



# MARAYONG ZONE SUBSTATION STATEMENT OF NETWORK NEED

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**Project TS146 2017/18**

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**Prepared by Asset and Network Planning**

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**November 2016**

REVIEW AND APPROVAL SCHEDULE

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## CONTENTS

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<b>1.0</b>	<b>BACKGROUND</b>	<b>4</b>
<b>2.0</b>	<b>ASSET CONDITION</b>	<b>4</b>
2.1	33kV SWITCHYARD	4
2.2	POWER TRANSFORMERS	4
2.3	11kV SWITCHGEAR	5
2.4	AUXILIARY SWITCHGEAR	5
2.5	PROTECTION RELAYS	6
2.6	CONTROL BUILDING	6
<b>3.0</b>	<b>NETWORK ISSUES</b>	<b>6</b>
<b>4.0</b>	<b>RECOMMENDATIONS</b>	<b>6</b>
<b>5.0</b>	<b>APPENDICES</b>	<b>6</b>

## 1.0 BACKGROUND

Marayong Zone Substation is a 33kV/11kV substation located in a residential area on the corner of Charles, Frederick and Raymond streets, Marayong. The load distribution for Marayong ZS is approximately 60% industrial, 20% commercial and 20% residential.

The substation is supplied at 33kV from Blacktown Transmission Substation via Feeder 445 and from Baulkham Hills Transmission Substation via feeders 473 (tee Kellyville ZS) and 470 (via Seven Hills ZS).

The substation is equipped with three 33/11kV 25MVA power transformers, outdoor 33kV switchgear and an indoor 11kV oil-filled switchboard.

The substation was constructed during 1964-65 and commissioned in October 1965. The transformers were augmented in 1973 and the control building was extended to include new transformer circuit breakers in 1980.

Therefore the substation equipment has various ages with the original part of the control building being 51 years. The condition and safety issues associated with the 11kV switchboard with bulk-oil circuit breakers, which are 1960-1965 vintage is driving this project.

Marayong ZS has been included in long term plans for renewal for a number of years. It was originally assessed for redevelopment in 2007/08 to address capacity constraints under Project PR337. However, the capacity constraints did not eventuate and the project did not progress. The renewal of the substation was assessed again in 2012 based on the age and condition of the 11kV switchboard. However, it was found that the assets did not present sufficient risk to warrant replacement at the time. Four years have passed since that assessment and it is considered appropriate to consider the substation for renewal again now.

## 2.0 ASSET CONDITION

### 2.1 33KV SWITCHYARD

Five of the six 33kV circuit breakers were replaced in 2004 and the fifth in 2011. They are in good condition and have no short to medium term renewal needs.

The 33kV isolators are rotary double-break types which are inherently reliable and appear to be in satisfactory condition.

The busbars and supports are aluminium and galvanised steel respectively and appear to be in satisfactory condition.

### 2.2 POWER TRANSFORMERS

The three power transformers were manufactured by Tyree in 1973 and are therefore 43 years in age. Table 1 below summarises the condition of each power transformer.

TABLE 1 – TRANSFORMER CONDITION INDICATOR: MARAYONG ZONE SUBSTATION

Condition Indicator	Reading		
	Transformer No.1	Transformer No.2	Transformer No.3
Furan levels	1.70ppm - steady	1.86ppm - steady	1.72ppm - steady
Oil Quality	Fair	Good	Good
Winding DLA	Within acceptable limits	At the lower end of acceptable levels	Within acceptable limits
Insulation Resistance	Within acceptable limits	At the upper end of acceptable levels	Within acceptable limits
DP (degree of polymerisation)	387 - satisfactory	446 - satisfactory	398 - satisfactory
Oil Leaks	Moderate	Moderate	Moderate

Condition Indicator	Reading		
	Transformer No.1	Transformer No.2	Transformer No.3
Corrosion	Extensive corrosion around radiators and fittings	Minor corrosion around radiators and fittings	Minor corrosion around radiators and fittings

The above results indicate that the internal condition of each of these transformers is satisfactory and that they are fit for continued service. Externally, these transformers exhibit surface corrosion (with extensive corrosion on Transformer No.1) around the radiators and fittings and moderate oil leaks. On the basis of these results the transformers are expected to have further life expectancy of 10-20 years, providing the corrosion on Transformer No. 1 is addressed and adequate maintenance is carried out. However, the project should investigate the benefits of replacing the transformers with other works required at the substation.

Furthermore, all transformers produce significant noise and hence it may be necessary to assess this impact as the substation is located in a residential area.

### 2.3 11KV SWITCHGEAR

The 11kV switchboard is a Westinghouse type HQ switchboard which features a compound filled busbar and Westinghouse B18 circuit breakers. It is estimated (based on their serial numbers) that 12 of these circuit breakers were manufactured circa 1960 and a further three in 1965. There are also three Reyrolle LMT bulk oil breakers which were installed in 1980 in three separate rooms as transformer circuit breakers. These breakers are connected by cable to the Westinghouse switchboard.

An acoustic test on the Westinghouse switchboard has found no significant partial discharge activity and it is therefore considered to be in satisfactory condition.

The Westinghouse B18 circuit breakers are in varied condition with a number with consistently high values of contact resistance and or low insulation resistance indicating that they are approaching the end of their effective lives. A number of other breakers however are showing respectable values of insulation resistance and contact resistance suggesting they have considerable life remaining. The three Reyrolle LMT circuit breakers are in good condition.

Information regarding the bushing DLA and breaker and busbar partial discharge levels are not available.

However, these circuit breakers are oil filled and breakers of this type have resulted in fires which have caused widespread damage to and a prolonged outage of other substations in Endeavour Energy's and Ausgrid's areas. In response Ausgrid are in the process of decommissioning all of their Westinghouse HQ switchboards.

The switchboard could be retrofitted with vacuum trucks under program TS173 as the 11kV busbar is currently in satisfactory condition. However, there is a level of uncertainty of when this compound filled busbar will start to display poor condition indicators, which will require the replacement of the switchboard. Therefore, it was resolved in the business case for program TS173 that the two substations with compound filled switchboards (Marayong and West Wollongong zone substations) would have their switchboards replaced rather than have vacuum trucks installed.

### 2.4 AUXILIARY SWITCHGEAR

The 11kV auxiliary switchgear is Magnefix MD430 which was manufactured in 1964. This switchgear is manually operated from directly in front of the equipment, has destructive failure modes and is not arc-fault contained. As a result this switchgear in zone substations across the network is being replaced under Program TS009. However, Program TS009 excludes the auxiliary switchgear at Marayong ZS with the intention that it be replaced in a cost effective and efficient manner as part of a larger substation renewal project.

## 2.5 PROTECTION RELAYS

The protection relays at Marayong ZS consist of electromechanical relays, manufactured in 1965, to numerical relays manufactured within the last 10 years. All relays appear to be in good condition. However, the fault clearance times of the older electromechanical units are slower than the new numerical relays resulting in a heightened risk of arc-flash injuries to electricity workers and the public in the 11kV distribution network.

This is being addressed through program PS012, which includes the installation of numerical feeder protection relays throughout the network. However, Marayong ZS has been excluded from this program with the intention that numerical protection relays will be installed in a cost effective and efficient manner as part of a larger substation renewal project.

## 2.6 CONTROL BUILDING

The control building is of double brick construction with a steel roof. It was built in 1964-65 and extended in 1980.

It is in reasonable condition and should have a life expectancy in excess of a further 10 years. There is no space, however, for further expansion within the building and this is a significant constraint on any plans to expand the capacity of the substation or to replace the existing 11kV switchboard and protection and control equipment in the building.

The cable basement is low with an unsealed floor under the 11kV switchboard. This presents space constraints and is a safety hazard for staff working in the basement area.

## 3.0 NETWORK ISSUES

Marayong Zone Substation is required in its current location for the foreseeable future. Further, the substations in the area have adequate capacity for the current planning period. However, longer term plans include the commissioning of a new zone substation to account for future load growth in the Blacktown CBD area. Providing greater transformer capacity at Marayong ZS may defer future augmentation of the network and therefore, should be considered in this program.

Furthermore, currently nine of the 13 11kV feeder circuit breakers are double-cabled. It is desirable to remove the double cabling to provide improved discrimination during faults and improved reliability for customers on those feeders. Accordingly, provision of additional feeder circuit breakers should be considered as part of any major redevelopment of the substation.

## 4.0 RECOMMENDATIONS

Given the design, safety issues and limitations of the 11kV switchboard and auxiliary switchboard at Marayong Zone Substation and the limitations of the existing control building it is proposed that consideration be given to the redevelopment or partial redevelopment of the substation.

The project should address the 11kV switchboard and auxiliary switchgear, the external condition of the power transformers and also the secondary systems in the substation. It should also consider any noise issues associated with the powers transformers.

The PIP 8.1B includes an allocation of \$16.4M for this work over the period of 2016/17 – 2020/21. Accordingly, it is proposed that a NIO team be inaugurated to consider the renewal of Marayong Zone Substation in the timeframe of 2016/17 – 2020/21.

## 5.0 APPENDICES

**APPENDIX A** - Location of Marayong ZS

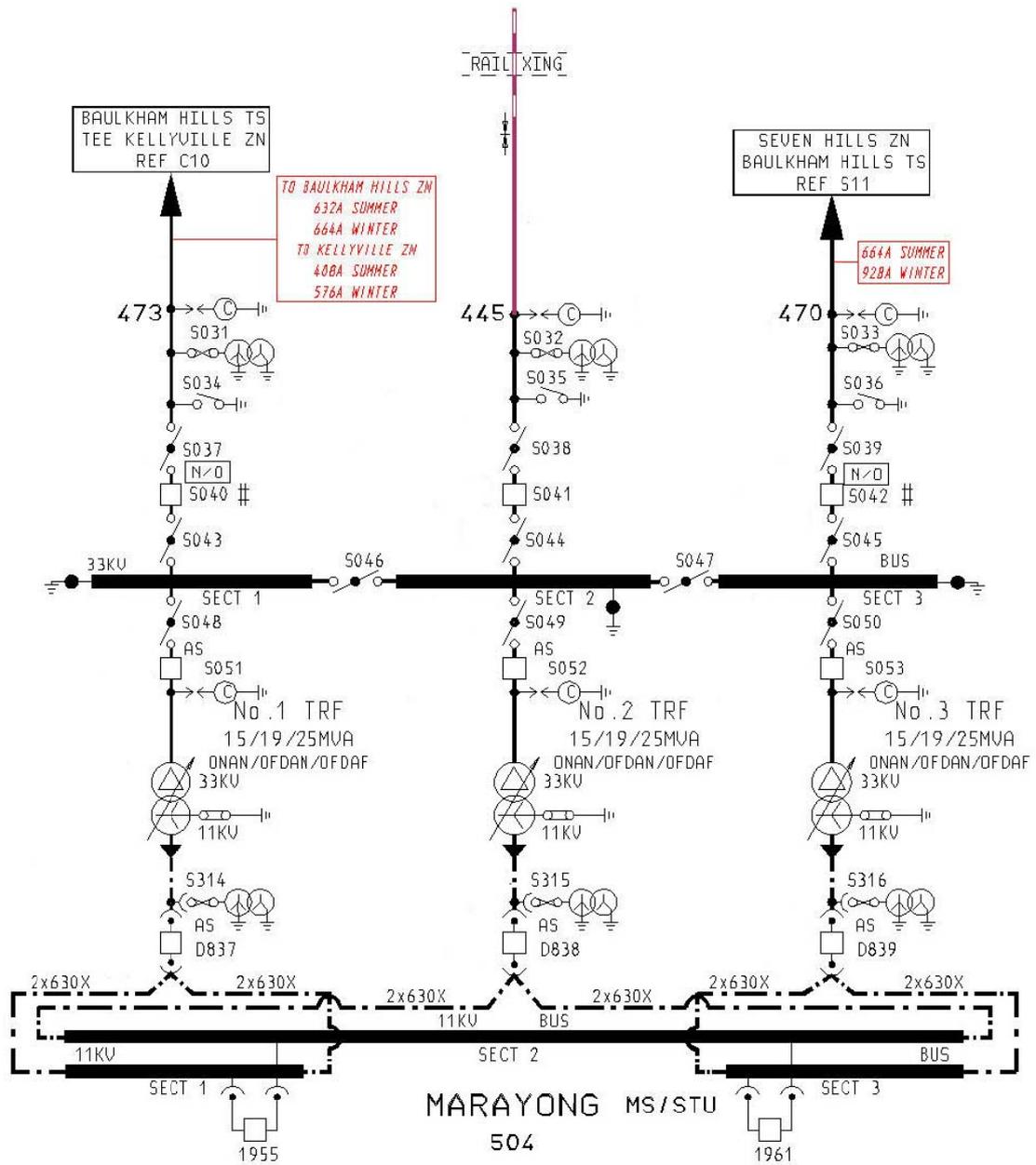
**APPENDIX B** - Single line diagram (existing)

**APPENDIX C - Images of the substation**





APPENDIX B - Single line diagram (existing)



APPENDIX C - Images of the substation



Marayong Zone  
Substation  
from Charles Street



33kV switchyard



11kV Westinghouse  
B18 switchgear