

Program of Works

2017 – 2022

Communication Network Technologies (PUBLIC VERSION)

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Contact

This document is the responsibility of Asset Engineering – Asset Management Division, AusNet Services. Please contact the indicated owner of the document with any inquiries.

Edoardo Viel

AusNet Services

Level 31, 2 Southbank Boulevard

Melbourne Victoria 3006

Ph: (03) 9695 6000

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1 Summary

PROGRAM	Replacement of transport and access equipment on communications network
SERVICE DATE	On-going throughout period 2018 – 2022
LOCATION	Various areas of Victorian Electricity Transmission Network
VALUE	\$ 29.87M

FY17/18	FY18/19	FY19/20	FY20/21	FY 21/22	Total
\$7.77M	\$8.28M	\$3.01M	\$5.39M	\$5.42M	\$29.87M

This works program document should be read in conjunction with the Communication Systems Asset Management Strategy¹. It details communication services , asset summary including service age and condition, key issues, requirements and the strategies.

2 Program Scope

A communication network is a system of systems that interacts with other networks to achieve multiple service objectives. The network addresses a common framework for the interaction of network elements and interoperability of service functions that together achieve specific communication objectives. To achieve these objectives, several technologies are used to fulfil specific functions.

- User access;
- Control;
- Transport;
- Transmission media.

User access systems include Plesiochronous Digital Hierarchy (PDH), Tele-protection equipment, switches, serial servers, and telephone exchanges. The control function is fulfilled by technologies which provide authentication, encryption, authorisation, and creation/termination of sessions. The transport function is provided by Wave Division Multiplexer (WDM), Synchronous Digital Hierarchy (SDH), Point-to-Point (PTP) radio, and Power Line Carrier (PLC). Transmission media include optical fibre, copper, phase conductors, radio antennas and waveguides.

This program of works addresses technologies related to user access, control, and transport systems excluding PTP radio and PLC which are covered in the Bearer Systems program of works.

The Asset Health Report, which captures a snapshot of the condition of assets, identified that the communication network assets are in general good health. Most of the assets still have a “Remaining life” of greater than 50%. However, some assets fall in the C4 and C5 condition therefore necessitating a programmed replacement in the next five to seven years if the availability of the network is to be maintained.

C4 condition rated assets have a “Remaining Life” of 25% which implies that the assets are in worse than average condition. The manufacturers no longer support maintenance of the equipment and the sale of spares has ceased. The only spares available are those in the AusNet Services storage facilities.

¹ AMS 10-56 Communication Systems.

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The C5 assets have a “Remaining life” of 5% meaning the assets have reached end-of-economic life. The manufacturers no longer support the equipment and spares are only obtained by salvaging parts from retired equipment. There is increasing lack of experience and skill to maintain the asset both within AusNet Services and externally.

To maintain the current level of availability and given the volume of assets on the network, this program proposes to replace the following group of assets:

Synchronous Digital Hierarchy (SDH)

- There are 150 SDH nodes installed on the communication network;
- 30% are in condition C4 and 10% are rated C5.

Plesiochronous Digital Hierarchy (PDH)

- 410 PDH nodes are installed across the network with the oldest being 15 years;
- 72% of the assets are in condition C4 and 8% are in condition C5.

Telephony

- 43 exchanges and one head-end system (oldest exchange is 11 years);
- 63% of the telephony system is C4 rating and 30% is rated C5;
- The third-party fixed landlines, into terminal stations, have been declared end-of-life by the supplier and AusNet Services has been requested to migrate to the new NBN services.

Tele-protection

- 300 tele-protection systems;
- 56% are condition C4.

Switches

- 100 Switches the oldest being 12 years old;
- 80% C4 rating.

Serial Servers

- 126 Serial servers;
- 40% of the assets are C4 rating and 10% C5 rating – the majority being Lantronix serial servers installed about 12 years ago.

2.1 Scope

The works, depending on the technology will include:

- Equipment design, installation and commissioning;
- Transfer and commissioning of services;
- Update asset management systems with new asset data as part of completion of works.

2.1.1 SDH Replacements

33 sites as shown in 0 have SDH equipment earmarked for replacement:

- 66 new SDH Nodes;
- Decommission and remove old equipment.

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2.1.2 PDH Replacements

67 sites as shown in 0 have PDH equipment earmarked for replacement:

- 302 new PDH Nodes;
- Decommission and remove old equipment.

2.1.3 Telephony Replacements

36 sites as shown in 0 have telephone exchanges earmarked for replacement:

- 36 new telephone exchanges;
- New telephone console, call logging and recording systems at CEOT;
- Migrate landlines to the National Broadband Network (NBN) leased services;
- Decommission and remove old equipment.

2.1.4 Tele-protection Replacements

26 sites as shown in 0 have tele-protection equipment earmarked for replacement:

- 170 new tele-protection devices;
- Decommission and remove old equipment.

2.1.5 Switch Replacements

29 sites as shown in 0 have switches earmarked for replacement:

- 80 new Ethernet switches;
- Decommission and remove old equipment.

2.1.6 Serial Server Replacements

29 sites as shown in 0 have switches earmarked for replacement:

- 60 new Serial Servers;
- Decommission and remove old equipment.

2.2 Project Budget

	Amount \$
SDH and PDH Replacement	C-I-C
WDM Replacement	C-I-C
Telephony System replacements	C-I-C
Tele-protection replacement	C-I-C
Serial Servers and Switches replacement	C-I-C
Total	29,869,000

3 Project Drivers

Implementation of this program of work will enable AusNet Services to economically address the following business drivers:

3.1 Safety

- Industry leadership in safety performance:
 - Minimise electricity transmission network associated risks to employees, contractors and the general public by enabling safe remote monitoring and control of network assets during maintenance and business as usual operations.

3.2 People

- High performing leadership, capability and culture:
 - N/A.

3.3 Financial

- Sustainable earnings and security holder value growth:
 - Reduce the risk of widespread power outages caused by failure of protection and signalling systems.
- Expansive and accretive growth:
 - N/A.

3.4 Business and Asset

- Safe, resilient and reliable networks
 - Comply with the National Electricity Rules (NER) by ensuring:
 - ❖ Stipulated fault clearance times are achieved so that the electricity system remains stable during fault conditions and equipment damage is minimised;
 - ❖ Power transfers are not constrained because of unavailability of communication systems;
 - ❖ The operation of independent systems such as protection operation is achieved during contingency events;
 - ❖ The system is available at all times except for short periods (up to 8 hours) of time for maintenance;
 - ❖ Data transfer from power stations and terminal stations meets Australian Energy Market Operator (AEMO) requirements;
 - ❖ Availability of a telephone system to be used during the most adverse of times;
- An efficient business model supported by intelligent, automated and integrated processes and systems:
 - The communications network continues to provide services that incorporate existing requirements while accommodating new technological evolution.
- Industry leadership and advocacy role in regulatory development:
 - N/A.

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3.5 Customer

- A highly developed customer service capability:
 - N/A.

4 Overview

The AusNet Services communications network interconnects various electricity transmission network operating systems, applications and devices. The system has over 3,500 circuits which are used for protection, SCADA, control, signalling, asset data gathering, business computer applications, and telephony systems. The majority of circuits are for the direct operation of the Victorian electricity transmission network. Therefore, any failure of the communication network is likely to constrain the capabilities of the electricity power network.

As corporate applications continue to demand more bandwidth between sites and operational applications migrate to Ethernet/IP connectivity there is an increasing demand and requirement for Ethernet and IP traffic. To minimise the growth of multiple networks as technology and needs evolve, this replacement program has taken into consideration these developments and proposes a plan that will economically deliver communications solutions for the Victorian electricity transmission network.

5 Risk Evaluation

5.1 External Risks

5.1.1 Political, Regulatory and Statutory

- Breach of power system protection operational requirements;
- Failure to provide data for the energy market operations.

5.1.2 Technology

- Inability to get spares to repair equipment because vendors have stopped manufacturing the products.

5.2 Internal Risks

5.2.1 Process and Services

- Increase in maintenance resources because ageing equipment is prone to failure.

5.2.2 Strategy

- Failure to align with corporate asset replacement strategy leading to increased operational costs (repair on failure).

5.2.3 Stakeholder Management

- Not providing and meeting customer needs adequately.

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5.2.4 Data/Information

- Communication network not meeting availability targets and affecting power systems protection and control operations.

5.3 Summary Risk Assessment

The risks associated with network technology assets in condition C4 and C5 are summarised as follows:

- Failure to operate the power system protection devices;
- Inability to acquire spares when equipment fails;
- Increase in resource requirements;
- Missing service availability targets;

The risk evaluation, using the AusNet Services' Risk Matrix2 (Corporate Risk Management Framework V3.0 RM 001-2006), is shown in Table 2 in the Appendix.

The figure below shows the current risk level and risk level after completion of the program of works.

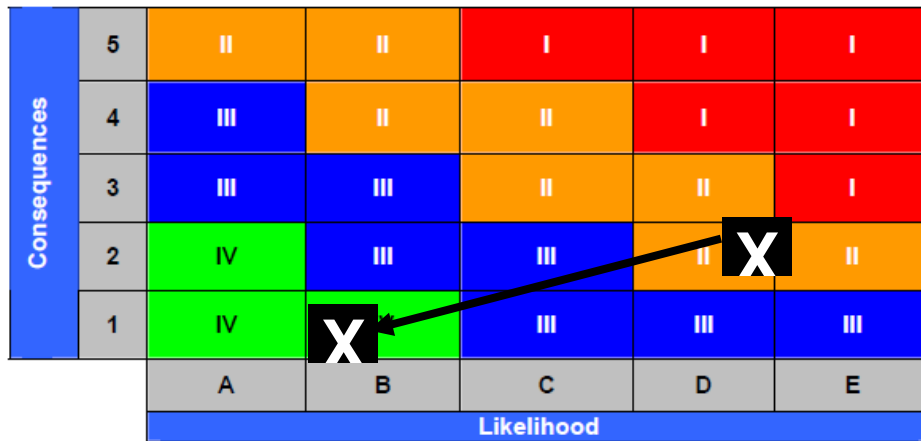


Figure 1 – Risk level before and after Program of Works

² AusNet Services Risk Management Framework – RM 001-2006.

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6 Options

The individual projects in the program will be evaluated with the following options:

- Option 1** Business as Usual
- Option 2** Replace Assets on Failure
- Option 3** Planned Replacement of Deteriorated Equipment

6.1 Option 1 – Business as Usual

The “Business as Usual” option operates and maintains existing assets until repairs are not possible and the assets are abandoned:

- Run assets and abandon when repairs are not possible;
- Engage rare resources to maintain assets.

6.2 Option 2 – Replace on Failure

Operate and maintain existing assets to a point where repairs are not possible and the asset is replaced with a similar type:

- Run assets and replace when repairs are not possible.
- Replace failed asset with like asset.
- Engage rare resources to maintain assets.

6.3 Option 3 – Planned Replacement of Deteriorated Assets

Plan replacement program on an economic timetable:

- Replace assets when maintenance costs become uneconomical;
- Consider current and future requirements;
- Increase capacity and functionality of the communication network as required;
- Select most appropriate technology.

7 Options Analysis

7.1 Option 1 – Business as Usual

This option fails to address the key business drivers in section 3. The ‘Business as Usual’ approach exposes AusNet Services to significant financial and regulatory risks which arise from:

- Gradual increase in operational and maintenance costs;
- Repeated communication network failures;
- Diminishing size of the communication network and eventual collapse
- Potentially significant financial liabilities and high electricity consumer costs associated with loss of electricity supply.

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7.2 Option 2 – Replace Equipment on Failure

- Increasing communication network failure frequency which affects network availability;
- Operational and maintenance costs increase for in-service equipment and reduce for replaced equipment;
- High capital expenditures over prolonged period because of high unplanned replacement costs;
- Network capacity and functionality remains static.

7.3 Option 3 – Planned Replacement of Deteriorated Equipment

This option addresses the key business drivers in section 3:

- Enables an economic asset management program which optimises resource allocation;
- Maintains the current level of communication network availability and safety;
- No step change to operational and maintenance costs;
- Modern equipment and new applications can be introduced to utilise the network functions;
- Network can handle the increase in demand;
- Good corporate image.

8 Financial Analysis

The options have been analysed using the corporate NPV model. The benefits and costs of each option are based on an estimate from the corporate risk model. Option 3 “Planned Replacement” achieves the greatest benefit for the lowest capital cost when compared with option 2.

Analysis of Investment Options (\$'000s)	Economic Least Cost Analysis				Financial Return		
	PV Capital Cost	PV Opex Costs	PV Community Costs & Benefits	Total PV Cost	NPV including Reg Return (post tax)	PV Cost Ratio	PV of Incentive / (Penalty)
1 Business As Usual	-	(468)	(58,028)	(58,496)	-	1.00	-
2 Replace on Failure	(31,283)	(50)	(23,389)	(54,722)	778	66.96	-
3 Planned Replacement of C5 Rating Assets	(28,218)	(50)	-	(28,268)	2,457	60.41	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-

All figures are in \$000's unless otherwise stated.

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8.1 Option 1 – Business as Usual

Business as Usual option will lead to complete loss of the communication network and failure to operate the electricity network.

PV of Capex and Opex	<ul style="list-style-type: none"> No CAPEX however substantial level of OPEX to maintain the assets until complete failure.
PV of Community Costs & Benefits	<ul style="list-style-type: none"> Loss of communications could lead to loss of supply, delays in restoration of an outage, or even a system black. Such an incident will lead to increased scrutiny from the regulator, undue press coverage and loss of stakeholder confidence in the company. The community costs arise from calculating Value of Customer Reliability (VCR) and include corporate reputation.

8.2 Option 2 – Replace on Failure

Replace on fail option will lead the eventual replacement of the degraded network assets however; costs will be high because unplanned mobilisation attracts higher rates than planned rates. The communications network will have long outages which could impact electricity supply.

PV of Capex and Opex	<ul style="list-style-type: none"> Opex Costs are high for in-service equipment but will reduce as the degraded assets are gradually phased out. Unplanned mobilisation costs typically attract a 30% premium.
PV of Community Costs & Benefits	<ul style="list-style-type: none"> Loss of communications could lead to loss of supply or delays in restoration of an outage. Undue press coverage and loss of stakeholder confidence in the company. Until all degraded assets are replaced this potential loss still exists

8.3 Option 3 – Planned Replacement

The planned replacement option targets assets likely to fail first and minimises the possibility of outages.

PV of Capex and Opex	<ul style="list-style-type: none"> No step change in OPEX.
PV of Community Costs & Benefits	<ul style="list-style-type: none"> This option will avoid the costs associated with the Business as Usual option.

9 Recommended Action

Option 3 Planned Replacement of deteriorated equipment is recommended.

10 Reference Documents

- Electricity Safety Act.
- Occupational Health & Safety Act – provision of safe work environment.
- AEMC National Electricity Rules (version 72).
- AMS – Victorian Electricity Transmission Network – Communications Systems (AMS 10-56).
- AMS – Victorian Electricity Transmission Network – Asset Life Evaluation (AMS 10-101).
- Asset Management Strategy for the Victorian Electricity Transmission Network (AMS 10-01).

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Appendix 1: Sites and Replacement Equipment

Sites	SDH	PDH	Telephony	Tele-protection	Switches	Serial Servers
ATS	yes	yes		yes	yes	yes
BATS	yes	yes	yes	yes		yes
BETS	yes	yes	yes	yes		yes
BIGH		yes				
BLTS	yes	yes	yes		yes	yes
BTS	yes	yes	yes	yes		yes
C-452	yes	yes				
CAMH		yes				
CBTS	yes	yes	yes	yes	yes	yes
C-EPS		yes		yes		
C-FVTS	yes	yes				
C-JLGA		yes				
C-LYGS		yes				
C-MOPS		yes				
C-MPS		yes				
C-NPSD	yes	yes				
COCK		yes				
C-PTH		yes		yes		
C-YTS		yes				
DDTS	yes	yes	yes		yes	yes
EPSY	yes	yes	yes	yes		
ERTS		yes		yes	yes	yes
FBTS	yes	yes	yes	yes	yes	yes
GNTS	yes	yes	yes		yes	yes

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Sites	SDH	PDH	Telephony	Tele-protection	Switches	Serial Servers
GTS	yes	yes	yes	yes	yes	yes
HOTS			yes			yes
HTS		yes	yes		yes	
HWPS		yes	yes	yes		
HWTS	yes	yes	yes	yes		
HYTS			yes		yes	yes
JERH		yes				
KCC	yes	yes				
KGTS			yes			
KTS	yes	yes	yes	yes	yes	
LY		yes				
LYPS		yes	yes		yes	yes
MAC		yes				
MBTS	yes	yes	yes	yes		yes
MLTS	yes	yes	yes	yes	yes	yes
MTBB		yes				
MTBD		yes				
MTBL		yes				
MTBN		yes				
MTBW		yes				
MTCL					yes	
MTMD		yes				
MTMJ		yes				
MTS	yes		yes			
MTSD					yes	
MTST		yes				

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Sites	SDH	PDH	Telephony	Tele-protection	Switches	Serial Servers
MTTA					yes	
MTWH		yes				
MWTS		yes				
OTHB		yes				
RCTS			yes		yes	yes
ROCC	yes	yes				
ROTS	yes	yes	yes	yes	yes	yes
RTS	yes	yes		yes		
RTTS		yes				
RWTS	yes	yes	yes		yes	yes
SHTS	yes	yes	yes	yes		yes
SMTS	yes	yes	yes	yes	yes	yes
SVTS		yes	yes			
SYTS	yes	yes	yes	yes		
TAMK		yes				
TATA		yes				
TBTS		yes	yes	yes	yes	yes
TGTS			yes			yes
TSTS	yes	yes	yes	yes	yes	yes
TTS	yes		yes	yes	yes	yes
VINE					yes	
VNSC	yes	yes	yes	yes		
WBTS	yes				yes	yes
WETS					yes	
WMTS	yes	yes	yes		yes	yes
WOTS		yes	yes		yes	yes

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Sites	SDH	PDH	Telephony	Tele-protection	Switches	Serial Servers
YPS		yes	yes	yes	yes	yes

Table 1 – Sites and Replacement Equipment

Appendix 2: Risk Register Template

Entity/Project: _____ Facilitator: Aloysius Nainhabo Date: _____

RISK IDENTIFICATION			RISK TREATMENT			RISK ANALYSIS						
Risk	Causes	Impacts	Controls (Current)	RCE	Treatment Actions (Future)	Residual Risk			Target Risk			
						Conseq Rating	Like. Rating	Residual Risk Rating	Project Financial Exposure (Residual)	Conseq Rating	Like. Rating	Target Risk Rating
Power system protection operational requirements fail during a fault condition	Failure of communication network resulting in failure to transfer Protection signaling between stations	Regulation/Compliance: <ul style="list-style-type: none"> Breach of regulatory requirement resulting in investigation and directive issued Reputation <ul style="list-style-type: none"> adverse national press reporting over several days Customer: <ul style="list-style-type: none"> Loss of supply 	Regular Maintenance	Partially Effective	Develop and implement replacement program for C5 condition assets	3	C	Level II		1	B	Level IV
Inability to get spares when equipment fails	Manufacturer stopped production of parts. Equipment classified as obsolete	Regulation/Compliance: <ul style="list-style-type: none"> Breach of regulatory requirement resulting in investigation and directive issued Reputation <ul style="list-style-type: none"> adverse national press reporting over several days Customer: <ul style="list-style-type: none"> Loss of supply 	Regular contact with manufacturers	Partially Effective	Develop and implement replacement program for C5 condition assets	3	C	Level II		1	B	Level IV
Increase in resource requirements	<ul style="list-style-type: none"> Increasing equipment failure rate Costs of repair on failure is comparatively higher than planned repair 	Financial <ul style="list-style-type: none"> Increase in OPEX cost 	Monitoring equipment failure rates and maintenance frequency	Partially Effective	Alignment with corporate Asset Replacement Strategy	2	C	Level III		1	B	Level IV

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RISK IDENTIFICATION			RISK TREATMENT			RISK ANALYSIS						
Risk	Causes	Impacts	Controls (Current)	RCE	Treatment Actions (Future)	Residual Risk			Target Risk			
						Conseq Rating	Like. Rating	Residual Risk Rating	Project Financial Exposure (Residual)	Conseq Rating	Like. Rating	Target Risk Rating
Missing service availability targets	<ul style="list-style-type: none"> Frequent failures Capacity constraints 	Regulation/Compliance: <ul style="list-style-type: none"> Breach of regulatory requirement resulting in investigation and directive issued Customer: <ul style="list-style-type: none"> Failure of the energy market People <ul style="list-style-type: none"> Reduced efficiency of corporate applications 	Monitoring equipment failure rates and maintenance frequency	Partially Effective	Develop and implement replacement program for C5 condition assets taking into consideration future requirements	3	C	Level II		1	B	Level IV

Table 2 – Risk Evaluation Table