

DEPARTMENT OF THE SENATE
PAPER NO. 1029
DATE 25 OCT 1967
PRESENTED
<i>J.R. Odgers</i>
Clerk of the Senate

1967

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

R E P O R T

relating to the proposal to construct the

STAGE 4 EXTENSION

of the

STOKES HILL POWER STATION,
DARWIN.

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PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

STOKES HILL POWER STATION, DARWIN - STAGE 4 EXTENSION

R E P O R T

By resolution on 7 September 1967 the House of Representatives referred to the Parliamentary Standing Committee on Public Works for investigation and report the proposal to construct the Stage 4 Extension of the Stokes Hill Power Station, Darwin.

The Committee have the honour to report as follows:

THE COMMITTEE'S INVESTIGATION

1. The Committee received submissions and drawings from the Departments of Territories and Works and took evidence at a public hearing in Canberra from representatives of these departments. We inspected the Stokes Hill Power Station, including the areas where the proposed work is to take place, in April 1967 while we were in Darwin in connection with the Western Barkly Tablelands Beef Roads and the Casuarina No. 2 Sub-Division references.

THE PROPOSAL

2. The proposal submitted to the Committee comprises:
- (a) excavating a section of Stokes Hill and reclaiming part of the foreshore;
 - (b) extending the turbine building;
 - (c) providing a 16 megawatt (MW) turbo-alternator, an oil-fired boiler, electrical equipment and auxiliary plant;

- (d) modifying the switchyard;
- (e) constructing a new cable tunnel;
- (f) demolishing an 8,000-ton oil storage tank and erecting a 16,000-ton tank; and
- (g) transferring to Stokes Hill a 1,380 kilowatt (kW) set from the diesel power station.

3. The present proposal will increase the installed capacity of the Stokes Hill Power Station from 47 MW to 63 MW and is planned on the basis of two subsequent stages with capacities of 23.5 MW and 47 MW respectively. The work in the current reference, which is estimated to cost \$4.6 million, is to be completed in 1971.

DARWIN'S EXISTING POWER STATIONS

4. Darwin has two power stations. The first, a small diesel station of 7 MW capacity was, until 1962, the town's source of electricity, but it is now used only for standby purposes. The other is the Stokes Hill Power Station, an oil-fired steam station.

5. The Stokes Hill Power Station In 1958 the Parliamentary Standing Committee on Public Works investigated and reported on the proposal to construct the Stokes Hill Power Station. The initial plan envisaged a station of about 45 MW capacity to be constructed in stages as the demand required. Stage 1 was to provide a capacity of 15 MW (two 7.5 MW sets) while two further sets, each of about 15 MW capacity, were to be installed later. Following the Committee's report, Stage 1 was constructed and commissioned in 1962 at a cost of nearly \$4 million.

6. At the time Stage 1 was planned it was expected that it would suffice until about 1971. However, due to the larger than forecast increase in the population of Darwin and to the greater use of electrical

equipment including air-conditioning, the demand for electricity after 1958 increased more rapidly than expected, and by 1963 it was evident that additional generating capacity would be required long before 1971. In October 1963, the Minister for Works, supported by the Public Works Committee, obtained Parliament's approval to proceed with the installation of No. 3 Set (Stage 2) without further reference to the Committee, on the grounds that the work was urgent and that no new technical or economic factors had arisen to alter the original planning.

7. The rate of load growth after 1963 was such that it was evident that No. 4 Set would be required shortly after No. 3. Tenderers for No. 3 Set were therefore invited to quote for additional identical equipment on the basis that it would be required before 1967. The contract for No. 3 Set, when let in 1964, included an option on a further set.

8. Stage 3 was exempted from reference to the Committee in 1965 as it also formed part of the development of the Station outlined in the evidence to the Committee at the initial inquiry. The Committee supported the motion for exemption, and the option on No. 4 Set was taken up in 1965.

9. The Stokes Hill Power Station, when Stage 3 is completed, will have two 7.5 MW sets and two 16 MW sets - an installed capacity of 47 MW. Stage 2 was commissioned in May 1967, whilst Stage 3 is due to be completed in November 1967.

10. The Diesel Power Station It is proposed to shut down the diesel station when Stage 3 of the Stokes Hill Station is commissioned. Although it has a nominal installed capacity of 7 MW, the real capacity, because of the age of some of the sets, is only about 5.6 MW. Thus it cannot now provide effective standby capacity even for the 7.5 MW sets at Stokes Hill. The Committee were told that under these circumstances it would be uneconomical to maintain the diesel station in an operating condition. It is proposed

to transfer one of the larger sets to the Stokes Hill Station for starting the steam plant and the other sets will be transferred to other power stations in the Northern Territory or sold.

THE NEED FOR ADDITIONAL GENERATING CAPACITY

11. The Load Growth Since 1957, the peak load on the Darwin electricity supply system has risen from 4 MW to 15 MW and it is now estimated that by 1971 it will reach 31 MW. This estimate is based on the assumption that the normal rate of the load growth in the next four years will be not less than that of the past two years - 15.5% compound per year - and in the knowledge that two abnormal loads will be imposed on the system in the next 12 months. These are 800 kW for the air-conditioning system at the Darwin Hospital later this year and 3,000 kW for the Radio Australia Booster Station on Cox Peninsular late in 1968.

12. Factors influencing the demand for electricity in Darwin are the steadily increasing population, the expansion of government services, the increasing industrial and commercial activity, the developments in the pastoral, mining and agricultural industries and the increasing popularity of Darwin as a tourist centre. In the six year period between 1961 and 1967, Darwin's population increased from 15,000 to 21,000 and the number of electricity consumers rose from 3,279 to 5,287. In the same period, the number of units of electricity sold annually increased from 28 million to 66 million.

13. The Mining Industry The mining industry in the Northern Territory is expanding and although much of the activity is in areas not served by the Darwin electricity supply system, recent developments have added to the load on the system.

14. The shipment of iron ore to Japan from the Frances Creek field began in June of this year, and while the mine itself does not draw power from Darwin, the ore is loaded at the Darwin wharf by electrically operated bulk handling equipment.

15. Another field, Mt. Bundy, is due to start producing in 1968 and it is expected that there will be an initial demand from this field for a block of power of 500 kW. The ore production plant will be electrically operated and a power line is being constructed to serve the field with electricity from Darwin. Ore from the field will be sent by road to a rail siding 22 miles from Darwin where it will be loaded by electrically operated equipment into rail trucks for delivery to the Darwin wharf. There the ore will be again handled by electrically operated plant.

16. It is probable that there will be further large scale developments in the industry in the future and even if these do not include the processing of ore, it is possible that the resulting demand for electricity could be large enough to distort the system's normal load growth pattern. However, the best information available suggests that it will be at least two years before any of the mining interests decide on the extent of their power requirements and whether these will be met by privately owned generating plant or be purchased from the Darwin Electricity Undertaking. For these reasons the influence that future developments in the mining industry will have on the demand for electricity is thought to be long range and has been disregarded for the present purposes.

17. Natural Gas If the current off-shore exploration for natural gas proves successful and this fuel becomes commercially available in Darwin, additional mineral processing as well as the establishment of other industries may become commercially attractive. In this event the demand for electricity would probably increase considerably. But, a

realistic assessment of the effect that the discovery of natural gas would have on future power requirements cannot be made now and in any case it would be some years before the effect of such a discovery would be felt.

18. The Committee's Conclusions In view of the rate of load growth in recent years and the factors influencing the demand for electricity, we consider it is reasonable to assume that the normal load will continue to grow at a rate not less than 15.5% compound per year for at least the next few years. We agree also that, in estimating the future peak load, allowance should be made only for assured loads which will be imposed on the normal growth pattern.

19. The Committee are satisfied that the forecast of peak load development, at least until 1971 when it is expected to reach 31 MW, is soundly based.

20. When No. 4 Set (Stage 3) of the Stokes Hill Power Station is commissioned later this year, the firm capacity of the Station will be 31 MW, i.e. the installed capacity (47 MW) less the capacity of the largest set (16 MW). As the peak load on the system is not expected to reach 31 MW until 1971, the Station will be able to meet the demand until that time. However, after then there will be a shortage of electricity unless additional generating capacity is operating.

21. The rate of load growth after 1971 is difficult to predict but there are no signs that the present rate will not continue. Accepting this as the basis for estimating loads after 1971, the peak load will reach 110 MW - the planned ultimate firm capacity of the Stokes Hill Power Station - by 1979. However, if an abnormally large demand for power arises in the meantime from mining or other developments, the load would reach the maximum capacity of the Station before that time.

22. The Committee concluded that there is a need to have additional generating plant operating at the Stokes Hill Power Station by 1971, and that on the evidence now available, it will probably be necessary to develop the Station to its ultimate firm capacity of 110 MW by 1979.

THE SITE

23. At the 1958 inquiry, detailed consideration was given to the choice of the site at Stokes Hill, which is adjacent to Darwin's wharves and close to the town. There was criticism of the site chosen, but after weighing all the arguments, including the views expressed by Defence experts, the 1958 Committee concluded that the site was the most suitable for the immediate purpose and for future expansion of the Station. We agree with this conclusion and that it is appropriate to continue the development of the Stokes Hill site to its full capacity.

METHOD OF GENERATION

24. A comprehensive study was made before Stage 1 of the Stokes Hill Power Station was commenced of the most appropriate method of generating electricity at Darwin. The suitability of diesel engines, gas turbines, hydro-electric power, atomic energy and oil-fired steam turbine plant were examined and it was decided that the most economic and practicable method for Darwin was generation by oil-fired steam turbine plant. The Committee were told that recent studies show that this situation has not changed although technological advances have been made in all methods of generation. It is proposed, therefore, that the Stage 4 plant be similar to that installed already.

25. It was noted that the type of boiler plant in use and proposed can be readily converted to use natural gas instead of oil. If gas is discovered near Darwin before the Stokes Hill Power Station is developed further, the possibility of installing gas turbines or gas turbine/steam turbine combinations will then be examined.

26. About other methods of generation, the Committee were informed that the demand in Darwin for electricity was too small to justify the high capital cost of an atomic power station. The possibility that Darwin will ever be served by a hydro-electric scheme also seems to be remote. The only possible source of hydro power within 200 miles of Darwin is at Katherine but its potential is small. Transmission costs from sources further afield would make such a proposal uneconomic.

THE ULTIMATE DEVELOPMENT OF STOKES HILL POWER STATION

27. The planning outlined to the Committee is based on the Stokes Hill Power Station having eight generating sets with a total installed capacity of 133.5 MW. Three sets are operating, a fourth is being installed, the fifth is the subject of this reference and the remaining three are planned for the future. The stages of development yet to be implemented and the proposed capacities of the sets in those stages are:

Stage 4	No. 5 Set	16 MW
Stage 5	No. 6 Set	23.5 MW
Stage 6	Nos. 7 and 8 Sets	23.5 MW each.

When the Station is fully developed it will thus comprise two sets each of 7.5 MW, three sets each of 16 MW and three sets each of 23.5 MW.

28. The Committee inquired into the reason for selecting sets of the capacities nominated for Stages 4, 5 and 6. Evidence was submitted that the sets proposed will give the lowest overall cost per unit generated, minimise capital expenditure in the middle stages of development of the Station and make the best use of the site and the facilities provided. After studying the evidence the Committee concluded that the most economic alternative is that proposed, viz. to instal a 16 MW Set in Stage 4 and three 23.5 MW Sets in subsequent stages.

29. Timing As the load on the supply system is expected to overtake the firm capacity of the Station in 1971, it is essential that No. 5 Set - the present reference - be commissioned during that year.

30. The commissioning dates of subsequent sets will depend on the rate of load growth after 1971. Assuming that the load continues to increase at the present rate of 15.5% compound per year, and disregarding the influence of exceptional industrial development, it is planned to commission No. 6 Set late in 1974 and Nos. 7 and 8 Sets early in 1979.

31. When No. 8 Set is installed the Stokes Hill site will be fully developed. Before that time it will be necessary to plan the development of a second power station.

CONSTRUCTION OF THE WORK IN THE PRESENT REFERENCE

32. Plant The plant proposed for the Stage 4 Extension is a 16 MW turbo-alternator with associated auxiliaries and switchgear to be installed in an extension of the power station building, and a single outdoor type oil-fired boiler which together with its stack is to be erected beside the existing boilers.

33. Concurrently with the installation of No. 5 Set, it is proposed to transfer a 1,380 kW diesel generating set from the diesel station to the Stokes Hill Station. This set will be used for starting the steam plant.

34. Building Because the future stages of development will be undertaken at intervals of only a few years, it is proposed in Stage 4 to extend the power station building to its ultimate size. We were told that the building extension not only will cost less than if staged, but it also will provide storage space which would otherwise have to be erected temporarily for use during later stages. Completion of the building extensions now will also minimise the precautions required to protect existing plant during later stages of construction.

35. Switchyard During detailed design of Stage 4 two alternatives will be considered for stepping up the generated voltage. One alternative involves a new cable tunnel and modification of the existing switchyard, whilst the other would mean establishing a new switchyard near the turbine building.

36. Site Preparation This work includes demolishing an 8,000-ton Navy oil storage tank (known as No. 5), excavating a further section of Stokes Hill, moving a privately owned bottled-gas installation, and reclaiming a section of the foreshore. The demolition of the tank and the excavation work will provide a level area for the building extension and the boilers. The bottled-gas installation is to be moved to make way for the proposed 16,000-ton fuel storage tank and it is necessary to reclaim part of the foreshore to provide for the extended switchyard.

37. Fuel Storage Stokes Hill Power Station uses about 25,000 tons of fuel annually and under the current supply contract five deliveries of 5,000 tons are made each year. The oil is stored in an 8,000-ton tank (known as No. 3) adjacent to the site. The present arrangement is that this tank which belongs to the Department of the Navy is loaned to the Darwin Electricity Undertaking on the understanding that it will be returned to the Navy in an emergency. Negotiations are now proceeding to transfer ownership of this tank from Navy to the Electricity Undertaking.

38. As the load on the Power Station is increasing, so also is the rate of fuel consumption, and it is estimated that the rate of consumption by 1970 will require storage capacity of 16,000 tons. To meet this need the Department of the Navy has agreed to the loan of a second 8,000-ton tank (No. 7).

39. To compensate Navy for the loss of the demolished No. 5 tank and the transferred No. 3 tank it is proposed to erect a 16,000-ton tank at the rear of the Power Station. One large tank is proposed because it will

cost less and occupy less space than two small ones on the restricted area available on the Stokes Hill Site. This tank will become the property of the Navy.

40. The Committee's Conclusion The Committee recommend the construction of the works in this reference which comprise the Stage 4 Extension of the Stokes Hill Power Station.

PROGRAMME

41. It is proposed to arrange a single contract for the Stage 4 Extension with the exception of the site preparation work and the erection of the 16,000-ton tank.

42. The target date for commissioning Stage 4 is September 1971. It is expected that the work will take three and a half years to complete from the time tenders are invited. The present target date for calling tenders is March 1968 but we noted that the possibility of advancing this date is being examined.

ESTIMATE OF COST

43. The estimated cost of the Stage 4 Extension when referred to the Committee was \$4.6 million.

44. Based on present prices, the estimated costs of future stages are:

Stage 5	-	\$5 million
Stage 6	-	\$8.8 million.

SELECTION OF A SITE FOR THE FUTURE POWER STATION


45. The Committee inquired whether steps had been taken to choose a site for the power station which will need to be erected when the Stokes Hill Power Station has been developed to capacity. We were informed that possible sites were being investigated.

46. Of six sites surveyed, four had been ruled out as unsuitable. The two remaining are Channel Island, which is in the Middle Arm of Darwin Harbour about seven miles south-east of Darwin, and Point Margaret on Cox Peninsular. Reservations have been placed over both sites and investigations are proceeding.

RECOMMENDATIONS AND CONCLUSIONS

47. The summary of recommendations and conclusions of the Committee is set out below. Alongside each is shown the paragraph in the report to which it refers.

	<u>Paragraph</u>
1. THE COMMITTEE ARE SATISFIED THAT THE FORECAST OF PEAK LOAD DEVELOPMENT, AT LEAST UNTIL 1971, IS SOUNDLY BASED.	19
2. THERE IS A NEED TO HAVE ADDITIONAL GENERATING PLANT OPERATING AT THE STOKES HILL POWER STATION BY 1971.	22
3. IT WILL PROBABLY BE NECESSARY TO DEVELOP THE STATION TO ITS ULTIMATE FIRM CAPACITY OF 110MW BY 1979.	22
4. IT IS APPROPRIATE TO CONTINUE THE DEVELOPMENT OF THE STOKES HILL SITE TO ITS FULL CAPACITY.	23
5. THE MOST ECONOMIC ALTERNATIVE IS TO INSTAL A 16 MW SET IN STAGE 4 AND THREE 23.5 MW SETS IN SUBSEQUENT STAGES.	28
6. THE COMMITTEE RECOMMEND THE CONSTRUCTION OF THE WORKS IN THIS REFERENCE WHICH COMPRISE THE STAGE 4 EXPENSION OF THE STOKES HILL POWER STATION.	40
7. THE ESTIMATED COST OF THE WORK WHEN REFERRED TO THE COMMITTEE WAS \$4.6 MILLION.	43


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Parliamentary Standing Committee on Public Works,
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19 October, 1967.