AMS – Victorian Electricity Transmission Network

Civil Infrastructure

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1 Executive Summary

This document states the asset management strategy for all Civil infrastructure assets situated within the boundaries of terminal stations in the AusNet Services transmission network.

Civil infrastructure assets include buildings, roads, footpaths, surfaced areas, foundations, support structures, metallic cabinets, 415 volt supply systems including changeover boards, signage, security systems, fences, cable ducting & trenching, water pipes, fire protection assets, sewerage pipes and drains.

The strategies are aimed at ensuring the effective, economic and consistent management of civil infrastructure assets in all terminal stations.

Condition assessments for civil infrastructure assets at 49 terminal stations indicate that approximately 30 per cent of these assets require refurbishment / replacement within the next 10 years. This can be achieved through targeted civil infrastructure work programs or inclusions in planned station rebuild projects.

The following summarises the key civil infrastructure asset management strategies:

- Perform civil infrastructure condition assessments at the remaining 26 terminal stations by 2017 and record results in the Asset Management System.
- Following completion of the civil infrastructure condition assessments, determine the optimum frequency for future inspections at each station and incorporate this into the existing civil infrastructure maintenance program.
- Include recurring condition assessments of civil infrastructure assets in the scheduled maintenance program for terminal stations.
- Complete the asbestos containing material (ACM) removal program by 2025.
- Supplement renewal, replacement or augmentation of condition C4 & C5 civil infrastructure in the scopes of major augmentation and station re-build projects as and when economic.
- Initiate targeted civil infrastructure (in condition C4 & C5) upgrade projects for sites with no major projects/rebuild planned in next 10 years.
- Where economic use relocatable buildings for new or major building refurbishments.
- Investigate the use of pre-fabricated concrete slab foundations for selected primary plant such as power transformers and capacitor banks.
- Complete final stage of oil containment and water treatment works by March 2016.
- Continue to upgrade security systems including CCTV camera surveillance systems and fences in compliance with AMS 10-63: Infrastructure Security.
- Continue to upgrade fire protection systems assets in compliance with AMS 10-61: Fire Detection and Suppression.

2 Introduction

2.1 Purpose

The purpose of this document is to define the asset management strategies for effective maintenance of civil infrastructure assets associated with AusNet Services' electricity transmission network.

2.2 Scope

The scope of this asset management strategy is civil infrastructure assets in the Victorian electricity transmission network, associated depots and offices. Civil infrastructure situated at zone substations which operate on the electricity distribution network is excluded. Standalone communication sites are excluded however, communication rooms within the main control / switch buildings in terminal stations are covered in this document.

3 Asset Summary

Civil Infrastructure assets include buildings, roads, footpaths, drains, surfaced areas, foundations, support structures, metallic cabinets, 415 volt supply systems including changeover boards, signage, security systems, fences, cable ducting & trenching, water pipes, fire protection assets, sewerage pipes and drains found within the boundaries of terminal stations.

These assets are mostly located at 49 terminal station sites across Victoria.

3.1 Population

The population of civil infrastructure in terminal stations vary widely across the transmission network.

Approximately 15 sites have undergone major equipment replacement or partial rebuilds over the last 12 years which have included civil infrastructure upgrade works. These sites are listed in Table 1 below.

Terminal Station	Code	Region
Brooklyn Terminal Station	BLTS	Greater Melbourne & Geelong
Keilor Terminal Station	KTS	Greater Melbourne & Geelong
Malvern Terminal Station	MTS	Greater Melbourne & Geelong
Ringwood Terminal Station	RWTS	Greater Melbourne & Geelong
Thomastown Terminal Station	TTS	Greater Melbourne & Geelong
Ballarat Terminal Station	BATS	Regional Victoria
Bendigo Terminal Station	BETS	Regional Victoria
Dederang Terminal Station	DDTS	Northern Corridor
Eildon Power Station Yard	EPSY	Northern Corridor
Geelong Terminal Station	GTS	Greater Melbourne & Geelong
Horsham Terminal Station	HOTS	Regional Victoria
Kerang Terminal Station	KGTS	Regional Victoria
Mount Beauty Terminal Station	MBTS	Northern Corridor
Redcliffe Terminal Station	RCTS	Regional Victoria
Shepparton Terminal Station	SHTS	Regional Victoria

Table 1 – Major terminal station refurbishments and rebuilds

MTS is the only station to have 90 per cent of its civil infrastructure replaced. Major terminal station projects and rebuilds generally result in the replacement of 20 to 80% of civil infrastructure in the station.

Major rebuilds are in progress at Brunswick (BTS) and Richmond (RTS) and are proposed for West Melbourne (WMTS) over the next five/ten years. Significant civil infrastructure replacements will take place during these station rebuilds. The move from outdoor air-insulated switchgear to indoor gas-insulated switchgear will also result in a substantial renewal of civil infrastructure assets at these stations.

Designs for the RTS and BTS rebuilds have been influenced heavily by the local community and council expectations with a focus on improving the stations aesthetics. Support structures, embankments, station buildings and security fencing are designed to be more visually discreet at these stations.

Details on the population of the different types of civil infrastructure in terminal stations are covered in the sections below.

3.1.1 Buildings

Approximately 216 buildings[1] provide all-weather housing for control equipment, protection relays, communication equipment, batteries, rotating machinery, diesel generators, compressors, switchgear, stores, workshops, laboratories, equipment spares, worker amenities and office equipment. Good building conditions are necessary to minimize safety risks for all this equipment and also to provide adequate temperature, dust and humidity control for the increasing volume of digital protection, control and communications equipment.

Terminal station buildings vary widely in materials and type of construction. These range from multi-storied brick and masonry construction to single story timber and asbestos cement sheet construction.

3.1.2 Roads and Drains

Approximately 13 km of reinforced roads[2] in terminal stations provide transport access for heavy equipment, such as large power transformers. A further 29 km provide all-weather access to electrical equipment located in switchyards. Reinforced roads are bitumen sealed or in some cases concrete with kerbing and/or concrete spoon drain. Switchyard access roads are commonly bitumen sealed with concrete spoon drains. Some switchyard perimeter roads are gravel surfaced without edging and rely on natural drainage.

3.1.3 Switchyard Surfacing

About 133 hectares of switchyard surfaces[3] have been graded, drained and surfaced (selected crushed rock is used for the surfacing) to assist with the installation, operation and maintenance of electrical equipment in all weather conditions.

More than 17 km of cable trenches exist in switchyards, protecting 43,000 secondary cables totalling over 6,000 km in length. The cable trenches are largely comprised of preformed concrete[4] trenching with galvanised steel covers. There are also significant quantities of direct-buried secondary cabling protected by concrete or plastic cover slabs. Secondary cable ducts and trenches are usually replaced as part of major station upgrade works.

3.1.4 Water Pipes

There is a substantial network of underground water pipes, associated fittings and valves supplying fire hydrants[5], transformer water deluge systems and domestic water supply[6]. The strategies that apply to fire systems are described in AMS 10-61 Fire Detection and Suppression.

[1] Station design manual Vol.5 Section.30 – Civil designs buildings.

[2] Station design manual Vol.5 Section.5 – Civil designs roads.

[3] Station design manual Vol.5 Section. 6 – Civil design switchyard surfacing.

[4] Station design manual Vol.5 Section.20 – Civil designs concrete.

[5] Station design manual Vol.5 Section.15 – Civil designs switchyard hydrant systems.

[6] Station design manual Vol.5 Section.10 – Civil designs water supply.

3.1.5 Support Structures, Earth Embankments and Retainer Walls

There are numerous support structures[7], earth embankments[8] and retainer walls[9] for various plant items in terminal stations. The structures are typically galvanised steel in bolted lattice or welded component arrangements. They are normally mounted on concrete foundations with weather sealing grout installed beneath their feet. Earth embankments are constructed to support initial excavation at terminal stations. They also improve the aesthetics of stations whilst providing barriers against flooding. Retainer walls provide support to raised ground levels at terminal stations ensuring soil movement or subsidence is prevented.

3.1.6 Signage

There are many equipment nameplates and signs[10] installed in all terminal stations. Most nameplates are installed to physically identify plant items for operational and electrical safety purposes. .

3.1.7 Foundations

There are numerous concrete[11] foundations installed in terminal stations supporting plant items, structures and buildings. Foundations are generally replaced along with associated equipment but are sometimes re-used during station augmentation and rebuild projects, depending on their suitability and condition.

3.1.8 Security Fencing

About 56 km of security fencing[12] encloses more than 532 hectares of land at over 100 individual sites. Early security fence design utilises a 2.5 m chain-wire panel mounted on galvanised posts (2.7 to 3m in height) topped with multiple strands of barbed wire. The lower edge of the chain-wire panel is usually buried. This provides some resistance against burrowing and tunnelling.

3.1.9 Oil Containment and Treatment Systems

A large number of stations plant equipment contains significant quantities of oil. In order to reduce the risk of contamination of stormwater drainage systems in the event of a spill; oil containment and treatment systems are installed at all terminal stations. AusNet Services' oil containment and treatment system design standards[13] are set in accordance with EPA and State Environmental Planning Policies (SEPP) guidelines.

3.1.10 CCTV Security Camera Upgrade/ Installation

A program has been initiated for the upgrade / installation of CCTV cameras in sites that are deemed critical for security by the Victoria Police.

Refer to AMS 10-63: Infrastructure Security for more details on condition of these CCTV camera equipment and proposed upgrade work program.

[7] Station design manual Vol.5 Section.22 – Civil designs steel structures.

[8] Station design manual Vol.5 Section.4 – Civil designs earth work.

[9] Station design manual Vol.5 Section.120 – Civil designs concrete construction.

[10] Station design manual Vol.5 Section.13 – Civil designs security fencing and signage.

[11] Station design manual Vol.5 Section.20 – Civil designs concrete.

[12] Station design manual Vol.5 Section.5 – Civil designs security fencing and signage.

[13] Station design manual Vol.5 Section. 8 – Civil designs oil containment.

3.2 Age Profile

In many cases existing civil infrastructure designs date back to the initial station construction but partial or full replacement of some of these assets, as part of station rebuild works, has resulted in nearly 63% of assets falling under 50 years of age.

Civil infrastructure has an average life expectancy of 60 years.. The Weighted Average Remaining Life (WARL) is approximately 52 per cent. The WARL demonstrates that some civil infrastructure assets are approaching the end of their useful lives while other assets offer sizeable remaining service potential (RSP).

The age profile of civil infrastructure across all the terminal stations is illustrated in Figure 1.

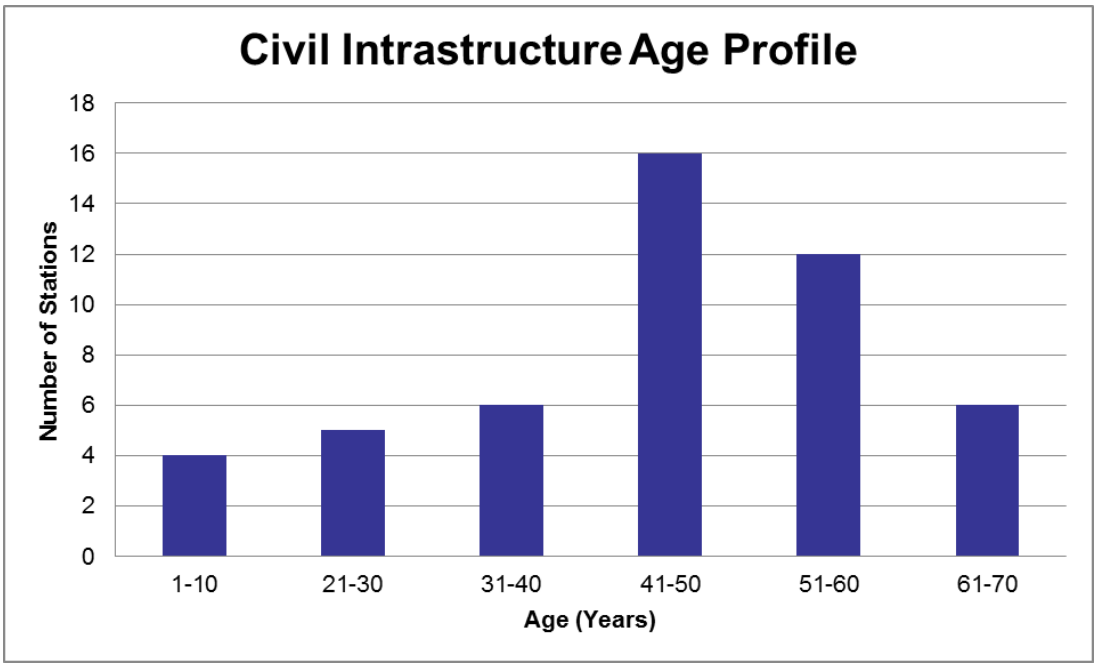

Figure 1 – Civil infrastructure age profile

3.3 Condition

The condition of civil infrastructure assets is good due to recent upgrades/refurbishments of some of these assets during station rebuilds and equipment replacement programs.

The condition of civil infrastructure assets is influenced by several factors such as:

- Operating conditions;
- Climatic and environmental conditions;
- Differing designs and construction material; and
- Past opportunities to integrate civil infrastructure replacement works into rebuild projects/programs.

Civil infrastructure assets in poor condition pose risks associated with asset failure. These issues are more prominent at stations which do not have extensive rebuild or asset replacement works planned in the next ten years.

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The condition assessment for the civil infrastructure in all terminal stations has been put together with the help of site inspections and field report information provided by the field crews at the respective terminal stations.

A process has been initiated to objectively assess the condition of all civil infrastructure assets detailed in section 3.1. Site inspections began in October 2012 with the highest priority given to the oldest stations located in the Greater Melbourne and Geelong region. A total of 23 stations have been inspected to date and inspections for the remaining 26 stations are expected to be complete by 2017. Following the completion of these inspections, the optimum frequency required for inspections at each station will be determined and incorporated into the existing civil infrastructure maintenance program.

Civil infrastructure assets are assigned condition scores which correspond to the remaining service potential (remaining life). Table 2 below lists details of condition scores including descriptions and the expected remaining service potential.

Condition	Description	Remaining Life (years)
C1	As New	> 60
C2	Good	> 30 & < 60
C3	Average	> 10 & < 30
C4	Poor	> 5 & < 10
C5	Very Poor	< 5

Table 2 – Condition scores

Figure 2 and Figure 3 illustrate the condition profile of all the civil infrastructure assets in 49 terminal stations / power stations switchyard sites (PSS).

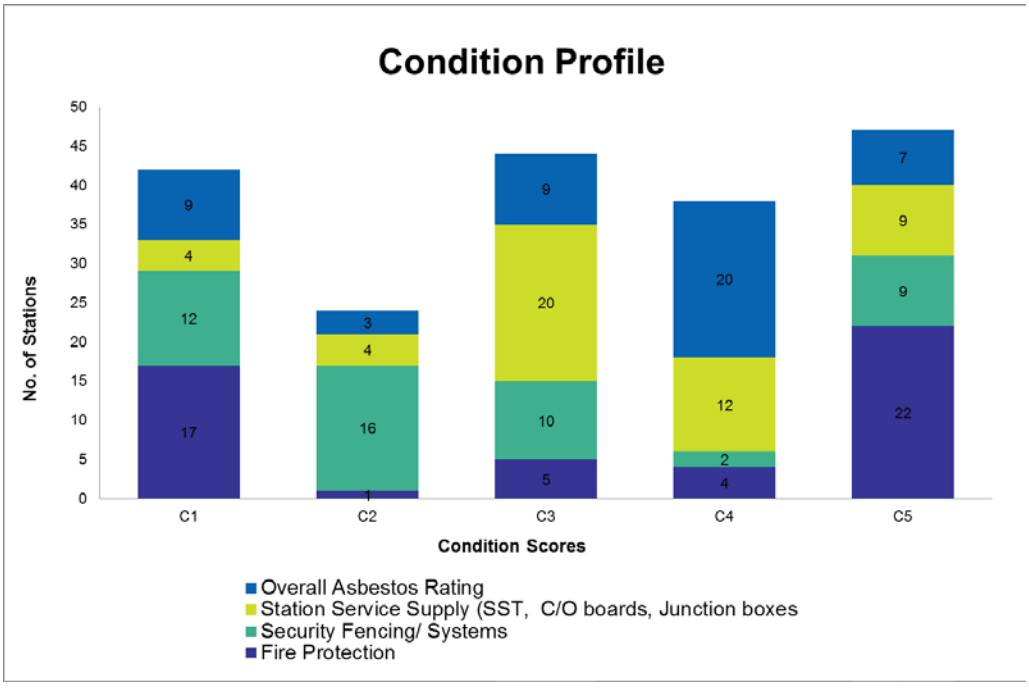

Figure 2 – Civil infrastructure asset condition profile for environmental equipment, switchyard surfaces, access roads & buildings

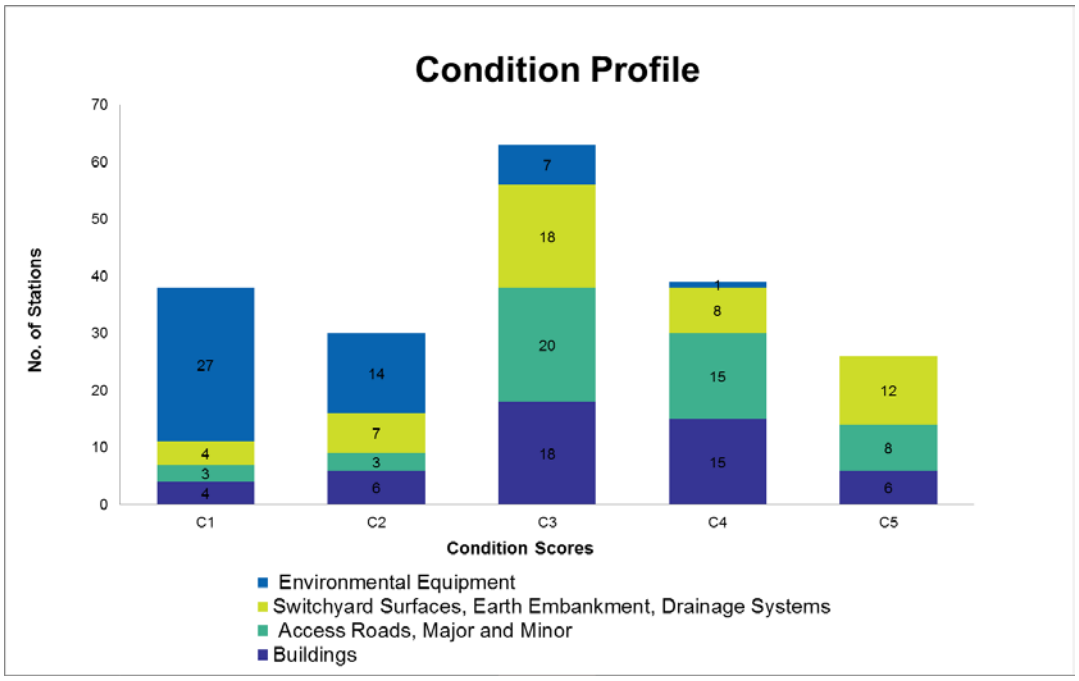

Figure 3 – Civil Infrastructure asset condition profile for asbestos rating, station service supply, security fencing and fire protection

Approximately 38% of the total civil infrastructure assets fall in categories C4 & C5 and hence require some remedial action within the next five to ten years.

Details on the condition of specific civil infrastructure assets in terminal stations are covered in the sections below.

3.3.1 Buildings

Buildings at terminal stations vary widely in the construction material used, age and condition. Many are in need of some refurbishment. Below is a list of recent building construction/upgrade works done at various terminal stations:

- Construction of a new Control/Relay room including extension of old buildings at Eildon power station (EPS), Ballarat (BATS), Bendigo (BETS), Brooklyn (BLTS), Geelong (GTS), Keilor (KTS), Malvern (MTS), Ringwood (RWTS) and Thomastown (TTS) terminal stations.
- Removal of old asbestos cladding and re-cladding of old control room buildings at BATS, Dederang (DDTS) and Shepparton (SHTS) terminal stations.
- Removal of minor buildings such as compressor houses and maintenance buildings which included asbestos materials at BATS, BETS, Kerang (KGTS) and TTS terminal stations.
- Removal of battery rooms from old control buildings at BATS, BETS, East Rowville (ERTS) and KTS terminal stations and Eildon power station (EPS).

3.3.2 Roads and Drains

Heavy vehicle transport roads have been used rarely at their load bearing capacity and hence are in good condition. However, with transformer service age and conditions suggesting increasing refurbishment and replacement works, the next few years will involve more frequent movement of heavy equipment on these roads, thereby making road augmentation and repairs more likely in the future.

The condition of most of the switchyard access roads is good due to investment in civil infrastructure in the recent years. However, some switchyard roads are currently only suitable for light operational traffic and will require improvement to facilitate access for construction traffic associated with equipment refurbishment or replacement. The C5 score is currently driven by the poor condition of some minor roads in terminal stations and not by the major road conditions.

Drains[14] in all terminal stations are in good condition. However, the increasing Environmental Protection Agency (EPA) requirements around controlling the discharge of rainwater from switchyards, which may have low oil contamination levels, are driving increased investment in purpose designed collection drains, piping of existing open drains and extensive oil interceptor traps and water treatment works.

3.3.3 Switchyard Surfacing

The return of average rainfall after a prolonged drought and the increased traffic in switchyards due to high volume of augmentation works are beginning to have a negative impact on the switchyard surface conditions. Although large investments in recent years have maintained switchyards in a good condition, forecasts of continuing asset replacement works over the next decade suggest the requirement of continuing investment in switchyard surfacing.

Extensive switchyard resurfacing has been completed at BATS, BETS, MTS and TTS and EPS.

Secondary cable ducts and trenches in switchyards are usually replaced as part of major upgrade works. Cable trench and covers upgrades have recently been completed at EPS, BETS, BLTS, MTS, KGTS, KTS and TTS.

3.3.4 Support Structures, Earth Embankments and Retainer Walls

The condition of support structures is good, however, some assets are beginning to show age related degradation which has been accelerated by a number of extreme weather incidents in the recent years. Furthermore changing community expectations are driving the need to reduce the visual impact of terminal stations, especially for those situated in close proximity to high density residential areas.

Support structures are sometimes re-used during station augmentation and rebuild projects, depending on their suitability and condition.

Retainer walls at BETS and DDTS have been replaced recently under civil infrastructure upgrade programs. Construction of a flood protection earth bund wall at KGTS has also been completed in 2015. This flood protection wall is required to prevent the reoccurrence of station flooding which took place in 2011. A flood protection wall at RCTS is currently under project development.

3.3.5 Signage

Plant nameplate conditions are generally good across all sites; however, nameplates and signs have a limited life and will need ongoing replacement. Security signage is generally replaced as part of fencing replacements.

3.3.6 Foundations

Foundations can sometimes deteriorate due to corrosion of the steel reinforcement. There are very few instances where foundations are replaced/repaired as independent targeted works and are usually included in the scopes of rebuild projects at various stations.

[14] Station design manual Vol.5 Section.7 – Civil designs storm water drainage.

3.3.7 Security Fencing

Over the past ten years, many stations were identified as critical security sites and these are being upgraded with electric power fencing constructed along with new chain wire mesh. These upgrades will also involve the retrofit of razor tape topping and footing plinths to existing security fences.

Progressive fencing upgrades and replacement works are planned to ensure that all station security fences will meet industry design standards[15] by 2022. Refer to AMS 10-63: Infrastructure security for more details on the condition of these fences and proposed upgrade work programs.

3.3.8 Oil Containment and Treatment Systems

In order to achieve compliance with EPA guidelines a major environmental upgrade program was initiated in 2002. The program involved the upgrade of oil containment / bunded areas situated beneath station plant; triple interceptor pits and the installation of above ground water treatment plants.

Four stages of the program have been completed successfully across 30 terminal stations. The fifth and final stage of the program will cover all remaining terminal stations and is expected to be completed by March 2016. Terminal stations included in stage 5 are: ERTS, Frankston (FTS), KTS, Loy Yang, Moorabool (MLTS), Morwell (MWTS), Rowville (ROTS), SHTS, Sydenham (SYTS) terminal stations and EPS and Morwell power station.

3.4 Performance Issues

The main areas where performance of civil infrastructure assets is not satisfactory are:

- Asbestos hazards identified including solid asbestos in walls, floor tiles, ceilings, roofs and equipment mounting panels and possible asbestos dust in cable trenches and ducts.
- 415V supply distribution changeover boards, transformer change over boards and junction boxes containing asbestos panels.
- Records for civil infrastructure assets are inadequate and do not include essential information such as installation date, quantity and condition.
- Challenges in maintaining switchyard surface electrical resistivity to ensure safe step and touch potentials for personnel working in switchyards.
- Stability of mobile work platforms and vehicles involved in maintenance and construction activities manoeuvring on crushed rock switchyard surfaces.
- Cable trenching is susceptible to damage from soil movement caused by movement of vehicles.
- Increasing security standards and changes in neighbouring land usage often render the existing security fencing inadequate before reaching its nominal service life.
- Some terminal stations contain critical underground water pipework which do not comply with current pressure rating standards.
- Increasing extreme weather incidents (such as floods, storms and high temperature days) in terms of both severity and frequency, impact civil infrastructure assets by causing increased damage and condition deterioration.

[15] National Guidelines for Prevention of Unauthorised Access to Electricity Infrastructure – ENA DOC 015-2006.

4 Risk Assessment

The primary risks associated with civil infrastructure assets are Asbestos Hazards. Asbestos audits have been undertaken at all terminal stations. These audits have identified 71 asbestos hazards[16]. Typical hazards identified include the presence of asbestos in walls, floor tiles, ceilings, roofs and equipment mounting panels. Subsequent risk assessments resulted in the designation of risk ranking scores for each individual asbestos hazard. The risk ranking scores have been quantified and assigned as per the AusNet Services' risk management framework[17]. AusNet Services' risk matrix is displayed in Figure 4 below.

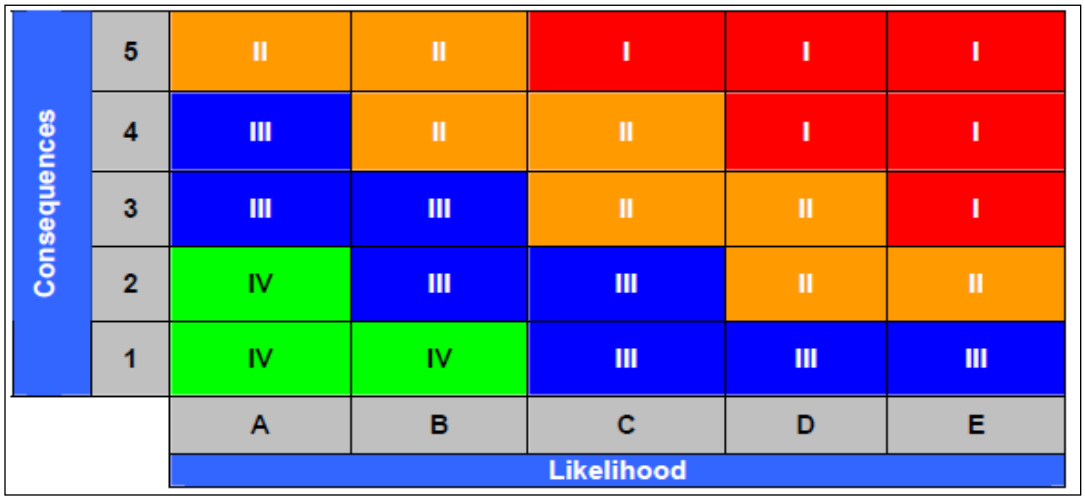

Figure 4 – AusNet Services' risk matrix

Risk ranking scores dictate the priorities for hazard rectification works set out in the asbestos removal plan. Figure 5 provides a graphical representation of the risk assessment findings across the terminal stations.

Figure 5 – Asbestos hazards risk ranking

[16] AusNet Services' "Asbestos register".

[17] AusNet Services' Risk Management Framework - RM 001-2006.

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Asbestos clad floor tiles have been removed at TSTS. Asbestos materials contained within control rooms, compressor and maintenance buildings have been removed at seven terminal stations. Asbestos removal works will continue more rigorously until the complete removal of asbestos in assets is achieved by 2025.

- Fire Protection Systems (FPS) and Fire Suppression Systems (FSS): A number of risks have been identified around the pipe works supplying FPS and FSS assets in terminal stations, details of which can be found in AMS 10-61 Fire Detection and Suppression.
- Infrastructure Security: A number of terminal stations have been deemed critical by Victoria police and are in need of infrastructure security systems upgrade. Details of risks specific to infrastructure security can be found in AMS 10-63 Infrastructure Security.

5 Strategies

- Perform civil infrastructure condition assessments at the remaining 26 terminal stations by 2017 and record results in the Asset Management System.
- Following completion of the civil infrastructure condition assessments, determine the optimum frequency for future inspections at each station and incorporate this into the existing civil infrastructure maintenance program.
- Include recurring condition assessments of civil infrastructure assets in the scheduled maintenance program for terminal stations.
- Complete the asbestos containing material (ACM) removal program by 2025.
- Supplement renewal, replacement or augmentation of condition C4 & C5 civil infrastructure in the scopes of major augmentation and station re-build projects when economic.
- Initiate targeted civil infrastructure upgrade projects for sites with no major projects/rebuild in next ten years which contain C4/C5 condition infrastructure assets.
- Where economic use relocatable buildings for new or major building refurbishments.
- Investigate the use of pre-fabricated concrete slab foundations for selected primary plant such as power transformers and capacitor banks.
- Complete the final stage of oil containment and water treatment works by March 2016.
- Continue to upgrade security systems in accordance with AMS 10-63: Infrastructure Security.
- Continue to upgrade fire protection systems assets in accordance with AMS 10-61: Fire Detection and Suppression.