1970

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

REPORT

relating to the proposed

AUGMENTATION OF ELECTRICAL SUPPLY SYSTEM CENTRAL CITY AREA

at

Darwin, Northern Territory

(THIRTEENTH REPORT OF 1970)

COMMONWEALTH GOVERNMENT PRINTING OFFICE
CANBERRA: 1970

C O N T E N T S

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

AUGMENTATION OF ELECTRICAL SUPPLY SYSTEM CENTRAL CITY AREA, DARWIN

REPORT

On 29 July 1970, His Excellency the Governor-General in Council referred to the Parliamentary Standing Committee on Public Works for investigation and report to the Parliament, the proposal for augmentation of the electrical supply system in the central city area of Darwin, Northern Territory.

The Committee have the honour to report as follows:

THE REFERENCE

1. The proposal submitted to the Committee involves provision of

- a city zone substation and associated outdoor switchgear;
- two 66 kV ducted underground cables from the Stokes Hill power station to the proposed substation;
- two additional 11 kV switching stations; and
- 11 kV ducted underground cables from the proposed substation to the planned and existing switching stations.

2. The present proposal represents the basic work involved in upgrading the electrical supply system in the central city area of Darwin. Supplementary works will be required later from time to time as the load grows including additional cables, transformers, switching stations, ducts and substations.

3. The present work is estimated to cost $3.05 million.

THE COMMITTEE'S INVESTIGATION

4. The Committee received written submissions and drawings from the Northern Territory Administration and the Department of Works and took evidence from their representatives and Mr. T.A. Bell, M.L.C., at a public hearing in Darwin.

5. We inspected the site of the proposed city zone substation and the overhead reticulation from the Stokes Hill power station.

EXISTING ELECTRICITY SUPPLY SYSTEM

6. Up to 1962, electricity was generated at a diesel power house and reticulated throughout Darwin at 6.6 kV. However, with the commissioning of the Stokes Hill steam power station, on which the Committee first reported in 1958, the distribution voltage was raised to 11 kV. Two 66 kV lines delivered to the Snell Street substation, where the power was stepped down to 11 kV for distribution to part of the city area and the outer suburbs. In addition, 11 kV feeders from the power station delivered to two substations for distribution to the central city zone secondary distribution system.

7. In 1968, a 66 kV circuit was commissioned from the Stokes Hill power station feeding by overhead line and submarine cable to Radio Australia on Cox Peninsula. The line between the power station and a point adjacent to the Darwin Hospital was constructed for 66 kV double circuit operation, the second circuit being operated at 11 kV to supply the hospital.

8. The system relies on the use of 11 kV overhead distribution feeders supplied directly from the power station 11 kV busbars, with some underground sections in the inner city area routed by feeders and spur lines to load centre substations.

THE NEED

9. The Load Growth In 1960, it was doubted whether the high rate of total system load growth would continue and the distribution system for most of the city area was planned to be fed for many years by the supply from the power station across the 11 kV busbars. However, Darwin's system load growth has continued at a high rate and in addition the demand for more blocks of power from the hospital and Radio Australia has necessitated the installation of further generating plant at the power station ahead of previously estimated requirements.

10. The Committee received lengthy evidence from the Northern Territory Administration about the factors which have contributed to the growth of Darwin in recent years and seem certain to ensure that this trend continues. We were also told of the many significant developments occurring in the city area which are giving rise to the need for the work in this particular reference and of the influence the spreading use of air conditioning is having on the demand for electricity.

11. We noted that since 1962, the electricity load growth in the central city zone has been at the rate of about 30% compound per annum and it is confidently expected that the load will double over the next five years. This rapid growth has outstripped the facilities provided and introduced problems which affect efficient operation of the supply system.

12. Deficiencies in Existing System The Committee were told that

- circuit arrangements with the additional generators being installed at Stokes Hill make it increasingly difficult to maintain both 11 kV levels to suit city supplies, and levels to suit 66 kV transmission;

- the short circuit fault level at the 11 kV busbars is becoming too high to impose on city distribution feeder equipment;
- there is insufficient capacity at the 11 kV busbars to meet growing city loads; and
- further 11 kV feeders are required as existing circuits are becoming fully loaded. Also, large air conditioned buildings requiring supply reliability restrict the area supplied by any one feeder and it is not possible for the power station to meet both the 11 kV supply and the feeder requirements due to the station's lack of space for switchgear and availability of feeder routes.

13. Reliability is also seriously affected by the use of the overhead 11 kV system. In particular, the extremely high incidence of lightning strikes in Darwin is the cause of many faults, reliability is inhibited by the many connections to pole-mounted distribution transformers and difficulty is being experienced in maintaining safety clearances between overhead conductors and buildings.

14. The Committee were told that it is generally accepted within the electric supply industry that initial moves towards total undergrounding should be made when an area's load density approaches 10 to 12 MW per square mile. Darwin's city area is already in excess of this level. Evidence was submitted that failure to go underground in the city area is uneconomical in the long term and will result in heavy multiple circuit overhead construction with space and structural problems and an unsightly wire jungle.

15. The works proposed in this reference are designed to resolve the problems mentioned in paragraphs 12 to 14 above. The 11 kV distribution system in the city area is mostly overhead, but some is underground already. As the opportunity permits, the remaining overhead system will be undergrounded. For this reason, the 11 kV reticulation work in the city area in this reference is to be put underground also.

16. Committee's Conclusion The Committee concluded that there is a need for the works in this reference and that undergrounding of the city area electrical supply system in Darwin is necessary.

THE PROPOSED WORKS

17. 66 kV Transmission The initial transmission link is to consist of two 66 kV circuits each rated at 60 MVA and run in a multiway concrete duct with space for additional future cables, from the power station switchyard via McMinn Street to the proposed city zone substation. The crossing at the rail yards may involve the use of a cable bridge. The two circuits will enable a firm 60 MVA to be supplied to the city zone substation with one circuit being held in reserve. As the light capacity 66 kV overhead circuit feeding Radio Australia is inadequate for city load requirements, the section between Stokes Hill power station and the city zone substation will be removed as its load can be handled by the new 66 kV underground cables.

18. The Snowy Mountains Hydro-Electric Authority's 20 year planning study of the Darwin area transmission system recommends the ultimate use of four 60 MVA cable circuits to transmit the generation output into the system. The proposed system allows for this development. Three of the proposed 66 kV cable circuits, including the two in this reference, will feed direct to the city zone substation whilst the fourth circuit will feed via the future

Temira substation in the north-west city area. The city zone substation will eventually be the source of 66 kV lines to zone substations at Snell Street, Radio Australia, Casuarina and other load centres in northern and eastern suburbs.

19. A control cable, also to be undergrounded, will be installed between Stokes Hill and the city zone substation to protect the 66 kV cables and to indicate zone substation electrical conditions at the power station control room.

20. City Zone Substation The substation is to be located on the Electricity Supply Reserve between Harvey and McMinn Streets. Areas will be grassed where possible, an aesthetically pleasing safety fence is to enclose the substation and the height of structures will be kept to a minimum.

21. Circuit breakers of 66 kV capacity will be used to control the 66 kV power station cables and the two 30 MVA main transformers to be installed. Provision will be made for a third transformer and additional 66 kV lines. Walls will enclose the transformers to limit noise nuisance and contain any oil transformer fires.

22. A two level control building fronting McMinn Street will adjoin the 66 kV switchyard. The upper level of the building will house centralised controls, instrumentation and protection for 66 kV and 11 kV switchgear and transformers, a station office, a toilet and a maintenance room. The lower level will contain 11 kV feeder and transformer switchgear, station batteries, an emergency standby diesel generator and a station service switchboard. Provision will be made for future expansion. Station service transformers will be incorporated to supply normal station power needs. The building will be designed to harmonise with future residential high rise development on McMinn Street.

23. 11 kV Express Feeders and Main Switching Stations To meet loads expected in the next 15 to 20 years, a number of main switching stations will be needed at various load centres as supply sources for general distribution 11 kV feeders. Each main switching station will be loaded to 12 MVA and supplied by two 11 kV 12 MVA express feeders, untapped for general supplies, from the city zone substation. The loss of any one express feeder will leave supply uninterrupted without overload on other feeders.

24. This reference includes the installation of two main switching stations. The first in Mott Street will become the supply source for general distribution feeders to the growing hotel and motel district, and the other in Wood Street the source for the commercial and accommodation development on the north side of the business district. The existing main switching stations in West Lane and Austin Lane will be further developed to cater for the central business and government offices district. The 11 kV express feeders proposed will supply the four main switching stations from city zone substation. The cables will be located in a duct system with provision made for future cables. The main switching stations will be housed in simple buildings about forty feet long. The Mott Street building will harmonise with future adjacent development whilst the Wood Street building will be designed to permit total enclosure in any future high rise building on the site.

25. Switchgear of 11 kV capacity, to accommodate an incoming express feeder and four outgoing general distribution feeders, will be installed initially in each new switching station. Provision will be made for an extension of this switchgear to accommodate the additional 11 kV outlets and the second incoming express feeder.

26. The development of the 11 kV general distribution feeder network, whilst not part of this reference, is planned however to match the express feeder and switching station layout and will be implemented progressively. It is expected that distribution substations from 300 KVA to 2,000 KVA will be required in the city areas to meet major loads.

27. Committee's Conclusion The Committee recommend the construction of the proposed works.

ESTIMATE OF COST

28. The estimated cost of the work when referred to the Committee was $3.05 million made up as follows:

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- 66 kV underground cable feeders and control cables from Stokes Hill power station to city zone substation	900,000
- city zone substation	1,060,000
- 11 kV express feeder cable and control cable system between the city zone substation and four switching stations	890,000
- new switching stations at Mott Street and Wood Street	200,000
	3,050,000

PROGRAMME

29. The maximum load of 20 MW which can be adequately supplied by the present 11 kV feeder system is expected to be reached by about September 1972. However, it will be September 1973 before the proposed work is completed and

at that time, a load of 22 MW is anticipated. Whilst the supply system will be heavily taxed, it is expected that interim measures to supply some load through the Snell Street substation and the diesel station substations will avoid the need for restrictions. However, supply reliability may be affected causing some inconvenience to consumers over the intervening period.

RECOMMENDATIONS AND CONCLUSIONS

30. 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.

		Paragraph
1.	THERE IS A NEED FOR THE WORKS IN THIS REFERENCE.	16
2.	THE UNDERGROUNDING OF THE CITY AREA ELECTRICAL SUPPLY SYSTEM IN DARWIN IS NECESSARY.	16
3.	THE COMMITTEE RECOMMEND THE CONSTRUCTION OF THE PROPOSED WORKS.	27
4.	THE ESTIMATED COST OF THE WORK WHEN REFERRED TO THE COMMITTEE WAS $3.05 MILLION.	28

(C.R. KELLY)
Chairman

Parliamentary Standing Committee on Public Works,
Parliament House,
CANBERRA, A.C.T.

1 September 1970.