Program of Works

2017 – 2022

Fire Protection System Replacement (PUBLIC VERSION)

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1 Summary

PROGRAM	Fire Protection Systems (FPS) Capital Replacement Program 2017/18 – 2021/22.
SERVICE DATE	On-going throughout period 2017 – 2022.
LOCATION	Various Terminal Stations across Victoria.
VALUE	$8.775M

Table 1 – Program Overview

1.1 Program Scope

The scope for replacement/upgrade of the fire protection system (FPS) program covers the following works:

- Replacement /upgrade of fire hydrant systems at 14 terminal stations (condition rating C4/C5).
- Replacement /upgrade of fire detectors and fire indicators panels (FIP) at terminal stations (estimated 20 sites).
- Replacement /upgrade of deluge systems for 7 transformers installed at four sites – Moorabool, Rowville, Keilor and South Morang terminal stations (MLTS, ROTS, KTS & SMTS) and identified with issues related with corrosion and age (condition rating C4/ C5).
- Fire wall at SMTS.
- Upgrade / installation of signage at 25 stations.
- Other midlife refurbishment / upgrade at five stations (condition score C4/C3).

1.2 Program Expenditure Forecast

2017/18 ($k)	2018/19 ($k)	2019/20 ($k)	2020/21 ($k)	2021/22 ($k)	Total ($k)
1,755	1,755	1,755	1,755	1,755	8,775

Table 2 – Program timing and forecast expenditure

The costs of the above works program were estimated according to the Project Cost Estimating methodology[1] using unit rates based on most recent project expenditures experienced during similar asset replacement projects.

[1] Project Cost Estimating Methodology.pdf

2 Program Drivers

Assessments of FPS assets conditions have revealed that several terminal stations have:

- Fire hydrants which are:
  - Non-compliant assets to current Australian Standards applicable to installation and maintenance of fire hydrant systems; and
  - Compromised effectiveness of the systems due to various reasons.
- Fire detectors and FIP which are technically obsolete comprising sensitive electronic panels with a limited life of 12 to 15 years.

Additionally:

- Two Four transformer sites have deluge systems exhibiting corrosion and other age related deterioration; and
- 25 sites have 'EXIT' signage that is deteriorated, damaged, or missing.

Major failure of fire protection systems can result in the following:

- Health and Safety incidents.
- Fire spread or bushfire ignition.
- Financial penalties.
- Significant repair costs.
- Severely constrained system capacity.

Implementation of this program of work will assist AusNet Services in addressing the following business drivers:

- Safety of employees, contractors and the general public:
  - Minimise OH&S risk to employees and contractors.
  - Minimise risk to public due to improved effectiveness of fire control systems.
- Financial risk:
  - Reduce capital and operating costs through asset damage control.
  - Reduce financial penalties associated with poor asset availability.
  - Reduce civil actions resulting from personal injury/compromised health.
- Regulatory compliance:
  - Compliance with National Electricity Rules.
  - Compliance with Electricity Safety Act.
  - Compliance with accepted Electricity Safety Management Scheme.
  - Occupational Health & Safety Act (provide safe work environment).
- Corporate image maintained as prudent asset managers:
  - Manage risk as low as practicable.

3 Overview

FPS (detection and suppression) protect AusNet Services' assets from fire and improve system security and security of supply. A fire in a terminal station's control or relay building could result in a major loss of supply from the station for a long time. Similarly, the loss of a major system transformer due to fire could render the system constrained for substantially long durations. Also uncontrolled fire could result in severe health and safety issues to public and company employee / contractor with possible bush fire initiation.

The main assets covered under fire protection systems are:

- Fire hydrant systems (FHS) and associated components such as pumps, valves, underground pipes, booster assemblies, water storage tank / dams, etc;
- Fire detectors (aspirating or non-aspirating type) and fire indicator panels (FIPs);
- Deluge or water sprinkler systems (including heat/ air pressure detectors, operating valve, nozzles, pipeline, etc);
- Fire suppression systems (portable extinguishers and INERGEN gaseous system); and
- Fire walls.

Asset Management Strategy Document 'AMS 10-61: Fire detection and suppression' provides further details related to asset summary, associated risks and risk management strategies for FPS assets. This proposed upgrade / replacement program of work aligns with AMS 10-61.

Economic evaluations by NPV modelling (AusNet Services' financial assessment tool) has been performed in conjunction with risk assessments to establish that the proposed upgrade/ replacement program of FPS assets is financially/ economically justified. This program of work will remove significantly the existing risk associated with major failure of FPS asset during a fire incident.

3.1 Fire Hydrant Systems

Each terminal station has fire hydrants installed at strategic locations to provide water supply for fire-fighting agencies attending to a fire. Fire hydrants locations and adequate water supply arrangements are designed in accordance to relevant Australian Standards and in consultation with relevant fire agencies operating in the area. Some of the most important standards providing the direction related with, requirement, design, installation and maintenance of fire hydrant systems are:

- Building Code of Australia (BCA).
- Building Act 1993.
- AS 2419.1(2012): Fire hydrant installations – System design, installation and commissioning.
- AS1851 (2012): Maintenance of Fire Protection Systems.

The water supply at hydrants comes via underground pipes from external mains supply or on-site storage facilities such as dams and tanks. Some stations have booster pumps installed to support weaker supply pressures.

AS 2419.1 (2005 and 2012) requires mandatory hydrostatic testing of the system and pipes annually. An audit in 2005 identified several terminal stations (37 sites) with major non-compliances to current standards along with other non-compliance issues such as excessive line pressure drop, insufficient flow rate and lack of booster connections for Country Fire Agencies (CFA). Further details regarding description of issues, risk ranking (C1-C5) and number of affected sites are detailed in AMS10-142: Fire Hydrant Systems for Terminal Stations – Asset Health Report.

A prioritised (condition/ risk based) program started in 2010 to upgrade the fire hydrant systems at various terminal stations. Stage 1 and stage 2 of the program have been completed last year to cover ten highest risk sites. Stage 3 was initiated to cover 9 more sites and is expected to be completed by March 2017. Additionally four sites (BTS, HTS, RTS, and WMTS) have been or will be covered by major rebuild projects. One site, MPS, may retire in near future.

All the remaining 13 systems in poor condition (C4/C5) are proposed to be upgraded (11 major and 2 minor) between 2017/18 and 2021/22. Additionally minor upgrades (midlife refurbishment works) are proposed at three stations (C3/C4) to reduce the risk further during the forecast regulatory period.

3.2 Fire Indication and FIPs

Fire detection and alarm systems are installed mainly in control rooms, relay rooms, battery rooms, communication rooms and switch rooms. Most of these systems have been upgraded between 2001 and 2005 to include the aspirating type VESDA detectors. Non- aspirating type thermal and smoke detectors are also installed in parallel to VESDA units or independent systems at several locations. The useful service life of detectors and panels (as per fire authority's experience) is normally 12 to 15 year. Based on a technical service life of 15 years, the majority of the terminal stations will require the upgrade of old fire panels and detectors before 2022.

Condition monitoring techniques are not able to identify any imminent failure of these fire detectors and panels and therefore the Australian Standard requires monthly operational test on these assets.

The failure rate for fire detectors and fire panels is quite low during their useful service life. They fail from time to time (approximately 2-3 detector failures each month), but the statistics are quite low considering more than 3000 detectors in service. Although defective fire detectors are replaced on operational failures, complete replacement programs are undertaken at the time of replacement or upgrade of FIPs.

AusNet Services has experienced three FIP failures since 2011 and two sites have experienced several issues and defective FIP and detectors. Four sites have been upgraded since 2011 and the process has been started for one other site. Several failures have confirmed the short service life of these assets. Based upon experience and average service life, a total number of 20 sites are estimated (specifically sites upgraded around 2001 – 2002), for upgrade of fire detectors and FIP during 2017/18 to 2021/22.

Additionally several terminal station sites have been identified with inadequate 'EXIT' signage and require upgrade of the signage. The 'Exit' signs provide directions to help in building evacuation during emergency situations-reducing possible fire injuries, and are mandatory under 'Building Code of Australia'.

3.3 Fire walls and deluge systems

The purpose of fire walls is to restrict the spread of fire to other transformers and other plant and equipment and buildings. Fire walls are a passive fire protection measure and don't require any specific maintenance to preserve their condition over time.

Fire walls have largely been installed in metro terminal stations and were first implemented with the ASEA transformers at WMTS in 1964.

Fire walls are in place adequately for all the in-service transformers and are in good condition. Improved fire protection for the spare transformers at SMTS requires the installation of a new fire wall or relocation of the spare transformer.

Water deluge systems are installed to spray water to cool and contain the fire. The release of water is initiated through heat detectors and the release of air pressure from air detection pipes.

There are 19 critical system transformers/reactors, and three synchronous condenser transformers with water deluge systems, installed between 1960 and 1970. These systems are installed only for critical transformers (part of the main interconnecting lines for the state) at HWTS, HYTS, KTS, MLTS, ROTS and SMTS. Most of these deluge systems are the only fire protection system in place to avoid the spread of fire, and therefore need to be kept in good operational condition.

The deluge system at HYTS is planned to be replaced by a fire wall in 2016/17. Also, the HWTS fire deluge system has been refurbished recently. All deluge systems installed in the 1960s are now showing signs of advanced deterioration, and are assessed with C4/C5 condition rating. Therefore, all the remaining deluge systems at MLTS, ROTS, KTS and SMTS (H transformer), are proposed to be replaced/upgraded during the period 2017/18 to 2021/22. The proposed upgrade will complete the fire deluge system replacement program.

Please refer to AMS 10 – 140: Fire protection for power transformers and oil filled reactors for further details.

4 Risk Matrix

The FPS upgrade / replacement program will significantly reduce the likelihood of a major FPS failure during a fire incident. This reduction in likelihood will be achieved by replacing/ upgrading FPS assets which are in poor condition or non-compliant. Implementation of the FPS upgrade / replacement programs will reduce the likelihood from moderate to unlikely.

Also, the majority of assets shall be compliant to current Australian standards reducing significantly the risk of any major asset damage, financial penalties, or compensations. Also with effective FPS systems the possibility of any fire spread shall be reduced significantly resulting in reduced asset damage and OHS risk and reduced negative impact on community.

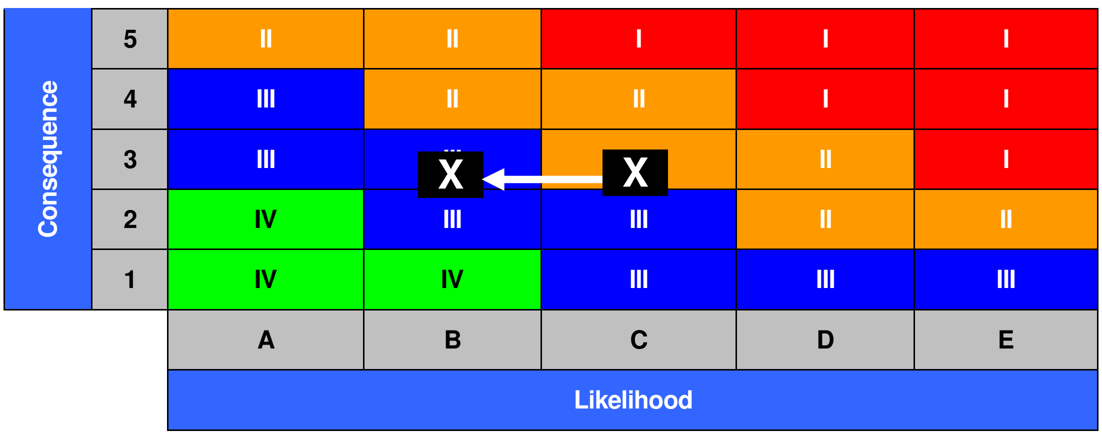

Figure 1 – Risk Matrix

5 Options

Option 1: Do Nothing.

Option 2: Replace/upgrade the non-compliant and ageing FPS assets based on condition/ risk assessment.

Option 3: Replace/upgrade FPS assets based on age.

Option 4: Replacement of assets only after failure.

5.1 Option 1 – Do Nothing

The Do Nothing option involves:

- Continuing inspection and maintenance activities for FPS assets.

- Reactively replacing failed components during inspections or identified as defective. No full replacement of assets.
- Continue with non-compliance (to Australian Standard) assets.

This option fails to address any of the key business drivers listed in the Program Drivers section and therefore it is not recommended.

The 'do nothing' approach exposes AusNet Services to significant financial and regulatory risk by failing to demonstrate an appropriate level of due diligence. This option presents potentially significant health and safety and financial liabilities.

This option involves accepting risks associated with aged and non-compliant assets assessed to have issues. Choosing option 1 will not assist with reducing risks and will not assist with maintaining acceptable levels of risks into future. Effectiveness of the FPS assets would be compromised significantly if this option is implemented.

5.2 Option 2 – Condition Based Replacements

Implementing a condition / risk based replacement program involves:

- Proactively replacing of the FPS assets, assessed with condition grades C4/C5 (including non-compliances issues sites) during next the period 2017-2022.
- Reducing the risks associated with major FPS failure significantly at an estimated direct cost of $ 8.8M.
- Continuing inspection and maintenance activities (including testing) for FPS systems in compliance with relevant Australian Standards.
- Reactively replacing assets which during inspections and maintenance activities are identified as defective.

This option addresses all of the key business drivers listed in the Program Drivers section economically and it is therefore recommended.

A risk based replacement program greatly reduces exposure to significant financial and regulatory risks associated with failing FPS assets. This option reduces potentially significant health and safety and financial liabilities by replacing non-compliant assets which, following a risk assessment, have been deemed economically justified for replacement.

Choosing option 2 ensures that risks associated with FPS assets and age based degradation are addressed in the most economic manner. Choosing Option 2 will ensure that risks associated with failure of FPS assets are reduced which is especially important considering the possible health and safety consequence associated with any major fire incident. Implementation of a risk based replacement program will maintain the levels of performance and reliability associated with the FPS assets.

5.3 Option 3 – Age Based Replacements

Implementing an age based replacement program involves:

- Proactively replacing the FPS assets which have exceeded the expected life.
- Reducing the risks associated with major FPS failure significantly at an estimated direct cost of $13.2M.
- Continuing the inspection and maintenance activities for FPS assets.
- Reactively replacing FPS assets which during inspections and maintenance activities are identified as defective.

This option addresses most of the key business drivers listed in the Program Drivers section but less economically than option 2.

An age based replacement program reduces exposure to significant financial and regulatory risks associated with failing FPS asset to demonstrate an appropriate level of risk reduction. This option reduces potentially significant health and safety and financial liabilities by replacing FPS which are above the mean age of FPS assets.

Although this option also addresses most of the business drivers, it requires approximately 50% more capex than the recommended option. Therefore, this option does not demonstrate efficiency and due diligence and hence it is not recommended.

5.4 Option 4 – Replacement of assets only after failure

Implementing an asset replacement only after failure involves:

- Reactively replacing the assets on failure of components or full asset failure.
- No risk reductions as assets are replaced only after failure.

This option is the most expensive option as it replaces the assets only after absorbing the full impact of the asset failure. Therefore this option involves most of the expenditure in emergency which could be up to two times of the planned replacement expenditure.

This option does not provide any risk mitigation at all and therefore involves significant risk exposure for AusNet Services' assets, contractor / employees, community and corporate reputation.

NPV modelling has indicated that this is the most expensive option and does not demonstrate efficiency and due diligence and therefore not recommended.

6 Financial Analysis

The four options have been financially analysed using an NPV model.[2] The capital costs used as inputs to the NPV analysis reflect the volume of assets targeted for replacement up to 2022.

Option 2, the risk based replacement option, achieves the greatest amount of benefit for the lowest capital cost when compared to other options. These benefits are based on significant (95%) risk reduction achieved through targeted replacement of FPS assets containing the high risk of major failure. Although Option 3 provides the maximum net present value, it requires significantly higher capital expenditure (additional 50%).

The risk based replacement option displays the lowest present value cost of $ 13.1M and has a positive net present value of $719k.

Economic Analysis of Options ($'000s)	PV Capital Cost	PV Opex Costs	PV Community Benefits	PV Proceeds From Sales	Total PV Cost	NPV including Reg Return
Do Nothing	-	(3,692)	(19,514)	-	(23,206)	**-**
Upgrade/ replace fire protection assets, condition based	(9,423)	(590)	(3,117)	-	(13,130)	**719**
Upgrade/ replace fire protection assets, aged based	(13,615)	(381)	(2,012)	-	(16,008)	**1,100**
Replace of assets only on fialure	(13,725)	(1,231)	(6,505)	-	(21,461)	**375**
	-	-	-	-	-	**-**

All figures are in $000's unless otherwise stated.
(nominal and discounted)

Table 3 – NPV Analysis

7 Recommended Action

The risk based replacement program, Option 2, is recommended as per table below.

Description of Program	Number of sites	Unit Rate ($k)	Total Estimated Cost ($k)
Major upgrade /replacement of fire hydrant systems	11*	C-I-C	C-I-C
Minor upgrade fire hydrant systems	5	C-I-C	C-I-C
Upgrade FIP and detectors	20	C-I-C	C-I-C
Upgrade/installation signage	25	C-I-C	C-I-C
Fire wall at SMTS	1	C-I-C	C-I-C
Upgrade fire deluge systems (KTS, MLTS, ROTS, SMTS)	4 (7**)	C-I-C	C-I-C
Total			8.775

- **BATS, BLTS, EPSY, FTS, HWPS, HWTS, MWTS, RCTS, RWTS, SVTS and YPS.*
- ***number of transformer and unit rate is for each transformer*

Table 4 – Proposed program of works with estimated costs

8 Reference Documents

- AMS 10-61 – Fire Detection and Suppression.
- AMS 10-142 – Fire Hydrant Systems for Terminal Stations.
- Fire Detection and Suppression Strategy – Asset Management Strategy (Victorian Electricity Transmission Network).
- AusNet Services Station Design Manual (SDM), Volume 5, Section 15.
- AS 2419.1(2005): Fire hydrant installations – System design, installation and commissioning.
- FM Global Risk Reports for various stations.
- AMS 10 – 140 – Fire protection for power transformers and oil filled reactors.
- AusNet Services Station Design Manual (SDM) Volume 5, Section 9 – “Transformer Fire Detection and Suppression”.
- AusNet Services Station Design Manual (SDM) Volume 5, Section 24 – “Transformer Fire Walls”.
- AS 1851 – Maintenance of Fire Protection Systems.
- Building Code of Australia.