PowerWater

Power and Water Corporation
Business Need Identification

NTC
Upgrade Tennant Creek ZSS Transformers

Proposed:

Jim McKay
A/Chief Engineer
Power Networks
Date: 26/02/2018

Approved:

Djuna Pollard
Executive General Manager
Power Networks
Date: 27/2/2018

1 PROJECT SUMMARY

Project Title:	Upgrade Tennant Creek ZSS Transformers		
Project No:	PRD	**SAP Ref:**	
Financial Year Commencement:	2019/20		
Business Unit:	Power Networks		
Project Owner (GM):	Djuna Pollard	**Phone No:**	8985 8431
Contact Officer:	Peter Kwong	**Phone No:**	8924 5060
Date of Submission:		**File Ref No:**	
Submission Number:		**Priority Score:**	
Primary Driver:	Asset Renewal	**Secondary Driver:**	
Project Classification:	Capital Category C		

2 RECOMMENDATION

It is recommended that IRC note the proposed project planned for the 2019-24 regulatory period for an estimated budget of $0.5 million, and approve the inclusion of this project into the SCI for this amount, with a corresponding completion date of June 2020.

It is also recommended that IRC endorse the expenditure of $10,000 for further investigations and concept development required to reach the Business Case Gateway.

3 DESCRIPTION OF ISSUES

The Tennant Creek area is serviced by 22kV feeders connected to a switchboard at the Power Station. There are two 22/11kV coupling transformers owned by PWC that receives electricity produced by generators owned by Territory Generation.

The current forecasted maximum demand for Tennant Creek as shown in the latest update to the Network Management Plan[1] indicates that under a single contingency event (loss of one transformer), the system will be able to meet

[1] D2017/263255 – Network Management Plan 2013_14 to 2018_19 - January 2017 Information Update

the required class G supply contingency criteria. However, after the publication of the January 2017 update to the Network Management Plan, an additional load of 1.9 MVA[2] has been committed and is currently under construction.

This additional load means that the maximum demand on the Tennant Creek Zone Substation will exceed the contingency capacity by approximately 0.9 MVA in 2019.

The two 7.5MVA 22/11kV coupling transformers were manufactured in 1999 and have a degree of polymerisation value that indicated "as new" paper insulation tensile strength. One transformer may have internal heating at higher temperatures. The condition is being actively monitored.

4 POTENTIAL SOLUTION

A number of potential solutions exists and are briefly discussed below:

1. Install radiator fans on existing transformers – This will increase transformer capacity to 10MVA (ONAF) with the operation of the radiator fans.
2. Post contingency load shedding – Provide an automated system to automatically shed load immediately following the trip of either coupling transformers.
3. Demand management – To be investigated in line with the Power Networks Demand Management Procedure[3]. Reducing the maximum demand of Tennant Creek Substation will allow the network investment to be delayed.

Early investigations indicate that the first option would likely be the recommended solution and will best meet the immediate and long term needs of the area.

5 STRATEGIC ALIGNMENT

This project aligns with the Corporation's key result areas of operational performance and customer centricity, where the goals are to be an efficient provider of services and delivering on customers' expectations.

The works will allow PWC to safely and reliably meet current and future demands for the Tennant Creek area.

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[2] D2017/189387 – NPR1604 Tennant Creek Power Station Transformer Upgrades
[3] D2013/273859 – Power Networks Demand Management Procedure

6 TIMING CONSTRAINTS

It is expected that the maximum demand on the Tennant Creek Zone Substation will exceed the contingency capacity by approximately 0.9 MVA in 2019.

7 EXPECTED BENEFITS

Driver	Benefit	Measure
Growth / Demand	To cater for existing and growing demand at Tennant Creek area.	Zone Substation able to meet the firm capacity of the Tennant area.

8 MILESTONES (mm/yyyy)

1. Investment Planning	2. Project Development	3. Project Commitment	4. Project Delivery	5. Review
07/2017	03/2019	06/2019	06/2020	09/2020

9 KEY STAKEHOLDERS

There is little risk of public opposition to increasing the capacity of the coupling transformers at Tennant Creek Zone Substation. This project will ensure a safe, reliable and high quality power supply for the area.

This capital project has been shown to comply with the National Electricity

Rules and is discussed in Appendix A, 'Network capital expenditure forecast - Compliance with Rules requirements'.

Description	Title / Business unit
Internal governance stakeholders	Chief Executive
	Investment Review Committee
	General Manager Power Networks
	Group Manager Service Delivery
	Chief Engineer
Internal design stakeholders	Senior Manager Network Development and Planning

	Senior Manager Contracts and Projects
	Senior Manager Asset Management
	Manager Test & Protection Services
	Manager SCADA and Communication Services
	Local Residents
External – Unions and public	ETU
	Ministers
	Utilities Commission
External regulators	Australian Energy Regulator

10 RESOURCING REQUIREMENTS (to next gateway)

Resource Type/Role	How Many?	Internal/ External?	Anticipated Start Date	Duration Required	Allocation (% time or # hrs/days/ wks/mths)
Planning Engineer	1	Internal	Jan 2019	3 months	30%
Procurement Officer	1	Internal	Jan 2019	3 months	30%
Project Manager	1	Internal	Jan 2019	3 months	30%

11 DELIVERY RISK

A Preliminary Project Implementation Assessment was conducted for this project and the key risks to delivery of the investment are detailed below:

Risk/Impact Description	Proposed Action
System Outages will be required for connection of new equipment or modifications to existing equipment	Cutover/outage plan to be developed with System Control
There may be new high voltage equipment installed in Tennant Creek Zone Substation (66kV & 11kV)	Personnel accessing the switchyard shall follow existing Access to Apparatus Rules.
Possible budget overruns	Ensure detailed budget and RACE analysis

	are completed during the project development phase.
Risk of release of hydrocarbon into the environment	Ensure hydrocarbon containment systems are to current standards

The project will be delivered by the Power Networks Contracts and Projects group, with the Investment Planning phase completed by the Power Networks Network Development and Planning group.

12 FINANCIAL IMPACTS

Cost estimate includes installation of radiator fans to the existing transformers. This project is to be included into the 2018/19 SCI.

12.1 Capex Profile

Year	2019/20 ($'000)	2020/21 ($'000)	2021/22 ($'000)	2022/23 ($'000)	2023/24 ($'000)	Balance ($'000)	Total ($'000)
Investment Planning	10						**10**
Project Development	10						**10**
Project Commitment	10						**10**
Project Delivery	460						**460**
Review		10					**10**
Total	**490**	**10**					**500**

12.2 Opex Implications

There will be annual operating cost of approximately $5,000 associated with the new transformer fans, if this option is chosen.

12.3 Variance

N/A

APPENDIX A

Network Planning Report – NPR1604
(D2016/87742)

PowerWater

Report No:	NPR1604	**File No:**	D2016/87742
Revision	Final	**Container No:**	F2005/13996
Date:	13th February 2018		
Author:	Craig Owens		
Approved by:	Tat Au-Yeung – Senior Manager Network Development and Planning		
Title:	**Tennant Creek Power Station Transformer Upgrades**		

- **Report Circulation**

The following staff members are on the circulation list for this report:

Goutham Maddirala	Christina Camilleri	Jana Lai	Peter Kwong

1. Executive Summary

The current forecasted maximum demand for Tennant Creek as shown in the latest update to the Network Management Plan[4] indicates that under a single contingency event (loss of one transformer), the system will be able to meet the required class G supply contingency criteria. However, after the publication of the January 2017 update to the Network Management Plan, an additional load of 1.9MVA ([redacted]) has been committed and is currently under construction.

[4] D2017/263255 - Network_Management_Plan_2013_14_to_2018_19_-_January_2017_Information_Update

[5] D2017/189387 - 20170505 CCamilleri - Email to Richard Drummond (of Southern Region, Power Networks) - RE: Load Increase Investigation - Warrego Line

[6] D2016/269280 2016/17 Load Log for forecasting All Regions created 16 June 2016

This additional load means that the maximum demand on the Tennant Creek Zone Substation will exceed the contingency capacity by approximately 0.9 MVA in 2019.

In order to overcome this contingency constraint, it is recommended that fans be installed on the Tennant Creek zone substation transformers to achieve higher cyclic ratings under ONAF cooling. The transformer manufacturer ABB has provided a quote to carry out this work.

2. Existing Situation

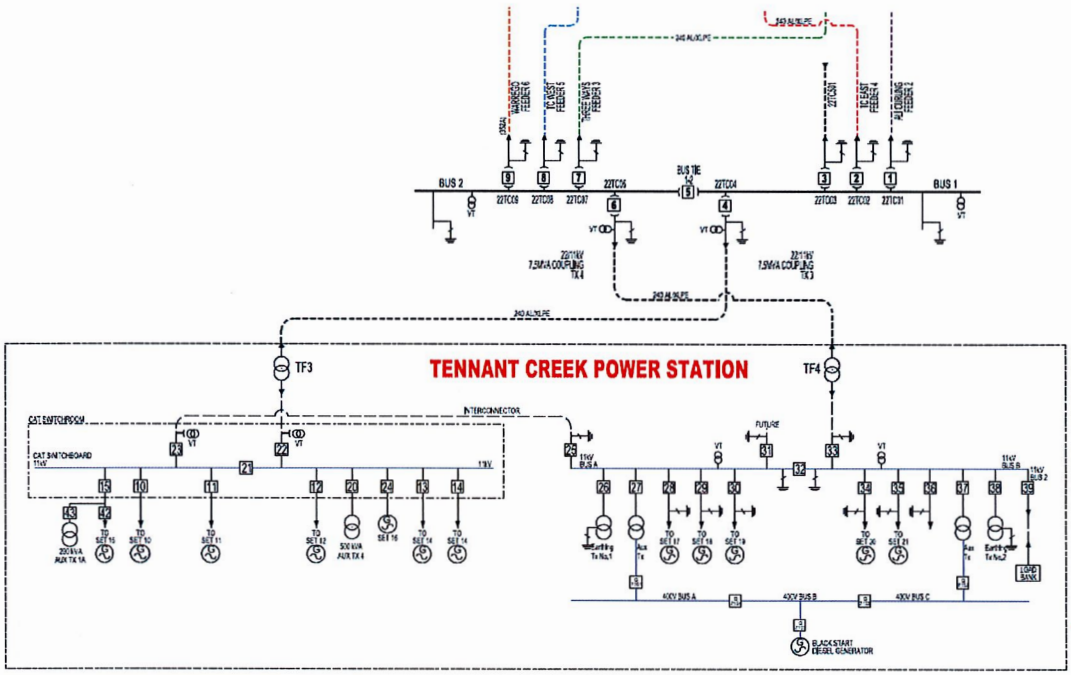

Figure 1: Tennant Creek System Diagram

The capacity at Tennant Creek ZSS is currently 16.6MVA under normal operating conditions and 8.3MVA under contingency. This is supplied through two 7.5MVA 22/11kV transformers (T3 and T4 – see **Figure 1Error! Reference source not found.**).

Both transformers were manufactured in 1999 and have a degree of polymerisation (DP) value that indicates "as new" paper insulation tensile strength. T3 condition code is rated green indicating that the transformer is in good condition with no notable anomalies. T4 is currently code amber primarily due to internal heating at higher temperatures. The condition of the transformer is being monitored.

Referring to **Figure 2**, the most recent demand forecasts for Tennant Creek Zone Substation indicates that in 2019, the standard weather maximum demand will be above the contingency capacity of the Zone Substation. Historical figures indicate that load growth has been minimal in Tennant Creek and apart from new block load, demand is relatively flat. The increase in demand between 2018 and 2019 is primarily due to new load of 1.9 MVA

([redacted]) which will be connected in 2018. The P50 forecasted demand for 2019 is 9.17 MVA, which exceeds the cyclic firm (contingency) rating of 8.3 MVA. This places the Tennant Creek area at risk of losing security of supply under the loss of one transformer.

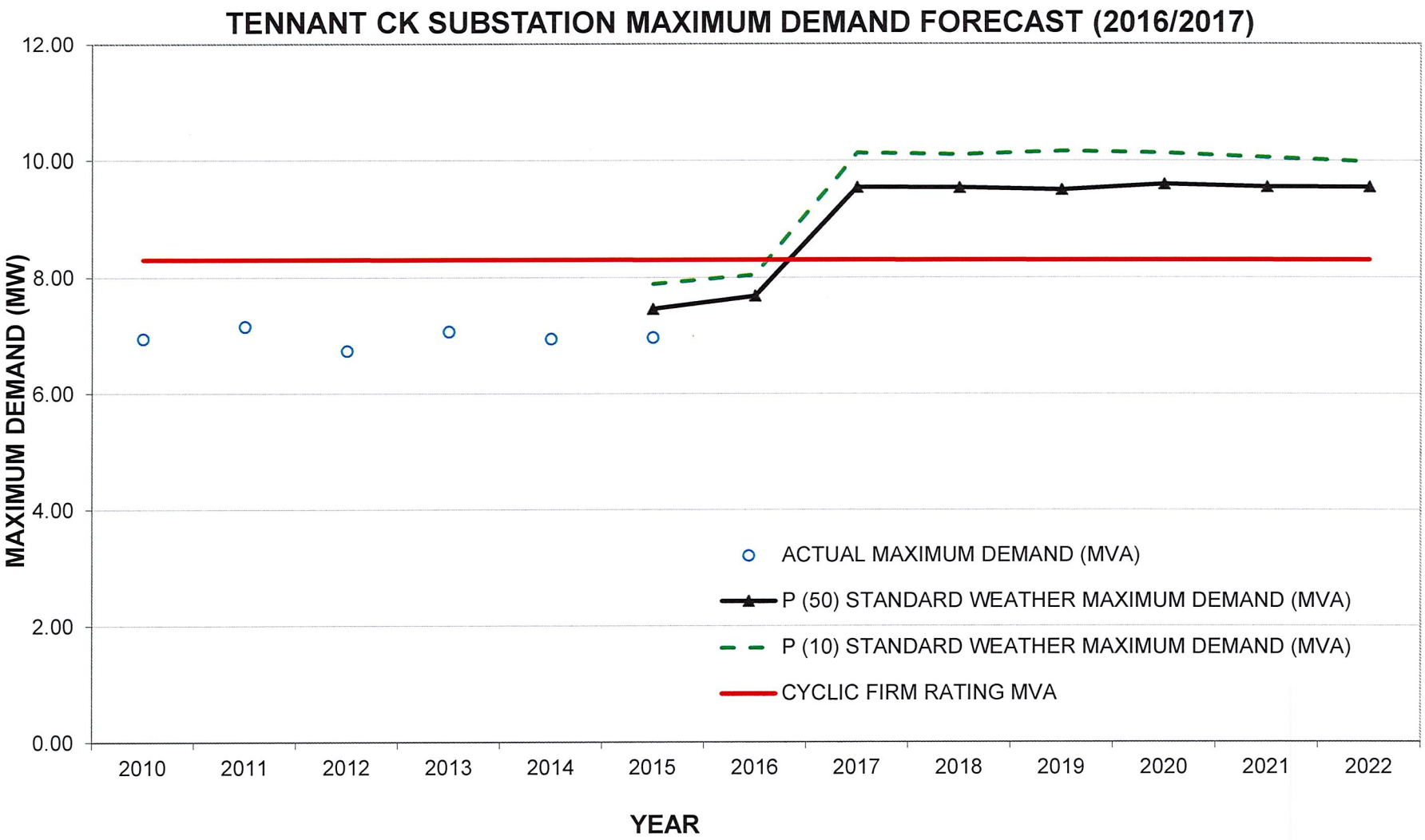

Figure 2: Tennant Creek Zone Substation Maximum Demand Forecast (2016/2017)

3. Possible Solutions

In order to overcome contingency constraints on the Zone Substation, the following solutions could be implemented:

- *Upgrade existing transformers to a larger capacity*
  This is the least preferred solution, as it is the most costly and complex of the proposed options.

- *System monitoring*
  This involves monitoring the system demand and splitting the bus when demand approaches contingency capacity. A demand greater than transformer cyclic rating will cause loss of system security.

- *Post contingency load shedding*
  This involves providing an automated system to operate in conjunction with the existing SCADA system. Such a system would operate immediately following the trip of either T3 or T4, and reduce load by interrupting feeders in order to reduce the load on the remaining transformer to within rating.
  Such a system may be able to meet requirements of the Network Planning Criteria, Class of Supply G[7], which requires load to be restored within three hours following a contingency.

- *Demand management*
  A demand management option which reduces the maximum demand on Tennant Creek Zone Substation by at least 0.9 MVA would allow any network investment to be delayed.
  PWC has not identified any demand management options which would meet this requirement.

- *Install fans on existing transformers to achieve higher ONAF capacity*
  The transformer manufacturer (ABB) has advised that it is possible to add fans to the existing transformers[8].
  It is envisaged that by installing fans, a 10MVA capacity under ONAF cooling could be achieved which would suffice under contingency conditions.
  AEMO's maximum P10 demand forecast is slightly higher than 10 MVA from 2019 onwards. Detailed calculations of the contingency cyclic rating should be carried out in consultation with the transformer manufacturer to determine the precise rating.
  In addition actual maximum demand values should be monitored at least annually to determine whether or not additional measures will be required.

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[7] D2013/653383 - Network Technical Code and Network Planning Criteria v3.1
[8] D2016/304579- 20160707 email from ABB to Jacob Lewis - ABB TC Tx upgrades

This is the preferred option as it is the lowest risk option and is less expensive than installation of new higher rated transformers.
This option meets class of supply G as stipulated in the "Network Technical Code and Network Planning Criteria Version 3.1"[7].

4. Recommendations and Actions

Given that transformers T3 and T4 are both in relatively good condition, the maximum demand is only expected to exceed contingency cyclic rating by approximately 0.9 MVA (according to current PWC forecasts) and that future load in Tennant Creek is expected to grow very slowly, a complete upgrade of the transformers is not justified.
System monitoring alone is not preferred because it does not mitigate risks of system outages under contingency.
Post contingency load shedding is not preferred, since it is a new technological approach for PWC, and carries with it the risks inherent in the implementation of new technology.
To date, no suitable demand management projects have been identified.

Therefore the recommended course of action in order to alleviate contingency constraints is installation of fans on transformers T3 and T4. ABB have provided a quote to carry out the work in Darwin[7]. Additional costs which may be incurred due to the remote location of the transformers will have to be considered.

APPENDIX C

Preliminary Project Implementation Assessment

(D2018/64383)