REPORT

OF

STATE ELECTRICITY COMMISSION

OF VICTORIA

ON

EXTENSIONS TO

YALLOURN POWER STATION

1949

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REPORT

ON

EXTENSIONS TO YALLOURN POWER STATION

The Hon. W. S. Kent Hughes, M.L.A.,

Minister in charge of Electrical Undertakings,

13-45 Spencer Street,

MELBOURNE, C.1.

Sir,

1. In this report the Commission presents for approval as an undertaking, within the meaning of the State Electricity Commission Act 1928, a proposed further extension of the Yallourn Power Station, comprising two 50,000 kW turbo-generators and associated boiler plant to be installed by 1956.

2. The report also reviews the growth of the Yallourn Station and indicates how its electrical output is integrated with the outputs from metropolitan steam stations and the hydro stations to form a balanced generating system designed to give a high degree of reliability at minimum cost.

GROWTH OF THE YALLOURN STATION:

3. Establishment of a power station adjacent to the brown coal deposits at Yallourn rested on the recommendation of an advisory committee under the Chairmanship of Dr. H. Herman, which was set up by the Government in June, 1917. This committee concluded that electrical energy derived from brown coal could be made available in Melbourne at a lower cost than by using any other fuel and it proposed that the power station at Yallourn be designed for an initial load of 50,000 kW and an ultimate load of 100,000 kW.

4. One of the first tasks of the newly appointed Electricity Commissioners was to translate the proposals of the advisory committee into a definite scheme, and their recommendations, based on a report of the then Chief Engineer, Mr. H. R. Harper, were accepted by the Government. The first section of the Yallourn "A" Station, comprising four 12,500 kW Metropolitan Vickers turbo-generators, was in operation by 1924, and by the addition of two similar machines during the next four years the installed capacity of the "A" Station was brought to 75,000 kW by 1928.

5. The Commission in a report to the Government in April, 1928, reviewed the future growth of power requirements in Victoria and, after considering alternative sources of supply, recommended a further extension of the Yallourn Station by 75,000 kW. Eventually it was decided to instal four 25,000 kW Metropolitan Vickers turbo-generators and this increment of 100,000 kW known as the Yallourn "B" Station was undertaken in stages and was completed by 1938.

6. The installed capacity of the Yallourn Station has remained at the 1938 figure of 175,000 kW, but soon after the war ended steps were taken to replace the machines in the "A" Station which now are approaching the end of a normal length of life. Orders for two 50,000 kW Parsons turbo-generators were placed in 1947, and it is expected that these machines,

together with a 6,000 kW back pressure set, which will comprise the Yallourn "C" Station, will be installed by 1953 and 1954 respectively. Owing to the rapid increase in load on the Commission's system, however, it will not now be possible to put out of service the "A" machines for some years, and there will be available in the "A," "B," and "C" Stations combined a total installed capacity of 281,000 kW of which the 75,000 kW in the "A" Station will be held for a few years as an emergency reserve and principally for meeting peak loads. Ultimately the machines in the "A" Station will be replaced by modern plant.

7. The proposal now submitted in this report, and to which Ministerial approval in principle already has been given, provides for the installation of a further two 50,000 kW turbo-generators by 1955 and 1956 respectively, to form Yallourn "D," bringing the total installed capacity of the Station to 331,000 kW in 1956 (after allowing for the retirement in 1956 of 50,000 kW of plant in the "A" Station), of which 300,000 kW will be suitable for operation as base load plant.

DEVELOPMENT OF A BALANCED GENERATING SYSTEM:

8. The successive extensions to the Yallourn Station have been planned to operate in conjunction with appropriate increases in the installed capacity of other parts of the interconnected State generating system; thus, in addition to the plant at Yallourn, there has been added since 1924 other generating plant in the metropolitan area (principally at Newport based chiefly on the use of high grade solid fuel), and at Sugarloaf/Rubicon and Kiewa based on the use of water power. Further additions to the plants at Newport and Kiewa are now in course as provided for in the Commission's reports to the Government of June, 1937, and November, 1947.

9. As well as these long-range plans the Commission has taken special measures to meet the unexpectedly rapid increase in demand for electricity since the war. These measures provide for the installation by 1952 of a 38,000 kW Brown Boveri turbo-generator set and oil burning Velox boilers at the Richmond Power Station, and a 30,000 kW Parsons turbo-generator set and La Mont oil or pulverised fuel burning boilers at the Spencer Street Power Station of the Melbourne City Council, together with 20,000 kW of diesel generating plant at metropolitan and country centres.

10. When all the new generating plant as now planned is completed by 1956, the installed capacity of the State system after allowing for retirement of over-age machines at Yallourn and elsewhere will be as follows:—

Base Load Stations:	
Yallourn Power Station and the briquette factories at Yallourn and Morwell	348,000 kW
Intermediate Load Stations:	
Hydro stations at Kiewa, Sugarloaf/ Rubicon and Hume	340,000 „
Peak Load Stations:	
Metropolitan and country stations, including Newport, Spencer Street, Richmond, Ballarat, Geelong, Shepparton and Warrnambool; and part of Yallourn	402,500 „
Total	1,090,500 kW

11. With the completion of this programme the three types of stations — base load, intermediate load and peak load — will be more appropriately balanced than at present in relation to the distribution of the load throughout the day. A detailed explanation of the functions of the various types of stations is given in the report of the Deputy Chief Engineer, Mr. C. H. Kernot, attached hereto as Appendix "A." This explanation is based on system load characteristics as experienced in recent years, but present trends indicate a gradually increasing proportion of base load. This trend serves to emphasise the need for additional generating capacity of the Yallourn type as proposed in this report.

THE YALLOURN "D" STATION:

12. The report of the Deputy Chief Engineer recommends the installation of two 50,000 kW turbo-generators and associated boiler plant at Yallourn by 1956. This advice has been adopted by the Commission and, with the approval of the Government, negotiations are proceeding for purchase of the major units of plant required.

13. The general design of the plant, which will be accommodated in an extension of the present buildings to the south, will be similar in all important respects to that now being installed in the "C" Station. The boiler plant will be of similar size – six 200,000 lb./hr. boilers operating at 600 p.s.i. pressure and 825° F. steam temperature – and will be mill-fired.

14. The "C" and "D" Stations will incorporate several major improvements in design as compared with the older "A" and "B" Stations,, including a higher steam pressure and temperature and provision for forced recooling of the circulating water; also the boilers will be mill-fired and the ash from all stations will be disposed of in the open cut.

15. For most of the year the natural flow of the Latrobe River will be ample to ensure the full output from the enlarged Station, but in the summer months it has been found necessary for these extensions to provide for artificial cooling by passing the heated water from the steam condensers through cooling towers where its temperature will be lowered by a cross draught of air under forced circulation.

16. The adoption of mill-firing of raw brown coal in the boiler plant instead of the older system of travelling and step grates follows modern German practice and will give higher efficiencies and improve operating conditions. Special care has been taken in the design to avoid dust emission from the stacks and the latest system of gas cleaning will be used involving a large number of cyclone dust traps through which the hot gases will pass on their way to the chimneys.

17. It is intended to instal a system of fuel handling which will permit the coal trains to be discharged into ditch bunkers at the dredger working levels; from there the coal will be taken to the Power Station by belt conveyors.

18. The advance which has been made in the design of plant for generating electricity from raw brown coal is reflected in the higher thermal efficiency of the "C" and "D" extensions, which will be nearly double that of the "A" Station.

COAL WINNING:

19. To provide for the greatly increased quantities of raw brown coal per annum which will be required by the enlarged Station it will be necessary to instal additional coal winning plant, including new dredgers, to meet a demand of the order of 10,000,000 tons per annum compared with the present output of about 6,000,000 tons per annum. This will require the opening of further coal faces and the provision of additional coal transport facilities such as locomotives, trucks and railway tracks.

20. In the planning of this additional coal winning plant there has not been overlooked the proper integration of the open cuts at Yallourn and Morwell.

TRANSMISSION OF POWER TO MELBOURNE:

21. The existing 132 kV double circuit transmission lines from Yallourn to Melbourne will not be able to transmit economically the increased power from the enlarged Station, and it is intended to construct a double circuit 220 kV transmission line adjacent to the present 132 kV lines and terminating at the Malvern Terminal Station with an interconnection to the 220 kV transmission line from Kiewa.

22. When the new 220 kV Yallourn-Melbourne transmission line is available the output of power from the "C" Station will be transferred to it leaving the existing 132 kV lines to carry the output from the "A" and "B" Stations only.

SUBSEQUENT ADDITIONS TO THE YALLOURN STATION:

23. The site of the Yallourn Station has such considerable natural advantages that clearly it is desirable to utilise it to the fullest extent. An ultimate capacity of 500,000 kW is a not unreasonable objective and where appropriate the works being undertaken for the "C" and "D" extensions are designed to permit later adaptation to such future development. This applies, for example, to the improvements to the coal winning and handling system and to the circulating water system.

24. The stage at which generating plant will be added beyond the "D" extension will not be decided until further investigations have been made of alternative sources of power, including a re-examination of a hydro-electric scheme based on the Mitta River. There will have to be taken into account also the effect of the power to be made available to Victoria from the Snowy Mountains project. Nevertheless, it is evident that further development of the Yallourn Station will need to follow closely upon the "D" extension.

25. With the installation of generating plant in accordance with the construction programme forecast in the Deputy Chief Engineer's report, there will have been established by 1953 the 20% of reserve plant which it is the Commission's policy to maintain. The expected growth of system generating capacity and of system maximum coincident demand up to 1956 is shown in the following Table No. 1:—

TABLE No. I

ESTIMATED SYSTEM GENERATOR CAPACITY AND SYSTEM MAXIMUM COINCIDENT DEMAND

Year	System Generator Capacity				System Maximum Coincident Demand
	Base load stations (Raw brown coal plants at Yallourn and the briquette factories)	Intermediate load stations (Hydro plants at Kiewa, Sugarloaf/ Rubicon and Hume)	Peak load stations (Briquette & oil burning plants in the metro-politan area and country districts; and part of Yallourn)	Total	
	kW	kW	kW	kW	kW
1949	183,000	52,000	224,000	459,000	511,000
1950	183,000	52,000	268,000	503,000	551,000
1951	183,000	52,000	329,000	564,000	593,000
1952	183,000	97,000	394,000	674,000	638,000
1953	253,000	169,000	407,500*[2]	829,500	685,000
1954	303,000	199,000	410,500*[3]	912,500	736,000
1955	373,000	229,000	377,500*[4]	979,500	789,000
1956	348,000*[1]	340,000	402,500	1,090,500	845,000

*[1] Allowing for retirement of 50,000 kW of plant at Yallourn.

*[2] Allowing for retirement of 1,500 kW of plant at Geelong.

*[3] Allowing for retirement of 3,000 kW of plant at Geelong.

*[4] Allowing for retirement of 30,000 kW of plant at Newport and 3,000 kW of plant at Geelong.

FINANCIAL:

26. The estimated capital expenditure chargeable solely to the Yallourn "D" extension, as shown in detail in the Deputy Chief Engineer's report, is £10,802,270 equivalent to £108 per kW of plant. This unit cost compares with an actual cost of £30 per kW for the "A" and "B" Stations completed in 1938, and reflects both the extraordinarily rapid rise in world prices since the war and the higher expenditure involved for more efficient plant.

27. In addition to the above capital expenditure solely chargeable to the "D" extension, the other associated works to be carried out as previously described will bring the total expenditure, based on present prices, to £16,557,680 as follows:—

	£
"D" extension	10,802,270
Coal winning plant and equipment	2,500,000
Transmission line to the metropolitan area, including switching stations	1,860,000
Works chargeable to later extensions	705,290
Works chargeable to the "C" extension and to the Morwell project	690,120
Total	£16,557,680

28. The operating costs of the "D" extension are expected to be 0.423d. per kWh generated. This compares with the present operating cost of the "A" and "B" Stations of about 0.3d. per kWh generated, and is largely due to the major increase in capital costs involved.

RECOMMENDATION:

29. The Commission recommends to the Government that the generating capacity of the Yallourn Power Station be increased by the installation of two 50,000 kW turbo-generators and associated boiler plant by 1955 and 1956 respectively, to be known as the "D" extension, and that other related works, including provision for a later "E" extension, be carried out as described in this report, to a total estimated cost of £16,557,680.

COMMENDATION:

30. The Commission expresses its appreciation of the valuable services rendered by all those officers concerned in the engineering and economic investigations involved in the preparation of this report. The proposals presented are based on the Yallourn "C" extensions — the design work of which was conducted under the direction of the Commission's Chief Engineer, Mr. E. Bate, M.C., B.Sc., Whit. Sch., A.M.I.E.Aust. — and subsequent engineering investigations carried out by the Commission's Design & Construction Department, headed by the Engineer for Design & Construction, Mr. W. B. Nelson, B.E., F.S.A.S.M., A.M.I.E.Aust., under the general direction of Mr. C. H. Kernot, E.W.S., Mun.E., M.I.E.Aust., M.Am.Soc.C.E., L.S., Deputy Chief Engineer of the Commission.

We have the honour to be, Sir, your obedient servants,

R. A. HUNT, Chairman.
W. D. CHAPMAN, Commissioner.
J. A. L. MATHESON, Commissioner.

17th October, 1949.

APPENDIX

REPORT

OF

DEPUTY CHIEF ENGINEER, MR. C. H. KERNOT

ON

YALLOURN POWER STATION

PROPOSED "D" EXTENSION AND ASSOCIATED WORKS

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OF

DEPUTY CHIEF ENGINEER, MR. C. H. KERNOT

ON

YALLOURN POWER STATION

PROPOSED "D" EXTENSION AND ASSOCIATED WORKS

INTRODUCTION:

In this report, proposals are submitted for the extension of the Yallourn Power Station by the addition of a further power generating unit comprising two 50,000 kW turbo-generators with boiler plant and associated facilities, to be known as 'D' Extension, together with proposals for additions to the coal winning plant in the Yallourn Open Cut and for the transmission of the energy generated to the Commission's main system.

At the present time, construction work is in progress at Yallourn on a generating unit, the 'C' Extension, which replaces the existing 'A' Station which is nearing the end of its useful life. It is proposed that following the completion of 'C' Extension, scheduled to come into operation in two stages in 1953 and 1954 respectively, the 'D' Extension should be completed, also in two stages, in 1955 and 1956.

It will be noted that the 'D' Extension is scheduled for completion in the same year as the final units of the Kiewa Scheme, and completes a further stage in the balanced development of steam and hydro-electric power stations postulated in the Chief Engineer's report on the Revised Kiewa Scheme, 260 MW, 1947.

In presenting this report at the present time, it is hardly necessary to stress the urgency for further development of power stations of the Yallourn type, burning raw brown coal at the coal field. The evergrowing demand for power, coupled with the increasing cost and difficulty of obtaining fuel for the metropolitan stations, would make this present proposal most attractive even if there were any possible doubt as to its economic advantages in the narrower, purely financial, sense. However, it is shown that, even disregarding the fuel problem, this extension is necessary for the development of a balanced system, i.e., one including the proper proportion of base load generating plant for the load to be carried.

ANTICIPATED INCREASE IN DEMAND FOR ELECTRICITY:

In forecasting likely future requirements, the Commission has considerable statistical material on which to base its conclusions, but estimates in respect of a long period ahead merely depict a general trend and, of necessity, cannot apply with accuracy to any particular year. Such estimates need to be kept under continuous review, and adjusted from time to time according to circumstances.

With due regard to their limitations, particularly as related to the existing uncertainty of world economic affairs inseparable from post-war conditions, the anticipated increase in the demand for electricity is shown in the chart of System Loading and Generator Capacity which is attached to this report.

This chart also shows the programme of plant installations already planned, or under investigation, together with further additions to the capacity of the Yallourn Power Station which would appear necessary on the basis of present-day trends in the growth of demand. Allowance has been made for plant retirements after 32 years' service in accordance with the weighted average life shown in the Chief Accountant's report on 'Depreciation,' dated 22nd June, 1948, to correspond with the depreciation lives now applied to steam power station plant and equipment.

ALLOCATION OF SYSTEM LOADING TO GENERATING STATIONS:

The Commission's interconnected generating system comprises three principal types of generating stations:

(1) The Yallourn steam generating station burning raw brown coal at the coal field. Because of the low cost and ample supply of this coal, the station is operated continuously at its maximum economic capacity supplying the sustained 'base load' on the Commission's system.

However, since the capital expenditure on this type of station is high, it is not used to supply 'peak' loads of short duration when fuel cost is relatively unimportant.

(2) Metropolitan steam stations of the Newport type, lower in first cost than the Yallourn type station, but burning much more costly fuel such as black coal, briquettes or oil, and therefore operated only to meet short-time peak loads on the system.

(3) The Kiewa hydro-electric stations, designed to operate at moderate load factor and to secure the greatest possible saving of the more costly fuels. These stations occupy a position midway between Yallourn with its sustained, high load-factor, loading and the Metropolitan stations with their short duration, low load-factor, loading.

With the Kiewa stations supplying a definite portion of the loading on the interconnected system, the proportions of Yallourn type stations and Metropolitan type stations can then be selected to supply the remaining portions of the loading at the minimum overall costs, choosing Metropolitan stations for the short-time peak loading where low first cost is more important than low running cost, and base load stations of Yallourn type for the sustained loads where a higher first cost is less important than low running cost.

CHARACTERISTICS OF LOAD SUPPLIED BY COMMISSION'S SYSTEM:

The characteristics of the load supplied by the Commission's generating stations can be appreciated more clearly by a study of a typical annual load duration curve which is attached to this report, and which is drawn for an assumed maximum demand of 845 MW.

The curve has been divided into three sections:—

(1) Metropolitan
(2) Kiewa
(3) Yallourn

corresponding to the type of generating station which normally supplies this particular component of the system load. Taking these in order—

(1) **Metropolitan**—

This section includes all loading in excess of 570 MW up to the maximum of 845 MW. The curve shows that the very highest load must be carried for only a very small part of the year, while the longest sustained load in this section, the part just above 570 MW, must be carried for about one quarter of the year. As the load increases above this value of 570 MW, the duration of the load decreases rapidly and the total amount of energy supplied over the whole year is comparatively small, as is shown by the small area of this section of the load.

At the extreme peak, a load of (845 – 570) = 275 MW must be supplied and, therefore, there must be sufficient generating plant to meet this demand, but, since the total amount of electricity to be supplied over the whole of the year is comparatively small, this generating plant is required to run for only a correspondingly small part of the year. It is then said to operate at low load factor, by which is meant that the total amount of energy generated during the year is only a small proportion of the energy which would be generated if all this plant operated continuously throughout the year.

This section of the load is, therefore, referred to as the low load-factor portion—it is the peak load of short duration and, as noted above, is best supplied by the Metropolitan type station which can meet the peak demand at the lowest capital cost while the short hours of running make higher fuel costs comparatively unimportant.

(2) **Kiewa—**

This section of the load, between 310 MW and 570 MW, is of moderate duration, ranging from about one quarter to two-thirds of the year, and would normally be supplied by the Kiewa Scheme. Design of the Kiewa Scheme to supply this section of the loading has been found to give the most economic use of the variable amount of water available in the region, allowing the Kiewa stations to take over the more sustained loading (usually supplied by the base load stations) when water is plentiful, and exchange duty with the peak load Metropolitan type stations when water is scarce.

(3) **Yallourn—**

This is the long sustained portion, the 'base load,' and includes that component of system loading up to 310 MW, part of which is sustained throughout the year and none for less than about two-thirds of the year.

Running costs are obviously all important and this portion of the load is, therefore, supplied by a station of the Yallourn type burning raw brown coal in a power station adjacent to the coal field. This results in low fuel costs which, for high load-factor operation, quite outweigh the extra capital cost of the station with its specialized boiler plant and the long transmission lines required to transmit the energy to the Metropolitan load centres.

The power stations associated with the Briquetting Factories at Yallourn and Morwell are also of 'Yallourn type,' being operated at high load factor in accordance with factory process demands.

It should be noted that a Metropolitan station burning raw brown coal does not conform to the 'Yallourn type' specification since brown coal delivered to the Metropolitan area is no longer a low cost fuel. The moisture content of the coal is 66% so that with every ton of fuel there must be carried two tons of water and a three ton freight charge is, therefore, levied on one ton of low grade fuel.

Since the position of Kiewa on the load duration curve is fixed by design, it remains only to define the limits of utilization of the Metropolitan and Yallourn type stations.

The costs of generation at the Yallourn and Metropolitan type stations have been compared and it is found that at a load factor of approximately 30% their total costs, including capital and running charges, are equal. At load factors above 30% the Yallourn type station, with its low fuel costs, is superior, while below 30% the Metropolitan station, with its lower capital charges is the better.

It might be expected that there will be changes in this critical load factor with future variations in the costs of generating plant and fuel, but it has remained substantially constant in the past and there is no reason to expect marked change in the future. In any event, quite wide variations are permissible without affecting the general conclusions for, as has been shown, the Kiewa Scheme supplies the intermediate load factor portion of the load, and it is difficult to imagine the radical change in plant and fuel costs that could result in the Metropolitan station becoming superior at the high load factors at which the Yallourn type of power station will be operated.

It is, therefore, clear that for the greatest economy the base load section of the system load must be supplied by generating plant of the Yallourn type.

REQUIREMENT OF BASE LOAD GENERATING PLANT:

It has been established that the base load section of the system load should be supplied by generating plant of the Yallourn type.

The characteristics of the load, as shown in the typical load duration curve attached to this report, are:—

Maximum load—310 MW, sustained for about two-thirds of the year;

Minimum load—140 MW, to be supplied continuously throughout the year.

The provision of generating plant to supply a sustained load of this type involves special considerations which do not apply to plant of the Metropolitan type used mainly for peak loading. There will always be a few hours during the day when the loading on the Metropolitan type plant can be reduced for minor maintenance and operational requirements, while the seasonal characteristic of the peak load enables this plant to be withdrawn from service during the summer for its annual overhaul. But to supply at a very high load factor, as is required of the base load plant, would require a generator and its associated boiler plant to carry its full load for nearly all of the year, which would allow little opportunity for temporary load reductions for operating adjustments, while it would be quite impossible to take the plant out of service for an annual overhaul. It is therefore necessary to provide plant over and above the actual maximum demand requirements, and the minimum addition which is appropriate in this instance would be equal to the largest single unit of the base load plant, i.e., a 50 MW generator. The installed capacity of base load plant should therefore be:—

$$310 + 50 = 360 \text{ MW.}$$

With 360 MW of plant supplying a load of 310 MW at high load factor, the utilization factor of the plant is of the order of 80%—this will allow for an annual overhaul period as well as minor load reductions necessitated by operational requirements.

Without the addition of 'D' Extension, the base load plant installed by 1956 would be:—

Yallourn	'A'	6 x 12.5 MW	Retired as base load plant.
	'B'	4 x 25 MW	100 MW
	'C'	2 x 50 MW	100 MW
	Briquetting		8 MW
Morwell	Briquetting		40 MW
			248 MW

and, even with the addition of 'D,' 348 MW, which is not quite sufficient.

It is therefore necessary, in order to meet the requirements for base load generating plant, that at least 100 MW of base load plant, i.e., 2 x 50 MW turbo-generators with boiler plants, should be installed by 1956.

ALTERNATIVE SITES FOR BASE LOAD GENERATING PLANT:

Consideration has been given to several alternative sites for base load generating plant of the Yallourn type, burning raw brown coal at the coal field, but it has been found that no development possible within the time available can compare with an extension of the existing power station at Yallourn.

Investigations into the possibility of exploiting the brown coal deposits at Altona have shown that the advantages of a location close to the load centre in the metropolitan area cannot compensate for the added expense of coal winning due to the greater depth of overburden.

Other possible developments in the Latrobe Valley area, beyond Yallourn and Morwell, are more promising and future requirements for Yallourn type generating plant must ultimately lead to the development of these areas but, in this present instance, they cannot compete with Yallourn. The opening up of a new coal field and the building of a new power station with the attendant problems of providing accommodation and services must occupy far more time, for investigation and planning alone, than can be spared in meeting this requirement. Investigations should proceed but, for the immediate future, the further development of the existing Yallourn site offers every advantage over any possible alternative.

Summarizing then: it has been established that to provide the requisite amount of base load plant, operating on low cost fuel at high load factor, for the most economic allocation of system load between power stations, it is necessary that by 1956 a further 100 MW capacity should be provided, over and above that already authorized, and that the most favourable site for this addition is at the existing Yallourn Power Station.

PROVISION FOR FUTURE EXTENSIONS:

In considering any further extensions at Yallourn, apart from renewal of existing plant, it will also be necessary to consider alternative possibilities of hydro-electric power generation. No metropolitan steam power plant can supply the high load factor section of the system load as economically as the Yallourn type station, and its only competitor is, therefore, a hydro-electric system designed for generation at high load factor.

Preliminary investigations show that it should be possible to develop on the Mitta River a power development, similar in many respects to the Kiewa Scheme. However, as at Kiewa, it is clear that the most economical use of the variable rainfall available is obtained from a system operating normally at moderate load factor, and able to move into the lower or higher load factor regions in accordance with the amount of water available.

The preliminary investigation of the Snowy Mountain Development has also been based on a system operating at moderate load factor, even lower than at Kiewa. Although such a system is designed to make the most effective use of the water available, it depends on the backing of an interconnected generating system containing a large proportion of steam power stations, normally supplying the higher and lower load factor sections of the system load, while the hydro system takes that part of the loading which it can most effectively supply with the amount of water available at the time.

Further developments of hydro-electric generating stations associated with irrigation reservoirs are expected in the future, but these cannot supply a high load factor loading, sustained throughout the year, since their outputs are dependent on the outflow from their reservoirs and must usually be reduced to zero for several months of the year while the reservoir is filling.

It is, therefore, clear that no hydro-electric development which can be visualized at present, can eliminate the need for further development of the Yallourn type station in order to supply the sustained high load factor section of the system load for which it is so eminently suited. It is also clear that there are considerable advantages in the maximum possible development of the Yallourn site, and that, following the completion of 'D' Extension, the next step would be to construct a similar addition, the 'E' Extension.

There is, therefore, good reason for combining with the work of the 'D' Extension, the provision of facilities for a further extension wherever it is found to be more economical to do the work now, rather than separately at a later date. This applies particularly to the new belt conveyor system for coal handling and to the circulating water system, where the provision of double capacity at this stage will be much more economical than building separately for the new extension later.

Provision is made in the schedule of estimated expenditure for the total amounts associated with these joint projects, and the appropriate part of the cost will later be transferred to the 'E' Extension.

THE GENERAL PLAN OF THE 'D' EXTENSION:

A site plan of the Yallourn Power Station area showing the location proposed for the plant and buildings for the 'D' Extension is attached to this report. It will be seen that the new section will be an extension of the existing station, taking over the area to the south now occupied by the central workshop and stores, which are to be moved to a less restricted site providing ample room for the expansion necessary with extensions to the power station and the coal winning activities.

As shown on the site plan, the space available will allow for a second extension of 100 MW, tentatively named 'E' Extension, which could provide for future demands for 'base load' generating plant and it is proposed to construct such facilities as the circulating water system and coal handling plant to provide for this future generating unit.

Although the 'A' Station is being replaced by the 'C' Extension, the actual physical replacement of plant and equipment will be deferred, because, although the generators will be 32 years old in 1956 and quite unsuitable for the sustained high loading demanded of base load plant, they will be of considerable value as reserve for emergency demands requiring only short running periods.

The generating plant will comprise two 50,000 kW turbo-generators, similar to those being included in the 'C' Extension, operating on steam at 600 lb./sq.in. 825° F, supplied by six boilers, each with a maximum continuous output of 200,000 lb. of steam per hour, and fired with Yallourn brown coal.

The steam pressure and temperature, 600 lb./sq.in. and 825° F, were selected on the basis of economic studies which are summarized in the graph attached to this report. This shows the relation between the steam conditions and the cost of energy generated, and it will be seen that minimum costs are obtained for the selected conditions.

This result may seem at variance with modern design practice in England, U.S.A. and other countries, where pressures of 900 and 1,200 lb./sq.in. are commonly employed for base load generating plants. However, these plants are using more expensive fuels, such as black coal, and the saving in fuel consumption justifies the increased initial expenditure on the high pressure plant.

Due consideration was also given to the most suitable size of turbo-generator for this application, before adopting a maximum continuous rating of 50,000 kW. The British Electric Authority has standardized on a 60,000 kW turbo-generator for use in their power stations, but this machine is designed for a pressure of 900 lb./sq.in., whereas the lower pressure of 600 lb./sq.in. is more economical with our low cost fuels. A 60,000 kW turbo-generator to operate on our selected pressure, 600 lb/sq.in., would not be a standard design and it would be difficult to obtain the robust, reliable type of machine required for base load service. It was, therefore, decided to select the 50,000 kW machine, the size also adopted for the 'C' Extension.

The combined effects of the higher steam pressure, larger turbo-generators and higher boiler efficiency proposed for the 'D' Extension, as compared with the existing 'A' and 'B' Stations, are shown in the tabulation below:

	Approximate thermal efficiency (based on net calorific value of raw brown coal)	Fuel Consumption (lb. of raw brown coal per kWh generated)
'A' Station	13.8%	(Combined 'A' and 'B' Stations) 7.2 lb./kWh
'B' Station	18.2%	
'D' Station (and 'C' Station)	24.5%	4.9 lb./kWh

SPECIAL FEATURES OF DESIGN:

In planning the 'D' Extension, as also the preceding 'C' Extension, a number of special technical problems affecting the general design had to be solved:

(a) Provision for cooling of circulating water during times of low flow in the Latrobe River;

(b) Design of boilers to obtain improved combustion of raw brown coal with minimum dust emission;

(c) Design of improved ash handling and disposal plant;

(d) Redesign of coal handling facilities from the Open Cut to the Power Station.

Taking these in order—

(a) **Cooling of Circulating Water—**

The Latrobe River, upon which the Power Station must depend for its circulating water, is not regulated by storages in its upper regions and from past experience it is known that, although for the greater part of the year there is an ample flow of water, there will be periods during the summer months when low river flow would limit the output of a larger station.

A complete investigation, covering the past 25 years, has been made of the river flows during each month of the year, and the attached curve shows, month by month, the load which the power station will then be able to carry, on the average, without raising the river temperature by an excessive amount.

It can be seen that the period during which the natural river flow is inadequate is relatively short. To provide additional cooling over this period it is proposed to construct cooling towers.

The hot water from the condensers is pumped into the towers, cooled by a cross draft of air as it falls and is then discharged into the pond above the weir for recirculation through the condensers.

Induced draft towers using electrically driven fans to maintain a vigorous circulation of the cooling air will be used, giving a compact design which can be easily accommodated in the space available at the power station site. These are preferred to the larger natural draft towers more commonly used in England, not only for their compact size, but also for their lower capital cost which quite outweighs their higher running costs during the short periods when it is necessary to operate the fans and pumps.

(b) **Boiler Plant**—

Since the economic use of raw brown coal is considered to be of national importance, it is planned to install the most efficient plant consistent with a reasonable initial capital cost.

The efficiency of the proposed boiler plant will be approximately 80%, corresponding to a temperature of about 350° F for the flue gas entering the chimneys, which is sufficiently high to avoid corrosion troubles. As is customary with boilers burning raw brown coal, the efficiency is based on the net calorific value of the fuel, which makes allowance for the unavoidable heat loss due to its high moisture content.

The boiler plant proposed represents a revolutionary advance in the use of a system of combustion known as 'mill firing,' in place of the travelling and step grates used in the 'A' and 'B' Station boilers. This system was developed in Germany in recent years and was investigated by the Mechanical Engineer during a visit in 1946.

The wet brown coal, crushed to about two inches in size, is fed into the mill rotor, together with hot flue gases drawn from the boiler furnace, and the drying and breaking up of the coal proceeds simultaneously. When the fuel is ground to the requisite fineness and is comparatively dry, it is discharged by the mill to the burners, one of which is placed in each of the four corners of the furnace.

Each boiler has four mills, installed in the boiler house basement. Each mill has a bladed rotor revolving at 1,000 revolutions per minute, and can fire 15 tons of wet brown coal per hour. Since the weight of coal which will be burned at full boiler output amounts to 45 tons per hour, one of the mills can, if required, be taken out of service for maintenance without reducing output.

For starting-up, small briquette pulverizing mills are provided, feeding separate auxiliary burners adjacent to the main burners. These ensure stable combustion at the low rate of firing necessary when warming up the boiler from cold and provide the heat necessary for drying the raw brown coal and commencing the drying cycle in the mills.

Oil firing equipment, of limited capacity, is also provided as an emergency method of stabilizing combustion at the main burners, particularly when the normal mill firing system is disturbed by extraneous causes.

The furnace itelf is approximately 20 ft. square and 60 ft. high. Its inside wall surface is completely lined with boiler tubes, thus absorbing as much heat as possible by direct radiation from the burning fuel while, at the same time, protecting the brick walls.

The hot gases leaving the furnace pass over a super-heater in which the steam is raised to a temperature of 840° F, after which they flow through the economiser which heats the incoming feed water, and then through the air preheater.

High availability is ensured by adoption of suitable furnace ratings and tube spacings and by the provision of the most modern soot blowing equipment.

Considerable attention has been devoted to avoiding flue dust emission from the stacks and it is proposed to install a gas cleaning system comprising a large number of small, specially designed cyclones through which the gases will flow on their way to the chimney. Investigations in Germany and discussions with manufacturers have made it apparent that, for the Yallourn brown coal with its remarkably low ash content, dust collection equipment of this type should be completely satisfactory.

(c) **Ash Handling Plant**—

The dust trapped by the cyclones, and the ash and dust deposited in the boiler itself will be withdrawn from the various collecting hoppers by a special vacuum extraction and conveying system. The material will be delivered to large receivers, and will then be intimately mixed with sufficient water to produce a plastic mass, suitable for handling on belt conveyors and in overburden trucks for ultimate disposal in the Open Cut.

(d) **Coal Handling**—

Instead of extending the existing coal handling facilities to provide for the additional supplies required by the 'D' Extension, it is proposed to construct a belt carrying system direct from the Open Cut, similar to that used for supplying coal to the Briquetting Factory. Coal trains will discharge the coal into ditch bunkers at the two dredger working levels and from these the coal will be elevated by two belt conveyors to the power station level.

Eventually this system will be extended to provide the whole of the power station requirements leaving the existing system of hauling coal trucks up to the power station working level as a standby.

In connection with the 'C' Extension, additional coal storage at the power station is provided by a new ground buffer storage of 37,000 tons capacity and this will be connected by belt conveyors with the 'D' Extension to allow coal to be discharged to or received from storage.

Space is shown available for a further storage of 5,000 tons to serve 'D' Extension and the possible future 'E' Extension, but it is not proposed to build this at this stage.

GENERAL DESCRIPTION OF THE 'D' EXTENSION:

The following is a brief description of the more important items of work included under the headings set out in the schedule of Estimated Expenditure (see below).

1. **Land and Preparation of Site—**

The work in this section will include the demolition of existing buildings, including the central workshops and store which are now located in the area required for plant extensions, the removal of the existing railway siding and the diversion of existing drains, sewers, etc. It also will include the regrading of the site in the areas which will accommodate the new boiler and turbine houses and the extensions to the switchyard.

2. **Buildings and Improvements—**

The turbine house and tank annex will form an extension of the existing buildings in a southerly direction, approximately 175 feet in length, while the boiler house will be a structure of approximately 230 feet in length by 200 feet wide, located south of and parallel to the existing 'A' boiler house Provision has been made for a plant repair bay and store, extending along the whole length of the south side of the boiler house. Ancillary buildings include a transformer repair bay and maintenance workshop, amenities and sanitary blocks, garage and extensions to the control room.

This section of the work also includes the extension of rail facilities and alterations to access roads and services in the area.

3. **Coal Handling—**

As described above, under 'Special Features of Design,' it is proposed to construct a belt conveyor line from ditch bunkers situated at the two coal dredger working levels in the Open Cut to supply the 'D' boiler house.

This section of the work will include the ditch bunkers and dredgers, a new crusher house, No. 3, a duplicate belt conveyor line from the ditch bunkers to the new crusher house, duplicate belt conveyors from the crusher house to the boiler house and a belt conveyor to provide supplies from the buffer storage.

4. **Ash Handling Plant—**

As described above, under 'Special Features of Design,' it is proposed to use a vacuum system for collecting the ash, grits and dust from the boilers, discharging into two elevated collecting and storage tanks. From these tanks the ash will be delivered to a conditioning plant and then discharged by means of a belt conveyor to the main ash storage bunkers.

5. **Boiler Plant and Chimneys—**

The boiler plant will consist of six boilers, each rated at a maximum continuous output of 200,000 lb. of steam per hour, at a pressure of 645 lb. per square inch and a temperature of 840° F.

As has been described more fully, under 'Special Features of Design,' the normal 'mill firing' equipment will be supplemented by starting-up equipment comprising auxiliary briquette pulverizing mills, with oil burners for emergency use.

In line with modern practice, automatic control for firing conditions will be adopted with all normal facilities for supervisory control and sequence interlocking of the starting equipment for the various auxiliaries.

There will be three brick-lined steel chimneys, approximately 300 feet high, set centrally on the roof of the boiler house, each serving two boilers.

6. **Turbo-generators and Condensing Plant—**

The proposed layout is similar to that for 'C' Extension, including two turbo-generators, each of 50,000 kW capacity and generating at 11,000 volts. These machines will be placed longitudinally in the turbine room with their steam ends adjacent to one another.

The condensers will be designed to enable the turbo-generators to carry full load without the vacuum falling below 26″ of mercury when the inlet circulating water temperature is as high as 95° F.

7. **Feed Water Plant and Piping—**

This section of the plant includes the necessary low and high pressure heaters to raise the temperature of the feed water to 350° F, together with evaporators, deaerators and extraction pumps.

Four boiler feed pumps, each of 750,000 lb. per hour capacity, will be provided, two pumps being normally allocated to each turbo-generator, one electrically driven for normal service and one steam turbine driven for emergency standby service.

There will be four feed water storage hotwells, each of 17,500 gallons capacity, tanks for general service, and weigh tanks for testing purposes.

Also included are the auxiliary pumps for general service, cooling and fire service and a complete general service water treatment plant to supply water for evaporators and other services.

8. **Circulating Water System—**

Circulating water will be drawn from the Latrobe River through additional screens installed in the new screen pit, which is being provided for the 'C' Extension. The inlet conduits will extend to two pump pits located on the west side of the turbine house which will also be able to accommodate the pumps for a future possible extension. The circulating water for the turbine condensers will be supplied from a central pumping system, arranged so that each pump can discharge into either or both of the duplicate pressure conduits leading to the condensers.

The circulating water inlet and outlet conduits will be of sufficient size to satisfy the requirements of the two 50,000 kW turbo-generators in this extension, as well as a possible future extension of similar capacity.

As noted above, under 'Special Features of Design,' cooling towers, capable of handling approximately 3,600,000 gallons of water per hour, will be installed to augment the cooling capacity of the river. The arrangements of piping and conduits allow the condenser discharge water to be drawn as required from the outlet conduit by means of pumps, which will deliver it to the cooling towers.

The whole of the circulating water system will be arranged for remote control from the power station. Remote control will also be applied to the cooling towers, which will be of the mechanical induced draft type. They will aggregate approximately 400 feet in length by 60 feet in width, and will be arranged adjacent to the pump pits, which will accommodate both the cooling tower pumps and the additional pumps required for the fire service to the Open Cut.

9. **Switchgear and Transformers—**

The output from the generators will be supplied to two 54,000 kVA main transformer banks stepping up the generator voltage of 11,000 volts to 220,000 volts for transmission to the metropolitan area. This section of the plant also includes the main switchgear, with provision for interconnexions with the 'C' Extension and the Morwell Briquetting Factories, as well as the circuit breakers and transformers for the power supplies to the station auxiliary equipment.

10. **General Equipment**—

Provision will be made for overhead travelling cranes and other station equipment, such as an air compressor for general services, instruments, telephones and a public address system.

11. **Spares**—

Provision will be made for adequate spare parts for the plant covered in each of the above sections.

ESTIMATED EXPENDITURE ON THE 'D' EXTENSION:

In the schedule below the estimated capital expenditure chargeable solely to the 'D' Station is shown in column 'D' and in column 'E' is shown the additional expenditure which will be incurred in the work of the 'D' Extension but will later be charged to the future 'E' Extension.

The amounts chargeable to the 'C' Extension and the Morwell Briquetting Project for works carried out in connexion with the 'D' Extension are shown in columns 'C' and Morwell respectively.

Nature of Works	Estimated Capital Expenditure			
	'D'	Amounts chargeable to projects other than 'D'		
		'E'	'C'	Morwell
	£	£	£	£
1. Land and preparation of site	92,800			
2. Buildings and improvements	1,924,800			
3. Coal handling plant and storage	345,320	311,890	262,990	
4. Ash handling plant	210,840			
5. Boiler plant and chimneys	3,536,500			
6. Turbo-generators and condensing plant	1,036,820			
7. Feed water plant and piping	673,900			
8. Circulating water system	569,540	191,270		
9. Switchgear and transformers	702,400	95,700	178,250	145,550
10. General equipment	129,580			
11. Spares	172,100			
12. Interest during construction	628,770	46,540	33,070	11,590
13. Overheads (Engineering and Administration)	727,200	59,890	44,120	14,550
14. Temporary construction facilities	51,700			
Totals	10,802,270	705,290	518,430	171,690
	£11,507,560			

EXPECTED OPERATING RESULT — 'D' STATION:

On the assumption that 'D' Station, when in full commission, can be operated with an annual load factor of 80% based on its total installed capacity, i.e., 100,000 kW, the estimated cost of generating energy is shown hereunder:—

Maximum load generated, 'D' Station		100,000 kW
Energy generated per annum		700.8 x 10^6 kWh

Estimated Fixed Annual Charges:

Estimated capital expenditure on 'D' Extension chargeable solely to 'D' Station	£10,802,270	
Amount included with the capital expenditure on 'C' Extension chargeable to 'D' Station	£38,970	
	£10,841,240	
Interest on £10,841,240 @ 3.75%	£406,547	
Depreciation on £10,841,240 @ 1.73%	£187,553	
Fixed portion of maintenance and operation charges	£100,000	
Administration and supervision	£85,000	
Total fixed charges:	£779,100	0.267d. per kWh generated

Estimated Variable Charges:

Fuel to supply steam to 2 - 50,000 kW turbo-generators—		
Coal—1,523,000 tons @ 4/- per ton	£304,600	
Briquettes—1,000 tons @ £2 per ton	£2,000	
Oil—500 tons @ £12 per ton	£6,000	
Operation, maintenance and supervision not included in fixed charges	£143,000	
Total variable charges:	£455,600	0.156d. per kWh generated

TOTAL COST — **0.423d. per kWh generated.**

TRANSMISSION OF POWER TO METROPOLITAN LOAD CENTRES:

At the present time, power generated at Yallourn is transmitted to the metropolitan area by two double circuit 132 kV transmission lines, one terminating at Yarraville and the other at Malvern and Richmond.

With the addition of 'D' Extension the normal generated output at Yallourn is raised by 100 MW, and it now becomes essential to provide additional transmitting facilities between Yallourn and the Metropolitan area. Investigations have been made, taking into consideration the requirements not only of the 'D' Extension but also of the possible developments of generating capacity at Yallourn and Morwell. Also, a study of overseas practice was made by the Commission's Electrical Engineer and Transmission Design Engineer, and it was finally determined that the most suitable operating voltage would be 220 kV, as adopted also for the main Kiewa transmission.

It is therefore proposed to build a double circuit 220 kV transmission line, adjacent to the existing 132 kV lines, from Yallourn to the metropolitan area. This new line will terminate at the existing terminal station at Malvern, with an interconnexion through a switching station to the 220 kV transmission lines from Kiewa.

Replacement of 'A' station by the 'C' Extension raises the normal generated output at Yallourn by 25 MW which is well within the capabilities of the existing transmission lines. Even when the reserve plant in 'A' Station is brought into service, stable transmission is still possible, but, at this high loading, the lines are being required to operate well above their economic limits with correspondingly high power losses in transmission. It was considered that in order to postpone capital expenditure this condition could be tolerated until the new 220 kV line was built in connexion with the 'D' Extension. The 'C' Extension would then be transferred to 220 kV taking advantage of the greater efficiency of transmission as well as avoiding excessive power losses on the 132 kV lines when 'A' Station was in operation.

With this end in view, the 'C' Extension switching structure has been designed to be suitable for 220 kV operation, and the main transformers are designed for ultimate operation at 220 kV, but arranged so that, by a simple reconnexion of the internal windings, they may operate initially at 132 kV. The only other change necessary for 220 kV operation will be the replacement of the 132 kV circuit breakers by 220 kV units, purchase of which was deferred in order to obtain the utmost advantage from the design progress now being made overseas.

Estimated Expenditure—

The estimated expenditure for all electrical works at the power station up to the start of the 220 kV transmission line has been included in the schedule of Estimated Expenditure on the power station.

The estimated expenditure on the transmission line and the terminal switching in the metropolitan area is:

Transmission Line—Double circuit—220 kV	£1,410,000
Switching Stations in Metropolitan Area (not including transformers or synchronous condensers)	£450,000
Total:	£1,860,000

COAL WINNING:

A major addition to the generating plant at Yallourn, as proposed in the 'D' Extension, requires a corresponding expansion of the coal winning operations in the Open Cut to provide the extra coal required by the enlarged station. Provision must also be made for the possible future 'E' Extension and it is estimated that it will be necessary to increase the present output of 6,000,000 tons per year to approximately 10,000,000 tons per year.

Such a substantial increase in coal production requires not only the purchase of new plant, such as coal and overburden dredgers, but also the development of a long range plan for the removal of overburden and the opening up of sufficient new coal faces to enable the new plant to be put into effective operation and coal production to be built up in accordance with demand.

A master plan for the future development of the Open Cut which will also show when each new item of plant is required, is now being prepared. The new plant to be obtained will be generally similar to that in operation in the Cut at present, while including any improvements found necessary by our own experience, or suggested as a result of the visits, past and present, of our engineers to the coal fields of Central Europe.

It is estimated that the cost of the additional plant required, including dredgers, locomotives and trucks, tracks, drainage and fire pumps and all the associated equipment, together with additional offices, maintenance and amenities buildings, water supplies and other services, will be approximately **£2,500,000,** and the cost of fuel, when full production is reached, will be of the order of **4/- per ton.**

SUMMARY OF ESTIMATED EXPENDITURE, 'D' EXTENSION AND ASSOCIATED WORKS:

'D' Extension:		
Amount directly chargeable to 'D' Station		£10,802,270
Amount for works to be carried out as part of 'D' Extension, but later to be transferred to 'E' Extension		£705,290
		£11,507,560
Transmission:		
Transmission line and switching stations	£1,860,000	
Coal Winning:		
Plant and equipment, buildings and services	£2,500,000	
	£4,360,000	£4,360,000
		£15,867,560
Additional Works:		
Amounts, not included above, for additional works to be carried out in conjunction with the 'D' Extension (see page 23)—		
Chargeable to 'C' Extension		£518,430
Chargeable to Morwell Briquetting Project		£171,690

CONCLUSIONS:

Summarizing, it has been shown that:

(a) For the most economic allocation of the system loading between generating stations, it is necessary that there should be a definite proportion of base load generating plant operating on low cost fuel at high load factor;

(b) By 1956 a further 100,000 kW of base load generating plant, over and above that already authorized, is required and this is best provided by an extension at the existing Yallourn Power Station;

(c) This proposed extension, designated 'D' Extension, would comprise two 50,000 kW turbo-generators with six 200,000 lb./hr. boilers fired with raw brown coal from the Open Cut;

(d) Expansion of coal winning operations in the Open Cut and additional transmission facilities to the metropolitan area will be required in connexion with this proposed extension;

(e) In the design of the 'D' Extension provision should be made for a further similar extension, the future requirement for which is clearly demonstrated by present trends in loading. The type of hydro-electric development best suited to a variable rainfall – which is characteristic of Australia – is not suitable for supplying long duration loading.

RECOMMENDATION:

It is recommended therefore–

(a) That approval be given for the construction of the 'D' Extension and associated works as described in this report, scheduled for completion by 1956, and estimated to cost £15,867,560;

(b) That approval be now given for the ultimate provision of a second similar extension, 'E' Extension, at the Yallourn site in order that development of the area may proceed in accordance with an established plan.

CHAS. H. KERNOT,

Deputy Chief Engineer.

12th August, 1949.

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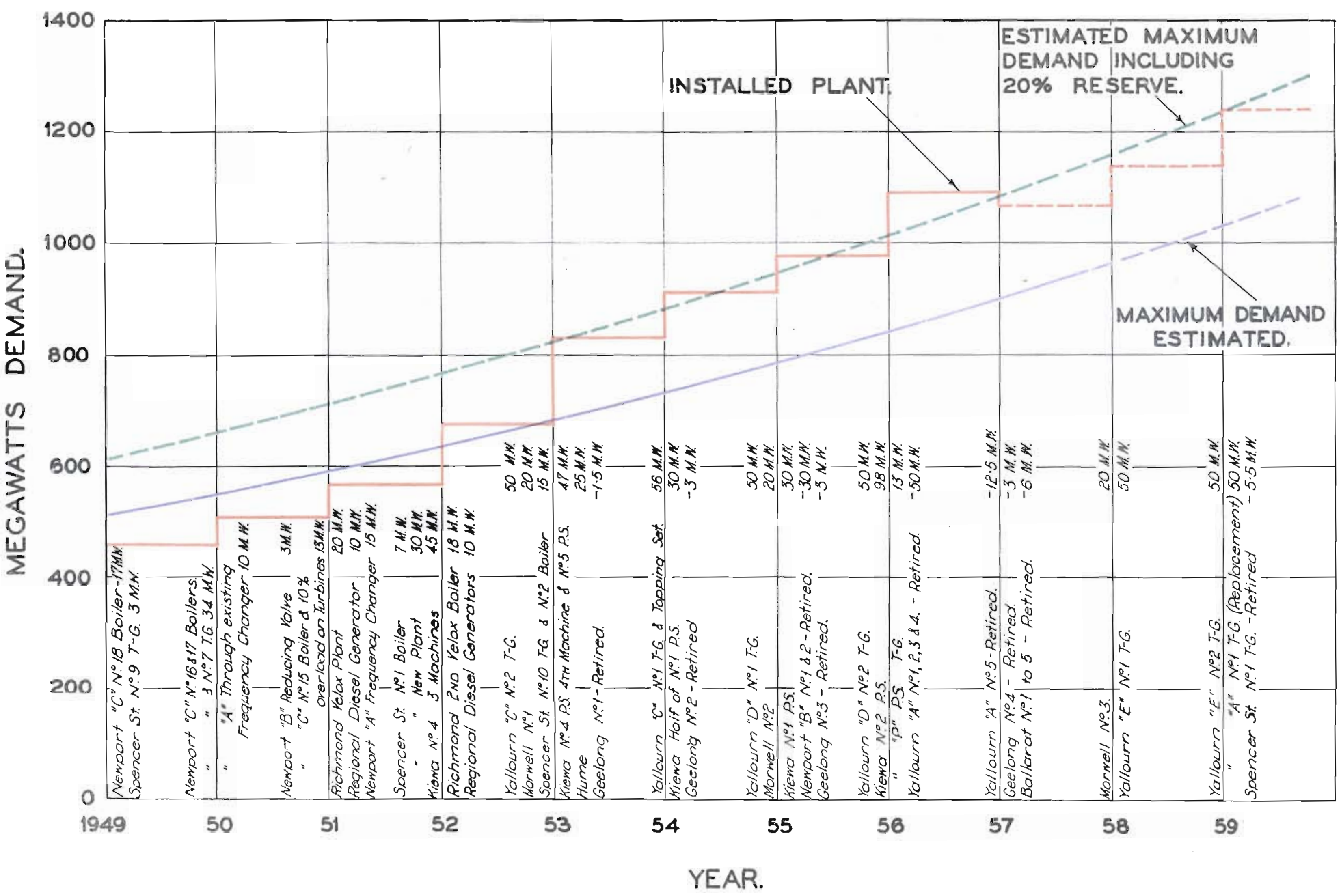
STATE ELECTRICITY COMMISSION OF VICTORIA.

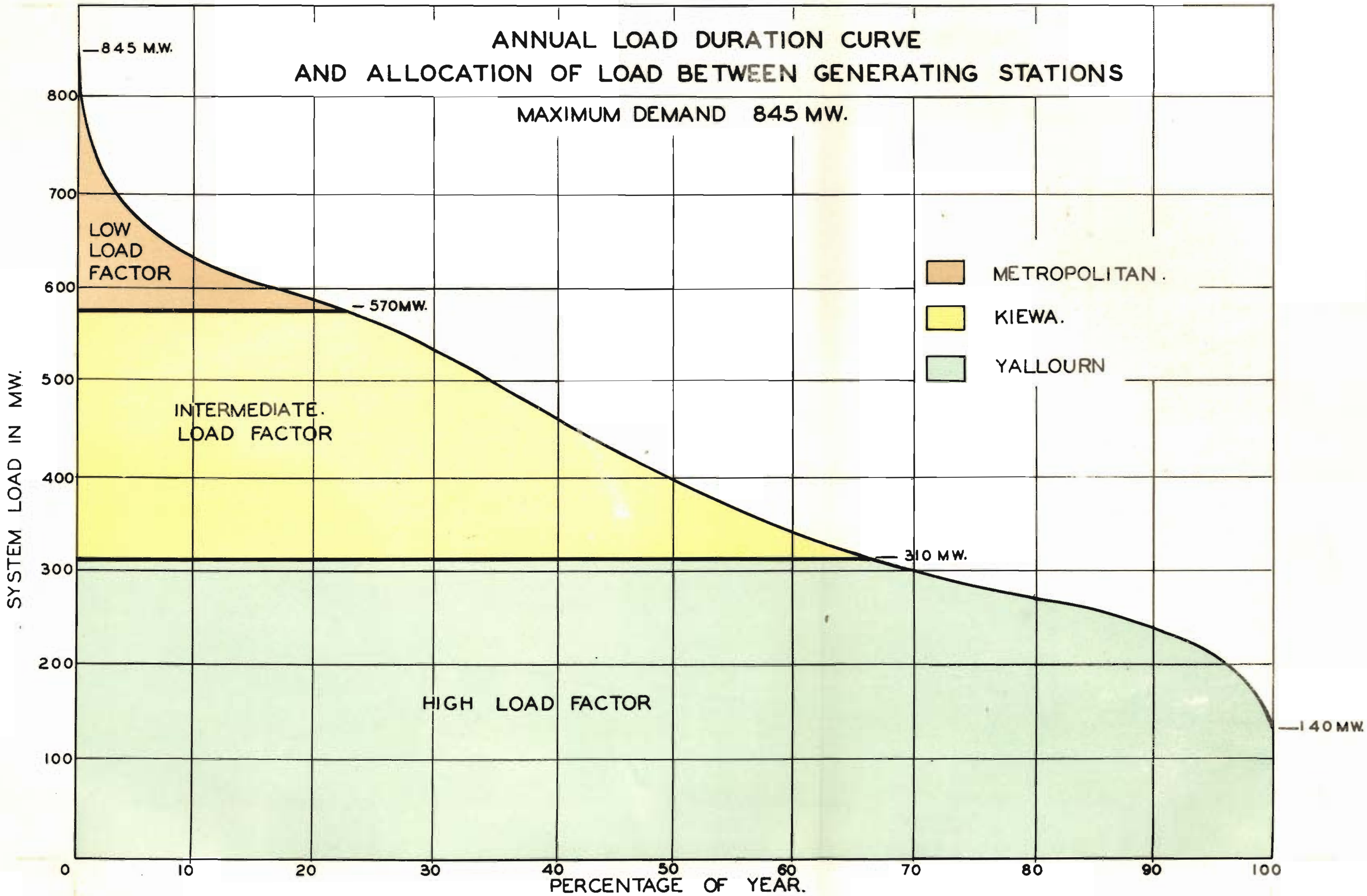
SYSTEM LOADING AND GENERATOR CAPACITY.



AUGUST 1, 1949.

PLATE 2.

STATE ELECTRICITY COMMISSION OF VICTORIA.



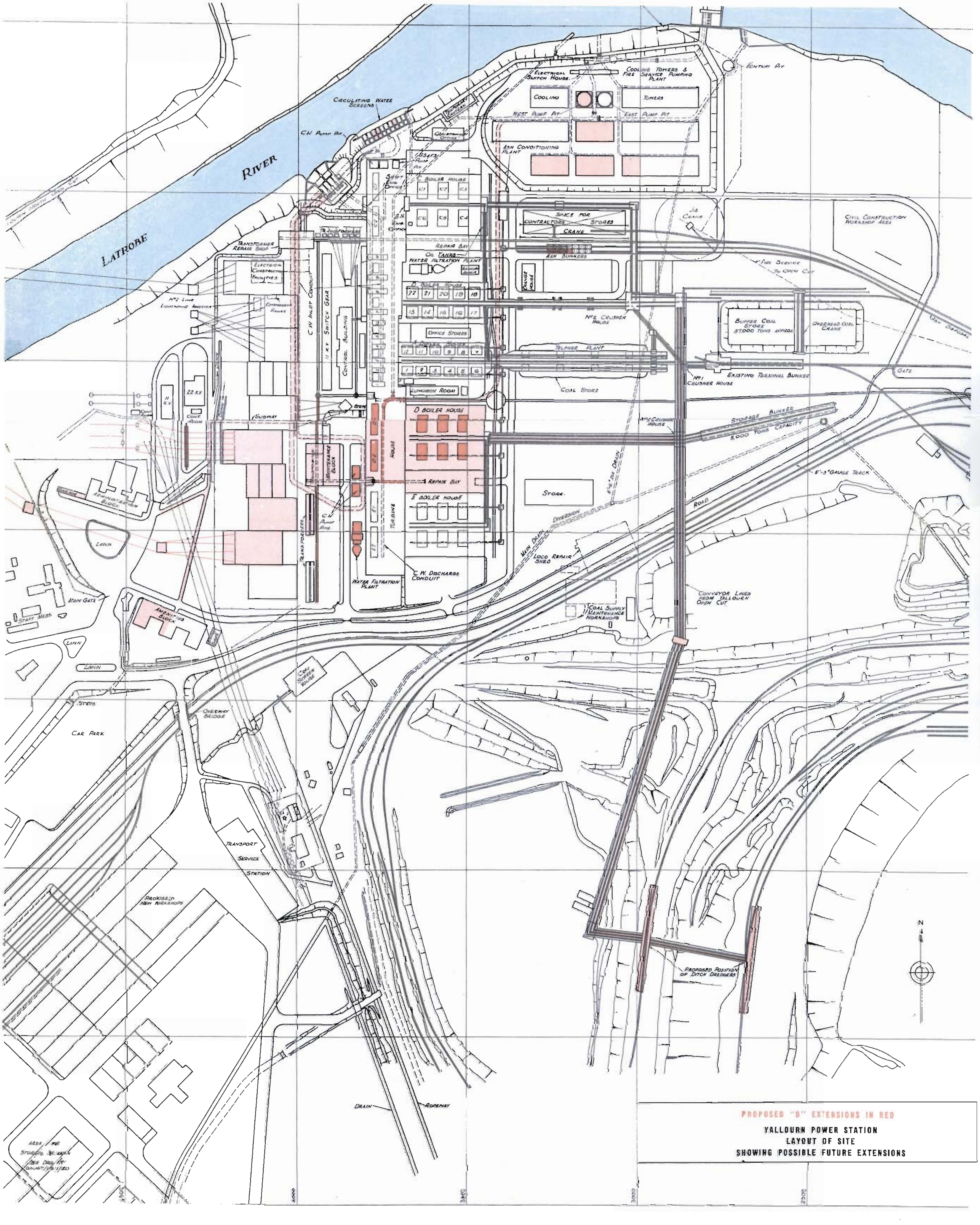

LATROBE
RIVER
Circulating Water Screens
C.W. Pump Pit
Electrical Switch House
Cooling Towers & Fire Service Pumping Plant
Venturi Pit
Cooling
Towers
West Pump Pit
East Pump Pit
Ash Conditioning Plant
C Boiler House
Space for Contractors Stores
Crane
Jib Crane
Civil Construction Workshop Area
Repair Bay
Oil Tanks
Water Filtration Plant
Ash Bunkers
Fire Service
To Open Cut
Transformer Repair Shop
Electrical Construction Facilities
No. 2 Line Lightning Arrester
Compressor House
C.W. Inlet Conduit
11 KV Switch Gear
Control Building
B Boiler House
Office Stores
No. 2 Crusher House
Buffer Coal Store 57,000 Tons Approx.
Overhead Coal Crane
Telpher Plant
No. 1 Crusher House
Existing Terminal Bunker
Coal Store
Gate
Luncheon Room
Subway
D Boiler House
No. 3 Crusher House
Storage Bunker 5,000 Tons Capacity
Maintenance Block
House
Repair Bay
5'-3" Gauge Track
Administration Block
Store
E Boiler House
Turbine
Transformers
C.W. Pump Pits
Road
Diversion
Main Drain
Loco Repair Shed
Lawn
C.W. Discharge Conduit
Water Filtration Plant
Conveyor Lines from Yallourn Open Cut
Main Gate
Amenities Block
Coal Supply Maintenance Workshops
Staff Mess
Lawn
Lawn
Steps
Overway Bridge
Coal Screen House
Car Park
Transport Service Station
Proposed New Workshops
Proposed Position of Ditch Dredgers
N
Drain
Ropeway
PROPOSED "D" EXTENSIONS IN RED
YALLOURN POWER STATION
LAYOUT OF SITE
SHOWING POSSIBLE FUTURE EXTENSIONS

PLATE 3

STATE ELECTRICITY COMMISSION OF VICTORIA.

YALLOURN 'D' POWER STATION.
ESTIMATED COSTS FOR POWER GENERATION AT VARIOUS STEAM – TEMPERATURES & PRESSURES.

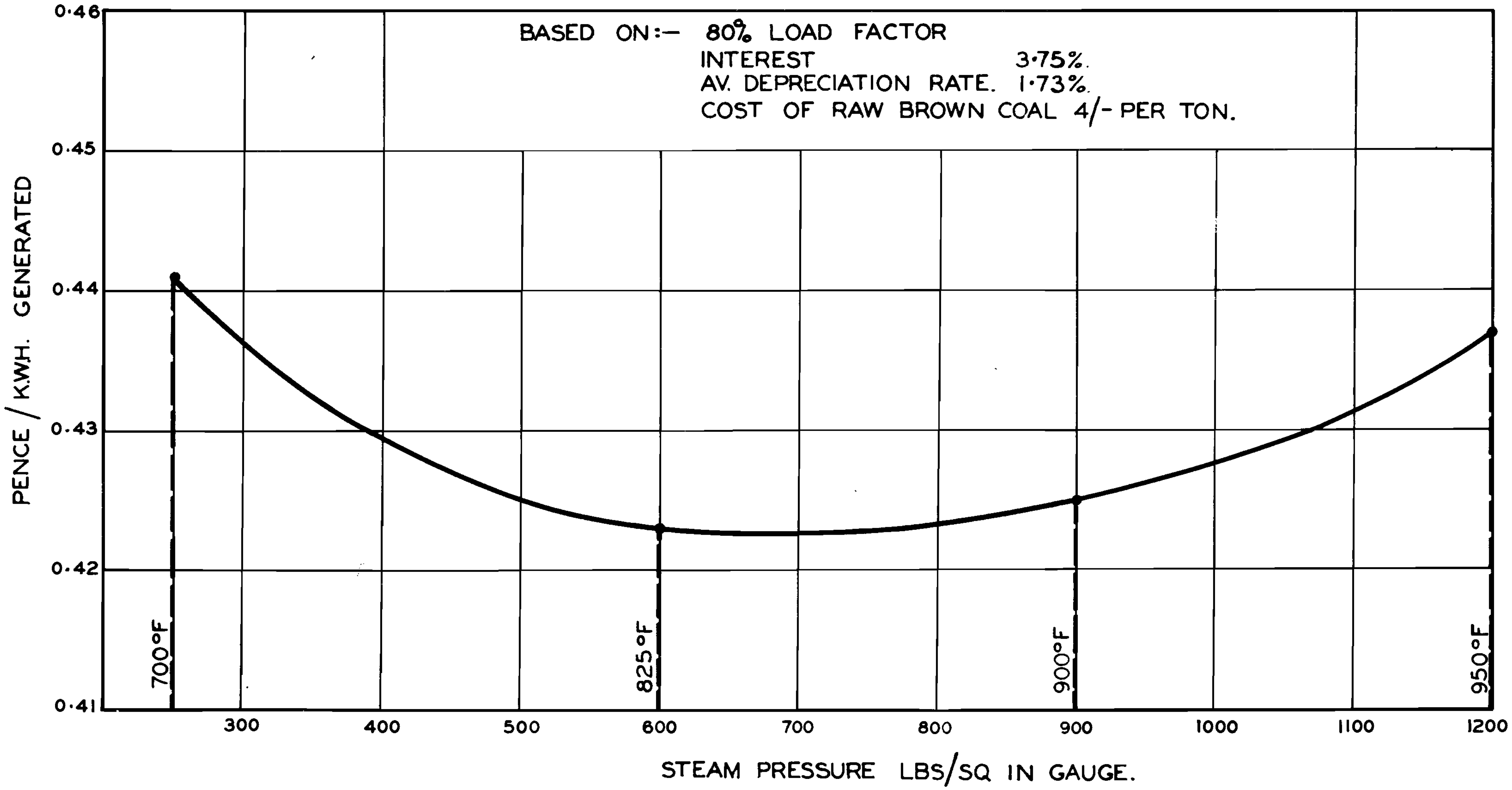
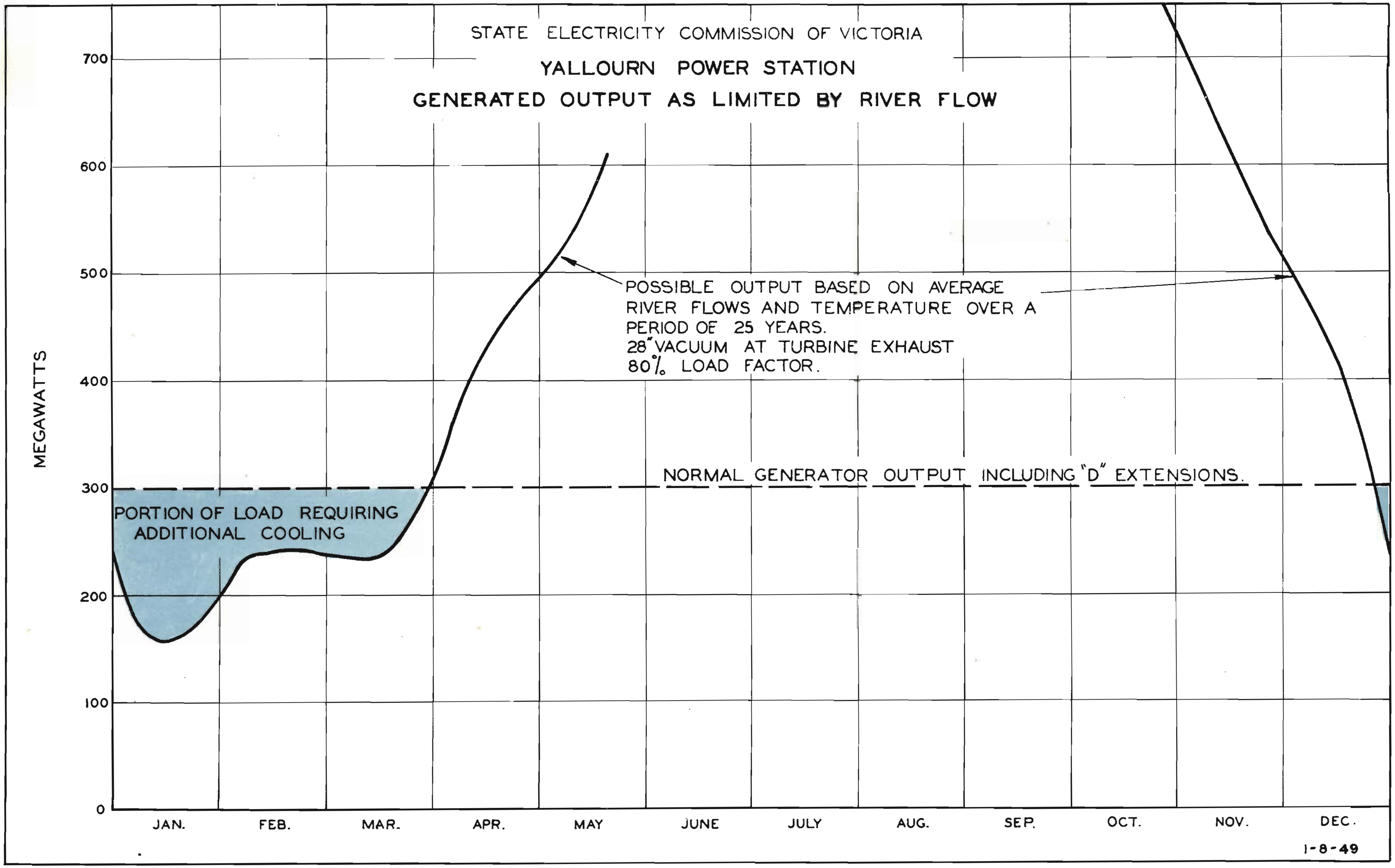


PLATE 5



STATE ELECTRICITY COMMISSION OF VICTORIA
YALLOURN POWER STATION
GENERATED OUTPUT AS LIMITED BY RIVER FLOW
MEGAWATTS
700
600
500
400
300
200
100
0
POSSIBLE OUTPUT BASED ON AVERAGE RIVER FLOWS AND TEMPERATURE OVER A PERIOD OF 25 YEARS.
28" VACUUM AT TURBINE EXHAUST
80% LOAD FACTOR.
NORMAL GENERATOR OUTPUT INCLUDING "D" EXTENSIONS.
PORTION OF LOAD REQUIRING ADDITIONAL COOLING
JAN.
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEP.
OCT.
NOV.
DEC.
1-8-49