1959

VICTORIA

REPORT

OF

STATE ELECTRICITY COMMISSION

ON

THE PROPOSED

HAZELWOOD POWER STATION

RETURN to an Order of the House
Dated 2nd September, 1959, for—

A COPY of the Report of the State Electricity Commission on the proposed Hazelwood Power Station.

(*Mr. Reid, Box Hill.*)

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PROPOSED HAZELWOOD POWER STATION

The Honourable G. O. Reid, M.L.A.,
Minister of Electrical Undertakings,
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, the proposed construction of a brown coal fired steam power station, with an installed capacity of about 1,200 MW, to be located in the Hazelwood area, two and a half miles to the south of the town of Morwell, and to be fuelled from the Morwell open cut.

2. The construction of this large power station was foreshadowed in your Statement to Parliament on 24th October, 1956, concerning the main activities of the Commission, on the basis that it would follow the Yallourn "E" Station (now under construction) and would be designated "Hazelwood".

3. The attached report of the Director of Engineering, dated 25th February, 1959 (Appendix "A"), describes the project in detail. This report has been adopted by the Commission.

4. The brown coal resources readily available in the selected locality will be sufficient to support a power station of at least 1,200 MW capacity, and it is proposed that the installation should comprise six 200 MW generating sets. In order to meet the minimum programme, the first generating set is required to be in service by the winter of 1964. The station would be completed to its full planned capacity by about 1970.

5. As condenser cooling water resources are restricted, it is necessary to have a cooling pond of some 1,500 acres water surface to the south and south-west of the power station. This will ensure the minimum use of water by avoiding the losses inseparable from cooling tower operation.

6. This report also surveys the anticipated growth of load on the Commission's generating system up to 1970 and the measures already adopted or proposed to meet this growth. The basis of this State's power development from 1963 up to 1970 is that the very substantial base load component will be met by the proposed installation of 1,200 MW at the Hazelwood Power Station. As to the peak load component, it can be expected that after 1963 further developments by the Snowy Mountains Hydro-Electric Authority will enable the Commission to rely on Snowy for any new peak load provision, at least up to 1970.

7. Specific authority to construct the first section of the Hazelwood Project with a capacity of 400 MW is sought, with provisional authority to order a third 200 MW set if tender prices received show that this step is advantageous to the State.

GROWTH OF SYSTEM DEMAND

8. The following table records the Commission's most recent estimates of the annual coincident maximum demand up to 1970:—

Calendar Year	Estimated Coincident Maximum Demand (MW) S.E.C. Estimate— April, 1958	Ebasco Estimate— November, 1956
1959	1,176	1,166
1960	1,265	1,249
1961	1,359	1,341
1962	1,464	1,440
1963	1,585	1,553
1964	1,707	1,673
1965	1,838	1,806
1966	1,976	
1967	2,122	
1968	2,275	
1969	2,437	
1970	2,612	

NOTE.—The figures include the Mildura-Redcliffs area from 1963 onward, when it is anticipated that this territory will be connected to the main system.

9. As the table shows, independent support for the Commission's estimates is provided by a forecast made in November, 1956, at the instance of the Commission, by Ebasco Services Incorporated of U.S.A., eminent electric utility consultants.

10. The Commission's estimate corresponds to a rate of growth averaging 8% per annum compounded over the years to 1965, and thereafter showing a gradual decrease to slightly more than 7% by the year 1970. This slower rate of growth has been introduced into the estimates for the sake of conservatism, but in fact, throughout the past 35 years, the Commission's growth has maintained a long-term average rate of 8% per annum, despite the temporary setbacks of the recession of the 1930's, World War II, and post-war electricity rationing.

BALANCED DEVELOPMENT OF GENERATING SYSTEM

11. The coincident maximum demand on the Commission's generating system determines the total capacity of generating plant which must be installed. But the proportions of the various types of plant making up this total are determined by the hour-to-hour loading throughout the year and by the most economical way in which this loading can be supplied.

12. On a typical working day, the daily load can be divided into two broad classifications — the base load, representing about 70% of the demand, sustained throughout the day and the night and falling off only for a short period during the early morning hours; and the peak load, about 30% of the demand, characterised by continual variations throughout the day and night, with sharply defined peaks and valleys.

13. For the long sustained base loading, fuel costs are all important, and in Victoria this load is most economically supplied by steam plant fuelled by raw brown coal and situated close to the coal field.

14. Fuel costs are less important in supplying the peak load. Much of this load is and can continue to be carried economically by power stations located near the loads they are to supply and using higher grade and more expensive fuels, such as briquettes and oil. However, an increasing proportion of the total peak load is being supplied by hydro-electric power stations, such as Kiewa, Eildon, and, in the near future, Snowy, which are specially planned for supplying this highly variable load of low energy content.

15. When the already authorised installations of new generating plant are complete in 1963, the loading met from the Latrobe Valley plants will be just under half of the total system load. This ratio needs to be improved gradually by increasing the base load plants on the brown coal fields to at least 70% of the total system generating capacity. Even with the Hazelwood plants completed by 1970 or thereabouts, the Latrobe Valley plants will still be no more than 60% of the total capacity.

The growth in peak loading, during the period when Hazelwood is being developed, will be met (a) by thermal plants (outside the Latrobe Valley) displaced from base load duty by the more economical Hazelwood plant; and (b) by further installations of hydro plant at Snowy.

PRESENT GENERATING CAPACITY AND PROPOSED ADDITIONS

16. The generating capacity of the Commission's interconnected generating system as at 30th June, 1959, will be as shown in the table below. The generating capacity of each station is shown in terms of its "Corrected Capacity", which is the actual maximum power which can be generated in the station under normally favourable conditions: in other words, it is the capacity which can be regarded as firm.

Station	Corrected Capacity as at 30th June, 1959 (MW)
Yallourn (including Briquetting)	389
Morwell	42
Newport	264
Richmond	48
Spencer Street	105
Geelong	40
Ballarat	20
Regional Diesel Stations	20
Kiewa	88
Eildon	100
Rubicon	13
Snowy	50
TOTAL	1,179

17. Further generating plant installations already approved, and the estimated Victorian share of Snowy power up to 1963, are as follows:—

Station	Addition to Corrected Capacity (MW)	Year in Service
Yallourn "E"	240	1961, 62
Morwell	109	1960-63
*Mildura-Redcliffs	22	1963
Kiewa No. 1	96	1960, 61
Snowy	170	1960-63
Total	637	
Less Reduction in Firm Capacity at Eildon and Plant Retirements	110	
Net Addition	527	
Corrected Capacity — 30th June, 1959	1,179	
Corrected Capacity — 30th June, 1963	1,706	

* The Mildura-Redcliffs 22 MW generating group is not new plant but is included as an addition to the interconnected system in 1963, when the transmission line to Mildura is planned to be completed.

The estimated coincident maximum demand for the year 1963 is 1,585 MW, leaving a margin of reserve of 7.7% for that year.

18. Beyond 1963, no installations are at present approved, but it is now known that the Snowy Mountains Authority intends to construct two further hydro-electric power stations by 1970, from which the share of the output allocated to Victoria is estimated to be 400 MW. The Hazelwood Station is planned for the first set to be in service in 1964 and the station to be completed to 1,200 MW about 1970. The proposed installation programme is set out in detail in the report of the Director of Engineering, from which it will be seen that ,to meet an estimated load of 2,795 MW, the planned system generating capacity as at 30th June, 1971, will be—

Station	Corrected Capacity as at 30th June, 1971 (MW)		
Yallourn (including Briquetting)	554	1,905 =	59.5%
Morwell	151		
Hazelwood	1,200		
Newport	228	463 =	14.5%
Spencer Street	105		
Other Thermal	130		
Kiewa, Eildon, Rubicon	213	833 =	26.0%
Snowy	620		
	3,201		100.0%

As already pointed out, even with the addition of 1,200 MW at Hazelwood, the proportion of Latrobe Valley plant will not have reached the desirable minimum of 70% of total system generating capacity.

RESERVE PLANT

19. A large generating system requires reserve capacity to provide for plant breakdowns, adverse operating conditions, exceptionally large load increases, national emergency, etc. The policy should be to provide a minimum reserve capacity to the extent of 10% of the estimated maximum loading or the capacity of the largest generating unit, whichever is the greater. The Ebasco view is that 15% would be more appropriate.

However, during the past year, the State generating system had no reserve plant of any significance. The Commission's anxieties concerning the resulting hazards of system operation are illustrated by an analysis which was made of the 240 working days in the 12-month period ending on 31st October, 1958. This disclosed that only on six of these 240 days had it been practicable to maintain a spinning reserve immediately available to cover the outage of even one of the large 50 MW sets at Yallourn. Furthermore, if there were added in the whole of the available plant, including the old unreliable and inefficient units which normally are withheld from service, there would still not have been sufficient plant to cover the loss of one of the 50 MW sets on 47 of the 64 working days in the critical months of June, July and August.

This gives especial point to the frequent references in official Commission reports to the lack of any reserve in the generating system, as well as to the reference on page 6 of the reprint of your special statement to Parliament on 24th October, 1956 (Hansard, page 5223). Hence the Hazelwood project, while providing for ultimate correction of this most serious operating disability, especially in meeting a system demand of 1½ million kilowatts (1963), cannot provide for complete rectification until about 1967, though the position will improve from 1961 onwards.

OTHER SOURCES OF POWER

20. In the period up to 1970, and probably beyond, the State's interests so clearly are served best by the concept of not less than 70% of its generating capacity being provided by Latrobe Valley plants, with dependence on Snowy for additional peak load generation, that discussion of less favourable alternatives to Hazelwood serves no useful purpose. But it is appropriate that this report should refer to the possible future impact of atomic power on Victorian electricity production. In the United Kingdom, for example, atomic power is now being developed to supply a substantial part of the base load requirement.

21. The Commission was represented at the second Conference on the Peaceful Uses of Atomic Energy, held at Geneva in September, 1958, at which a most comprehensive world survey of present-day atomic power developments was presented. While this conference revealed lines of development that evidently must lead eventually to reduced costs of atomic power, this does not call for any immediate revision of the following conclusions which had been reached following an International Symposium held in Sydney earlier in 1958, which had dealt with this same question but of course on a less representative scale than at Geneva—

(i) Operating costs of atomic power stations of the types now being built in Britain for commercial use are not competitive with the present and expected operating costs of the Commission's Latrobe Valley power stations.

(ii) An atomic power station in Australia would suffer further disabilities due to the lack of local facilities for economically processing spent fuel.

(iii) Atomic power stations of the present design are relatively inflexible in operation, and their use would simply increase the Commission's overall generating costs by forcing existing base load thermal stations into less economic operation at variable loading.

22. It is obvious that with the rapid rate of scientific progress in the field of nuclear energy, the Commission must continue to keep abreast of such developments in their influence on the studies of Victoria's plans for power generation after 1970. These studies have already commenced.

BASIC DESIGN FEATURES

23. The description of the project on pages 15 and 20 of Appendix "A" does not need to be amplified in this report, but the following aspects have had especial attention in formulating the overall plans:—

(a) The coal resources not only are quite adequate for the existing Morwell power and briquette development plus Hazelwood, well beyond the useful lives of all these plants, but a somewhat greater installed capacity of power plant also could be served from the Morwell open cut without overtaxing it.

(b) The power station is sited clear of winnable coal and is well removed from open cut workings and possible earth movements.

(c) When Hazelwood is complete, the Morwell open cut will have been gradually brought to an annual production of 19 million tons of coal.

(d) Until tenders are received it will not be decided whether each 200 MW unit will be served by a single boiler (1.4 million lb./hr. capacity) or by two boilers.

(e) The choice of sets of 200 MW capacity accords with latest overseas developments and with the advice given by Ebasco Services Incorporated of U.S.A.

(f) Power generated in the Hazelwood Station will be stepped up in voltage to 330 kV and transmitted to the metropolitan area. These transmission lines will not be on the existing Morwell-Yallourn-Melbourne transmission line easements.

(g) In the choice of sets as large as 200 MW to operate in a system of 1,800 MW capacity (1964), it has been kept in mind that during 1959 the main generating systems of New South Wales and Victoria will be interconnected through their 330 kV transmission systems. The two State Commissions are negotiating an agreement for the interchange of electricity to their mutual benefit. Thus the 200 MW Hazelwood sets will, in effect, be operating in a system of some 4,000 MW capacity, which is an entirely acceptable condition.

(h) The area adjacent to the Morwell open cut is not plentifully supplied with natural water courses. The condensing water requirements of a station of 1,200 MW are large, and at the location concerned are best met by a cooling pond. Such a pond of 1,500 acres water surface is to be formed adjacent to the power station by flooding a natural depression. Most of the water needed for filling the pond will be the recoverable effluent water from the Morwell briquette factories, originally drawn from the Moondarra (Tyers River) system of the Latrobe Valley Water & Sewerage Board.

(i) Fire fighting services and open cut fire prevention are being provided for by a storage reservoir of 120 million gallons capacity near the open cut. This water will be drawn from the same source, i.e., briquette factory effluent water.

TERRITORIAL NEEDS

24. In territorial matters such as housing, road and rail access, water to maintain the cooling pond level and water supplies for boiler feed and other power station needs, the Commission recognises the need for the closest co-operation where the interests of other Government utilities or like organisations can be involved. For example, the Latrobe Valley Water & Sewerage Board's Moondarra system will serve the permanent water needs of the power station, and it is preparing to make the supply available when required. In the early stages of construction the Morwell Waterworks Trust will supply the needs for works purposes. However, most of the problems involving interests outside the Commission already are under discussion with the authorities concerned.

25. Housing and works accommodation for single men is governed by the intention to commence the preliminary earthworks by contract at Hazelwood this year. The numbers employed on construction, mainly by contractors, will increase year by year, probably reaching a peak during 1962. As construction employment decreases in the later years, the numbers engaged on power station operation will increase, and it is expected that the total number engaged on Commission work at Hazelwood, Morwell and the Open Cut will stabilise at about 3,000.

26. During the construction phase, contractors will be responsible for the accommodation of their employees. Hostel accommodation will be provided by the Commission for single men on the permanent operating staff. For the housing of the married men and their families, reliance will be placed on the Housing Commission and private investment.

FINANCIAL

27. The capital estimates summarised hereunder are assembled in a form that permits—

(i) approval in principle of the 1,200 MW project;

(ii) firm authority to be given the Commission to develop the project up to 400 MW by 1965, with the proviso that a third set of 200 MW would be ordered if advantageous to the State.

NOTE:—As to the continuing expenditure under (ii), review by Parliament in any event will occur in 1961, when legislation will be needed to again raise the borrowing limit of the Commission.

Estimated Capital Cost – Hazelwood Power Station

	400 MW £	1,200 MW £
Single Unit Boiler Arrangement		
Power Station	34,948,000	89,150,000
Morwell Open Cut	3,500,000	10,000,000
TOTAL	38,448,000	99,150,000
Two Boilers per Turbine Arrangement		
Power Station	37,121,000	95,795,000
Morwell Open Cut	3,500,000	10,000,000
TOTAL	40,621,000	105,795,000

(a) These estimates are detailed on pages 21 to 23 of Appendix "A".

(b) The estimates for the power station have to be confirmed by tenders closing on 3rd June, 1959. Until then a choice between single unit boiler arrangement and two boilers per turbine cannot be made.

(c) The estimates are at October, 1958, price levels.

(d) The estimates include the transformers and switchgear up to the outgoing 330 kV transmission lines at Hazelwood Power Station. They exclude the consequential capital expenditure for transmission from Hazelwood to metropolitan and country load centres.

28. **Estimated Capital Cost for Transmission to Load Centres**

	400 MW £	1,200 MW £
Transmission Lines	5,660,000	8,440,000
Terminal Stations	5,110,000	14,230,000
TOTAL	10,770,000	22,670,000

(a) These estimates provide for the 330 kV transmission lines from Hazelwood, 220 kV interconnectors and radial lines, transformer, switchgear and reactive equipment in the 330 kV and 220 kV metropolitan and regional terminal stations.

(b) The estimates are at October, 1958, price levels.

29. In accordance with current practice, interest incurred during construction, totalling approximately £11 million for the 1,200 MW power station and its associated coal winning and transmission facilities, or £4.8 million to the 400 MW stage, will be met from the Commission's revenues and forms no part of the final capital cost in the Commission's books.

30. The estimated costs and time programmes stated are based on the premise that capital funds will be forthcoming as required. The financing of expenditure of this magnitude will present a special problem which the Commission is closely examining: any shortage could result not only in a delay in the time schedule but also an increase in the overall cost.

Practically all of the work will be undertaken by contract, and the Commission, in an endeavour to spread the incidence of payments in respect of major works, is seeking alternative offers based on payments over an extended period.

EXPECTED OPERATING RESULT

31. The addition of a large station, such as Hazelwood, to the interconnected system will affect, to a greater or lesser degree, the unit costs of all other stations, because there will be a re-arrangement of loading, the new and more efficient station taking as large a proportion of the total system loading as practicable.

Thus the unit cost of the Hazelwood Station does not, by itself, express completely the economic value of the station to the whole system. Furthermore, the position changes from year to year with changes in loading on the various stations.

32. However, as an indication of the effect on total system generating costs of the Hazelwood Station, the following expected operating results may be compared with the budgeted costs for the Yallourn "C" and "D" stations in 1958/59—

Item	Yallourn "C" and "D" 200 MW	Hazelwood 400 MW Stage	Hazelwood 1,200 MW Stage
Fuel	0.22d.	0.13d.	0.12d.
Capital Charges	0.34d.	0.26d.	0.22d.
Operation, maintenance and other charges	0.25d.	0.20d.	0.15d.
Total cost per kWh sent out	0.81d.	0.59d.	0.49d.

NOTE.—The above estimated fuel costs per kWh are based on approx. 7/6d. per ton of coal for Yallourn "C" and "D"; on 7/- per ton for Hazelwood at the 400 MW stage, and 6/6d. per ton at the 1,200 MW stage.

RECOMMENDATION

33. It is recommended—

(a) that approval be given for the construction of the Hazelwood Power Station of an ultimate installed capacity of 1,200 MW, as detailed in this report, and that the project be submitted on that basis for the approval of the Governor in Council as an "undertaking" within the meaning of the State Electricity Commission Act.

(b) that the Government authorise the Commission to proceed with the first section of the project up to 400 MW, with authority to order a third 200 MW set if tender prices in response to the invitation for the public tenders which close on 3rd June, 1959, show that this step is advantageous to the State.

34. The expenditures to the earlier stages for the power station and open cut are between £38,448,000 and £40,621,000 for the 400 MW stage, and between £56,726,000 and £60,420,000 for the 600 MW stage. Expenditures on transmission are estimated at £10,770,000 up to the 400 MW stage and £14,100,000 up to the 600 MW stage.

35. The ultimate cost of the 1,200 MW station, including the related expenditure to expand the output of the Morwell Open Cut, is estimated at between £99,150,000 and £105,795,000, and the parallel expenditure on facilities for the transmission of the power generated to metropolitan and country load centres is estimated at £22,670,000.

COMMENDATION

36. The Commission expresses appreciation of the valuable services rendered by all those officers who have contributed to the engineering and economic investigations necessary to enable this report to be submitted. The proposals presented are based on investigations under the direction of the Commission's Director of Engineering, Mr. N. T. Jewell, M.E.E., A.M.I.E. Aust., which were carried out by the several Engineering Branches of the Commission's Design and Construction Department, the Head of which is Mr. A. R. Shepley, B.C.E., B.Sc., M.I.E. Aust., Engineer for Design and Construction.

• • •

We have the honour, Sir, to submit the foregoing for your consideration,

W. H. CONNOLLY, Chairman,

A. W. HENDERSON, Commissioner.

A. A. FITZGERALD, Commissioner.

B. A. MORRIS, Commissioner.

D. H. MUNRO, Secretary.

5th March, 1959.

APPENDIX "A"

STATE ELECTRICITY COMMISSION OF VICTORIA

REPORT

OF

DIRECTOR OF ENGINEERING

(MR. N. T. JEWELL, M.E.E., A.M.I.E. AUST.)

ON

PROPOSED HAZELWOOD POWER STATION

25th February, 1959

To meet the continually growing load on the Commission's interconnected system, generating plant additional to that already approved for installation will be needed, and, to that end, it was decided in May, 1955, that the next power station to be constructed should be located at Hazelwood and supplied with coal from the Morwell Open Cut. This is in accordance with the principle of locating new power stations on the brown coal fields in the Latrobe Valley to the extent which will bring the capacity of those stations to something over 70% of the total generating capacity available.

It is proposed that the Hazelwood Station shall consist of six 200 MW generating units. There is sufficient coal available in the top seam of the area delimited for the present Morwell Open Cut to supply the Morwell Power Station and Briquette Factories now under construction, the proposed 1,200 MW Hazelwood station and, if necessary, two additional briquette factories at Morwell for the full lives of those plants. Based on the latest tentative information on the probable dates of availability of future increments of power from the Snowy Scheme, it appears that the Hazelwood Station need not be completed till 1971. By that time, the estimated total system load will be approaching 3,000 MW, and, even with the addition of the 1,200 MW Hazelwood Station to the system, the total generating capacity located in the Latrobe Valley will not reach 70% of the total generating capacity available. Thus, a 1,200 MW station is not too large from that aspect, and, as the station will contain only six generating units, it should not be too large from the operating aspect.

There is set out below an up-to-date revision of the table of estimated load and plant capacity included in the Statement on the State Electricity Commission made by the Minister of Electrical Undertakings to Parliament on 24th October, 1956—

Year	Estimated Load (April, 1958)	"Minimum" Programme to meet Estimated Load and Provide some Reserve Plant			
		Firm Plant Capacity in Megawatts			Margin of Reserve
1958	MW 1,088 (Actual load was 1,103 MW)			1,091	—
		Yallourn "D'	20		
		Morwell	42		
		Spencer Street	20		
		Snowy (T1)	50		
		Warrnambool (set restored to service after repair)	1		
		Ballarat "A"	— 5		
		Richmond	— 4		
		Newport "A"	—36		
				88	
1959	1,176			1,179	—

		Morwell	24		
		Snowy (T1)	50		
		Richmond	— 5		
		Kiewa (No. 1)	32		
				101	
1960	1,265			1,280	1.2%
		Yallourn "E"	120		
		Morwell	25		
		Kiewa (No. 1)	64		
		Richmond	— 5		
		Geelong "A"	— 3		
				201	
1961	1,359			1,481	9.0%
		Yallourn "E"	120		
		Snowy (T2)	53		
		Eildon	—10		
		Geelong "A"	— 4		
				159	
1962	1,464			1,640	12.0%
		Morwell	60		
		Snowy (T2 and Guthega)	67		
		Mildura and Redcliffs	22		
		Eildon	—47		
		Newport "A"	— 6		
		Newport "B"	—30		
				66	
1963	1,585			1,706	7.7%
		Hazelwood	200		
		Yallourn "A"	—50		
		Geelong "A"	— 3		
		Eildon	—27		
				120	
1964	1,707			1,826	7.0%
		Hazelwood	200		
		Yallourn "A"	—13		
				187	
1965	1,838			2,013	9.6%
		Snowy (M6)	127		
				127	
1966	1,976			2,140	8.3%
		Hazelwood	200		
		Yallourn "A"	— 6		
				194	
1967	2,122			2,334	10.0%
		Hazelwood	200		
		Snowy (M6)	126		
		Yallourn "A"	— 6		
				320	
1968	2,275			2,654	16.7%
		Snowy (M7)	73		
				73	
1969	2,437			2,727	11.9%
		Hazelwood	200		
		Snowy (M7)	74		
				274	
1970	2,612			3,001	14.9%
		Hazelwood	200		
				200	
1971	2,795			3,201	14.5%

Note.—The minus signs indicate reductions in plant capacity due to retirements or other causes.

The above table includes plant capacity from the Murray stations of the Snowy Scheme in accordance with advice received from the Snowy Mountains Hydro-Electric Authority in January, 1959, and as a consequence, the third Hazelwood set has been deferred to 1967 from the previously proposed service date of 1966. The programme in the later years will depend very much on the load growth actually realised and on the outputs finally available from the Murray stations of the Snowy Scheme, and can be rearranged to suit requirements at the appropriate time.

The selection of 200 MW sets for the station is based on the largest proved design available at present, and takes into account the ratio of a set of this size to the total system capacity. Further, sets of such size will achieve the objective of obtaining reasonable increments in system capacity in the shortest possible time at a minimum cost. While sets of larger size may be available before completion of the station, it can be seen from the table above that, unless load growth is greater than now estimated, any set larger than 200 MW would form a somewhat unduly large proportion of the total system capacity, and, therefore, it is probable that the station will be completed with 200 MW sets.

LOCATION OF STATION AND SITE LAYOUT

The proposed location of the station is shown on the attached Drawing No. OG. 58/1/1, which also shows the Commission's and other projects in the Latrobe Valley. The station will be situated approximately 1¾ miles south-west of the Morwell Power Station and Briquette Factories and on the easterly slope of the Morwell Ridge. Drawing No. OG.58/1/2 shows to a larger scale the location of the station relative to works in the Morwell area. Information available from test bores shows that, on the western slopes of the Morwell Ridge, the coal level is approximately 60-80 feet below the surface, whilst, on the eastern slopes, it drops away to 300 feet. Significant earth movements (due to the effect of open cut operations), which could adversely affect foundations, can be expected on the western slope of the Ridge, and it was, therefore, decided that the station should be located on the eastern slope where the deep overburden and the increased distance from the edge of the open cut will ensure satisfactory conditions; consequently, further consideration was limited to this area. The Morwell Briquette Factories are similarly located on the eastern slope of the Ridge at a point where the overburden depth is also in excess of 200 feet.

Rail access to the station will be provided by a single track extension of the Victorian Railways system at the Morwell Power Station and Briquette Factories.

Road access to the station will be provided from three directions, the major road being taken from the West Jeeralang Road, while other roads will connect to the Ridge Road and to the Midland Highway.

Drawing No. OG.58/1/3 shows the proposed site plan of the station.

An unusual feature of the station is that requirements of circulating water, general services and fire service water will be provided from a cooling pond, the surface area of which will be 1,500 acres approximately.

Coal from the Morwell Open Cut will be supplied to the Power Station by means of conveyors.

STEAM CONDITIONS AND STEAM CYCLE

In this particular case, three main factors enter into the question of steam conditions. Firstly, there is the question of whether there should be one boiler or two boilers per turbo-generator. Having regard to the fuel to be used, two boilers per turbo-generator may be preferable to one from the availability angle, on account of the large size of boiler involved with only one boiler per turbo-generator. Secondly, there is the matter of reheat and the complications which might ensue with reheat if there were two boilers per turbo-generator. Thirdly, there is the question whether a 200 MW turbo-generator without reheat (i.e. operating on a straight condensing cycle) is a practicable proposition.

The number of reheat installations with two boilers per turbo-generator, when taken on a world-wide basis, is very small. It is, therefore, concluded that, if reheat is adopted finally, it should be on the unit boiler basis. Inquiries have revealed that there is no fundamental difficulty in a 200 MW straight cycle turbo-generator operating at a pressure of either

1,800 lb./sq.in. or 1,500 lb./sq.in. Consequently tenders will be invited on the following alternative steam conditions:—

(a) 2,350 lb./sq.in., 1,050°F at the turbine stop valve, with reheat to 1,000°F;

(b) 1,800 lb./sq.in., 1,050°F straight cycle } at turbine stop valve.
(c) 1,500 lb./sq.in., 1,050°F straight cycle }

Under (a), there would be one boiler per turbo-generator, while, under (b) and (c), tenders will be obtained for both one boiler and two boilers per turbo-generator. Conditions under (a) are the standard adopted in the United Kingdom and the United States for installations such as the one proposed. However, either of the conditions under (b) or (c) is acceptable should special considerations in our particular case render them preferable.

The lower pressure of either 1,800 lb./sq.in. or 1,500 lb./sq.in., in combination with the maximum temperature (1,050°F) permissible without recourse to austenitic steel pipework, does avoid the necessity for reheating, and, therefore, would permit a simple two boilers per turbo-generator arrangement. This latter arrangement may be desirable in order to limit the boiler capacity out of service at any one time, but a decision on this need not be made until further information is available, including that which will be given by tenderers in their tenders.

STATION CAPACITY

For the purpose of this report, the ultimate station capacity has been assumed to be 1,200 MW. The final maximum capacity which can be installed with the cooling pond as at present envisaged is dependent upon the steam pressure and temperature adopted. Steam conditions of 2,350 lb./sq.in. and 1,050°F, with reheat to 1,000°F, permit about 12% greater capacity for the same vacuum conditions than would be possible with steam conditions of 1,800 lb./sq.in. or 1,500 lb./sq.in. and 1,050°F without reheat.

The first stage installation will be two 200 MW units, although the specification will provide for an optional extension of 200 MW should prices be favourable and circumstances warrant the increase in the installed capacity.

STATION EFFICIENCY

For the highest steam conditions, it is envisaged that the designed boiler efficiency will be approximately 80%, based on the expected average net calorific value of Morwell coal, i.e., 3,450 B.T.U. per lb. for coal with a moisture content of 63%.

The average annual operating costs do not vary significantly with a small variation (up to 5%) in boiler efficiency. In order to reduce capital expenditure as far as possible, the selection of a boiler efficiency toward the lower end of the acceptable scale is considered justified by the low cost of fuel, and by the fact that a boiler efficiency of the order of 80% will ensure a final gas temperature sufficiently high to give a reasonable temperature differential and to avoid back-end fouling and corrosion of mild steel elements of air heaters.

The designed overall station efficiency on the net calorific value of the fuel for the highest steam conditions is expected to be approximately 34%, based on units generated. Power required for auxiliaries reduces this to 31.3%, on the basis of units sent out. Deterioration from test conditions and higher summer circulating water temperature further reduce the figure to 29.3%, on the basis of average annual units sent out. For the lower steam conditions, the respective figures are for the same boiler efficiency — 32% designed generated basis, 29.7% designed sent-out basis, and 27.8% for the basis of average annual units sent out

GENERAL LAYOUT OF STATION

The type of boiler plant envisaged is of the semi-outdoor type. It will be very similar to, but, in the case of unit sets, larger than, that provided for Yallourn "E" Power Station.

The arrangements tentatively proposed for the turbine house provide that the majority of the auxiliary plant be located under the main turbine house crane. The turbine house width will be that required to permit the boiler feed pumps and feed heating arrangements to be located in the turbine house annexe adjoining the boiler house. In this arrangement, the annexe is fully used, containing, on successive levels from the basement, the electrical annexe, unit control room, tank floor and bunkers.

Other arrangements of plant will be investigated following the receipt of tender information.

GENERAL DESCRIPTION OF THE STATION

The following is a brief description of the more important items of work covered by the headings under which the estimated cost figures are segregated (see later in this report)—

1. Land and Preparation of Site –

The land on which it is proposed to erect the power station itself is already the property of the Commission. Provision is made for the acquisition of approximately 1,550 acres of land for the cooling pond.

2. Buildings and Improvements –

The principal items in this section are the turbine house and the foundations for both turbine and boiler houses. The boiler house structure has been included under "Boiler Plant and Chimneys", as it appears logical to include it under that heading inasmuch as the boiler house will be supported directly from the boiler steelwork.

The boiler spacing proposed is 150 foot centres for unit boilers and 120 foot centres for two boilers per set, and is considered to be reasonable for adjacent boilers, but confirmation of this and other major dimensions must await the receipt of information supplied with the tenders. Assuming that the dimensions cited are not exceeded, the arrangement gives a volume/capacity ratio of approximately 30 cu.ft./kW for boiler house and turbine house buildings, a figure which is comparable with similar United Kingdom plant layouts and should ensure low building costs.

As has proved the case at Yallourn "E" Power Station, the adoption of semi-outdoor boiler plant will result in a simpler and cheaper form of building construction.

Amenities Blocks.—Provision has been made for permanent amenities blocks for the use of power station personnel, and for other amenities blocks of a temporary nature for joint use by Commission and contractors' construction personnel. The size and location of these blocks can only be tentative at this stage (as they also are for other ancillary buildings) pending further consideration of the work forces involved, which will depend on the design of the major plant and the installation programme.

Administrative Office Block.—Provision has been made for a separate administrative office block. It is envisaged that all power station staff, except shift operation personnel, will be housed in this block, which will contain all facilities for amenities, first aid and sanitation, etc., as well as drawing office, laboratories, records section and general office accommodation, including that for the timekeepers, etc. If erected in the early stages, this building could also serve construction staff.

Workshop and Store.—The proposed workshop and store will be of a size sufficient, in the case of the former, to handle only the general maintenance work required. Major workshop facilities are available at Yallourn and Morwell, and road connection with these facilities will be provided. The stores building is intended to hold normal power station plant spares and expendable stores only.

Garage and Car Parking Facilities.— In view of the size of the project, and in anticipation of the concurrent erection in various stages of possibly three or four boilers and associated plant which will require a large work force, it is considered advisable to make provision for ample car parking space for cars belonging to construction personnel, and it is tentatively proposed to locate this immediately outside the station area. It is also proposed to construct a bus terminal in a suitable position. Garage space for a power station car pool will also be provided.

Rail Tracks.—The main rail access will be a single track extension of the Victorian Railways system from the Morwell Power Station and Briquette Factories, as shown on Drawing No. OG.58/1/2, connecting across a causeway with the station rail system.

Rail tracks on the site have been designed to provide access to both ends of the completed turbine house and to the workshop and store. On the construction store area, a layout of rail loops, with direct connection back to the main track, has been provided to ensure that stagnation of rail trucks does not occur. Rail tracks have been set out with a minimum radius of 300 feet, which is sufficient for Victorian Railways shunting locomotives and vehicles, including the proposed stator and transformer vehicle designed to transport similar plant for Yallourn "E" Station. Further examination of the rail track layout will be made after receipt of tenders to determine the essential minimum requirements.

Roads.—Road access has been provided from three points, as tentatively shown on Drawing No. OG.58/1/2, the major road being taken from the West Jeeralang Road and running parallel to the rail track. The road connecting directly to the Ridge Road and thence giving direct access to the Morwell Project Workshops is considered necessary, as no major workshop will be provided on the station area. The third road provides connection to the Midland Highway to the south.

The cooling pond dividing bank will also be constructed with a crest road for maintenance and inspection purposes. Access to the periphery of the cooling pond is generally available from existing and diverted public roads.

General.—Whilst the proposals for the abovementioned section are based on a general layout of the site, some modification to this layout will probably be necessary as further information relating to the type of plant, manning schedules, construction force, etc., becomes available.

3. **Coal Handling Plant –**

The daily coal requirements for each unit boiler or two-boiler group will be approximately 7,000 tons, and initially will be drawn from a transfer house on the conveyor line between the open cut ditch bunkers and the Morwell Power Station and Briquette Factories, as shown on Drawing No. OG.58/1/2.

The arrangement of the conveyor system from this point to the Hazelwood slot bunkers is dealt with under the heading "Supply of Coal to the Power Station from Morwell Open Cut."

The coal handling system at the station will consist of—

(a) Slot bunkers with a total storage capacity of approximately 12,000 tons.

(b) A crushing station in which the coal is crushed to a suitable size and screened.

(c) Bunker discharge wagons which extract coal from the slot bunkers and load conveyor belts delivering coal to the crushing plant.

(d) Duplicate conveyor belts to each 400 MW section of the boiler house transfer stations at front and rear or either side of the boiler house (assuming eight mills are used).

(e) Shuttle conveyors for distributing the coal to the boiler bunkers.

Each line, comprising bunker discharge wagons, crushers, screens and conveyors, would have a capacity of 1,400 tons per hour.

4. **Ash Handling and Disposal Plant –**

A hydraulic ash handling plant, similar in design to that adopted for Yallourn "E" Station, is proposed. The system is adaptable to the collection of fine ash and dust from the multitude of points inherent in pulverised fuel boilers, and finally delivers the ash in a condition suitable for disposal by pumping to the disposal area.

Preliminary investigation of several methods of ash disposal indicates that the adoption of a full hydraulic system, capable of the disposal of ash to the adjacent areas shown on Drawing No. OG.58/1/2, is to be preferred. Investigation into the characteristics of ash from Morwell coal, particularly when the ash is mixed with water for disposal, is being undertaken. The three disposal areas, as shown on Drawing No. OG.58/1/2, should provide capacity until approximately 1984.

5. **Boiler Plant and Chimneys –**

It is proposed that the boiler plant will consist either of six unit boilers, each of approximately 1,400,000 lb./hr. capacity, operating with turbine stop valve conditions of 2,350 lb./sq.in. and 1,050°F, with reheating to 1,000°F, or, alternatively, of six boilers, each 1,600,000 lb./hr., or twelve boilers, each 800,000 lb./hr., with steam conditions at turbine stop valve of 1,800 lb./sq.in. or 1,500 lb./sq.in. and 1,050°F.

The boilers will be arranged in line parallel to the centreline of the turbines. The fans and chimneys will be arranged at ground level at the rear of the boilers with the intervening space available for externally located air heaters and dust collectors. The saving in building costs, resulting from the adoption of semi-outdoor plant, is expected to be substantial, as it was in the case of Yallourn "E" Station, mainly due to reduced civil engineering costs.

There will be one gunite- or brick-lined chimney of the self-supporting type, approximately 350 feet high, serving each boiler. It is possible that offers for reinforced concrete chimneys will also be received.

Pulverised fuel firing being a necessity for brown coal boilers of this size, the boilers will be equipped with all plant required to achieve high availability and minimum atmospheric pollution. For the first (400 MW) stage, there will be either two or four boilers.

The main firing equipment will be supplemented by starting-up equipment — probably auxiliary briquette pulverising mills as at Yallourn "E".

6. **Turbo-Generators and Condensing Plant –**

The final installation at present proposed will comprise six turbo-generators of the tandem compound design, each having a continuous maximum economic rating of 200 MW, operating at one of the alternative pressures already referred to.

If stop valve steam conditions of 2,350 lb./sq.in. and 1,050°F are adopted, steam would be exhausted from the high pressure section of the turbine to the reheat section of the boiler, and thence to the intermediate pressure section of the turbine at 1,000°F.

The machines will be arranged longitudinally in the turbine house, probably with the steam ends of each pair of machines adjacent.

The arrangement and capacity of main turbine house cranes will depend principally on the information obtained from turbine manufacturers. However, it is intended to obtain prices for one electric overhead travelling crane of approximately 150-ton capacity, with suitable auxiliary hoists, and, as an alternative arrangement, for a similar type of crane with a capacity of approximately 60 tons, together with special stator and rotor lifting gear which would operate entirely separately from the main crane.

The heaviest probable lift, i.e., the generator stator, will be of the order of 150 tons. The overhead crane must be installed at an early date in the programme to be of use in the erection of plant.

Generators will be of the water or hydrogen gas-cooled type, and generation voltage will probably be between the limits of 15,000 and 20,000 volts.

The condensers for the turbines will be proportioned to allow the machines to develop their maximum continuous rating when supplied with water at approximately 90°F.

A unit control room, in which will be mounted all the control equipment for both boilers and turbines for the first two units, will be provided centrally located to the plant. Control of turbine and boiler auxiliaries, the station service system, and the generator 330 kV circuit breaker will be arranged in this unit control room, as well as the turbovisory equipment. The synchronising loading and voltage control of the individual units will be effected at this location. Similar unit control rooms will be required for each additional pair of units added to the station.

In addition, a station control centre will be provided, located on the south side of the turbine house between the second and third units, from which the supervision of operation and loading of the station and individual units and the supervision of the switchyard and switching of the 330 kV transmission line circuit breakers will be effected. This control centre will be the communications centre for the station, and will be in continuous contact with System Control and coal winning operations, and will contain all equipment required to ensure satisfactory and efficient operation of the station as a whole.

7. **Steam and Feed Piping and Plant** –

The feed water plant will include bled steam heaters and de-aerating equipment — all arranged to give suitable boiler feed at a temperature of 460°F, which is the accepted standard for the steam conditions of 2,350/1,050/1,000. A slightly lower feed temperature will be specified for the lower steam conditions.

The type of feed heating plant which will be adopted is expected to be similar to that selected for Yallourn "E" Station, having all feed water heating on the suction side of the main feed pumps. Lift pumps delivering to the heaters are usually associated with this arrangement.

Condensate storage tanks, designed for pressure, in order to maintain sufficient head on lift feed pump suction to avoid the effect of high temperature water on pump performance, will be required. These tanks are made to act as de-aerators, thus avoiding the necessity for the provision of separate de-aerating plant.

It is intended that two sets of lift and main feed pumps will be provided for each unit, each pump set having a capacity of approximately 1,540,000 lb./hr. for the highest steam conditions and approximately 1,820,000 lb./hr. for the lower steam pressures.

Boiler feed water make-up plant with a total capacity of approximately 250,000 lb./hr. (approximately 3% of total boiler output) has been provided for. The plant will probably be arranged in two sections, and is expected to be similar to the demineralising plant for Yallourn "E" Station. Raw water supply will be obtained from the reticulation at the Morwell Power Station.

Tanks for the storage of filtered and unfiltered water are included in this section, whilst provision is made for all necessary general and fire service water pumps and reticulation piping. Also included are high pressure main steam and reheat steam piping (where required), feed and condensate piping, together with drain and bled steam piping other than that included as an integral part of boilers or turbines.

8. **Circulating Water System** –

The circulating water system will consist of a screening plant located on the south-western side of the site, as shown on Drawing No. OG.58/1/3, from which a single inlet conduit will lead to the circulating water pump pits. A deep intake to the screen pits will be provided so that water will be drawn into the pumps from a depth of 25-30 feet below the surface of the pond.

There are included, for each 200 MW unit, two 100% duty circulating water pumps located in circular pits immediately adjacent to the inlet conduit and between the transformer bay and the switchyard. Each pump is envisaged as being capable of delivering approximately 3,250,000 gallons of water per hour for the highest steam conditions and 4,000,000 gallons of water per hour for the lower pressure installations. These quantities provide for circulating water requirements and include an allowance of 5% for air and oil cooler requirements. The pumps will be mounted as in Yallourn "E" Station, with the motor mounted directly above the pump.

The outlet conduit will be located on the centreline of the switchyard, normal to the turbine house axis, and deliver to the discharge channel in the cooling pond.

Cooling Pond.—Circulating water and water for general services will be drawn from the proposed cooling pond located in the natural depression in the area to the south-south-west of the station site.

The pond is designed for an ultimate surface area of approximately 1,500 acres with full supply level at R.L.260′ 0″, and will be formed by an earth dam across Eel Hole Creek at the south end of the Morwell Ridge and by an earthen embankment running parallel to Switchback Road. For the first (400 MW) stage, a somewhat smaller area and lower full supply level for the pond are acceptable, and it is proposed to build the retaining dam and embankment to a height suitable for a full supply level of R.L.255′ 0″. There will be no difficulty in raising the dam and embankment to provide the ultimate full supply level of R.L.260′ 0″ at a later date when required. Some deviation of existing roads will be necessary, and relocation of a section of the Gas and Fuel Corporation's main will also be required.

Circulation of water within the pond will be controlled by dividing banks as required Generally, water from the circulating water outlet after entering the pond adjacent to the south-east side of the station site will be led to the southern end of the pond, and thence back through the inlet side of the pond.

It is proposed to erect outlet and spillway structures in the Eel Hole Creek Dam; the former will permit a gradual replacement of the water over, say, 10 years, thus keeping salinity to a satisfactory figure, while the latter structure will function only in times of flood conditions. The pond at the northern end will abut on the proposed causeway which carries the road and rail track, and defines the southern limit of the probable initial ash disposal area. It is proposed to connect the cooling pond with the Morwell Low Level Reservoir north of the station. (This reservoir is being established as part of the coal area fire fighting resources.) Make-up water for the pond is available from a number of sources, the principal one being the Tyers River. This make-up water includes recoverable water from the Morwell Briquette Factories, and will be diverted via the Morwell Low Level Reservoir. Minor contributions will be available from Eel Hole Creek and Bennett's Creek diversion, and, at a later stage, water will also be pumped from the Morwell River.

The total area of land which it will be necessary to acquire to establish the cooling pond is about 1,550 acres.

9. **General Equipment –**

The overhead travelling crane and alternative lifting gear in the turbine house have been dealt with under the heading "Turbo-Generator and Condensing Plant".

In the boiler house, passenger lifts, one for each unit boiler or one for each pair of smaller boilers if adopted, and electric hoists for the adequate handling of plant for each boiler will be provided. Provision has been made for ample general and fire service water and air compressor capacity and the associated reticulation pipework.

Included also in this section are all control equipment not included with boiler or turbine plant for the control room (the arrangement proposed being one for each adjacent pair of units) and all minor electrical equipment of a general nature for both boiler and turbine houses.

For the maintenance of circulating water pumps, it is proposed to provide a rail-mounted gantry crane of the type in use at Yallourn Power Station, and this will serve all pits.

10. **Switchgear and Station Auxiliary Transformers –**

It is not possible to finalise the arrangement of auxiliary switchgear and transformers until details of the plant actually to be installed are available. Generally, however, it is anticipated that 6,600 V and 400 V buses will be established for each set to provide power for the larger and smaller electric motors respectively. The 6,600 V buses will be normally supplied from unit transformers which will be connected to the generator terminals, and, for starting-up and standby purposes, facilities will be provided to supply them from auxiliary transformers connected to the system.

Connection between the 6,600 V and 400 V buses will be via 6,600/400 V transformers located within the station.

TRANSMISSION SYSTEM

11. **Buildings and Improvements –**

A station control centre, as already mentioned in Section 6, will be provided on the south side of the turbine house; there will also be a relay house adjacent to the switchyard as shown.

12. **Switching Station Electrical Equipment –**

Power generated in the station will be stepped up in voltage by the main generator transformers to 330 kV, and switched at the switchyard for transmission to Melbourne at 330 kV.

SPARE EQUIPMENT

13. **Spares.**

Taking into consideration the location, the relatively advanced steam conditions, and the general circumstances, provision has been made for adequate spare parts.

TEMPORARY CONSTRUCTION FACILITIES

14. **Construction Facilities, Buildings –**

Space for storage of plant and equipment must be available for contractors within a reasonable distance of the erection site. The actual amount of space required will be determined largely by the number of sets being installed at any one time. Road and rail access has been allowed for, and cranes for material handling will be installed. The actual area and layout and facilities to be provided will be determined when the installation programme is more clearly defined and needs assessed.

Provision has been made for adequate space for contractors' personnel and for the Commission's construction work force, there being a combined amenities block for these personnel. As indicated before, location and size of the building are subject to modification.

For the storage of smaller items of boiler and turbine plant, such as instruments and control equipment, and for plant and equipment requiring covered storage, it is considered that the proposed power station store could be erected at an early date and utilised.

It has been assumed that there will be some expenditure necessary for construction equipment in addition to costs of facilities such as telephones, workshop and stores equipment, site water supply and sanitary services, and general drainage. The road and rail access facilities described in Section 2 have been regarded as construction facilities covered by this Section, although portion of these will remain as part of the permanent installation.

SUPPLY OF COAL TO POWER STATION FROM MORWELL OPEN CUT

The Morwell Open Cut will need to be developed so as to increase production to an estimated total of some 19,000,000 tons per annum in 1971 to meet the requirements of both Morwell Power Station and Briquette Factories as well as Hazelwood Power Station.

Coal from the Morwell Open Cut will be drawn off at transfer house T.H.2 on the Morwell Open Cut-Briquette Factories main conveyor system. From this point, two routes are possible — one in a straight line to the Hazelwood Power Station slot bunkers, crossing the proposed Morwell Open Cut fire service water storage, the other running in a straight line to a transfer house, located adjacent to the probable new southerly pivot point of the Morwell Open Cut, thence to the slot bunkers at the Hazelwood Power Station.

It would be advantageous to future operation of coal winning plant from a new pivot point in the open cut to provide for these alternative conveyor schemes to be reversible. Further examination of these proposals is necessary before a final layout can be determined.

It is proposed that coal, as delivered to the Hazelwood slot bunkers, will be primarily crushed to 8″ size. Secondary crushing before delivery to the boiler bunkers will be necessary.

TRANSMISSION OF POWER TO LOAD CENTRES

Transmission of power from Hazelwood Power Station to Melbourne will be by means of 330 kV transmission lines to suitable metropolitan terminal stations, whence the power will be fed into the metropolitan 220 kV network and State Grid by means of 220 kV interconnectors and radial lines.

Transformation between the 330 kV and 220 kV systems will be by means of 330/220 kV auto-transformers at 330 kV receiving centres, with transformations of 220/66 kV and 220/22 kV at metropolitan and regional terminal stations. It will also be necessary to install static capacitors and synchronous condensers at appropriate locations to provide the MVAR capacity needed for the transmission of large blocks of power from remote generating sources.

ESTIMATED EXPENDITURE ON HAZELWOOD POWER STATION

In the schedules below are shown the total estimated costs of the 1,200 MW Hazelwood Station and of the first stage of 400 MW capacity for both the unit boiler scheme and the two boilers per turbine scheme in each instance. At this juncture, owing to the absence (pending receipt of tenders) of definite information in respect of the type of plant involved, the estimates are approximate only. The figures are based on present-day price levels.

In the estimates, overheads have been included at an overall figure of 9% on direct expenditure.

Hazelwood Power Station
Unit Boilers
Schedule of Costs
Showing Total for Each Section of Plant

No.	Item	Estimated Costs Based on Prices at October, 1958 — 1,200 MW Total £	1,200 MW £/kW	First Stage 400 MW £
	Power Station			
1.	Land and site preparation	916,000	0.76	861,000
2.	Buildings and improvements	4,151,000	3.46	1,685,000
3.	Coal handling plant	3,044,000	2.54	1,345,000
4.	Boiler plant	36,774,000	30.65	12,154,000
5.	Ash handling plant	1,300,000	1.08	797,000
6.	Turbo-generators and condensing plant	13,341,000	11.12	4,426,000
7.	Steam and feed plant and piping	6,282,000	5.24	2,071,000
8.	Circulating water system	4,335,000	3.61	3,232,000
9.	General equipment	912,000	0.76	448,000
10.	Switchgear and station transformers	1,317,000	1.10	500,000
	Switch Yard			
11.	Buildings and improvements	184,000	0.15	133,000
12.	Switching station electrical equipment	6,136,000	5.11	2,534,000
	Spare Equipment			
13.	Spares	1,600,000	1.33	600,000
	Temporary Construction Facilities			
14.	Buildings, plant, water supply, sanitary services and drainage, rail and road, etc.	1,497,000	1.25	1,276,000
15.	Direct Works — Sub-Total Items 1-14	81,789,000	68.16	32,062,000
16.	Overheads at 9% on Item 15	7,361,000	—	2,886,000
	TOTAL:	89,150,000	74.29	34,948,000

In addition, the Commission will provide, from its revenues, interest during construction amounting to £8.7 million for the 1,200 MW station and £3.8 million for the 400 MW first stage.

Hazelwood Power Station

Two Boilers per Unit

Schedule of Costs

Showing Total for Each Section of Plant

No.	Item	Estimated Costs Based on Prices at October, 1958		
		1,200 MW		First Stage 400 MW £
		Total £	£/kW	
	Power Station			
1.	Land and site preparation	916,000	0.76	861,000
2.	Buildings and improvements	4,151,000	3.46	1,685,000
3.	Coal handling plant	3,044,000	2.54	1,345,000
4.	Boiler plant	42,562,000	35.48	14,053,000
5.	Ash handling plant	1,300,000	1.08	797,000
6.	Turbo-generators and condensing plant	13,341,000	11.12	4,426,000
7.	Steam and feed plant and piping	6,590,000	5.49	2,166,000
8.	Circulating water system	4,335,000	3.61	3,232,000
9.	General equipment	912,000	0.76	448,000
10.	Switchgear and station transformers	1,317,000	1.10	500,000
	Switch Yard			
11.	Buildings and improvements	184,000	0.15	133,000
12.	Switching station electrical equipment	6,136,000	5.11	2,534,000
	Spare Equipment			
13.	Spares	1,600,000	1.33	600,000
	Temporary Construction Facilities			
14.	Buildings, plant, water supply, sanitary services and drainage, rail and road, etc.	1,497,000	1.25	1,276,000
15.	Direct Works — Sub-Total Items 1-14	87,885,000	73.24	34,056,000
16.	Overheads at 9% on Item 15	7,910,000	—	3,065,000
	TOTAL:	95,795,000	79.83	37,121,000

In addition, the Commission will provide, from its revenues, interest during construction amounting to £9.3 million for the 1,200 MW station and £4.0 million for the 400 MW first stage.

Morwell Open Cut in Respect of Hazelwood

The approximate fixed capital expenditure on the Morwell Open Cut to meet the requirements of the 1,200 MW Hazelwood Power Station is estimated at £10 million, while about £3.5 million will be required for the 400 MW stage.

In addition, the Commission will provide, from its revenues, interest during construction amounting to £0.51 million for the 1,200 MW station and £0.19 million for the 400 MW first stage.

Terminal Stations at Load Centres

The capital costs of switching and transformation equipment at metropolitan and regional terminal stations for the final (1,200 MW) installation and for the first (400 MW) stage are estimated to be—

	1,200 MW Stage £	400 MW Stage £
330 kV transmission lines to metropolitan terminal stations and 220 kV interconnectors and radial lines, excluding the switchyard at Hazelwood	8,440,000	5,660,000
330 kV and 220 kV terminal stations in metropolitan and country areas and reactive plant in metropolitan area	14,230,000	5,110,000
	£22,670,000	£10,770,000

In addition, the Commission will provide, from its revenues, interest during construction amounting to £1.25 million for the 1,200 MW stage and £0.6 million for the 400 MW stage.

RECOMMENDATIONS

It is recommended that approval be given, in principle, for the construction of the 1,200 MW Hazelwood Power Station and associated works, as described in this report, at an estimated cost of between £99,150,000 and £105,795,000 for the station itself (including coal winning assets), depending on the number of boilers per set decided on, plus an estimated additional amount of £22,670,000 for the necessary terminal station switching and transformation equipment at load centres.

Further, it is recommended that definite approval be given for proceeding immediately with the first stage of the station of 400 MW capacity, with the first 200 MW set scheduled for service in 1964 and the second in 1965, at an estimated cost of between £34,948,000 and £37,621,000 for the station itself (including coal winning assets), depending on the number of boilers per set decided on, plus an additional amount of £10,770,000 for the necessary terminal station switching and transformation equipment at load centres.

(Sgd.) N. T. JEWELL,

Director of Engineering.

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STATE ELECTRICITY COMMISSION OF VICTORIA

HAZELWOOD, MORWELL AND YALLOURN

AREA PLAN

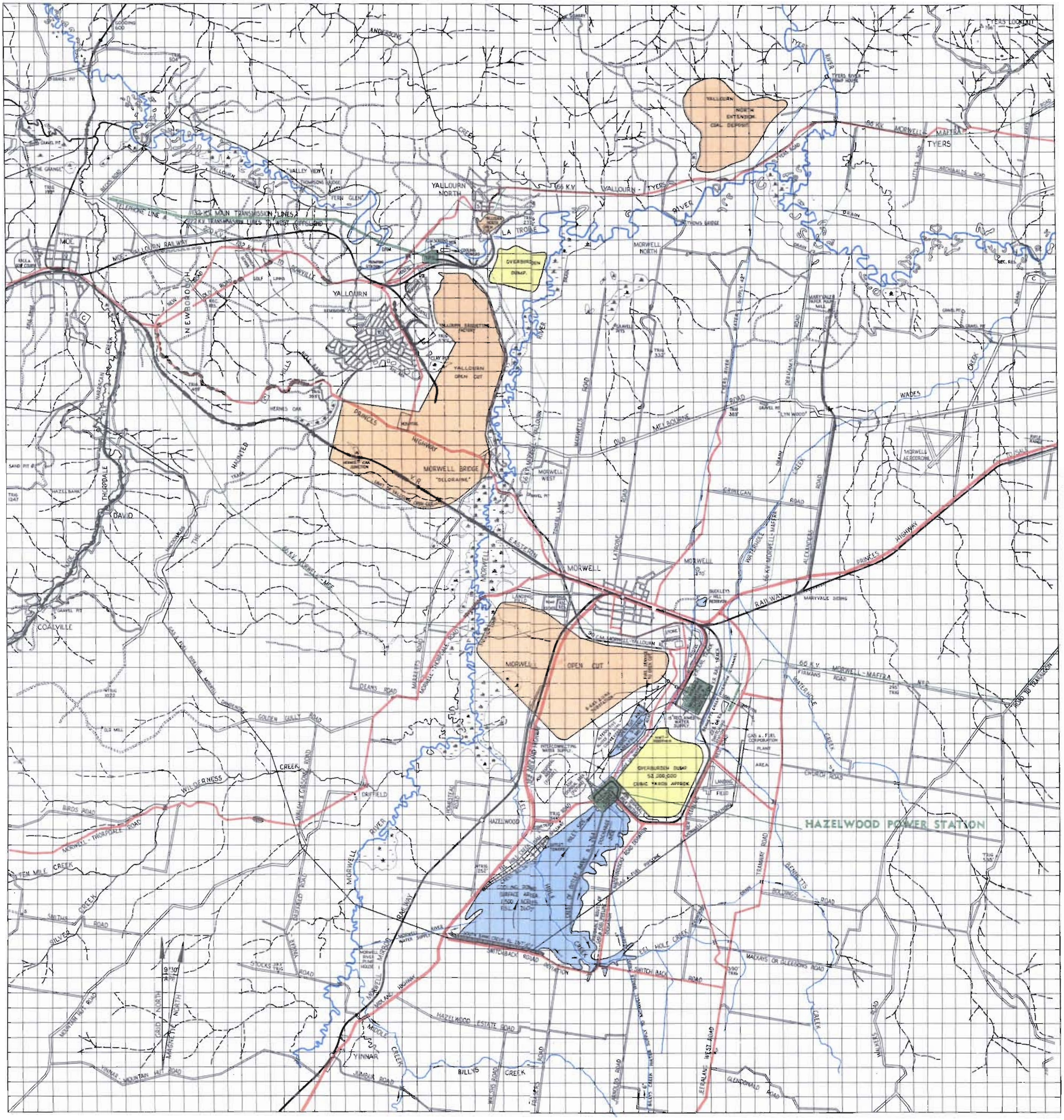

PLATE No. 2

DRAWING No. O.G. 58/1/2

STATE ELECTRICITY COMMISSION OF VICTORIA

HAZELWOOD POWER STATION

LOCATION OF 1,200 MW STATION IN RELATION TO COOLING POND, MORWELL OPEN CUT, OVERBURDEN DUMP, BRIQUETTING FACTORY AND POWER STATION

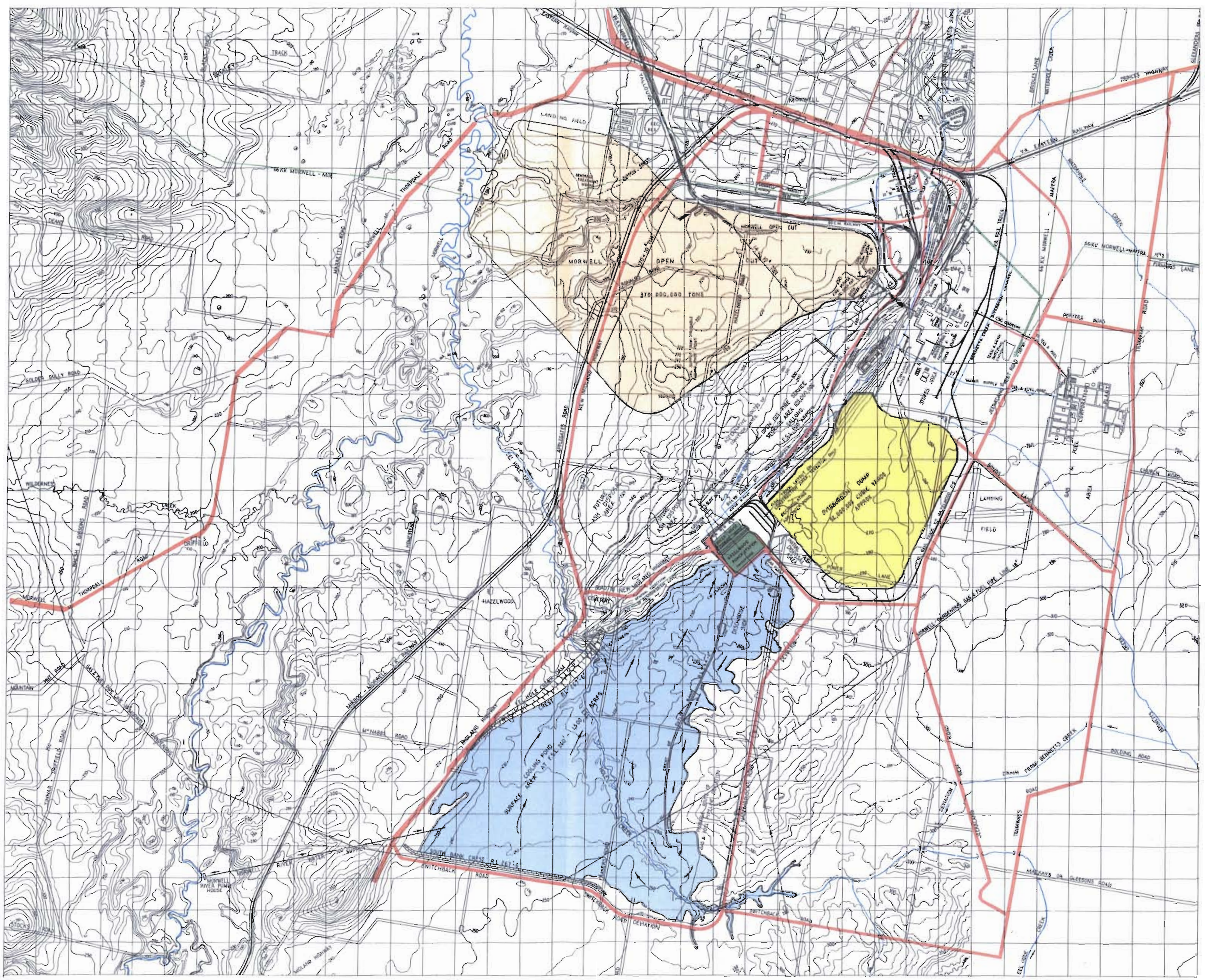

PLATE No. 3

DRAWING No. O.G. 58/1/3

STATE ELECTRICITY COMMISSION OF VICTORIA

HAZELWOOD POWER STATION, 1,200 MW

SITE PLAN