which the Public Works Department now has the organization, will continue to be constructed by that Department, in collaboration with the new Department, and to its designs and requirements.

FUTURE SCOPE

The State already has invested in its various electrical undertakings a sum of over £29,000,000, and obtains an annual revenue of over £2,750,000. Statistics indicate that over a period of years the demand for electricity expands at an average rate of at least 10 per cent. per annum. This means, therefore, that the capacity of the present generating plants, which are now seriously overloaded, will have to be doubled within the next seven or eight years, and that we will have to expend as much capital in the next seven years on electrical development as has been expended since the Government commenced its first works at Lake Coleridge in 1911. The State hydro-electric developments have been so successful in the past that they have been able to meet all charges for operation, interest, depreciation, and loan redemption without calling upon the Consolidated Fund, or any fund outside the Electric Supply Account, for assistance.

With the same prudent administration, I feel confident that, even with the rapid increase in capital indicated above, our electric-supply business will continue to be one of the most successful State undertakings.

PERSONNEL

The continual increase in the size and importance of the operating side of the undertaking, together with the large programme ahead, has made it necessary to reorganize and extend the staff of the Department. The Electricity Act, 1945, named and appointed the previous Chief Electrical Engineer of the Public Works Department, Mr. F. T. M. Kissel, B.Sc.(Eng.), A.M.I.C.E., M.I.E.E., as General Manager. As Mr. Kissel is fully qualified in the three branches of engineering—mechanical, civil, and electrical—and, in addition, as Chief Electrical Engineer of the Public Works Department for the past twenty-two years has been in control of all activities of the Hydro-electric Branch of that Department, the Government is fortunate in having him in initiating its new programme. Under Mr. Kissel's general direction, Mr. A. E. Davenport, B.E., A.M.I.E.E., previously Assistant Chief Electrical Engineer, has been appointed Chief Electrical Engineer, and will have charge of all operation and the design and construction of electrical sections. Similarly, Mr. C. W. O. Turner, B.Sc.(Lon.), M.E.(Illinois), M.I.C.E., previously Chief Inspector in the Ministry of Works, will have charge of civil engineering works, and Mr. S. Roberts, A.R.A.N.Z., of accountancy, clerical staff, and administration sections.

Considerable difficulty is being experienced in getting sufficiently educated and trained officers to build up the staff, particularly on the design and investigation side. Professional vacancies are therefore being advertised in Australia and the United Kingdom.

FINANCIAL RESULTS

I stated in my Public Works Statement, 1945, that the annual accounts of the Electric Supply Account would not be in sufficiently complete form to permit of their publication at the time, but that they would be published later and in separate form B.–1 [Pt. 4]. This is being done, and as this year's accounts have not been audited I am showing herewith a brief summary of the results of the operations for the year ended 31st March, 1946:—

North Island Scheme

Capital outlay at end of year, £19,688,037

	£	£
Revenue	1,927,143	
Operating-costs	962,633	
Gross profit	———	964,510
The capital charges are—		
Interest	515,413	
Depreciation	260,731	
Total	———	776,144
Leaving a balance of		£188,366

Income-tax, social security, and national security taxes amount to £279,981, resulting in a net deficiency of £91,615, with the result that we are unable to meet any of the statutory requirement of £272,588 for loan-redemption purposes this year.

Arrears of Loans Redemption Fund now amount to £376,531.

SOUTH ISLAND SCHEME

Capital outlay, £9,810,194.

	£	£
Revenue	964,994	
Operating-costs	317,697	
Gross profit	———	647,297
The capital charges are—		
Interest	333,162	
Depreciation	33,399	
Total	———	366,561
Leaving a balance of		£280,736

The balance has been used to pay income-tax, &c. (£143,693), and loans redemption of £137,043.

Arrears of loans redemption are £176,623, an increase of £1,498 for the year.

The financial position has been adversely affected for the past few years by the heavy payments of taxation and by the extent to which, owing to power-shortages, it has been necessary to operate the comparatively expensive fuel-burning plants, particularly in the North Island. It is hoped that with a return to more normal times we may be able to obtain some relief from each of these difficulties.

NEW WORKS

Throughout the war period, operations in connection with new works and extensions urgently needed to meet ever-increasing demands have been greatly restricted owing to difficulties in materials, man-power, and deliveries of plant from overseas. Every effort has, however, been made to push ahead with the new works at Karapiro and Kaitawa (Waikaremoana) in the North Island, and with Tekapo in the South Island. It is hoped that the first unit at Karapiro will be available before next winter, that two others, each 30,000 kW, will follow at intervals of three to four months, and that the Kaitawa development will also be completed before the end of 1947, and a further unit—21,000 kW.—installed in the existing Arapuni power-house by the end of this year. It is regretted that, owing to staff limitations, it has not been possible to proceed with the construction of a dam which is badly needed in the Cobb scheme to carry over the short periods of low flow which are known to occur in that watershed. It is, however, anticipated that this work will be in hand this year.

On the next big development—the Waikato, at Maraetai—for which generating-plant was ordered last year, work has commenced on roading, buildings, and general preparation of the site. In connection with this job, and others which will follow at adjacent sites on the river, we propose to erect a semi-permanent town at Mangakino, from which workmen can be conveniently transported to work at Maraetai, and at least two further developments. By providing better accommodation and some of the amenities of town life we shall be able to secure and retain a better and more contented class of workman than we would be able to obtain in what otherwise would be an isolated and unattractive area. In this connection, also, I am in negotiation with my colleague the Minister of Lands to secure the co-operation of his Department and the Public Works Department into bringing into production, particularly for milk and vegetables, the adjacent lands at present totally undeveloped, but which, with proper treatment, should be capable of

becoming farms comparable with any of those in the Tokoroa district on the other side of the Waikato River. Other stations will follow Maraetai, and, if fully developed, the Waikato River could ultimately be made to produce over 800,000 kW.

ELECTRICITY SHORTAGE AND CONTROL

In the North Island, as in the previous year, it has been necessary to exercise a considerable amount of restriction and control over electricity-supply in order to keep the demand within the means of supply. In the first part of the year it was hoped that, by fully utilizing the storage available at Lake Taupo and by drawing down the level of Lake Waikaremoana by means of siphons, we should be able to supply a demand about 3 per cent. greater than was the case last year. Unfortunately, that has not been possible, and since the middle of March considerable restrictions have had to be imposed. There has been for some time a definite shortage due to delays in delivery of plant and other causes, all more or less consequent on the war, but the exceptional drought period which was experienced in the centre portion of the Island in the past summer has made the position considerably worse. For the four summer months the rainfall recorded at the various rainfall stations in or adjacent to the Taupo and Waikaremoana watersheds was less than one-third of the rainfall recorded in the similar period averaged over the previous ten years, and less than one-half of the rainfall over the same period in any year of the previous ten. It has been necessary for the General Manager, in his capacity of Electricity Controller, to allocate to each Supply Authority a definite number of units for each week, the number being a specified increase or decrease, based upon the actual consumption in the corresponding week of previous years. As the various Power Boards and other Supply Authorities are in charge of the retail distribution of electricity, it was considered that they had a more detailed knowledge of the needs of the actual consumers and a more detailed knowledge of the ways in which economies could be effected. The responsibility of keeping down to the actual weekly allocation was, subject to a few general provisions, left in their hands. When it is remembered that there are over thirty Supply Authorities in the Island, that they supply over 300,000 consumers, with very varying requirements, or varying degrees of essentiality, and with varying means of control over different supply lines, it is inevitable that there must be some inconvenience and criticism. That there has not been more is, I think, to the credit of the Electricity Controller and the various Supply Authorities who have been required to carry out this most unwelcome, but necessary, duty.

AUXILIARY PLANTS

In my Statement last year I mentioned the fruitless search overseas for fuel-driven plant by the Inspecting Electrical Engineer of the Department. Early in this year there was a possibility of acquiring a 24,000 kW. floating power-station, two of which had been declared surplus by the United States of America upon the cessation of hostilities. A report was obtained, and, after full consideration, the plant was rejected as unsuitable on technical grounds. The plant required extensive overhaul in order to put it in condition to run, while time was also a factor, and it was very doubtful whether it could be reconditioned, towed to New Zealand, and commissioned before Karapiro Station could be brought into operation.

While it can be generally agreed that a measure of fuel-driven plant is desirable to act as a standby and to tide over periods of water shortage, the plant should be suitable for New Zealand conditions, and, above all, must be reliable. It is also desirable that the plant should not be purchased at a time when prices are at a peak, and when other countries, including Great Britain, are in extremely urgent need of similar plant.

RURAL ELECTRICAL RETICULATION

Although electricity has been made available to 96 per cent. of the people of New Zealand, it is the Government's desire that more of the settlers in sparsely populated areas enjoy this service. It was appreciated that the annual cost of keeping some rural lines in operation was beyond the economic limit of many Electric-power Boards. Opportunity was accordingly taken to make provision in the Electricity Act, 1945, for the establishment of a Rural Electrical Reticulation Council. This Council is empowered to levy Supply Authorities up to a maximum of 5s. per cent. of the gross revenues from the sales of electrical energy, and to pay annual subsidies up to a maximum of 7½ per cent. of the capital cost of any approved line built to give supply to a sparsely populated area. The Council consists of three elected members of electrical Supply Authorities, the General Manager, and another officer of this Department.

The inaugural meeting of the Council has just been held, and steps have been taken to collect from Power Boards detailed information upon which to frame a policy for assisting settlers in remote areas.

APPENDIX

Further information relating to the past year's working is included in the attached report by the General Manager.

APPENDIX

ANNUAL REPORT OF THE GENERAL MANAGER FOR THE YEAR ENDED 31ST MARCH, 1946

The GENERAL MANAGER to the Honourable MINISTER IN CHARGE.

Wellington, 26th June, 1946.

SIR,—

I have the honour to present herewith, pursuant to section 15 of the State Supply of Electrical Energy Act, 1917, the annual report of all operations of the State Hydro-electric Department for the year ended 31st March, 1946.

In the interests of paper economy, the report is condensed and various statistical data have been omitted.

ELECTRICITY CONTROL

The provisions of the Electricity Control Order, so far as they concern permits and connections and load control in the North Island, were amended in November, 1945, to ensure that the essential electricity requirements of housing and industry, as well as farming, would be met. Otherwise the restrictions upon the use of electricity referred to in previous reports, are still in force.

During April and May the demand for electricity in the North Island was consistently heavier than in the corresponding months of 1944. By 24th May the system peak load had risen to 306,400 kW., and a cold spell of weather which set in on 28th May increased the demand for power to such an extent that load had to be shed to prevent serious and dangerous overloading of the generating-stations. Throughout June and early July load rationing

had to be applied, but thereafter, with the demand tending to fall and with hydro conditions at the main generation stations improving, less difficulty was experienced in carrying the system peak loads. A material reduction in peak loads was afforded by extending in June the afternoon half-hour shut-down of all broadcasting-stations to one hour from 5 p.m. to 6 p.m. on week-days. All steam standby and auxiliary generating-plants which could be paralleled with the system were in use throughout the winter months.

The consumption of electricity in January and February, 1946, was in excess of the allocations given to all supply authorities. Present indications are that the supply position for the 1946 winter will be much more difficult than was anticipated would be the case a few months ago. Since last November rainfall in the catchment areas at Taupo and Waikaremoana has been abnormally low. For the four months November to February the mean rainfall in the Taupo and Waikaremoana drainage areas was less than one-third of the average over the corresponding months of the past ten years. The lake-levels have steadily fallen, and by the end of March were lower than the lowest levels previously recorded for twenty years. Steps were taken in February to reduce consumption, so that coal and water would be conserved against the winter demand for power, but on 4th March an unseasonable spell of very cold weather and the breakdown of a machine at Arapuni and a boiler at Evans Bay brought matters to a head. Load had to be shed by disconnecting supply to consumers, and strict control has since had to be exercised to keep the consumption of power within our resources. Although the actual plant breakdowns were soon made good no relief to the position is possible until heavy rains replenish supplies of water at the main hydro-generating stations. Nevertheless, compared with the first quarter of 1945, over 3½ per cent. more electrical energy was used by consumers in the first three months of 1946.

RURAL RETICULATION

Under the Electricity Act, 1945, Part II, three members of the Rural Electrical Reticulation Council shall be appointed on the recommendation of the Electric-power Boards and Supply Authorities' Association. On the Association's recommendation the Hon. R. Masters, M. E. Lyons, Esq., and H. V. Murray, Esq., were appointed to the Council in March of this year.

Preliminary investigations have been made into the problem of giving a supply of electricity to settlers in the sparsely occupied areas, and shortly it should be possible to call the first meeting of the Council to determine the procedure for dealing with applications for subsidies in cases where the costs of giving supply would otherwise be unduly high.

NORTH ISLAND ELECTRIC-POWER SYSTEM

1. System Operation and Load Despatch

The maximum half-hourly load on the system was 306,400 kW., as compared with 295,000 kW. last year. The peak occurred between 17.30 and 18.00 hours on Thursday, 24th May. The peak would have been higher in the ensuing weeks but for the severe rationing implemented on Thursday, 31st May, because of coal shortage at King's Wharf generating-station.

The highest Saturday peak was 273,700 kW. between 17.30 and 18.00 hours on 21st July. Last year's Saturday peak was 258,200 kW.

The highest Sunday peak was 239,200 kW. between 11.30 and noon on 6th May, compared with 233,900 kW. last year.

The greatest weekly generation was 34,169,000 units (last year 32,534,000) for the week ending Sunday, 22nd July, 1945, an increase of 5 per cent. The maximum daily output was 5,232,000 units (last year 4,946,000) on

Wednesday, 18th July, 1945; the highest Saturday output was 4,643,000 units (last year 4,400,000) on Saturday, 28th July and the highest Sunday output 4,173,000 (last year 3,946,000) on Sunday, 29th July.

Generation details (compared with 1944–45) are as follows:—

Station.	Year ended 31st March, 1946.			Year ended 31st March, 1945.		
	Maximum Kilowatts.	Units generated.	Annual Load Factor.	Maximum Kilowatts.	Units generated.	Annual Load Factor.
			Per Cent.			Per Cent.
King's Wharf ..	28,899	47,023,796	18·5	29,199	26,817,637	10·5
Arapuni	130,000	897,224,300	78·7	129,800	758,195,400	66·7
Horahora	12,300	94,847,530	88·0	12,300	91,603,380	85·0
Tuai	62,700	192,129,700	34·9	65,500	287,337,945	50·1
Piripaua	44,000	126,295,040	32·7	44,000	180,698,200	46·9
Mangahao	20,900	124,823,000	68·1	20,900	106,820,000	58·3
	..	1,482,343,366	..	..	1,451,472,562	..
Auxiliary and standby stations—						
Penrose		2,775,150			1,939,395	
Wilsons		2,824,200			4,661,256	
Taumarunui		3,473,330			3,774,630	
Tauranga		8,839,844			9,250,155	
New Plymouth		15,674,460			15,712,860	
Opunake		1,648,838			1,653,927	
Palmerston North ..		2,510,965			1,449,723	
Kourarau		2,846,829			3,087,680	
Evans Bay		47,338,100			37,405,030	
Other miscellaneous purchases		5,730,769			2,126,050	
Total units generated and purchased ..		1,576,005,851			1,532,533,268	

2. Operation and Maintenance

(*a*) *Power-stations*

Kings Wharf.—The poor hydraulic conditions resulted in heavy running for this station. A fault developed in the rotor of No. 10 5,000 kW. generator which necessitated rewinding. This was the first time any of the rotors had been touched, and the conditions found suggest that trouble is probable in the future in the other machines. Preparations were made to commission No. 7 generator to pick up some 750 kW. of local service load during power shortage, and this machine is expected to be in service in the winter of 1946. Good progress was made in the rewinding of No. 8 machine, and it is expected that this also will be in service in the winter of 1946.

Coal consumed was 52,624 tons, deliveries amounted to 47,418 tons, and 964 tons were sold under orders from the Mining Controller. Of the coal received, 30,045 tons came from the South Island and 17,373 tons from the North Island. The stock in hand at 31st March, 1946, was 1,940 tons.

The grit nuisance was very severe, and investigations into available types of grit-arresters were made. It was not found possible to determine the volume of material that the arresters would have to deal with nor to accumulate any data on particle size and character, but as a result of studies made it appears that we may soon be able to make an advance in this direction.

Arapuni and Horahora.—The running-times of the Arapuni and Horahora generators, together with particulars of outage and shutdowns, are as follows:—

Generator Number.	Time on Load.		Time Idle.		Time under Repair.	
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).
			Arapuni Power-station			
1	8,418	96·10	337	3·85	2	3 (*a*)
2	8,394	95·83	341	3·89	25 (*b*)	..
3	8,447	96·43	312	3·56	1	..
4	7,706	87·97	309	3·42	44 (*c*)	710 (*d*)
6	6,782	94·83 (*e*)	370	5·17 (*e*)	(In service from 5th June, 1945, only.)	
7	8,431	96·25	294	3·35	35 (*f*)	..
8	8,017	91·52	283	3·23	460 (*g*)	..
			Horahora Power-station			
1	8,155	93·10	591	6·74	14	..
2	8,467	96·66	290	3·31	3	..
3	8,433	96·27	309	3·53	18	..
4	8,469	96·68	289	3·30	2	..
5	8,477	96·77	273	3·12	..	10 (*h*)
6	8,438	96·32	314	3·58	8	..
7	8,586	98·01	96	1·10	67 (*i*)	11 (*j*)
8	8,667	98·94	83	0·95	10	..

NOTES.—(*a*) Shutdown on 11th September, 1945, for 3 hours to remove pieces of presspahn packing which had worked out from under the pole-caps of the rotor and were rubbing against the stator. (*b*) Water in lubricating-oil system, 8th May, 1945. (*c*) The main shutdowns were of 16½ hours on 18th August, 1945, to rectify an oil-leak in a servomotor-cylinder, 9 hours on 28th December, 1945, to overhaul the 6 kVA. generator brush gear, and 14 hours on 6th February, 1946, for governor repairs. (*d*) One of the 11 kV. cable-boxes on the generator-transformer cables failed on 10th September, 1945, causing an outage of 52 hours; and a burn-out of the stator-winding occurred on 4th March, 1946. The generator was still under repair at 31st March, 1946. (*e*) Percentages are for the period 5th June, 1945, when the generator first went into service, to 31st March, 1946. (*f*) The main shutdown was of 22 hours on 27th March, 1946, to attend to loose laminations in the stator. (*g*) Shutdown on 14th January, 1946, for 457 hours to repair faults in the parallel paths of the stator winding and to replace temporary C.T.s in the neutral ends of the parallel paths by permanent C.T.s. (*h*) Shutdown on 6th April, 1945, for 10 hours to renew burned out D.C. leads between slip-rings and field-coils. (*i*) Except for a shutdown of 4 hours on 3rd March, 1946, to replace a defective solenoid relay, all shutdowns were for work on the governor, totalling 7 hours in August, 28 hours in November, and 28 hours in January. (*j*) Shut down on 17th June, 1945, for 11 hours to repair a seized governor-pump bearing. The other times shown under "Not in Demand" were mainly routine maintenance work.

Waikaremoana.—Further maintenance was carried out on the Tuai penstock slip. The concreting of the pipes at the No. 3 anchor block was completed with the placing of the open concrete drain at the top ends of the blocks and the sump into which it drains. The excavation of a bench alongside the pipe-line will be carried out as soon as a mechanical shovel becomes available.

During the month of March this year the starting and the initial testing of the temporary siphons was carried out. Since then the siphons have been used as required by the load-despatcher.

At Onepoto 50·46 in. of rain were recorded, and at Tuai 38·23 in. were registered. The drought conditions that prevailed throughout the latter part of the year reduced the level of Lake Waikaremoana to 2,006·4 ft. at 31st March. Further reductions in levels were recorded in April through continued mild weather conditions and the operation of the temporary siphons.

The usual cleaning and attention has been adhered to, and routine tests carried out. Nos. 1 and 2 units were shut down for major overhauls and repairs. Machines were shut down as required to allow installations and connections to be made on the new control panels.

Electrodes were installed on No. 5 pipe-line and the salt velocity method utilized in efficiency tests on No. 5 machine. Both machines have been out of service for minor repairs, cleaning, and general maintenance. Operation gave complete satisfaction.

Generator-running times were as follows for the year:—

Generator Number.	Time on Load.		Time Idle.		Time under Repair.	
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).
			Tuai			
1	5,394	61·5	2,456	28·0	865	45
2	5,474	62·5	2,293	26·2	991	02
3	7,293	83·5	1,242	14·2	225	..
			Piripaua			
4	4,810	54·9	3,430	39·1	519	01
5	3,917	44·7	3,227	36·8	1,614	01

Mangahao.—Rainfall at No. 1 dam was above average and well distributed over the year. This made maintenance of roads continuous, though there was only one large slip.

Rainfall for year was: No. 1 dam, 198·05 in.; No. 2 dam, 134·77 in.; No. 3 dam, 100·00 in.; Power-house, 50·02 in.

Inspection of part of inside of pipe-lines was made and the surge chamber cleaned out. Painting of outside of pipes was carried out as weather conditions permitted.

Due to lack of suitable new turbine buckets during the year and rapid deterioration of original cast-steel ones, a considerable amount of bucket changing and repairing had to be done. The situation has been relieved only to a very small extent by the recent receipt of a new set of bronze buckets which have been fitted to No. 4 turbine. Many of those released are unfit for further service. The extent to which Mangahao has been used is shown by the yearly load factor of 68 per cent. on a maximum load of 20,900 kW.

The generator-running times were as follows:—

Generator Number.	Time on Load.		Time Idle.		Time under Repair.	
	Hours.	Percentage.	Hours.	Percentage.	Not in Demand (Hours).	In Demand (Hours).
1	8,612	98·3	66	0·8	76	6
2	8,641	98·7	44	0·5	69	5
3	8,664	98·9	36	0·4	54	6
4	8,444	96·4	36	0·4	275	4
5	8,676	99·0	35	0·4	45	4

(*b*) *Transmission and Distribution*

Inspections and patrols were regularly carried out throughout the year and maintenance effected as and when required. Lightning again was the predominant cause of transmission faults, but, as in previous years, the very high standard of reliability of supply was maintained.

Special gangs were employed on the overhaul of lines in the Wairarapa and Taranaki areas. The hardwood poles in the Taranaki area had not been thoroughly examined since erection in 1930–32, and the stringent acceptance tests applied in those days are showing results in the relatively low percentage of replacements now required.

Telephone-lines.—Telephone-line maintenance gangs completed the overhaul of several lines, tests being progressively carried out by the telephone technician. Lightning, gales, fires, and opossums were again the chief causes of interruptions to the communication system.

Test Department.—In addition to routine tests and maintenance throughout the system, extensive tests were carried out on transformer switchgear relays, &c., at Piripaua. Turbine efficiency tests were also completed at this station. The commissioning of the New Central Park substation was effected and supply given to the Wellington City in May, 1945.

3. Construction

(*a*) *Power-stations*

Arapuni.—A new 24.000 kVA. generator was completed and put into service on 5th June, 1945. The erection of the eighth generating-unit is proceeding.

Karapiro.—Substantial progress has been made on the dam. The spillway and intake section have been carried to near completion. The main arch, which was commenced late in 1944, has made rapid progress and approaches completion.

The power-house building is structurally complete; painting and plastering will be done later. Plant erection is in hand. Progress has also been made with the outdoor station and buildings.

Drains are being laid in the valley of the Karapiro Stream to ensure that any seepage that comes through from the lake will not cause erosion.

Satisfactory progress has been made with road deviations, culverts, and bridges rendered necessary by the formation of the lake.

Contracts were let in New Zealand for intake and spillway gates. These require a high standard of workmanship. Every effort is being made to produce satisfactory equipment and have it ready in time for the station to operate in the winter of 1947.

Maraetai.—Progress has been made with access roading, service buildings, and single men's accommodation. A road has also been made along the bottom of the gorge and the country opened up with a view to commencing the diversion tunnel.

Extensive boring has been done to define the bottom of the river-bed, and generally to check the quality and continuity of the rock structure.

Whakamaru.—Investigations were recommenced in October, and further test bores have been drilled, shafts excavated, and contour and geophysical surveys carried out.

Tuai (Waikaremoana Main Development): With the exception of alterations to a number of operating posts in Bay 1, all structures in the outdoor station are now complete. Four 110/50 kV. transformers were transferred from Auckland, reconditioned, dried out, and placed in service. The installation and adjustment of permanent switchgear is progressing steadily.

The Mangaone and two lesser streams were diverted to Whakamarino Lake. Metalling and preparation of roads and footpaths for sealing is continuing; the total area sealed being 2,510 square yards. The road between the Tuai Village and the Frasertown – Lake House Main Highway was improved in alignment by making use of recent excavation and filling in the vicinity.

Piripaua (Waikaremoana Lower Development): The widening and clearing-out of the tailrace commenced early in 1945 below the junction of the by-pass canal, and the tailrace stream was completed during June.

The concreting of the double garage was completed, concrete paving being extended around to the entrance. Doors and windows were installed.

The chlorinating-plant was installed, but some adjustments and minor work are still required.

Sealing of roads is complete except for 1 chain on the village road. The Tuai–Piripaua access road was maintained, and a start was made on the reshaping of the surge-chamber road.

Kaitawa (Waikaremoana Upper Development): A building and float well was constructed for Kaitawa Lake automatic level gauge. Erection of the crane at the power-house was completed and a test load of 30 tons provided for the Inspector of Machinery. Two main transformers were transported, assembled on undercarriages, and placed on pads outside. Further installations are being carried out as materials are provided.

Two 110 kV. P.T. banks ex Waipawa and Dannevirke, were installed for new distant protection, which is now in service. Concrete paths and car drives were laid down at cottages in village.

At the beginning of the year the two tunnels being driven towards the control shaft had penetrated into very wet country, which continued almost to the shaft. No. 1 tunnel was carried through to the shaft and, going beyond towards the lake, it has been enlarged from 8 ft. to 10 ft. diameter so that it will provide enough water for both tunnels and both machines. Better progress has been made and less water encountered in the section from the shaft to the lake than from the valley to the shaft. The second control shaft is under construction and will be completed before the second tunnel is connected through. The position and prospects are now very satisfactory, and it is anticipated that the break through to the lake will be achieved without serious difficulty.

A contract was let for the fabrication and erection of the two penstocks. There has been some delay in starting, but a factory was built, and work of welding the steel pipes is now in progress.

Construction of the power-house is virtually complete, but finishing cannot be done until the generating machinery is erected. Plastering has yet to be done.

Work on the tailrace, including a new flood spillway, has been done, and, in conjunction with this, the canal leading to the intake of the main development is being enlarged.

(*b*) *Substations*

Penrose.—A further seventeen 22 kV. switches were converted during the year, making a total of twenty-one out of twenty-four.

Both of the new 110 kV. P.T.s were put into service during the year, and distance relays were energized from one of them (No. 1 line).

The new control room was fitted with a false ceiling and with fluorescent lighting, and has been partially in use as the changeover of the 22 kV. switchgear has proceeded.

Cable junction boxes were fitted in the structure, and cabling for the 110 kV. O.C.B. control panels commenced.

The old temporary 110/50 kV. transformer bank was dismantled and returned to Tuai.

The communications room was completed ready for installation of equipment and the panels for the Penrose – Mount Roskill supervisory control system were placed in position, but not wired for service.

Henderson.—Roller shutter doors were erected. The casting and fitting of concrete cable trench cover slabs was continued throughout the year as a spare-time job, and practically completed. Floodlight standards were also cast as opportunity occurred. A 30,000 kVA. 110/50 kV. bank intended for Hamilton was diverted to Henderson and prepared for service.

Mareretu.—A second 2,250 kVA. bank, ex Tahekeroa, together with 2,250 kVA. booster and paralleling equipment, was installed. The structure was extended by the addition of a tower, gantry, and delta-bus cantilever to accommodate the bank. Pads were installed for the two spares, and a further pad for transfer purposes. A second main 11 kV. incoming switch was also added to the indoor switchgear. The earthing system was extended without much improvement.

Mount Roskill.—The operating rods and mechanisms for the A.B.S.s, E.S.s, and disconnects, together with the auxiliary switchgear, interlocks, &c., were received and installed, thus completing the outdoor structure. All the control cables were run and the changeover from temporary to permanent control panels completed. The side roller shutter door was erected.

Aongatete.—A temporary 50/11 kV. substation was completed to provide another supply-point for the Tauranga Power Board.

Ohura.—A new 110/11 kV. station was completed to supply the State coal-mine and village at Tatu.

Waiuku and Maraetai.—New 50/11 kV. substations are in the course of erection.

Waihou.—Steady progress was maintained on the erection of this 110/50 kV. station.

Greytown.—Preparatory work for the installation of a 5,000 kVA. transformer bank and 11 kV. switchgear was commenced.

Masterton.—Wooden buttresses were erected to reinforce the workshop. Concrete pads, &c., have been prepared for the installation of a new transformer bank from Hawera.

Mangamaire.—Concrete earthing-pads have been put down at the operating handles of A.B.s 51 and 61. A new switchroom and workshop was completed by contractors.

Woodville.—Extension to the walls and roof of the substation building are in progress and are nearing completion.

Wairoa.—Concrete curbs and walls have been made to divide grassed and metalled areas in the new substation. A concrete pedestal was cast for mounting the earth switch. Installation of switchgear, &c., is proceeding. A boundary fence has been erected.

Bunnythorpe.—Two new 10,000 kVA. transformer banks were put into service with associated T.C.O.L. control panels, replacing 7,500 kVA. banks. New car-type battery installed.

Bunnythorpe (New).—Levels were extended over further land to a grand total of 88½ acres, embracing the area of 38¾ acres finally chosen for the sub-station and its village. The right of entry was secured into the three properties concerned, and tree-cutting, fencing, and fence removal commenced.

Marton.—The contractor commenced erection of the new switchroom. Access road was metalled. Spare transformer unit, ex Stratford, installed.

Wanganui.—New control and relay panel for 100 kV. O.C.B.s erected, also panel for transformer protection. System telephone and alarm installed in single men's quarters. Outside fire-extinguisher box mounted and extinguishers installed. Road drained and resurfaced and concrete kerbing constructed. Some 6 in. tile drains laid. Two new 110 kV. P.T.s installed.

Hawera.—Bushing cupboard made up and tubular heaters installed. New cottage (No. 4) erected. New car-type battery and trickle charger put into service. 7,500 kVA. transformer bank, ex Bunnythorpe, received and placed on pads and connected on 110 kV. side. Concreted cable trench completed. New 110 kV. and 11 kV. busbar structures erected to enable spare transformer to be connected in without shifting.

Stratford.—7,500 kVA. transformer bank, ex Bunnythorpe, received and placed on pads. Poles erected and transformer fuses and A.B.s mounted for alternative local service supply. Cables run and changeover switch installed. New battery put into service. New pad put down for O.C.B. 62.

Mataroa.—Pole-rack constructed. Concrete pad laid under pole-gantry.

Ohakune.—New oil-store built. Storage tank for spare 110 kV. bushings mounted on steel structure.

Khandallah.—20,000 kVA. synchronous condenser and associated switch and control gear received, and installation neared completion. Transfer of control to new control-room completed and Central Park supervisory in service. 110 kV. P.T.s put into service on Central Park line. New relays put into service on all 110 kV. lines. New switchboard for substation local service erected, also new board in oil-house. Bushing cupboards made up and heaters wired. New supports installed for lightning arresters. New house erected in Calcutta Street for operator.

Central Park.—Seven 11 kV. feeders and main busbar livened up for testing on 7th April. Supply taken by Wellington City Council on 28th April, 1945. Second transformer bank not yet in service, but all necessary drying out has been done. T.C.O.L. gear not yet in service pending receipt from manufacturers of replacement parts. Site for operator's two-unit house purchased.

Melling.—Second 20,000 kVA. transformer bank dried out but not yet in service. New battery installed. Spare bushing cupboard constructed and heaters wired. Outside fire-extinguisher box mounted.

Haywards.—Levels were extended over a number of building lots adjacent to the main area to a total of some 40 acres.

Paraparaumu.—Cables run from transformers to T.C.O.L. regulator, replacing overhead connections. New house in course of erection.

Pahautanui.—Spare transformer, ex Stratford, placed on pad and tested ready for service.

Upper Hutt.—Spare transformer, ex Stratford, placed on pad and tested, ready for service.

(*c*) *Transmission-lines*

The 220 kV. line survey was continued throughout the year. One circuit of the Otahuhu–Whakamaru section has been virtually completed, as well as about 60 per cent. of the Whakamaru–Bunnythorpe section.

The survey of the 220 kV. and 110 kV. lines at Otahuhu was completed. A preliminary location of the route for the 110 kV. Henderson–Maungatapere line was also made.

Towers for the rerouting of the Takapuna–Belmont line to its original surveyed position were erected.

New 50 kV. lines were completed from Bombay to Waiuku and from Arapuni to Maraetai, also a new 110 kV. line from Hamilton to Karapiro, but these lines are not yet in service. A 110 kV. line from Hamilton to Waihou and a 50 kV. line from Arapuni to Whakamaru are nearing completion.

The survey of the new Tuai–Bunnythorpe 110 kV. line was continued, and the formation of access tracks, roads, and bridges, scrub clearance, and establishment of line-construction camps was proceeded with. A commencement was made of the construction of the line, but only a small amount of steelwork for the tower formation has been received so far.

The 110 kV. tie-line between Tuai and Kaitawa has been virtually completed, except for the end span at Kaitawa.

SOUTH ISLAND ELECTRIC-POWER SYSTEM

1. System Operation and Load Despatch

The maximum half-hourly demand on the Department's generating-stations was 121,460 kW., as compared with 117,890 kW. last year, an increase of 3 per cent., whilst the combined demand, which includes the Dunedin City Council's plants, increased from 134,680 kW. to 142,734 kW., 5·98 per cent.

The system generation for the whole year was 678,225,892 units, as compared with 634,220,456 units the previous year, an increase of 6·9 per cent.

Details of output of individual stations for the inter-connected South Island system are as follows:—

Station.	Year ended 31st March, 1946.			Year ended 31st March, 1945.		
	Maximum Kilowatts.	Units generated.	Annual Load Factor.	Maximum Kilowatts.	Units generated.	Annual Load Factor.
			Percentage.			Percentage.
Waitaki	68,000	358,588,820	60·2	67,280	327,959,850	55·6
Coleridge	41,800	133,015,560	36·3	42,040	138,733,400	37·7
Highbank	26,000	37,281,630	..	(Commenced 8th June, 1945.)		
Arnold	3,250	23,093,200	81·0	3,200	24,992,900	89·2
Monowai	6,600	24,599,300	42·3	6,600	31,834,250	55·0
Waipori (D.C.C.) ..	..	101,108,211	..	..	109,391,318	..
Auxiliary and standby stations	..	539,171	..	..	1,308,738	..
Totals ..	..	678,225,892	..	..	634,220,456	..

2. Operation and Maintenance

(*a*) *Power-stations*

The generating-plant at all stations gave satisfactory running, there being no major breakdowns.

At Waitaki Station routine maintenance only was required, and at Coleridge Station No. 3 and No. 9 units received a general overhaul.

Ample water-supplies were available during the year. The maximum flows recorded in the Waitaki River were 35,719 cusecs on 6th February, 1946, and on 6th December, 1945, 35,629 cusecs. The minimum average weekly flow was 3,953 cusecs for the week ending 8th July, 1945. The average flow for the year was 15,157 cusecs. The maximum level of Lake Coleridge was 1,673·85 ft., and the minimum 1,667·27 ft., on 2nd August, 1945.

The Monowai Station was in continuous operation throughout the year in parallel with other stations. The Invercargill City steam-plant was run on a few occasions to allow maintenance and repair of the Winton–Invercargill main supply-line to be carried out. Routine maintenance was carried out, and renewing of panels damaged by fire was completed.

The machine-running times, together with details of outages and shutdowns, are as follows:—

——	Running Time.		Idle Time.		Outage Time (under Repair).	Outage Time on Demand.	Percentage Availability for Service.
			Coleridge				
	h. m.	Percentage.	h. m.	Percentage.	h. m.	h. m.	Percentage.
1	6,501 30	74·3	2,141 20	24·4	117 10	..	98·65
2	6,203 00	70·8	1,964 10	22·4	590 50	2 0	93·26
3	4,946 25	56·5	1,919 45	21·9	1,893 50	..	78·4
4	1,916 11	21·9	5,027 19	57·4	1,816 30	..	79·3
5	1,816 30	20·7	6,943 30	79·3	..	..	100·0
6	1,611 55	18·4	7,045 15	80·5	102 50	..	98·83
7	1,674 15	19·1	7,071 35	80·7	14 10	..	99·8
8	2,999 00	34·2	5,524 30	63·1	236 30	..	97·31
9	3,238 35	37·0	3,841 15	43·7	1,680 10	..	80·7
			Waitaki				
1	7,790 45	88·9	774 50	8·9	194 25	..	97·8
2	7,700 07	87·9	991 13	11·3	64 40	..	99·26
3	6,217 08	71·0	2,365 27	27·0	177 25	..	97·98
4	5,842 07	66·7	2,739 43	31·3	178 10	..	97·97
			Arnold				
1	7,978 25	91·1	..	..	781 35	..	91·08
2	8,758 05	99·9	..	..	1 55	..	99·98
			Dobson				
1	107 09	1·2	8,652 51	98·8	..	..	100·0
2	117 48	1·3	8,642 12	98·7	..	..	100·0
3	114 55	1·3	8,645 05	98·7	..	..	100·0
4	17 39	0·2	2,375 52	27·1	6,366 29	..	27·3
			*Highbank**				
Main	2,559 04	35·9	4,568 56	64·1	..	..	100·0

* From 8th June, 1945, only.

(*b*) *Transmission and Distribution*

The most severe weather conditions ever recorded in the north Canterbury and Coleridge districts were experienced during the year. Sixteen inches of snow fell at Coleridge on 14th July, and lay for seven weeks in sheltered places near Coleridge village.

On 8th August heavy snow did considerable damage to the Coleridge–Hororata transmission-lines, Coleridge Station being isolated from the system for 9 hours 16 minutes.

On 31st August and 1st September a violent north-west gale swept across Canterbury, doing further damage to transmission and telephone lines.

On each of these occasions supply to consumers was seriously interrupted, the worst conditions being experienced during the July outage, when South Canterbury Power Board was without supply for 10 hours 5 minutes. Ashburton Power Board for 21 hours 13 minutes, Waitaki Power Board for 18 minutes, North Canterbury Power Board for 36 hours., and Banks Peninsula Power Board for 35 hours.

There was also a number of short interruptions to the West Coast supply due to the opening of the O.C.B.s at Coleridge during the storm. Supply to the West Coast in general was satisfactory throughout the year, there being no failures on the transmission-lines between Coleridge and that area.

Routine inspections, insulator testing, and general maintenance was performed.

Retail Supply (Southland).—During the year 56 miles of additional distribution-lines were erected to afford supply of electricity to 370 new consumers. The year's increase in connected load amounted to 3,965 kW.

Total units sold totalled 41,791,294, as compared with 37,142,587 for the previous year, an increase of 12½ per cent. Sales to coal-mines increased by 42 per cent., from 1,412,816 units to 2,018,838 units, and sales for domestic purposes increased by 13 per cent. to 10,413,713 units. The demand from lime-works, however, was less than last year.

3. Construction

(*a*) *Power-stations*

Highbank Station was brought into operation on 8th June, 1945, and ran in parallel with the system until 28th November, when it was shut down for the summer. It took up load again on 28th March, 1946.

Tekapo.—Progress on this work has been disappointingly slow, especially in the tunnel. Apart from certain mechanical troubles this has been largely due to a test drive put in about six years ago. The timbers have failed and the shingle fallen in. No satisfactory progress can be expected until the end of the drive is reached. A second shield is nearly ready at the lake end of the tunnel, and it is hoped better progress will be made from there.

Little progress, other than the tunnel, has been made on permanent works, but a start has been made towards installing the intake structure, which will be floated out and sunk in the lake.

(*b*) *Substations*

An additional 7,500 kVA. bank of transformers was installed at Timaru Substation, and a 10,000 kVA. 66/33 kV. bank was installed at Addington. A start was made on the 4,500 kVA. auto reclose substation at Milton which will provide a second supply point for the Otago Electric-power Board. The South Canterbury Power Board commenced taking supply from Temuka Substation on 7th October, 1945.

(*c*) *Transmission-lines*

The survey of the line connecting the Cobb River system with the West Coast has been continued during the year.

Work was done on the Gore–Invercargill line consequent upon the decision to raise the working voltage from 66 kV. to 110 kV.

NELSON–MARLBOROUGH SECTION

1. System Operation and Load Despatch

Load.—The maximum load on the system was 7,180 kW., an increase of 33 per cent. compared with last year's peak of 5,400 kW. The peak load on the Cobb generators was 6,980 kW. on 10th July, 1945. Of the 34,288,308 units generated, 33,464,800 were from the Cobb Power-house, the balance being divided among six auxiliary stations. 5·2 per cent. of the units generated were "lost," and the system annual load factor was 54·5 per cent.

Reliability of Supply.—There were eight faults on the Department's system which caused interruptions of supply to consumers during the year. Of these, three were confined to the 11 kV. line supplying power to the asbestos works and to the Works Department at the dam.

The following table gives an analysis of both the accidental and pre-arranged shut-downs:—

Faults on Department's System

Description.	Y.E., 31/3/45 Number.	Y.E., 31/3/46. Number.	Duration.	Distributing Authorities affected.
			h. m.	
1. 66 kV. lines: Defects	..	..	..	..
2. 66 kV. lines: External causes	3	1	0 19 5 8	2 2
3. 11 kV. lines: Defects	..	..	..	..
4. 11 kV. lines: External causes	..	..	..	..
5. Lightning	4	1	0 2	2
6. Storms: Nature of trouble not discovered	..	..	..	..
7. 6·6 kV. apparatus	..	..	..	..
8. 11 kV. or 33 kV. apparatus	..	..	..	..
9. 66 kV. apparatus	..	1	0 12	1
10. Generators	2	..	..	..
11. Relays	..	..	..	..
12. Control circuits and batteries	..	..	..	..
13. Operation: Mistakes	1	..	..	..
14. Operation: Accidents	..	1	0 0½	1
15. Faults and overloads on consumers system	2	1	0 44	1
16. Other causes	..	3	7 45	10
17. Cause unknown	..	..	..	..
Totals	12	8	14 1½	19

2. Maintenance and Operation

(*a*) *Power-stations*

Cobb.—The normal operation of the station was interrupted on 14th July, when heavy rain, following a long period of frosty weather, caused a sudden fresh which partially blocked the intake screens with weeds and debris. The loss of head due to reduced flow made it necessary to shut down the machines, causing a total interruption to the supply of power. All auxiliary stations were operating within one and a half hours, but a partial restoration of power to the Marlborough and Waimea Electric-power Boards was made within twenty minutes. The Cobb machines were back on the lines after three hours ten minutes. The increased flow in the tunnel due to the restricted intake caused a scour which brought some debris down the pipe-line to the nozzles. Most of the small pieces of wood and stones passed through, doing only slight damage to the turbine buckets. Some larger pieces of rock lodged in the nozzle of No. 1 machine and necessitated the withdrawal of the spear for their removal.

Owing to low river flows it was necessary to run auxiliary stations in June last year and in January, February, and March of this year. The rainfall for the year was probably much less than average, a total of only 67·79 in. being recorded at the power-house, and of this, 16·78 in. fell in August.

Throughout the year the generators, turbines, and all other equipment have operated very satisfactorily, and very few adjustments have been required. In co-operation with the manufacturers' agents, governor-oil pressures were adjusted. The solenoid and valve controlling No. 2 machine governor received attention, and some corrective measures were taken to check the tendency of the governor-pump belts to run to one side. The remainder of the plant required only normal maintenance.

(*b*) *Substations*

Stoke.—Apart from the running required for generation purposes regular trial runs of the Diesel machines were made. A partial overhaul of No. 1 machine was made and a list was prepared of all spares required to put both machines in good order. An indent order based on this information has now been placed.

A broken lift rod in an O.C.B. at Stoke caused a twelve-minute interruption to the Marlborough Electric-power Board in March.

No major troubles occurred at any of the substations, and the normal routine was all that was necessary for their operation and maintenance.

(*c*) *Transmission and other Lines*

66 kV. Lines.—An interruption of supply to all Power Boards and to the Golden Bay Cement Works occurred on 2nd March when a phase of the 66 kV. line fell to earth due to a cross-arm on pole 22 at Upper Takaka burning through. A spark from a scrub fire had apparently lodged on the cross-arm. All relays operated correctly and the conductor was undamaged. No other faults occurred on this line, but during various prearranged shut-downs arcing horns were fitted at the substations and general maintenance work carried out.

11 kV. Lines.—On 27th January, a severe wind on top of the Cobb Ridge caused phases of the power-house–dam line to contact owing to a loose binder tearing away. In February this line was checked for further signs of trouble and several renewals were made. The renewals were twelve insulators with loose pins. The porcelains are in good order, but the steel pins were loose in the lead heads.

Telephone-lines.—A good deal of trouble was experienced during the year, a large number of faults, due to varying causes, being reported. These were gradually eliminated, and the service at the latter end of the year was improved. A certain amount of trouble due to plantation and scrub fires occurred during the dry summer.

(*d*) *Testing*

During the year routine tests of protective relays have been carried out. Revenue-metering equipment has been tested and installed for various departmental consumers. New equipment has been tested and checked before being placed in service. Faults have been located and repairs carried out where necessary. The installation and wiring of the test benches and equipment in the Nelson test-room has been completed.

3. Construction

(*a*) *Power-stations*

Cobb.—Two additional voltage regulators were installed. Each generator now has its own regulator. A new 6·6/11 kV. 500 kVA. transformer was put into service, replacing the temporary 200 kVA. transformer which had been supplying the dam and the asbestos works. In August a 11/·4 kV. 15 kVA. transformer was connected in to supply the cookhouse and huts at No. 2 camp, where several casual day-workers were accommodated. A battery-charger and panel were erected in the power-house and put into operation in June.

Lightning-arresters were installed at the 66 kV. terminal, and also at the three terminals of the 11 kV. powerhouse–dam–asbestos works line.

To prevent ice-formation at the penstock intake, screen-heating was installed and operated during the winter on thermostatic control.

A Telemark water-level transmitting-indicator was also installed and went into service in April.

A shed was built to house the oil-filtering equipment, which installation is now complete. A post-drilling machine and a small air-compressor were also installed in the power-house.

A rock wall was built along the river-bank to protect road access to the garages, and a parapet and guard-rail were placed on top of the river wall in front of the power-house.

A two-stall departmental garage and a multi-stall staff garage in reinforced concrete were completed and a four-roomed annex with bathroom has been built to supplement the hostel accommodation. An army hut has been erected to serve as a first-aid room.

Concrete paths have been laid at all cottages in the village, and preparations are being made for the necessary fencing.

(*b*) *Substations*

Stoke.—Two 3,000-gallon Diesel fuel-tanks were installed, a new 2,400 gallon water-cooling system connected, and transformer oil-pipes laid.

Blenheim.—The two additional cottages were completed and occupied by September. In October a local service 33/4 kV. transformer was connected in and the 400-volt services changed over. 66 kV. lightning arresters were mounted and connected in.

Motupipi.—In February an 11 kV. voltage regulator was installed to regulate the supply to the Golden Bay Cement Works, but as control equipment was not immediately available this regulator was not put into automatic operation for several months.

Motueka.—The new permanent 11 kV. switchgear was erected and went into service on 22nd March.

Tarakohe.—In May a three-phase 300 kVA. 11/4 kV. transformer was installed temporarily pending the delivery of the permanent 750 kVA. transformer, the installation of which was completed in August, and it was put into service, with new metering-equipment, in September, in parallel with the 1200 kVA. bank.

(*c*) *Transmission-lines*

Stoke–Blackwater Transmission-line.—Work on the survey of this line has continued throughout the year.

DESIGN AND PROJECT PLANNING

(*a*) Civil and Hydraulic Section

Karapiro.—Apart from miscellaneous design details, the principal work has been the preparation of specifications and the supervision and checking of contracts, particularly for the scroll cases, headgates, spillway gates, together with their operating equipment. A close liaison with the Public Works Department's construction Engineer and the Resident Engineer on the works has been maintained.

Maraetai.—An arch dam has been designed for this station, and excavations being made are to be examined before the proposal is committed.

A river-diversion procedure has been worked out and the tunnel and accessories, except for details, have been designed.

Work is in hand on all the principal works, including headgates, penstocks, flood spillway, and spillway gates.

This Department has collaborated with the Public Works Department on the methods to be used in carrying out the works and the provision of plant and its layout.

Whakamaru.—Studies have been made of the very complex structure of this site, and further surveys and geophysical tests have been made and are being made to determine all the old river channels and generally define the outlines of the rocks on which the dam and other structures must be founded.

Waikaremoana.—The closest possible liaison has been kept with the field, especially in regard to the tunnel into the lake. Important decisions have been reached on the manner of breaking through to the lake, location of the intake, and its general form. Details of the intake are well in hand, but cannot be completed until work on the job is more advanced and the exact conditions are known.

The penstock has been fully designed and a contract let for its construction.

In connection with the tailrace of the upper development, the intake race for the main development is being enlarged and a new spillway of greater capacity is being provided to deal with flood-waters. A contract for automatic gates has been let in this connection.

In order to concentrate on more important schemes, it has been decided not to proceed with minor schemes below Piripaua in the meantime.

To meet the acute situation that has arisen in regard to the supply of power, a decision was reached to install siphons to obtain more water from the lake for use in the two existing stations. Three siphons, each feeding a 4-ft.-diameter pipe were installed, and they have been very successful. The lake is very low, and there is a limit below which the siphons cannot operate. Their installation was only justified on the understanding that the Kaitawa and Karapiro Stations would be operating for the winter of 1947.

Cobb River.—Because of lack of staff and insufficient knowledge of the rocks underlying the proposed dam-site, no substantial progress has been made with this scheme. In view, however, of the probability that an earth dam will be built, an intensive study of the flooding possibilities of the river has been made, and tests have also been made on local materials with a view to their use in an earth dam.

Tekapo.—Design of the intake structure is complete, and gates, surge-chamber, penstock, and tailrace are in hand.

Pukaki.—A proposal to control water from Lake Pukaki has been initiated with a view to augmenting the output of the Waitaki Station. A study of the catchment is being made so that adequate provision is made for floods, and steps are being taken to ensure that inordinate flooding does not occur. These studies also cover Lake Ohau, which will probably be controlled in the near future.

Black Jack's Point.—The survey and examination of this site on the Waitaki River is complete, and it has also been thoroughly examined by a geologist. A scheme for development has been outlined.

Clutha River above Roxburgh.—This site has reached the same stage as Black Jack's Point, and the Public Works Department has been asked to carry out drives, shaft-sinking, and boring at both sites to prove the foundations prior to a report and recommendation being submitted.

Clarence River.—Comparatively little has been done on this survey on account of staff difficulties and inaccessibility. An examination has been made of the dam-site, and a geological report has been obtained of the whole area. Contouring of rough and inaccessible country is being done by the Lands and Survey Department from aerial photographs.

It is now recognized that the Clarence scheme cannot compare with Black Jack's Point or the Clutha schemes, primarily because of its inaccessibility and the time required to get construction started, but probably also because of cost. The survey promises a very substantial development, and it is proposed to complete the investigation far enough for a scheme to be outlined and filed for future use.

Minor Schemes.—A number of these have been looked into, including a number of suggestions for the production of power. Some inspections have been made, notably the Four-mile Creek near Charleston, and Lake Omapere.

Hydrology.—In addition to run off studies in the Cobb and Southern Lake catchments, records have been kept up to date of a number of principal and typical streams throughout the country. The oldest of these, at Taupo and Rotoiti, have now been kept continuously for forty years.

(*b*) Structural Section

The major portion of design work and preparation of full working drawings for the Karapiro and Kaitawa Power-station machinery foundations were completed. This included the planning of all services required.

Further plans were finalized for Kaitawa Power-station to permit installation of all outdoor switchgear and transformers. Heavy concrete retaining-walls and floor slabs for the tailrace lining were designed.

A steel-frame store was designed for Tokoroa to provide storage for generator and turbine parts now arriving from overseas for schemes on the Waikato River.

Preliminary work for other power schemes and distribution centres included machinery layouts and architectural planning of Maraetai and Cobb River Power-houses, workshops, control, and administrative blocks.

The initial designs for workshops, control rooms, switchrooms, and offices for the 220 kV. substations at Otahuhu and Bunnythorpe involved extensive investigations into the load-bearing properties of the ground.

Milton and Temuka substation buildings and small service buildings at Piripaua power-station were designed, and planning commenced on the permanent village at Maraetai allowing for an initial thirty houses, hostel, and recreational facilities.

Designs were prepared for traverser tracks, turntables, and water rheostats for various locations, and manufacturers' designs of cranes were checked as required.

(*c*) Electrical Section

Design work for Karapiro Power-station was completed and drawings supplied to the erection staff. Specifications were drafted for Maraetai control and protective equipment, 400-volt switchgear, and carbon-dioxide fire-quenching equipment, and also for King's Wharf transformers, 22 kV. and 66 kV. switchgear, and control equipment. Investigations were made into Maraetai 220 kV. switchgear. Consideration was given to control arrangements for Whakamaru, and future 220 kV. switching-stations and to Cobb River 66 kV. switchgear. Design work was commenced on Tekapo lighting and power installations. Cable quantities were worked out for No. 5 unit at Waitaki. Equipment for transformer-oil acidity tests was designed and ordered, whilst locally-made transformers were inspected during manufacture. Other work included short-circuit and inductive interference calculations and scheduling cable requirements for the annual bulk order.

Substation design work included Standard 110 kV., 66 kV., and 50 kV. switchgear structures, which have already had considerable application, 110 kV. wood-pole switchgear structure to enable erection at Milton to proceed and the new remote control-room panels for Khandallah 11 kV. switchgear were designed. Drawings for new Otahuhu 220 kV./110 kV. substation were advanced as far as possible pending decision regarding site. Layout drawings for the new Bunnythorpe 220 kV./110 kV. substation site were prepared to enable taking of land, levelling, and provision of rail access to proceed. Specification drawings were made for new 10 MVA. transformer banks, 11 kV. 250 MVA. switchgear, and control panels for Ashburton and Oamaru. Drawings for extension to Halfway Bush involved a new 20 MVA. 110 kV./33 kV. transformer bank, new 33 kV. structure, and a two-bay extension to the 110 kV. structure. In connection with the possible link-up of the South Island system and duplication of the Cobb–Stoke 66 kV. transmission line, preliminary investigations were made for extension to Stoke, Motueka, Upper Takaka, Motupipi, and Blackwater substations. The proposed new Gore–Invercargill 110 kV. transmission-line necessitated designs for extensions involving two-bay structures for Gore and Edendale and a three-bay structure with two new 10 MVA. 110 kV./11 kV. T.C.O.L. transformer banks for Invercargill.

Drawings were prepared for communication trunk line and cable entries at Penrose, Bombay, Hamilton, Karapiro, Ongarue, Hawera, and Khandallah. Transposition designs were prepared for the new telephone circuits being erected between Hamilton and Karapiro with ultimate extension to Arapuni and Maraetai, for the complete reconstructed Khandallah–Bunnythorpe line, and for the Bunnythorpe–Stratford line, on which reconstruction is in progress. A survey of the South Island system was made to increase the efficiency of trunk lines. New telephone-exchanges were designed for Penrose, Hamilton, Arapuni, Karapiro, Tuai, Bunnythorpe, Mangahao, and Khandallah, the last-named being in operation. Preliminary plans were made for installation of carrier equipment at Khandallah, Bunnythorpe, Hamilton, Penrose, and repeater equipment at Ongarue. Specifications were drafted for a twenty-line cordless switchboard for use at power-stations and major substations. A.C. and voice-frequency impulsing was investigated for Penrose supervisory control, and the establishment of standard equipment was advanced with the design of component units and parts.

(*d*) Transmission-lines

The specification for steel towers for the 220 kV. lines was prepared and tenders called for the manufacture and supply of the towers.

Conductor and earth-wire tensions for the 220 kV. lines were investigated and stringing charts prepared for both normal conditions and parts of the line where snow is encountered. Strength charts were prepared for the towers, and also charts for controlling the swing of suspension insulators.

An examination was made of the designs submitted with tenders for the 220 kV. steel towers, and an order for the towers has been placed for their manufacture in New Zealand.

For the Tuai–Bunnythorpe 110 kV. line an investigation was made of a clearance strip required through a State forest reserve.

Structure drawings and stringing charts for the conductors for the Gore–Invercargill 110 kV. line were supplied to the field for survey and other purposes.

Stringing data for the conductors on the Nelson – West Coast line was investigated and charts supplied for use in the field.

REGULATIONS, LINES INSPECTION, ETC.

Part III of the Electricity Act passed in December made certain amendments to the Public Works Act, 1928. These amendments included power to make regulations; to define what may be deemed to be a dangerous electric line or work; to authorize and control the inspection and testing of electrical materials, appliances, apparatus, and accessories; to prohibit the manufacture and sale of appliances, apparatus, and accessories which do not satisfy certain tests or which may be dangerous to life or property. The definition of the term "electric line or work" was extended to provide for present and future uses of electricity. Power was also given to prohibit any person from bringing anything within specified distances of an electric line.

Six licenses were issued to erect electric lines, and two licenses issued to use water-power for the purpose of generating electricity.

Three lines licenses and one water-power license were revoked.

Three permits to use water-power for the purpose of generating electricity were issued.

The Otago Central Electric-power Board took over the electric lines and plant of the Queenstown Borough Council during the year. Upon the merger of the Sumner Borough with Christchurch City the electric lines at Sumner became the property of Christchurch. This city's sphere of control was further extended by the acquisition of the electric lines in the Waimairi County. Another amalgamation was the sale of the Reefton reticulation by the Reefton Electric-power and Light Co., Ltd., to the Grey Electric-power Board.

Seventy-nine permits to carry out electrical wiring in connection with private generating-plants were issued.

The regulations require that electrical supply authorities shall, in the interests of safety, inspect every consumer's installation at five-yearly intervals in congested areas and eight-yearly intervals outside such areas. From various causes these inspections have fallen very much in arrears, although in a few cases the supply authority is up to date. It is anticipated, now more material is available and the man-power position is becoming less acute, that this important work will proceed in accordance with the regulations.

After a lapse of nearly four years due to war conditions the inspection of the electric lines and works of electrical supply authorities recommenced, and the lines and works of twelve supply authorities were inspected.

Forty-five of the electrical supply authorities gave notice of their intention to extend their electric lines.

There were 10,513 broken wires reported by the electrical supply authorities and 444 broken poles.

The principal causes of the broken wires were—snow, 5,528 (52 per cent.); trees, 2,059 (19 per cent.); contact, 993 (9 per cent.); gale, 944 (9 per cent.).

The fires reported by the electrical supply authorities as being of electrical origin are as follows:—

Appliances (refrigerator motor seized)	1
Contact between aerial conductors (radio aerial fell on service-line)	1
Contact between steel conduit and composition gas pipes	3
Defective fuse contact	1
Improper use of appliances (irons left switched on)	2
Lightning	1
Switchboard wiring	8
	17

There were reported thirty-three accidents to human beings due to electrical causes and six to stock. Six of the accidents to human beings were fatal and all of those to stock.

Details of the accidents to human beings are—

Children (under eight years)	1	
Commercial users	2	
Domestic users	1	
Electrical employees (other than linesmen)	6	(1 fatal)
Electrical linesmen	10	(2 fatal)
General public (not otherwise classified)	7	
Industrial users	1	(fatal)
Tradesmen (not otherwise classified)	5	(2 fatal)
	33	

REGISTRATION OF ELECTRICAL WIREMEN

Examinations were held for electrical wiremen, electrical servicemen, radio servicemen, radio transmitters, and cinematograph operators.

Special examinations were again held overseas in Italy, Middle East, and in the Pacific Areas for members of the Armed Forces, while special examinations were also held in New Zealand for returned servicemen.

The September examination for electrical wiremen was noteworthy for an outstanding achievement by an Electrical Supply Authority apprentice from Masterton, who secured the highest marks for New Zealand in both the written and the practical parts of the examination.

A record number of candidates sat the regular wiremen's and servicemen's examinations in New Zealand during the year; 1,080 candidates sitting the September, 1945, examinations, and 1,168 candidates the March, 1946, examinations; a grand total of 2,248 candidates. Of this number, 934 candidates sat the wiremen's examinations—*i.e.*, 538 written part and 396 practical part.

Assessment of credit for rehabilitation trade training purposes continues to occupy the time of the Registration Board to a large extent. To date, credit has been assessed for full registration purposes in 154 cases, and for limited registration purposes in 103 cases. Of these numbers, it is estimated that in 55 cases trade training agreements have already been entered into for full registration and 5 for limited registration training.

During the year quite a number of English, Australian, and American personnel, demobilized in New Zealand, have applied for recognition of previous electrical experience, both civilian and Armed Forces, with the object of continuing the trade in this country.

APPRECIATION

I would also thank all members of the Department for their loyal co-operation and assistance and to place on record my appreciation of their services during a particularly trying period.

I have, &c.,
F. T. M. KISSEL, B.Sc., M.I.E.E., A.M.I.C.E.,
General Manager.

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