Asset Management Plan
Telecommunications

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Part of the Energy Queensland Group

Executive Summary

This Asset Management Plan (AMP) covers the management of Energy Queensland Limited's (EQL) Telecommunications asset class, which consists of networking devices and equipment, along with the infrastructure that provides power, security and physical support.

Telecommunications assets assist in facilitating the automation and control of the power network by operating at the Data Link, Network and Transport OSI layers to provide real-time communications allow centralised monitoring and management of the power network as well as extend the reach of corporate information systems across a common infrastructure.

EQL owns and maintains over 1068 sites that contain telecommunication assets throughout Queensland with 690 (64%) in the North and South region and 378 (36%) in the South East region.

The asset class is faced with a number of issues, most of which relate to the challenges associated with needing to keep pace with technological advancements and the increased network capacity requirements of rapidly advancing intelligent devices.

Given the large scope of telecommunications assets, EQL maintains robust asset management strategies that ensure each asset is dealt with appropriately. These include performance monitoring systems, periodic condition inspections, regular scheduled maintenance; condition based asset retirement, as well as simply taking a Fail-Fix approach of replacing assets when they fail in service.

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1 Introduction

Energex employs the use of telecommunications networks whose primary function is to directly support the automation and operation of the power network through the transport of information. The equipment within these networks involves telecommunications devices such as routers & switches and microwave links, along with the infrastructure used to power, secure and physically support these devices. Telecommunications assets are installed at substations, dedicated telecommunications sites, control & data centres, depots and offices.

The functionality supported by this asset class includes protection signalling, SCADA, operational telephony, security, alarming and ancillary services that are present within the power network, for the following purposes:-

- Improve safety through effective person-to-person remote communication in real time;
- Make possible the centralised monitoring & management of the power distribution network and coordination of protection between sites;
- Extend the reach of corporate information systems for improved productivity across the organisation;
- Support the efficient operation and adaption of the electrical distribution network through a common infrastructure.

Energy Queensland Limited (EQL) was formed 1 July 2016 and holds Distribution Licences for the following regions:

- South East Queensland (Legacy organisation: Energex Limited); and
- North and South Queensland (Legacy organisation: Ergon Energy Corporation Limited).

There are variations between the EQL regions as a result of geographic influences, market operation influences and legacy organisation management practices. This Asset Management Plan (AMP) reflects the current practices and strategies for all assets managed by EQL, recognising and annotating the differences that have arisen due to legacy organisation management. These variations are expected to diminish over time with integration of engineering and asset management practices.

This report details the asset management practices undertaken by Energex to ensure the effective and efficient use of telecommunications equipment. Due to the significant variety of asset types within this class, there are a number of management approaches taken; ranging from regular inspection and maintenance in order to prolong service life, to relying solely on replacement of in-service failures for some other assets (also known as Fail-Fix strategies). Most assets, however, are replaced alongside vendor procurement and support conditions which imposes artificial lifespans.

1.1 Purpose

The purpose of this document is to demonstrate the responsible and sustainable management of Telecommunication assets on the EQL network. The objectives of this plan are to:

1. Deliver customer outcomes to the required level of service.
2. Demonstrate alignment of asset management practices with EQL's Strategic Asset Management Plan and business objectives.
3. Demonstrate compliance to regulatory requirements.
4. Manage the risk associated with operating the assets over their lifespan.
5. Optimise the value EQL derives from the asset class.

This asset plan will be updated periodically to ensure it remains current and relevant to the organisation and its strategic objectives. Full revision of the plan will be completed every five years as a minimum.

This Asset Management Plan is guided by the following legislation, regulations, rules and codes:

- *National Electricity Rules (NER)*
- *Electrical Safety Act 2002 (Qld)*
- *QLD Electrical Safety Regulation 2013 (Qld) (ESR)*
- *Queensland Electrical Safety Code of Practice 2010 – Works (ESCOP)*
- *Work Health & Safety Act 2014 (Qld)*
- *Work Health & Safety Regulation 2011 (Qld)*
- Ergon Energy Corporation Limited Distribution Authority No D01/99
- Energex Limited Distribution Authority No. D07/98

This Asset Management Plan forms part of EQL's strategic asset management documentation. It is part of a suite of asset management plans, which collectively describe EQL's approach to the lifecycle management of the various assets which make up the network used to deliver electricity to its customers. Appendix 1 contains references to other documents relevant to the management of the asset class covered in this plan.

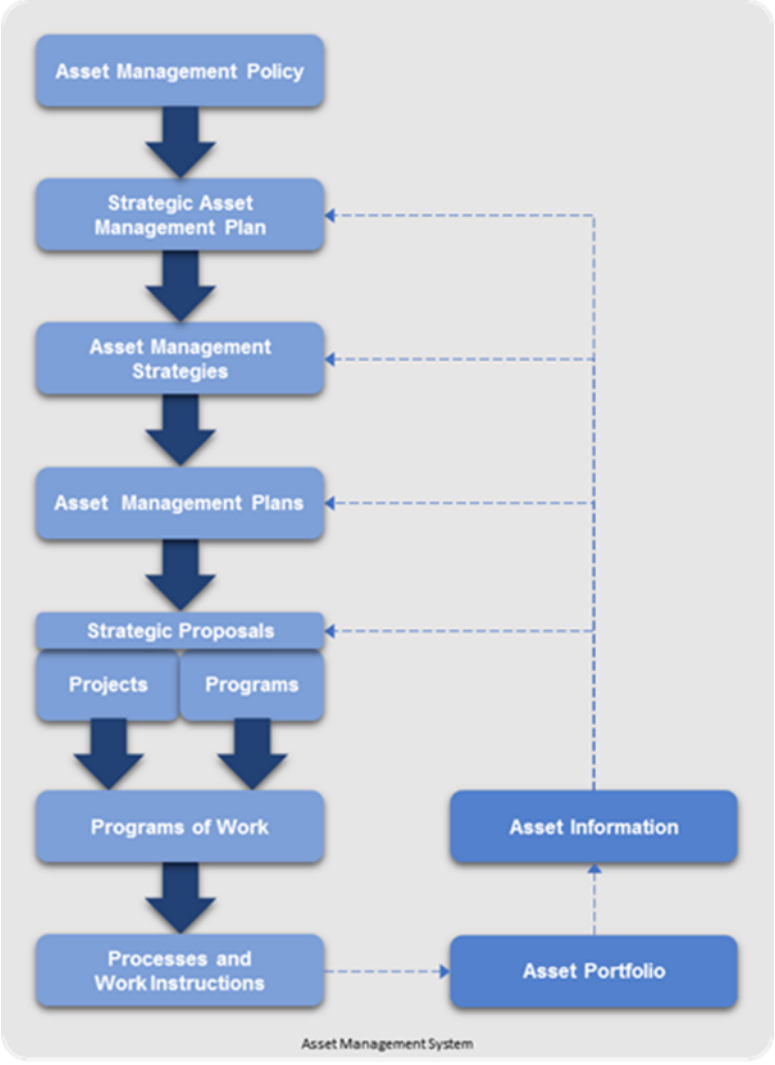

Figure 1: EQL Document Hierarchy

1.2 Scope

This AMP considers assets from both the South East and North and South Regions which primarily include:

- VHF Network
- P25 Network
- SATPTT Voice Communication
- SDH and PDH equipment
- Public Switched Telephone Network (PSTN) Phones
- Operational Call Control
- Voice Mail System
- Dial-up Modems
- IP Networking Equipment
- High Capacity Microwave Links
- Low Capacity Microwave Links
- Operation Support Systems
- Buildings, Structures and Site Access
- Battery Banks and Chargers
- Uninterruptible Power Supplies (UPS)
- Generators
- Solar Power Systems
- Site Security Systems
- Air Conditioning

This AMP does not cover the following assets, as they are captured within other AMP's:

- Fibre optic cable
- Pilot cable
- Substation DC systems (Battery and Chargers)
- Depot switches and routers dedicated to the Corporate Data Network
- South East Telephone line isolation units (equipment is not to be replaced)
- Unregulated commercial services over third-party networks
- Regulated services over third-party networks

1.3 Total Current Replacement Cost

The assets covered by this AMP range from being of relatively high volume and low cost to low volume and high cost. The high volume/low cost assets are typically managed on a population basis using their supply and obsolescence status, and the low volume/high cost using a per-asset approach with periodic condition and serviceability inspections. Depending on the potential risk for in-service failure and the impacts thereof, some assets may be removed from service proactively – other assets are managed with a Run-to-Failure strategy.

EQL Telecommunications equipment has a total replacement value to the order of $0.88 billion, based on asset quantities and associated replacement costs - $0.56 billion within the North and South Regions and $0.32 billion in the South-East Region. This valuation is the gross replacement cost of the assets, without asset optimisation or age depreciation considered.

Figure 2 provides an indication of the relative financial value of EQL Telecommunications assets compared to other asset classes.

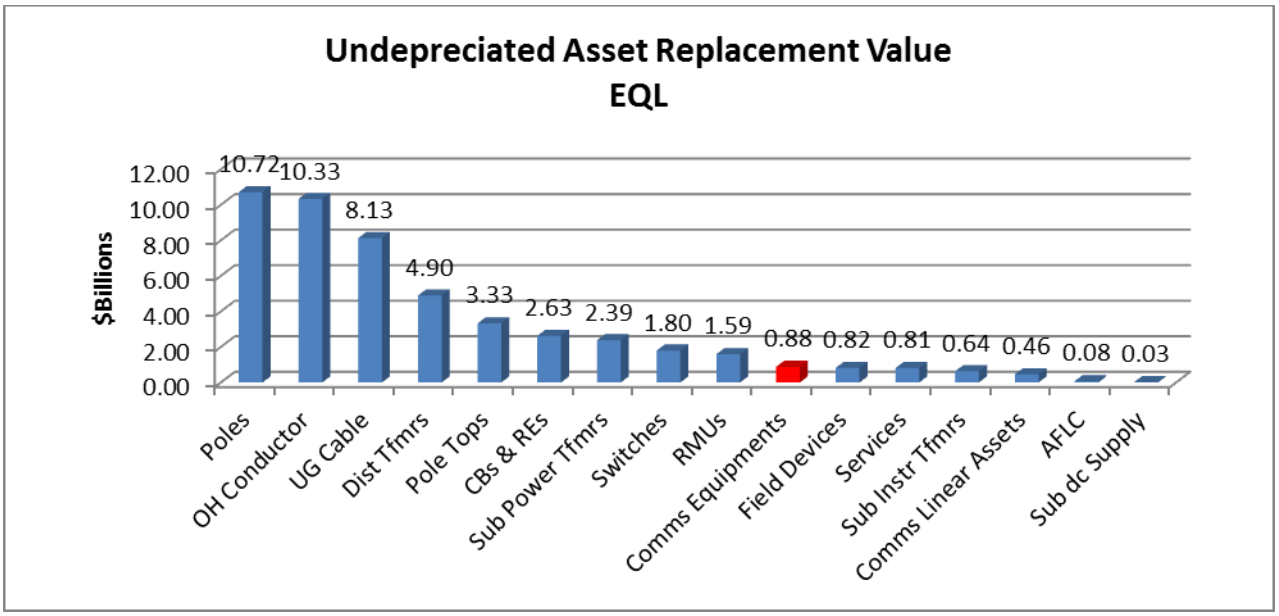

Figure 2: Total Current Replacement Cost

1.4 Asset Function and Strategic Alignment

Telecommunications assets are an essential component of power network infrastructure as they enable corporate, field communications, advanced protection and control services. This in turn vastly improves safety for personnel and plant and improves the power network's performance both during regular operation and during/following an abnormal condition.

Failure of any communications asset to perform its designed function will result in a negative impact to EQL's objectives relating to safety, service delivery, customer outcomes and legislative compliance.

Telecommunications assets are a relatively low cost, high volume asset and are managed on a per asset basis. They are, in most cases, continuously monitored for correct operation, often proactively replaced near end of economic life and before failure occurs, dependent on a range of risk factors.

The table below details how Telecommunications assets contribute to the corporate strategic asset management objectives.

Relevant Asset Management Objectives	Relationship of Asset to Asset Management Objectives
Ensure network safety for staff, contractors and the community	Diligent and consistent maintenance and operations support asset performance and hence safety for all stakeholders
Meet customer and stakeholder expectations	Continued asset serviceability supports network reliability and promotes delivery of a standard quality electrical energy service.
Manage risks, performance standards and asset investment to deliver balanced commercial outcomes	Failure of this asset can result in increased public safety risk and disruption of the electricity network. Asset longevity assists in minimising capital and operational expenditure.
Develop asset management capability & align practices to the global ISO55000 standard	This AMP is consistent with ISO55000 objectives and drives asset management capability by promoting a continuous improvement environment
Modernise the network and facilitate access to innovative energy technologies	This AMP promotes the replacement of assets at end of economic life as necessary to suit modern standards and requirements

Table 1: Asset Function and Strategic Alignment

EQL provides various services to Telecommunications carriers - some of which facilitate the provision of communication for these carriers. EQL does not provide condition and maintenance services for third-party telecommunication assets except as an unregulated independent service. This AMP relates to EQL owned assets only and excludes any consideration of such commercial services. It should be noted that EQL has a subsidiary company (trading as Nexium) that is a registered telecommunications carrier. Nexium utilises all EQL owned telecommunication networks for the provision of services and these elements are included within the scope of the EQL Telecommunication AMP.

1.5 Owners and stakeholders

Role	Responsible Party
Asset Owner	Chief Financial Officer
Asset Operations Delivery	EGM Distribution
Asset Manager	EGM Asset Safety & Performance

Table 2: Stakeholders

2 Asset Class Information

The following sections provide summary of the key functions and attributes of the assets covered in this management plan.

2.1 Asset Description

There is a substantial range of different assets that are collectively considered “Telecommunications Equipment,” including numerous devices that are functionally different but have been grouped together in order to aid in their understanding and modelling. Below are descriptions of the asset types captured within this AMP.

2.1.1 VHF Network

The VHF private wireless network within the North and South Regions utilises analogue voice links and repeaters to provide mission critical field voice communications for the operational workforce. The equipment does not provide any intelligent routing, call handling or other text type messaging.

2.1.2 P25 Network

The P25 private wireless network is the North and South Regions’ digital equivalent VHF network. It similarly provides mission critical field voice communication for the operational workforce, using IP based technology. It has many advantages over the analogue VHF network with built-in safety features, call routing, vastly improved clarity, greater capacity, better coverage and the option for low-speed data services.

2.1.3 SATPTT Voice Communications

The SATPTT voice communication equipment is installed in areas within the North and South Regions that are not practically or economically feasible for the installation of the P25 network. It uses satellite and mobile network technology to provide mission critical field voice communication for the operational workforce.

2.1.4 PDH and SDH Equipment

SDH (Synchronous Digital Hierarchy) and PDH (Plesiochronous Digital Hierarchy) equipment are previous generation equipment that was designed to allow many different types of services to be provisioned over a single network platform. It was developed before IP (Internet Protocol) became the dominant networking solution and is now nearing obsolescence. Nodes are comprised of a variety of electronic networking devices, that collectively allow multiple services to be “multiplexed” onto digital links between sites, these are collectively called multiplexors.

2.1.5 Public Switched Telephone Network (PSTN) Phones

PSTN is a service provided by a third-party vendor which the business relies upon for a significant number of telephone services between substations, offices, depots and communication sites. In sites with fibre presence, Voice over IP (VoIP) technology can be used as a replacement and as such PSTN equipment is progressively being phased out of use.

2.1.6 Operational Call Control System

North and South's operational call control system is required to facilitate phone calls across the business.

2.1.7 Voice Mail System

The corporate voice mail system allows for user to exchange voice messages, it is now end of life and requires upgrading to modern packet switching technology.

2.1.8 Dial-up Modems

Dial-up modems are used for out of band management of network assets, and utilise Public Switched Telephone Network technology. The decommissioning of Public Switched Telephone Network will result in the removal of dial-up modems across the network.

2.1.9 IP Networking Equipment

IP networking equipment utilises packet switched technology including Ethernet, Internet Protocol (IP) and Multi-Protocol Label Switching (MPLS). This allows data to be packaged when transmitted across the network providing an effective and efficient transmission method.

2.1.10 High Capacity Microwave Links

These are signal transmitter and receiver equipment that communicate via microwave radiation. Microwave communications require line of sight between the transmitter and receiver, and thus multiple microwave links are used to transmit across greater distances by involving intermediate signal repeating stations. High capacity links on the network represent high risk exposure for in service failure due to the impact on multiple control and protection services.

2.1.11 Low Capacity Microwave Links

As stated above microwave links are used to transmit information between communication sites. Low capacity links on the network are generally legacy devices that have limited visibility, capacity and functionality. The only exception is microwave links installed for P25 use only.

2.1.12 Operation Support Systems

To manage the Telecommunications networks operational support systems are utilised to improve network configuration, operate and report performance for the various telecommunications and other facilities monitored. They are also used for inventory, service provisioning, fault management and allow for access a centralised resource and service within the network

2.1.13 Buildings

There are multiple types and styles of building used across the network to house the communication equipment. They are either external cabinets or buildings which are constructed from, galvanised iron, fibro, brick and colourbond.

2.1.14 Structures

Across the network, a variety of communication structures are utilised which include, steel towers, steel guyed masts, and concrete, steel and wooden poles.

2.1.15 Site Access

Communication sites have either an access track or helipad, they are the primary access infrastructure to the site and need to be in good order to ensure maintenance and emergency response work can be conducted.

2.1.16 Battery Banks

In the event of a power outage, the battery banks provide a backup DC supply for the site, in some cases, they are used in conjunction with a generator. Where there is no generator or the generator fails to start the battery bank will be utilised to ensure the site remains operational until power is restore or the issue with the generator is rectified.

2.1.17 Uninterruptible Power Supplies (UPS)

In the event of a power outage the UPS provides a backup power supply while the generator is engaged to start if the generator doesn't start the UPS will be utilised until the issue with the generator or power outage is rectified or until battery capacity is depleted.

2.1.18 Generators

Generators are a backup power supply at a site and are designed to ensure the site can remain operational until service technician can attend the site or power is restored.

2.1.19 Solar Power Systems

Solar systems are utilised in areas that AC mains is not available or economically viable, it is the primary power supply and works in conjunction with a battery bank to provide power at times when there is little or no solar radiation available.

2.1.20 Air Conditioning

Air conditioning is used to regulate the atmospheric conditions within substations and telecommunications sites in order to maximise the serviceability of sensitive equipment within. In addition to temperature control, air conditioning is important for humidity control.

2.1.21 Site Security

South East employs a range of site security measures such as electronic and mechanical access control, security perimeter fencing, CCTV and intrusion monitoring systems. The goal of these systems is to prevent or minimise the risks of personal harm to unauthorised personnel within site grounds, as well as to prevent damage or theft of equipment contained on site.

2.2 Asset Quantity and Physical Distribution

The table below lists the total asset population quantities for each asset type within the telecommunications network.

Asset Type	South East	North	South	Total
VHF NETWORK - BASE STATIONS	-	103	140	243
P25 NETWORK - BASE STATIONS	-	37	50	87
SATPTT - DEVICES	-	4	4	8
MULTIPLEXERS	533	269	252	1054
PSTN PHONES	~630	~237	~211	~1078
OPERATIONAL CALL MANAGERS	-	2	0	2
VOICE MAIL SYSTEMS	-	2	0	2
DIAL UP MODEMS	-	~108	~20	~128
IP NETWORK EQUIPMENT	203	649	852	1704
HIGH CAPACITY MICROWAVES	30	70	269	339
LOW CAPACITY MICROWAVES	13	145	399	544
OPERATIONAL SUPPORT SYSTEMS	-	30	48	78
BUILDINGS	-	60	101	160
STRUCTURES	55	100	180	335
VECHICLE ACCESS	3	43	87	133
BATTERY BANKS	34	227	283	510
UPS	-	8	9	17
GENERATORS	9	21	48	70
SOLAR POWER SYSTEMS	4	20	30	54
AIR CONDITIONING	9	88	159	256
SITE SECUIRTY	8	4	4	16

Table 3: Asset Quantity

2.3 Asset Age Distribution

Asset age data is an incredibly important resource for use in asset management strategies. This information has been recorded and compiled where possible for most asset types within the telecommunications equipment class, however, there are still significant variations in the quality of data collected. This is anticipated to improve over time as data acquisition and storage processes mature and are refined.

2.4 South East

2.4.1 Last Century Data Communications

Outlined in the graph below is the age distribution of assets under the Last Century Data Communications category.

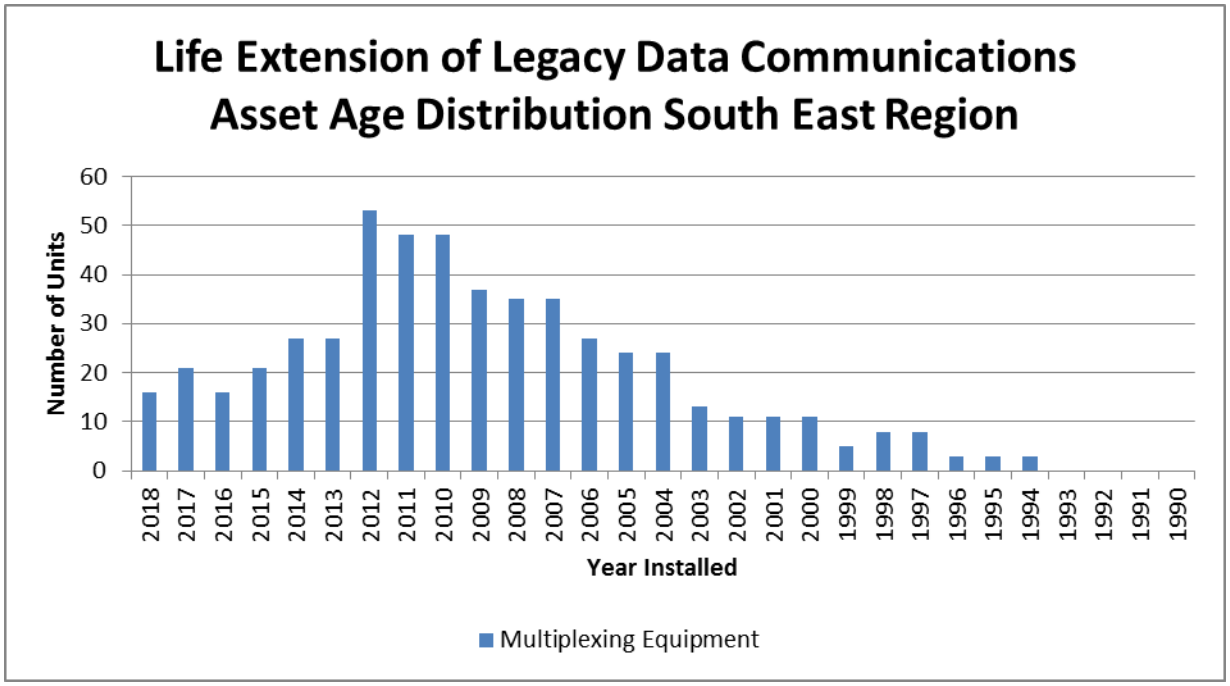

Figure 3: Last Century Data Communications Asset Age Distribution South East Region

2.4.2 Intelligent Grid Data Communications

Outlined in the graph below is the age distribution of assets under the Intelligent Grid Data Communications category.

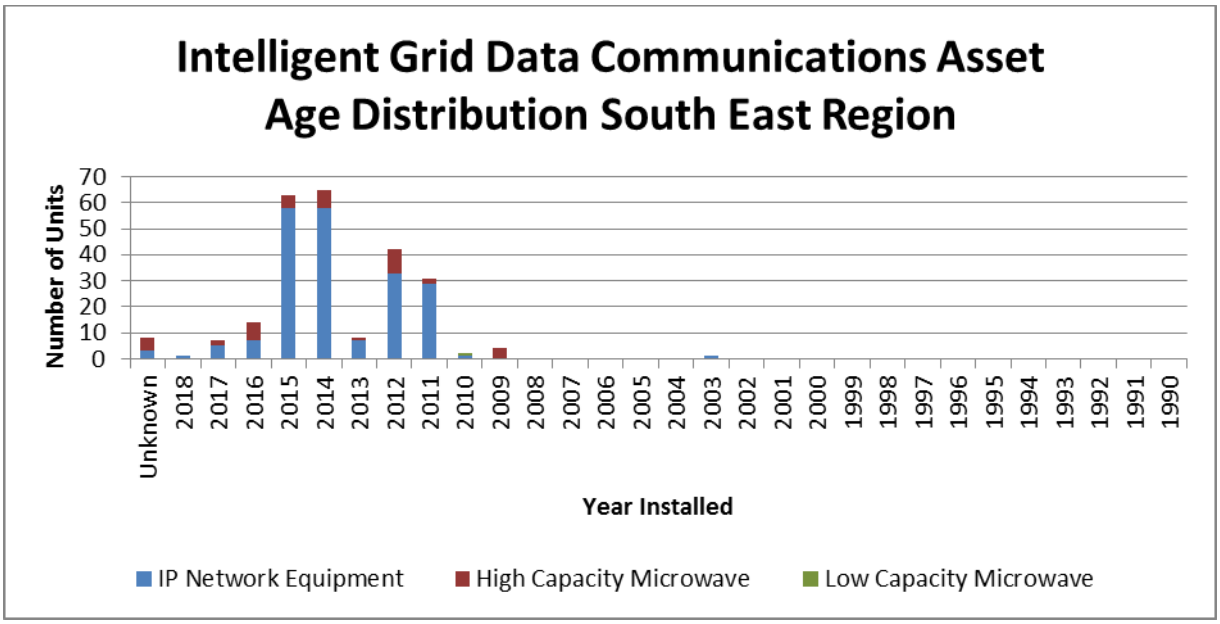

Figure 4: Intelligent Grid Data Communications Assets Age Distribution South East Region

2.4.3 Communications Site Infrastructure

Outlined in the graph below are the age distribution for communications site structures, air conditioning systems and site security. Site access assets of access tracks and helipad have not been included due to the limited age data available.

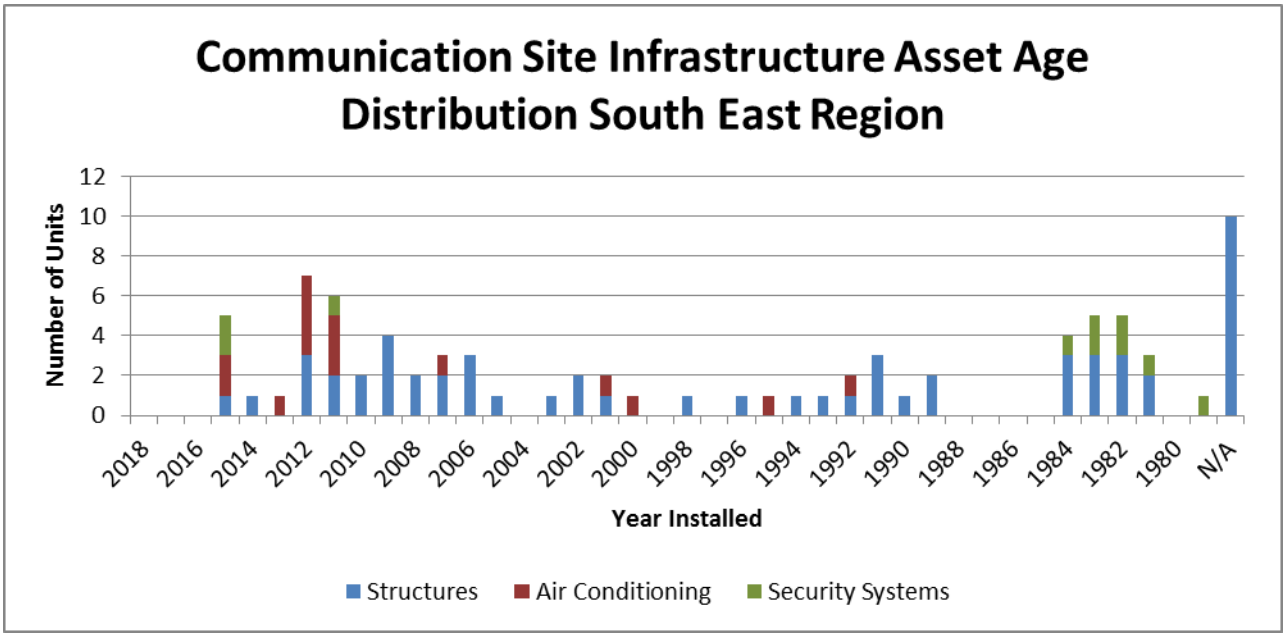

Figure 5: Communication Site Infrastructure Asset Age Distribution South East Region

2.4.4 Communications Power Systems

Outlined in the graph below is the age distribution for battery banks, generators and solar systems.

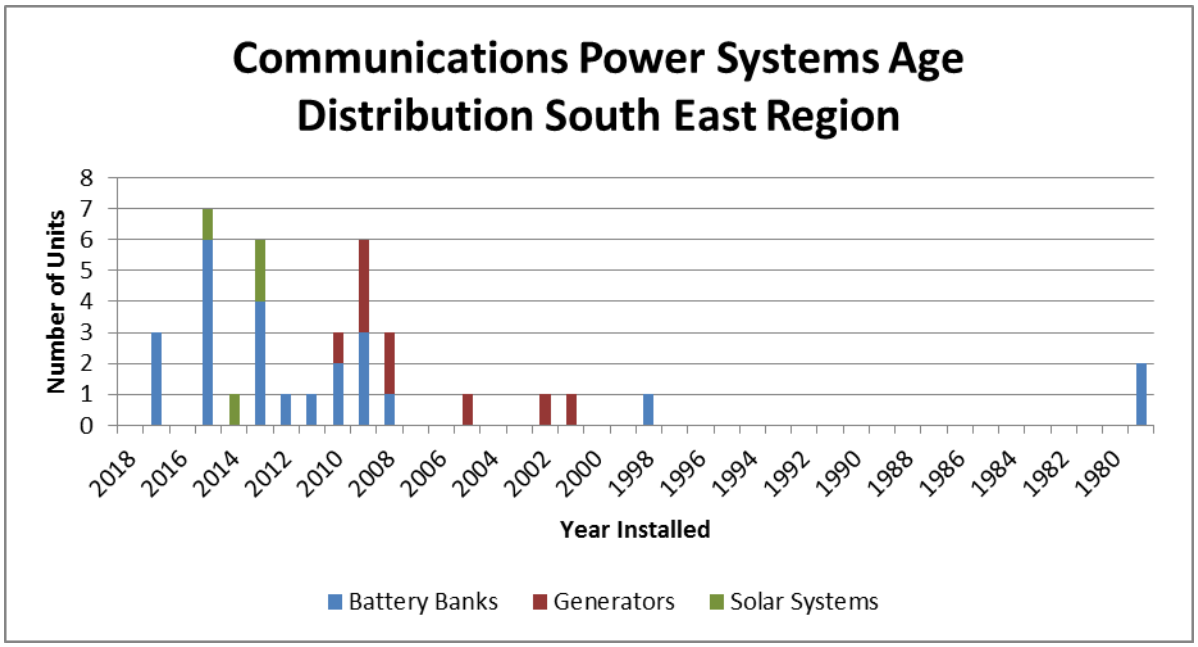

Figure 6: Communication Power Systems Age Distribution South East Region

2.5 North and South

2.5.1 Field Mobile Voice Communications:

Outlined in the graph below is the age distribution of base stations for the VHF and P25 network base stations.

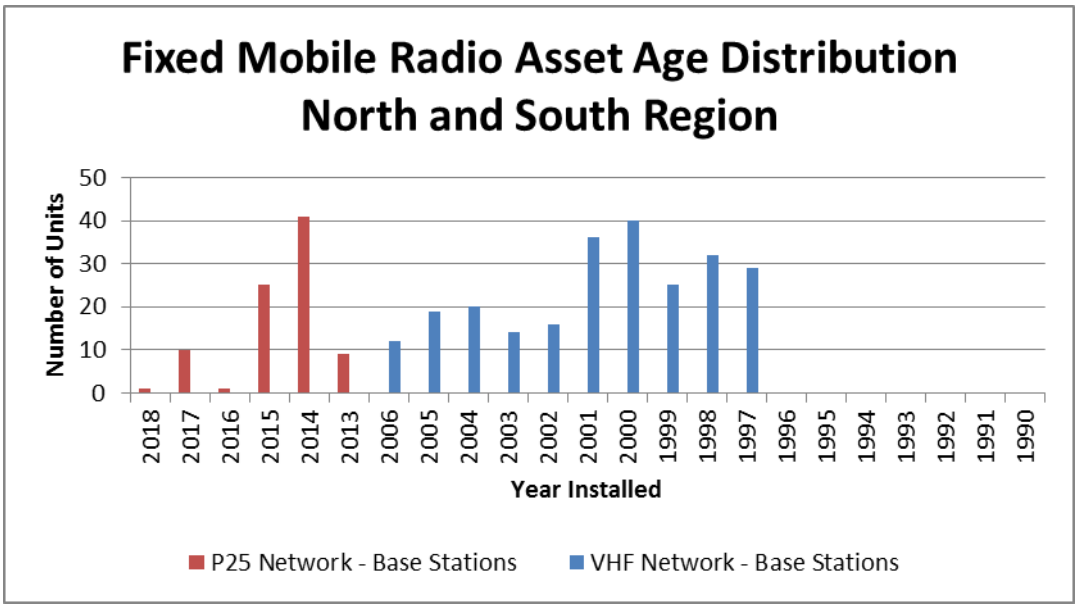

Figure 7: Field Mobile Radio Asset Age Distribution North and South Region

SATPTT has not been included in the age profile as there is no network integration equipment in operation at the present time.

2.5.2 Last Century Data Communications

Outlined in the graph below is the age distribution for PDH networking equipment.

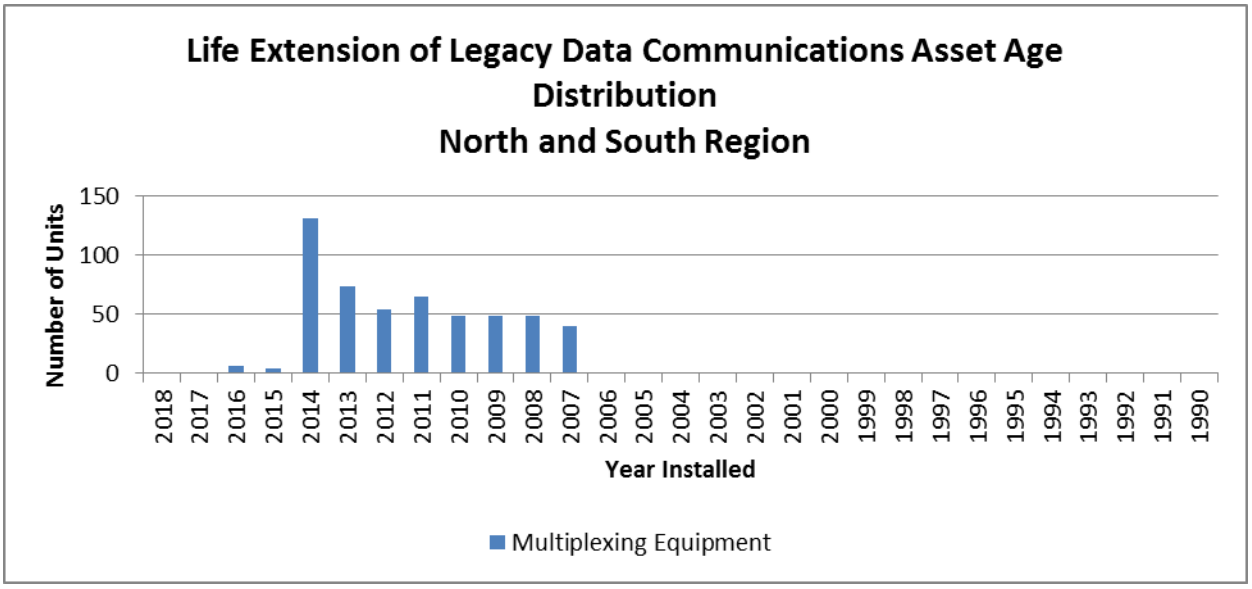

Figure 8: Last Century Data Communication Age Distribution North and South Region

2.5.3 Last Century Fixed Voice Communications

There is limited age data available for all assets under the Last Century Fixed Voice Communication strategy. The following is known;

- PSTN Phone – Approximately 549 services that have been commissioned between 1980 and 2004.
- Operational Call Control System – There are 2 systems located in North Queensland which were commissioned in 2005.
- Voice Mail System – There are 2 systems located in North Queensland which were commissioned in 2005.
- Dial-Up Modems - Approximately 128 dial-up modems across the network where the majority of were commissioned in 2004 and 2011 due to changes to the network architecture. Additionally, modems were commissioned between this period when new services were required.

2.5.4 Intelligent Grid Data Communications

Outlined in the graph below is the age distribution of asset s under the Intelligent Grid Data Communications category.

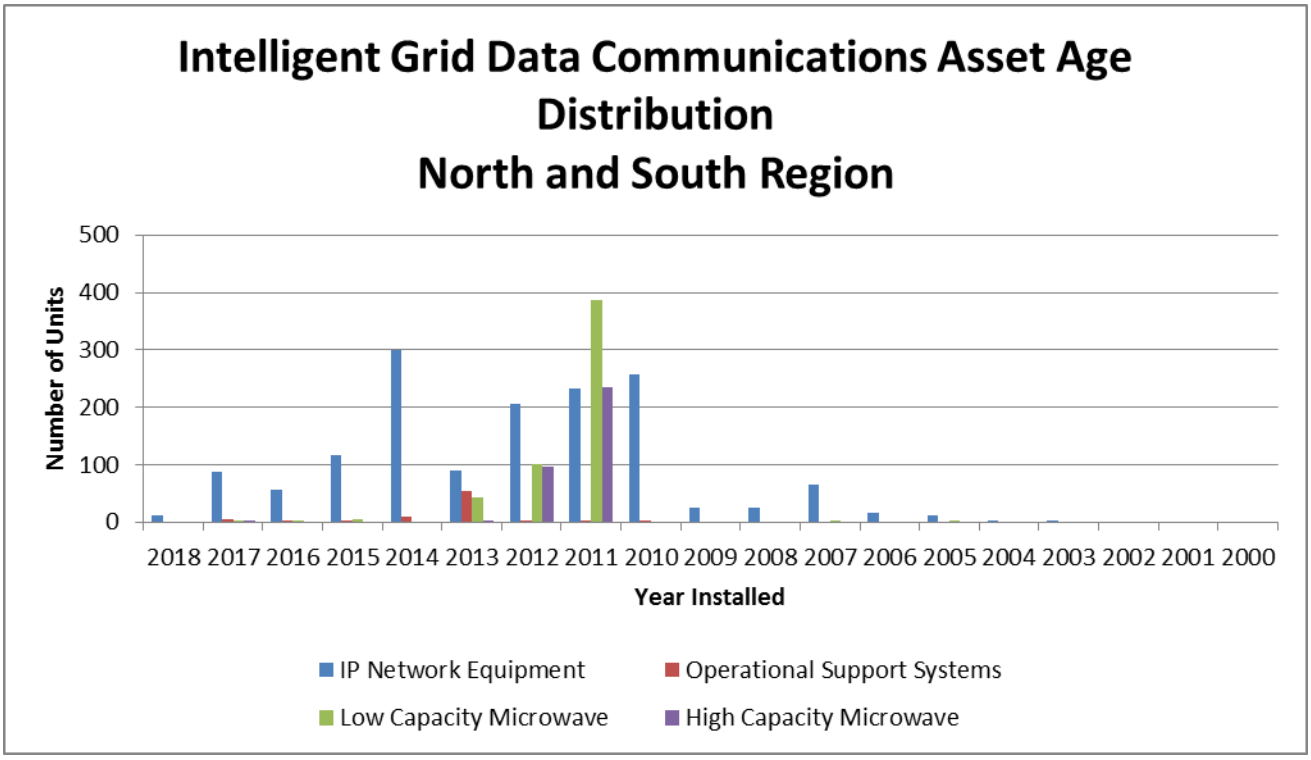

Figure 9: Intelligent Grid Data Communication Asset Age Distribution North and South Region

2.5.5 Communications Site Infrastructure

Outlined in the graph below is the age distribution for structures and buildings. Site access assets of access tracks and helipad have not been included due to the limited age data available.

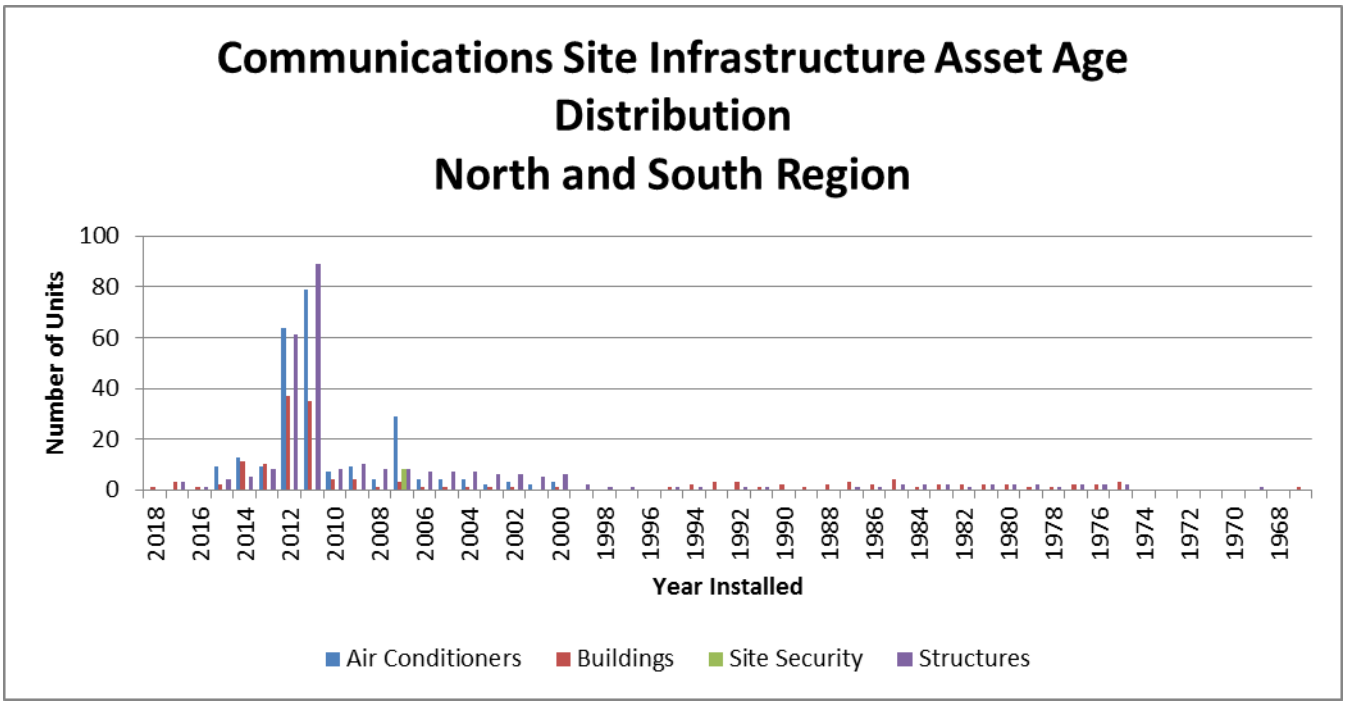

Figure 10: Communication Site Infrastructure Asset Age Distribution North and South Region

2.5.6 Communications Power Systems

Outlined in the graph below is the age distribution for battery banks, generators, solar systems and UPS.

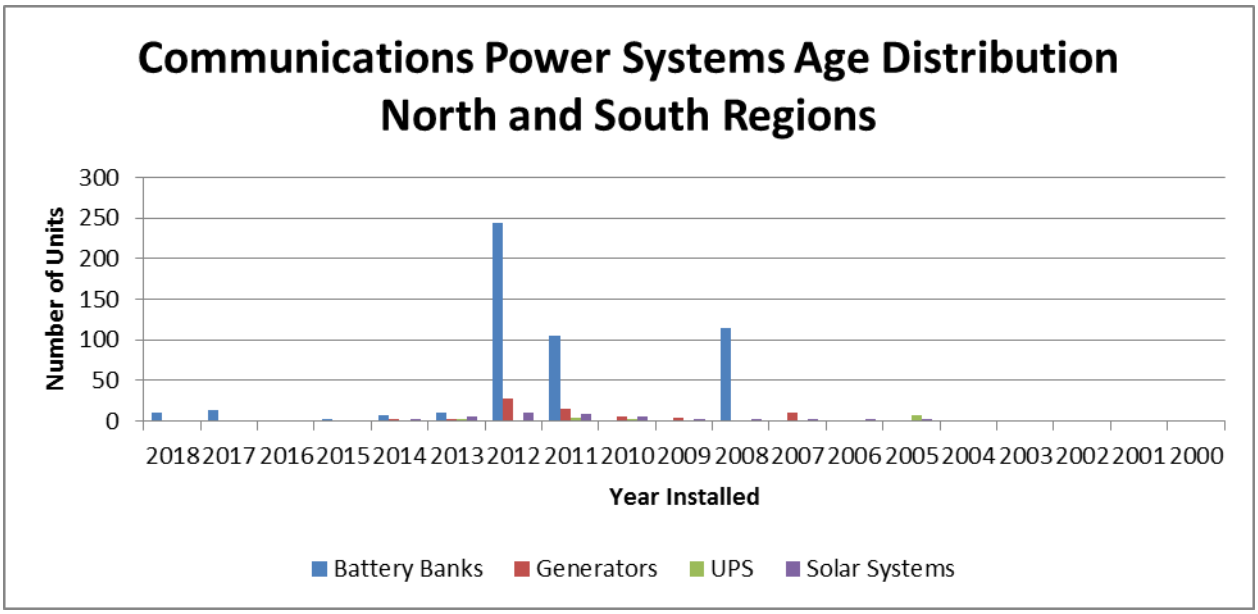

Figure 11: Communication Power Systems Asset Age Distribution North and South Region

2.6 Population Trends

With consideration to the Age Profiles above, a number of observations can be made in regards to trends in the changing population of Telecommunications equipment - these are discussed below.

2.6.1 Technology Advancement

There is an increasing demand for equipment with higher capacity and reliability than previously accepted, along with cheaper services on the network, which is driving the growth of newer technologies such as IP based networking devices within EQL. The past decade has seen a significant decrease of new PDH Multiplexing equipment as a result, and this is expected to continue into the future. To sufficiently handle this shift in technology, strategies such as the Intelligent Grid Data Communications Strategy within the North and South Regions seeks to prioritise devices that appropriately service the rising network requirements over the 2020-2025 AER period. Furthermore, the Last Century Data Communications Strategy aims to prolong the life of this legacy equipment in order to achieve a smooth transition in technology. Increasing awareness of and technical proficiency in the newer IP based technologies within the workforce will be vital to ensure the success of this equipment into the future.

2.6.2 Asset Deterioration

A significant program was undertaken in the North and South Regions from 2010 to 2014 which involved developing an internal telecommunication infrastructure platform and primary backbone that enabled the deployment of a multipoint network solution to service intelligent network devices and deliver enhanced monitoring & control of the distribution network. The assets that were installed through this program are now reaching the end of their useful life; and as equipment begins to deteriorate there is an increasing chance of in-service failure across the network which poses significant risks to the organisation. To help mitigate these risks, assets will begin to be replaced/refurbished under the Intelligent Grid Data Communication, Communication Power Systems and Communication Site Infrastructure strategies.

2.6.3 Security Awareness

As the organisation collectively becomes more conscious of security, there has been a push for improvements in existing physical and cyber vulnerabilities. While the latter has been largely addressed under the scope of Operational Technology, physical asset and site security have only experienced a small number of upgrades over the past few decades. In 2018 a project has commenced to radically overhaul the telecommunications radio site security infrastructure – modernising the technology implemented to current EQL standards. This effort will vastly improve the security and control of these sites, but also introduce a range of new assets to manage.

2.7 Asset Life Limiting Factors

Factor	Asset	Influence	Impact
Age	All	Under typical conditions, mechanical and electronic components experience degradation over time, leading to reduced serviceability or failure.	Mechanical or electronic components degrading over time
Environmental / Atmospheric Corrosion & Damage	All	Exposure to an abnormal, uncontrolled atmosphere, environment or corrosive substance degrades the asset over time.	Asset degradation due to weathering and corrosive pollutants, leading to decreased material strength and a resulting reduced life span.
Third-party Damage	All	Graffiti, vandalism or accidental damage from third parties.	Damage to equipment resulting in reduced serviceability or failure.
Operational Damage	All	Damage caused by operation - such as vibration or mechanical wear - causing material stress and deterioration.	Degradation of materials, reducing the serviceability of the asset.
Vendor Support Expiration	All	Asset procurement and support contracts with vendors expire for specific equipment.	Procurement and support ceases for a given asset, resulting in an inability to continue sourcing or maintaining the asset, causing obsolescence.
Decommissioning of Third-party Service	PSTN Dial-up Modems	A third-party ceases offering service.	The service is no longer operational and requires replacement.
Weather Events	Outdoor Equipment	Extreme weather events can induce excessive forces on asset structures.	Asset degradation due to excessive forces, leading to structural failures or component damage.
Load	Battery Banks	Load characteristics on batteries vary the electrical operation of the device; suboptimal loads will cause higher degradation rates.	Excessive degradation of batteries due to sub-optimal operating conditions, reducing the lifespan of the asset.
Thermal Cycling	Generators, Batteries, Solar Systems, Air Conditioning	Thermal cycling as part of the operational process can cause material damage or deformation and deteriorate the serviceability of the asset.	Thermal expansions gradually degrade material strength or structural form, reducing asset serviceability and lifespan.

Table 4: Asset Life Limiting Factor

3 Current and Desired Levels of Service

EQL has an asset management objective to ensure a safe and reliable network for the community. Programs associated with these asset classes, therefore, aim to reduce in service failures to levels which deliver a safety risk outcome which is considered So Far As Is Reasonably Practicable (SFAIRP) and as a minimum maintains current performance standards. These performance standards are not expected to change in the near future for telecommunications equipment, however, the associated network will expand as necessary to accommodate for arising needs.

3.1 Desired Levels of Service

Telecommunications Equipment will continue to be managed, consistent with corporate asset management policy, to achieve all legislated obligations and any specifically defined corporate key performance indicators, along with supporting all associated key result areas as reported in the Statement of Corporate Intent (SCI).

Safety risks associated with this asset class will be eliminated SFAIRP, and if not able to be eliminated, mitigated SFAIRP. All other risks associated with this asset class will be managed ALARP.

All inspection and maintenance activities will be performed consistent with manufacturers' advice, good engineering operating practice, and historical performance with the intent to achieve longest practical asset service life.

Assets may be operated longer than their nominal expected lifespans where suitable, consistent with legislative, reliability and risk based constraints. Conversely, problematic assets such as those which unusually high maintenance requirements or with significant associated risks will be considered for early retirement.

Assets of this class typically become obsolete before end of life. Once the asset type is obsolete, assets will be managed, replaced, and reallocated as appropriate to achieve appropriate risk management and optimum asset class longevity and performance.

3.2 Legislative Requirements

Whilst there are no specific legislative requirements that the telecommunications equipment directly needs to adhere to in addition to general electrical safety standards, some functionalities that they are responsible for facilitating have associated legislation requirements and this puts some restriction on the management of these assets.

In general, regulatory performance outcomes for this asset include compliance with all legislative and regulatory standards, including the Queensland Electrical Safety Act 2002, the Queensland Electrical Safety Regulation 2013 (ESR), and the Queensland Electrical Safety Codes of Practice.

The Queensland Electrical Safety Act 2002 s29 imposes a specific Duty of Care for EQL, which is a prescribed Electrical Entity under that Act:

1) An electricity entity has a duty to ensure that it works—
    a. are electrically safe; and
    b. are operated in a way that is electrically safe.
2) Without limiting subsection (1), the duty includes the requirement that the electricity entity inspects, test and maintain the works.

In addition, EQL needs to comply with the NER / AEMO in instances where the protection function is lost due to an equipment failure, or a bearer fault (such as degradation or mechanical damage). Under circumstances resulting in the failure of any 132 / 110kV (and some 33kV) protection circuits, EQL will notify Powerlink who will subsequently notify AEMO of the outage.

EQL is also required to restore the affected protection function “as soon as possible”. AEMO may determine that having a feeder in service without the protection function will compromise the security of the network in the event that a fault occurs. AEMO may call for the feeder to be de-energised.

Telecommunications equipment that functions on the transmitting and receiving of radio waves - such as microwave links - are subject to Frequency Licenses that dictate what frequency band they may operate in, to allow for other users in a given airspace. These licenses are governed by the Australian Communications and Media Authority (ACMA). In order to remain compliant, EQL must ensure that associated equipment is operating within suitable specifications to prevent a drifting of settings that would encroach into other frequency bands.

If EQL does not replace End of Life equipment before in-service failure occurs - especially with the lack of strategic spares or readily available like-for-like replacements - it puts the ability to meet these compliance requirements at risk.

Note in some Transmission installations achieving the specified clearing times may be prohibitively expensive. There is a provision under the National Electricity Register (AEMC, 2013) for the Network user to seek exemption from the Network Service Provider (Powerlink) with negotiation from AEMO.

3.3 Performance Requirements

Due to the relatively low number of assets per asset type in the Telecommunications asset class, EQL does not have a specific business target relating to individual telecommunications asset failures. Instead, EQL measures the performance of networks providing telecommunications services. Asset failures will impact the performance of the network either reducing the service uptime or increasing the risk associated with systems that have some level of redundancy.

The Telecommunications network must meet required services levels for the following services;

- NER and AEMO
- C-Diff Protection Scheme
- Distance Protection Scheme
- SCADA
- Mobile Radio Voice Services (VHF, P25 and SATPTT)
- Operational Telephony
- Engineering Access
- OCN
- Corporate
- Revenue Metering
- Commercial Requirements

3.4 Current Levels of Service

3.4.1 South East

The following table shows a summary of the average uptime of the network. Due to the collection of this data being a fairly recent endeavour for the South East region, a limited amount of historical performance can be represented.

	Average Up Time of E-Line Services	
Year	Corporate	Operational
2016	-	99.78%
2017	99.96%	99.99%
2018 (August)	99.97%	99.99%

Table 5: Network Average Up Time South East Region

3.4.2 North and South

The following table shows a summary of the average uptime of the network.

	Average Up Time of E-Line Services	
Year	Corporate	Operational
2013	99.97%	100.00%
2014	99.96%	100.00%
2015	99.94%	99.98%
2016	99.98%	99.97%
2017	99.86%	99.99%
2018 (August)	99.84%	99.82%

Table 6: Network Average Up Time North and South Region

4 Asset related corporate risk

As detailed in Section **Error! Reference source not found.**, Queensland legislation details that EQL as a Duty to ensure its works are electrically safe. This safety Duty requires that EQL take action So Far as is Reasonably Practical (SFAIRP) to eliminate safety related risks, and where it is not possible to eliminate these risks, to mitigate them SFAIRP[1].

Figure 7 provides a threat-barrier diagram for EQL Services assets. Many threats are unable to be controlled (e.g. third-party damage), although EQL undertakes a number of actions to mitigate them SFAIRP. Failure of a Service risks public and staff safety in several ways, most notably:

- Loss of communication services, including;
  - Protection Signalling
  - SCADA
  - Voice communication (P25, SATPTT and VHF radio)
  - Corporate systems
- Falling objects and debris from Telecommunication infrastructure

EQL's safety Duty results in most inspection, maintenance, refurbishment and replacement works and expenditure related to Services being entirely focused upon preventing and mitigating Service and Service connection failure.

The asset performance standards described in Section 4.0 detail EQL's achievements to date in respect of this safety Duty. The following sections detail the ongoing asset management journey necessary to continue to achieve this performance in the future.

[1] Queensland Electrical Safety Act 2002 s10 and s29

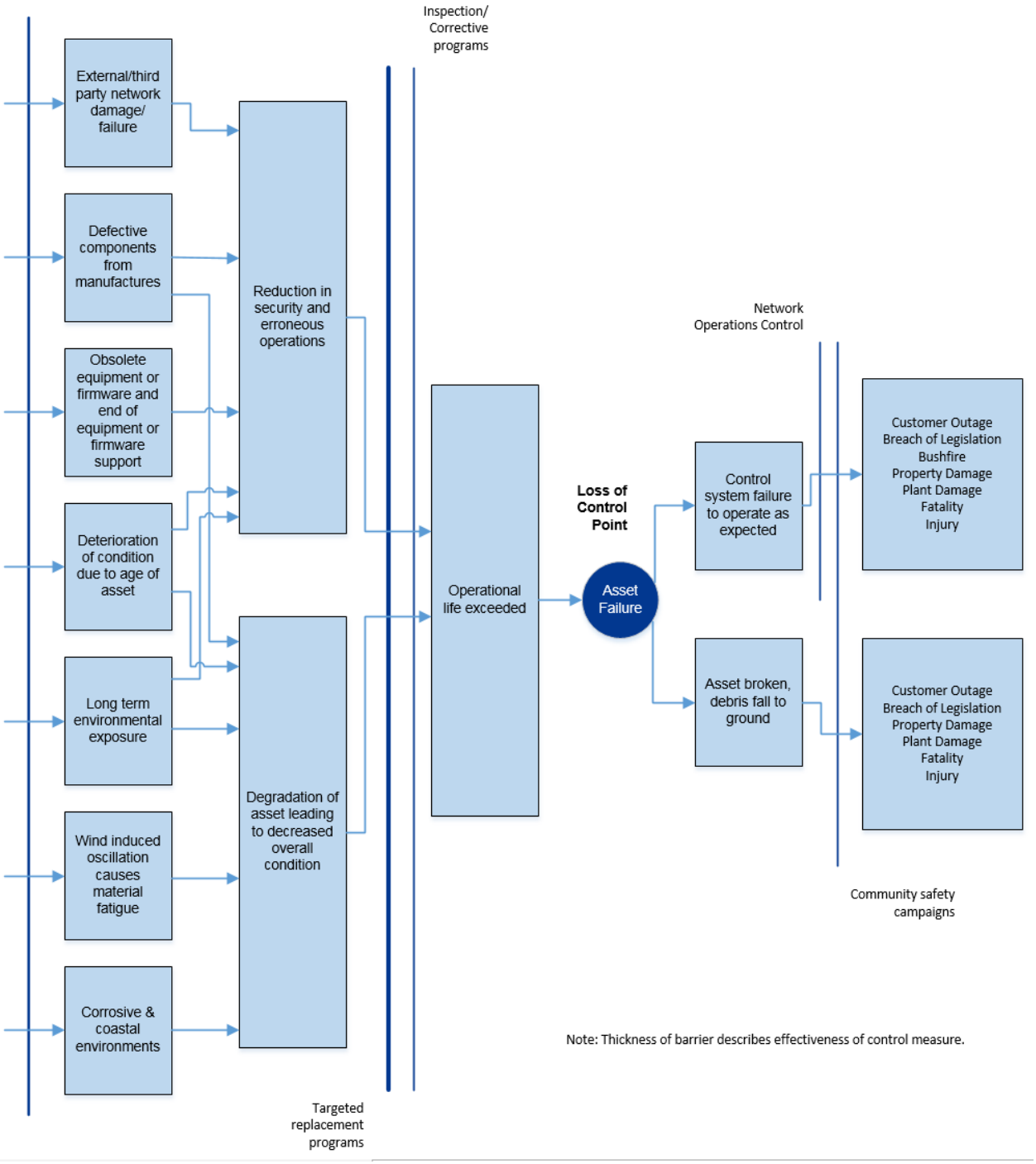

Figure 12: Telecommunications Threat Barrier Diagram

5 Health, Safety & Environment

Telecommunications equipment has a number of risks associated with its implementation and maintenance – such as electromagnetic radiation from microwave technology and oil/fuel substances in generators. However, the majority of these are minimised with adequate planning and responsible installation. For instance, site selection and satisfactory clearance for microwave links and documentation, and bunding for oil spill prevention.

The remaining risks involved with the maintenance is related to the relative isolation of radio sites and the physical heights that equipment atop towers or other structures is fixed at – which are minimised with sufficient preparation and following established work practices.

6 Current Issues

The following section defines current issues that are impacting asset management strategies.

6.1 Excessive Deterioration of Support Structures

Some support structures have deteriorated over time to such an extent that their serviceability is questionable, despite being under their expected end of life age. Typically this situation occurs when they have been exposed to significant alteration – i.e. large numbers of installations and uninstallations – such as the case at Gregor's Creek. This pole, in particular, was installed in 1980 and has since been used and vacated by multiple third-party organisations, in addition to South East. This deterioration has developed to the point where EQL staff will no longer climb the pole directly, rather deploying an Elevated Working Platform when required. These deteriorating assets are not planned for in regular maintenance programs as this excessive degradation is often hard or impossible to anticipate, however, pose a risk to the network all the same.

Action 6.1-1: Conduct an investigation into the condition and serviceability of targeted sites that may have been, or continue to be, prone to overuse. Plan for their replacement or for an alternative infrastructure solution if necessary.

6.2 Site Security Modernisation

Telecommunications sites have historically had their security infrastructure components installed or upgraded independently of each other or any overall corporate strategy. This has resulted in a range of differing keys and technologies implemented which is proving cumbersome to manage. A current project aims to primarily standardise the access keys for South East radio sites, along with a variety of additional security infrastructure upgrades in order to fill in any vulnerabilities identified. This will result in new security infrastructure at numerous radio sites.

Action 6.2-1: Conduct a vulnerability analysis for remaining telecommunications sites, upgrading security infrastructure where necessary.

6.3 National Broadband Network Service Cutovers

As the National Broadband Network continues its development within the state, many sites are being required to swap any existing third-party networking services – such as ADSL - to the new NBN service. EQL is proactively identifying affected sites and ensuring that if any impacted services

cannot be migrated to the organisations' IP network, then the transferral to the NBN network is well planned and will be as seamless as possible.

Action 6.3-1: Continue to identify telecommunications sites that require service cutovers, prioritising the use of the EQL owned fibre communications network.

6.4 Incomplete Historical Failure Data

EQL lacks a formal process or database specifically for capturing the complete failure data of OTE assets, outside of the JIRA platform which tracks issues within the OTE and telecommunications space. Whilst failure data can be extracted from JIRA, the exact assets affected and the distinction between faults or non-critical issues compared with a complete failure is not well defined. The failure modelling of telecommunications assets would greatly benefit from a purpose-made failure tracking process and database.

Action 6.4-1: Investigate potential solutions for the capture and analysis of telecommunications-specific failure data.

6.5 Battery Banks

In the 2014-2015 period, EQL identified a far greater than expected number of failures of battery banks within the network. Investigations determined that the cause appears to be a fault within the manufacturing process, affecting some individual battery cells within an estimated 65% of all battery banks currently in service. Under the Communication Power Systems strategy, these batteries are targeted for replacement in order to minimise the increased risks associated with network outages and their resulting reactive costs.

Action 6.5-1: Continue to identify and replace the battery cells and banks affected by the manufacturing defect.

6.6 IP Network Equipment Software Bug

First identified in late 2017, an error-producing bug is present in some IP networking devices that results in a service fault when triggered. The anecdotal evidence suggests that these faults are caused when the configuration of affected devices is modified, or additional devices are added or relocated from an affected portion of the network. A detailed investigation into the specific cause was conducted in co-operation with the device support agent, however, the bug was not able to be reproduced in the test environment and as such the underlying issue has not yet been properly deduced.

To date, 6 devices have had faults in this way; a total of 100 devices are estimated to be affected. In order to resolve the issue and prevent further escalation of this issue, the affected devices will be removed under the Return To Service program and the broader Intelligent Grid Data Communications strategy.

Action 6.6-1: Continue to identify and replace the IP networking devices affected by the software bug.

6.7 Technology Obsolescence

Many telecommunications devices are procured with vendor supply and support contracts that define the time period that further purchases and operational support of these devices will persist. As these factors significantly impact EQL's asset management strategies, assets will often be considered obsolescent at the expiration of these contracts. Maintaining a fleet of obsolescent assets on the network carries significantly increased risks - especially when strategic spares holdings dwindle – so these assets are typically targeted for replacement prior to reaching obsolescence. The removal of obsolescent devices from the network is generally complex given the quantities and service integration, so the process is often staggered into consecutive stages. The first devices pulled from service can also be held as strategic spares to minimise in-service failure risks until the further removals are completed.

Action 6.7-1: Continue to aim for asset replacements prior to the expiration of supply and support contracts, in order to minimise the risks associated with their continued operation.

6.8 Capacity Shortage

The increased demand for analytics and services on the network has the potential to cause capacity issues. Additionally, there is the risk of future demand not meeting forecasted expectations and upgraded services are not able to be utilised effectively resulting in wasted investment. To mitigate the risk of either issue occurring, appropriate measures will be undertaken where the criticality of the capacity limitation is investigated to ensure effective and prudent management. Through the Intelligent Grid Data Communications strategy, critical IP network equipment will be replaced as it reaches end of life or when greater capacity is required.

Action 6.8-1: Investigate the likelihood of increasing demands on the capacity of the telecommunications network, provisioning further network expansions were prudent.

6.9 Decommissioning of Third-Party Services

Similar to the NBN Cutovers, a number of third-party services are currently planned for decommissioning such as PSTN, ISDN and Frame Relay technologies. These services are planned to be resolved prior to the disconnection date through the Last Century Fixed Voice Communications strategy. In the future, other third-party services are expected to be planned for decommissioning, such as the 3G network in much the same fashion the 2G network has been decommissioned.

Action 6.9-1: Continue to plan and implement service cutovers prior to their decommissioning where necessary.

6.10 Telecommunications Site Access

Rectification work of access tracks and helipads has increased over the past 12 months, from 2 access track issues in 2016/17 to 4 access track and 3 helipad issues in 2017/18. During the previous 5 years, there had been no issues recorded.

In the past, access tracks and helipads were upgraded or built when significant projects were undertaken at site. Due to factors such as increased usage and abnormal weather conditions they

are now deteriorating more significantly to a state that requires repair. This issue will be addressed on an as-needed basis, under the Communication Site Infrastructure strategy.

Action 6.10-1: Continue to conduct repairs of the site access infrastructure identifying, any needs for upgrades.

6.11 Asbestos in Communications Buildings

Due to the business requirement of removing asbestos entirely from all buildings by 2030, there is a potential impact for some communications buildings to be demolished and removed if it is deemed impossible to sufficiently remove the asbestos otherwise. This, along with general repairs to the buildings in response to other impacts, is covered under the Return To Service program and Communication Site Infrastructure strategy within the North and South Regions.

Action 6.11-1: Identify and investigate potential asbestos-containing sites and the impacts of its removal, implementing work where necessary.

7 Emerging Issues

The following section defines emerging issues that have been identified with the potential to impact asset management strategies into the future.

7.1 Technology Driven Obsolescence

The enormous global market for internet enabled products and services have driven telecommunications network technologies and new network product developments. The effects of global markets and the global financial crisis had a significant impact on the telecommunications network suppliers, with many products ranges being sold, rationalised, or discontinued. For example, the major provider of PDH (Time Division Multiplexed Technology) multiplexer equipment that was the mainstay of the South East Region's operational telecommunications network through the 1980's, 1990's and 2000's has stopped sale of that product line. This will be a market place trend.

Action 7.1-1: Continue to be aware of changing industry conditions and the sources of assets for procurement.

7.2 Cybersecurity Pressures

Threats to the availability of telecommunications services will increase due to the increased interconnectivity of systems, greater extent and higher exposure. The extent will increase in physical (e.g. geographical) and logical (e.g. number of subsystems) dimensions. The exposure will increase through connectivity with external (potentially hostile) systems and through the use of commercial telecommunications components having well publicised vulnerabilities.

Action 7.2-1: Ensure that networking devices are consistently patched when updates are available, and implement asset replacements when these devices are no longer supported in order to mitigate security vulnerabilities.

7.3 Accommodation of Ongoing Changes to Business Needs

As EQL responds to changes in customer needs, economic conditions and developments in the products available for improved network performance, it can impact planned works. The consequential changes to telecommunications service requirements can require re-allocation of resources to enable cost-effective, architecturally compliant solutions. The emergence of Smart Grid technology is one such challenge; the adoption of intelligent equipment - such as power quality monitors - brings increased demand in telecommunications network capacity. Additionally, the migration to and continued rollout of the core IP network equipment will continue to present challenges in implementation, most prominently of which is the up-skilling required of the workforce.

Action 7.3-1: Continue to keep the collective workforce knowledge and experience up to date on current and future technologies, along with industry trends, so that the network can develop efficiently and prudently.

7.4 Data Centre Rationalisation

EQL continuously seeks to produce the best value for money through asset management strategies and property leasing conditions. With the combination of an upcoming lease renewal at the Wharf Street Data Centre, along with Data Centre asset renewals due to occur, EQL will seek to rationalise the current South East Region Data Centres. This process may result in an identified need to move telecommunications assets to new locations and decommission services at current Data Centres.

Action 7.4-1: Investigate the potential benefits and impacts of a Data Centre rationalisation in the South East Region.

7.5 Systems Integration

The convergence of technologies across the whole Operational Technology & Telecommunication (OT&T) domain – telecommunication, protection, SCADA, automation, condition monitoring, and IT, raises serious questions about how to organise equipment, systems, processes and skills for maximum business benefit.

Action 7.5-1: Continue seeking to identify and pursue efficiency opportunities within asset management strategies and processes.

7.6 Future Changes to Regulation and Statutory Requirements

Due to the regulation and statutory requirements that EQL must adhere to, there is a risk that any changes will have a significant effect on the management of telecommunication assets. If changes are required, then all new builds and installations, along with existing infrastructure and assets, may be affected causing additional cost to the design and construction phase.

For example, the current changes in legislation regarding the existence of asbestos within structures has resulted in the need for EQL to seek and remove it in its entirety by 2030, at a cost to the organisation.

Action 7.6-1: Continue to be aware of changing regulatory and statutory requirements, implementing any changes as necessary.

7.7 Extending Asset Life

With a focus on reducing expenditure, extending asset life has become an expected and commonplace practice. The inherent risk of this practice is an increase of in-service failures which will also increase the expenditure of reactive programs, such as Return To Service. The risk mitigation strategy for this issue is the use of data analytics to improve the associated decision making.

Action 7.7-1: Continue to utilise risk-based replacement strategies where possible, in order to reduce the costs associated with unnecessary asset replacements.

7.8 Emergence of New Technologies

With the increased demand for services and more effective remote monitoring, there is a likelihood that new technologies will be introduced into the network which will require effort into its research and development. This introduction has the potential risk of integration issues, poor uptake and asset management liabilities.

An example of one such new technology is 5G cellular services, which may result in the implementation of new devices across the network and change the architecture of the network.

New technologies will be introduced under the Last Century Data Communications strategy.

Action 7.8-1: Continue to be aware of emerging and future technologies, investigating the benefits and impacts of its implementation on the network where prudent.

8 Improvements and Innovation

EQL seeks to identify potential improvements and innovations for existing and future systems and processes, a number of which are detailed below.

8.1 South East

8.1.1 Establishing Internal Confidence in Teleprotection Over MPLS

While the South East Region is by no means at the leading edge with respect to MPLS adoption, the migration of critical teleprotection services to MPLS transport is still relatively new in the industry.

In the 2015-2020 period, the South East Region has been actively identifying the constraints and appropriate conservative engineering boundaries required to migrate these critical services to MPLS transport within the capability limits of our IP network. This process will be continued in the 2020-2025 period, with a migration of teleprotection services occurring where feasible and prudent.

This will facilitate withdraw from service of the older/obsolete PDH based network products.

Action 8.1-1: Continue to conduct trials of MPLS technology within the network to determine its suitability for further uptake.

8.2 North and South

8.2.1 Site Reduction due to Technology Advancements

With the continued development of technology within the telecommunications industry, the requirements for implementing particular services have changed as a result. With the installation of SATPTT and P25 networks under the Field Mobile Voice Communications strategy, there are opportunities to reduce the number of sites held by EQL as there is no longer a need for terrestrial base stations for this function. This would reduce the costs associated with the upkeep of these sites, including site visitation and maintenance.

Additionally, there is potential for third-party carries to implement new technology in areas where EQL has historically held sites for little telecommunication presence. This may provide a cost-efficient alternative to the current arrangements.

Action 8.2-1: Continue to identify and investigate the benefits and impacts of service rationalisation and site reductions within the network as a result of new or improved technologies.

8.2.2 Network Visibility

The increase of IP services throughout the network allows for improved monitoring and visibility of site infrastructure and equipment, through self-check functionalities and service monitoring systems. This improvement will allow the business to reduce site visits and improve response times to faults. There is a focus to continually increase site monitoring and visibility to improve network operations, which will naturally progress as IP Network equipment is further utilised across the network.

Action 8.2-2: Continue to identify the potential opportunities to increase network visibility through the use of IP networking devices or technologies with similar functionalities.

8.2.3 Software Defined Networking

The emergence of Software Defined Networking (SDN) will significantly change the current network architecture. SDN will allow control from a centralised control console, which is significantly more efficient than the current architecture which requires changes to be made to each individual IP network device. The integration of this innovation would occur under the Intelligent Grid Data Communications strategy and would be subjected to significant research and development before implementation.

Action 8.2-3: Investigate the potential benefits and impacts of the implementation of SDN technology on the network.

8.2.4 Automation and Big Data

The utilisation of data and automation will become a key aspect of network operations in the future. Presently, it has already been utilised to collate battery bank data to help improve decision making regarding asset life, maintenance and asset issues. There are also opportunities for automation to significantly change current network management processes. Both innovations are considered in all strategies to ensure the network is operating in the most effective and efficient manner.

Action 8.2-4: Investigate the potential benefits and impacts of utilising big data in applications relating to the automation and analysis of the network.

9 Lifecycle strategies

9.1 Philosophy of approach

9.1.1 South East

Given the broad scope of the encompassing Telecommunications equipment asset class, the philosophy of asset management varies for each asset type. South East takes a number of different approaches for this management; ranging from replacement on asset failure for equipment such as the IP network equipment and PDH networking devices, to regularly scheduled inspection and maintenance on more critical equipment like the diesel generators and security infrastructure.

In general, assets should ideally be removed from service and replaced before they would fail in service, but not at the expense of significant service life. Where practical, regularly scheduled maintenance provides an opportunity to identify issues with the assets and react accordingly – either with maintenance activities or replacement. For assets that are not feasible for this approach, other methodologies are employed such as simply replacing the equipment when it fails (or fail/fix). Whilst this approach may not necessarily be optimal, asset management strategies are continually advancing in maturity - through better data acquisition and asset understanding - to the point where these assets can utilise predictive approaches to proactive replacement

9.1.2 North and South

North and South actively manage Telecommunication assets through an aged or condition-based approach. The aged replacement of the assets is driven from either the end of life notification or the estimated operational life; both are supplied from the manufacture or vendor. The risk of condition based failures is mitigated by the RTS program; these replacements are completed on an ad-hoc base.

9.2 Supporting Data Requirements

9.2.1 South East

Ideally, data collection systems would be mature enough to produce a database of failure records for each asset class, allowing the organisation to model lifecycle characteristics and be able to determine when proactive replacement should occur with greater precision. Currently, there are a number of such data acquisition methods for telecommunications equipment in use; however, their primary function is intended for the tracking of maintenance works progress rather than for data analysis, such as Jira. Another such system is the recently launched Maintenance Strategy Support System (MSSS) which captures corrective maintenance works with a far higher degree of data quality than previously achievable.

9.2.2 North and South

The primary driver for the replacement strategies is the End of Support (EoS) and End of Life (EoL) notifications which are issued by the vendor. Where EoS and EoL are not relevant to the asset the age profile and asset condition is the primary driver for the replacement strategy, the data utilised to formulate the age profile and condition is from the failure in service rate under the Return to Service (RTS) program, internal databases and maintenance condition reports.

9.3 Acquisition and procurement

Telecommunications assets are procured via periodic vendor supply contracts or a tender process depending on quantity required and the nature of the asset. Given that the availability of asset spares

is a critical component of EQL asset management strategies, these time-limited supply contracts are a major driver for asset replacement. Similarly, with intelligent assets such as PDH & IP networking equipment requiring continued firmware update support to maintain serviceability; these supply contracts typically also include continued support from vendors up to the point of agreement expiry.

9.4 Operation and Maintenance

The operation and maintenance of Telecommunications equipment include the preventive and corrective maintenance of the assets as well as the holding and management of strategic spares. The methods involved vary between regions.

Within the South East Region, routine inspections of Telecommunications equipment are carried out in accordance with the South East Network Asset Management Program. The frequency of these inspections is varied depending on the function, strategic criticality and nature of the asset; ensuring that any condition deterioration is detected in sufficient time for repair or replacement to occur. The Energex Network Asset Management Program identifies the various jobs associated with this activity, their population, and their proposed frequencies.

Where practicable, corrective actions should be carried out during the routine inspection and maintenance activity, to negate the need for extra work to be scheduled and executed, where:

- Asset maintenance personnel are competent.
- The corrective action identified is reasonable and consistent with the Substation Defect Classification Manual (where applicable).
- Corrective action(s) can be carried out safely and in accordance with safe working practices.

9.4.1 Preventive maintenance

Preventive maintenance is work done to an asset in response to an identified defect to prolong its service life, whilst that asset is still in service and operational. This is distinct from corrective maintenance, which is done to return the asset to an operational state following a failure or the identification of a defect that prevents normal operation.

9.4.1.1 South East

Defects found during routine inspection shall be classified and prioritised in accordance with the Substation Defect Classification Manual where applicable. Definitions and the standard coding system for defect ratings are defined in the Company's Standard for Network Assets Defect / Condition Prioritisation.

Consequently, these identified defects are rectified in 'Preventive Demand (PD)' jobs. Depending on the classification of the defect, these preventive demands will have a time allowance applied in which the maintenance must be completed within.

9.4.1.2 North and South

Preventive maintenance activities consist of in-service site maintenance which is conducted at all communications sites every 6 months. Additionally, out of service maintenance is conducted on specific equipment such as VHF and P25 base stations, fall arrest systems, protection signalling and communication structures. The annually produced 'Standard for Preventive Maintenance Programs' (ref STNW0717) summarises the timing requirements of these activities, and the functional performance specifications are detailed in a set of asset specific standards published on the Process Zone.

9.4.2 Corrective maintenance

Corrective maintenance is done in response to an active fault situation in order to return the assets and associated network segment to normal operation.

9.4.2.1 South East

The main time constraint driver for corrective maintenance works is ensuring that the South East Region remains compliant with AEMO's requirement for any given feeder to be without protection for no longer than 8 hours.

Further escalation may be required if risks associated with the defect are not sufficiently mitigated through corrective maintenance. This might involve a project being raised to perform replacements of the asset and any additional associated infrastructure or equipment, or further corrective work orders being raised in an OPEX repair job.

9.4.2.2 North and South

Corrective maintenance is generated from preventive maintenance programs, ad-hoc inspections and public reports. Any corrective action identified that can be performed in situ must be carried out by an authorised crew as corrective maintenance. The time to respond is shorter than for preventive maintenance as the condition of wear or deterioration is perceived to be more advanced.

Corrective actions that cannot be remedied at the time of inspection shall be collated from completed maintenance job cards and shall be programmed as specific corrective maintenance activities. This work is to be performed in a planned manner and is not of the highest priority or sufficiently serious to require immediate action under emergency conditions.

Additionally, forced maintenance is work that is necessary to complete immediately in order to avoid serious consequences. Reactive forced maintenance activities are performed as required, with short notice and of the highest priority to restore supply or to make the situation safe.

9.4.3 Spares

Spares are assets that are held in stores which are identical to equipment found in the field, to be used for timely like-for-like replacements in planned or reactive situations.

Strategic spares are a critical component of the South East Region and North and South Regions' asset maintenance strategies, as their availability significantly cuts down on asset replacement time and by extension network downtime. Spares may exist from additional assets being procured from vendors or from refurbished equipment in decommissioning projects, along with being proactively removed from service specifically for the intention of being sent to spares inventory. This proactive removal of assets is often performed when a low stock of spares has been identified and determined to put the specific asset type at unacceptable risk levels.

9.4.3.1 South East

Strategic spares for telecommunications equipment are typically stored at the Victoria Park Data Centre.

9.4.3.2 North and South

The North and South Region hold the following approximation of strategic spares as of the date of publication.

End of Life Assets	Comments (Average %)
Multiplexers	Approx. 14.3% spares available
Low Capacity Microwave Links	Approx. 32.14% spares available

Table 7: Strategic Spares North and South Region

9.5 Refurbishment and replacement

9.5.1 Refurbishment

Refurbishment is when an asset is removed from service and replaced, with the intention to repair and then re-use it once again.

9.5.1.1 South East

South East rarely participates in refurbishment for Telecommunications assets, as it is more cost effective to perform repairs of the asset on-site, or where further service life is not possible to rather replace the asset altogether. As discussed earlier, in some cases assets will be proactively removed from service with the intention of using them as strategic spares, however, in almost every case these assets are otherwise healthy and do not need to be refurbished before returning to service.

9.5.1.2 North and South

The North and South Regions utilise refurbishments as part of the Return to Service program. This includes replacements of equipment components to return failed assets to service and restore the network to normal operation as soon as possible.

Action 9.5-1: The risk of in service failure needs to be mitigated by the correct utilisation of the RTS program. It is paramount to ensure that the RTS program is effective and efficient in the use of funding and forecasting is conducted comprehensively and accurately.

9.5.2 Replacement

Asset replacements occur when the equipment has been selectively identified for proactive removal as per the asset management strategies governing that asset, or it has failed in service and cannot be repaired sufficiently. Where strategic spares exist, they are typically prioritised for replacements.

Action 9.5-2: The development of technology, age replacement and network capacity increases need to continue to be carried out through the strategies outlined to reduce the risk of the current and emerging issues.

9.5.2.1 Last Century Data Communications

Extend the existing extensive obsolete TDM network's lifetime, provision of an efficient and effective pathway to migrate services from the TDM network and replacement of a legacy service management system. The strategy includes;

- Spares mining of multiplexers using the transmission method of Time Division Multiplexing (TDM);
- Establishment of a Teleprotection solution utilising IP network equipment;
- Prudent service transition from TDM to IP network; and
- Replacement of a bespoke legacy telecommunications service management system.

9.5.2.2 Last Century Fixed Voice Communications

Preserve existing voice, ADSL, ISDN and Frame Relay services to substations. This is a business as usual driven by:

- Removal of existing PSTN substation phone services by NBN;
- Removal of existing dial-up modems utilising wideband services by Telstra; and
- Proactive aged replacement of EQL voice mail system and operational call control system.

9.5.2.3 Intelligent Grid Data Communications

Continue business as usual aged replacement of obsolete hardware, software and supporting assets classes based on end of life/support notifications and condition based assessments, specific asset include;

- IP Network Equipment;
- Low Capacity Microwave Links;
- High Capacity Microwave Links, and ;
- Operation Support Systems

9.5.2.4 Field Mobile Voice Communications

Continuation of the aged VHF network replacement program is to establish a largely homogenous modern two-way radio network across Queensland. A modern two-way radio network has operational benefits over that of the retiring radio system including the ability to work and communicate away from the vehicles. The Field Mobile Radio strategy has a focus on quality, availability, and reliability to support a safe and efficient work environment for our field crews. The strategy includes the following relating to each asset class;

VHF

- To be decommissioned and removed once P25 and SATPTT is operational in all areas,
- Appropriate approval and consultation to be conducted before decommissioning P25,
- Replace the aged analogue VHF radio network in coastal and near coastal areas,
- Primary solution already developed through the building of 79 P25 sites in P25 Mackay to Maryborough,
- Build and commission 18 P25 sites which include 2 towers, 1 helicopter pad, 10 poles and 12 solar systems,
- Installation and commissioning of P25 mobile radios in 68 vehicles,
- Implementation of low cost enhancements at up to 18 P25 sites and identify potential low coverage areas,
- Establishment of portable P25 base stations and backhaul,
- Improved redundancy equipment,

- Expand P25 coverage to areas that do not receive VHF network coverage,
- Undertake full GME radio model replacement to all GME radios and safety updates to all vehicles,
- A managed project timeline developed with the field that will enable efficient resource usage and vehicle availability and aligned to the suppliers production capabilities.

SATPTT

- Replace the aged and limited coverage analogue VHF radio network for remote vehicles,
- Implement SATPTT units across remote vehicles in limited coverage areas,
- Integrate with P25 to establish a largely homogenous modern two-way radio network.

9.5.2.5 Communication Site Infrastructure

The continuation of a program to replace ageing and degrading telecommunication infrastructure that facilitates the use of radio and network equipment which can include microwave radios, IP network equipment, P25 and VHF network. The network can be the primary communication system in the area for daily operations and disaster recovery, therefore it is vital site infrastructure meets the appropriate standards and condition. The strategy will focus on;

- Replacement/rectification of;
    - Communication Building,
    - Communication Structures,
    - Site Access.

9.5.2.6 Communication Power Systems

The Power Age replacement program will ensure that telecommunication sites have adequate supply of power through the use of generators, UPS and battery banks to remain operational when outages occur on the electrical network and ensure solar systems remain adequate. The strategy will focus on;

- Age replacement of;
    - Generators,
    - UPS,
    - Solar Systems, and
    - Battery Banks.

Assets of the highest risk will be categorised as a priority, this will be conducted through data analytics and maintenance results.

9.6 Disposal

Assets will be disposed in accordance with standard EQL corporate process.

10 Program Requirements and Delivery

The programs of maintenance, refurbishment and replacement required to outwork the strategies of this AMP are documented in Network Program Documents and reflected in corporate management systems. Programs are typically coordinated to address the requirements of multiple asset classes at a higher level such as a substation site or feeder to provide delivery efficiency and reduce travel costs and overheads. The Network Program Documents provide a description of works included in the respective programs as well as the forecast units.

Program budgets are approved in accordance with Corporate Financial Policy. The physical and financial performance of programs is monitored and reported on a monthly basis to manage variations in delivery and resulting network risk.

11 Summary of Actions

The following provides a summary of the specific actions noted throughout this AMP for ease of reference.

Action 6.1-1: Conduct an investigation into the condition and serviceability of targeted sites that may have been, or continue to be, prone to overuse. Plan for their replacement or for an alternative infrastructure solution if necessary.

Action 6.2-1: Conduct a vulnerability analysis for remaining telecommunications sites, upgrading security infrastructure where necessary.

Action 6.3-1: Continue to identify telecommunications sites that require service cutovers, prioritising the use of the EQL owned fibre communications network.

Action 6.4-1: Investigate potential solutions for the capture and analysis of telecommunications-specific failure data.

Action 6.5-1: Continue to identify and replace the battery cells and banks affected by the manufacturing defect.

Action 6.6-1: Continue to identify and replace the IP networking devices affected by the software bug.

Action 6.7-1: Continue to aim for asset replacements prior to the expiration of supply and support contracts, in order to minimise the risks associated with their continued operation.

Action 6.8-1: Investigate the likelihood of increasing demands on the capacity of the telecommunications network, provisioning further network expansions were prudent.

Action 6.9-1: Continue to plan and implement service cutovers prior to their decommissioning where necessary.

Action 6.10-1: Continue to conduct repairs of the site access infrastructure identifying, any needs for upgrades.

Action 6.11-1: Identify and investigate potential asbestos-containing sites and the impacts of its removal, implementing work where necessary.

Action 7.1-1: Continue to be aware of changing industry conditions and the sources of assets for procurement.

Action 7.2-1: Ensure that networking devices are consistently patched when updates are available, and implement asset replacements when these devices are no longer supported in order to mitigate security vulnerabilities.

Action 7.3-1: Continue to keep the collective workforce knowledge and experience up to date on current and future technologies, along with industry trends, so that the network can develop efficiently and prudently.

Action 7.4-1: Investigate the potential benefits and impacts of a Data Centre rationalisation in the South East Region.

Action 7.5-1: Continue seeking to identify and pursue efficiency opportunities within asset management strategies and processes.

Action 7.6-1: Continue to be aware of changing regulatory and statutory requirements, implementing any changes as necessary.

Action 7.7-1: Continue to utilise risk-based replacement strategies where possible, in order to reduce the costs associated with unnecessary asset replacements.

Action 7.8-1: Continue to be aware of emerging and future technologies, investigating the benefits and impacts of its implementation on the network where prudent.

Action 8.1-1: Continue to conduct trials of MPLS technology within the network to determine its suitability for further uptake.

Action 8.2-1: Continue to identify and investigate the benefits and impacts of service rationalisation and site reductions within the network as a result of new or improved technologies.

Action 8.2-2: Continue to identify the potential opportunities to increase network visibility through the use of IP networking devices or technologies with similar functionalities.

Action 8.2-3: Investigate the potential benefits and impacts of the implementation of SDN technology on the network.

Action 8.2-4: Investigate the potential benefits and impacts of utilising big data in applications relating to the automation and analysis of the network.

Action 9.5-1: The risk of in service failure needs to be mitigated by the correct utilisation of the RTS program. It is paramount to ensure that the RTS program is effective and efficient in the use of funding and forecasting is conducted comprehensively and accurately.

Action 9.5-2: The development of technology, age replacement and network capacity increases need to continue to be carried out through the strategies outlined to reduce the risk of the current and emerging issues.

Appendix 1. References

It takes several years to integrate all standards and documents after a merger between two large corporations. This table details all documents authorised/approved for use in either legacy organisation, and therefore authorised/approved for use by EQL, that supports this Asset Management Plan.

Legacy organisation	Document Number	Title	Type
Ergon Energy	EPONW01	Network Asset Management Policy	Policy
Ergon Energy	PRNF001	Protocol for Network Maintenance	Protocol
Ergon Energy	PRNF003	Protocol for Refurbishment and Replacement	Protocol
Ergon Energy	STNW0330	Standard for Network Assets Defect/Condition Prioritisation	Standard
Ergon Energy	STNW1128	Standard for Neutral Earthing Resistors and Reactors	Standard
Ergon Energy	STNW1160	Maintenance Acceptance Criteria	Manual
Ergon Energy	EP26	Risk Management Policy	Policy
Ergon Energy	EP51	Defect Management Policy	Policy
Ergon Energy	SGNW0004	Network Optimisation Asset Strategy	Strategy
Ergon Energy	STNW0717	Standard for Preventive Maintenance Programs for 2017-18	Standard
Ergon Energy		Substation Defect Classification Manual	Manual
Ergon Energy	STNW1002	Standard for Substation Protection	Standard
Ergon Energy	STNW1156	Standard for Protection Systems	Standard
Ergon Energy	ETS03-01-07	Technical Specification for Optic Fibre Cable	Specification
Energex	01207	Maintenance Standard for Telecommunications	Standard
Energex	STNW3993	Telecommunications Design Guide	Standard
Energex		Network Asset Management Program – Opex – Planned Maintenance 2015-2020	Program
Energex		Obsolete Telecommunications Equipment	Business Case
Energex		At-Risk Telecommunications Equipment	Business Case

Appendix 2. Definitions

Term	Definition
Distribution	LV and up to 22kVnetwork, all SWER networks.
Subtransmission	33kV and 66kV networks.
Transmission	Above 66kV networks.
Forced maintenance	This type of maintenance involves urgent, unplanned repair, replacement, or restoration work that is carried out as quickly as possible after the occurrence of an unexpected event or failure; in order to bring the network to at least its minimum acceptable and safe operating condition. Although unplanned, an annual estimate is provided for the PoW against the appropriate category and resource type.
Preventative maintenance	This type of maintenance involves routine planned/scheduled work, including systematic inspections, detection and correction of incipient failures, testing of condition and routine parts replacement designed to keep the asset in an ongoing continued serviceable condition, capable of delivering its intended service.
Corrective maintenance	This type of maintenance involves planned repair, replacement, or restoration work that is carried out to repair an identified asset defect or failure occurrence, in order to bring the network to at least its minimum acceptable and safe operating condition. An annual estimate is provided for the PoW against the appropriate category and resource type.
Internet Protocol (IP)	A set of rules governing the format of data sent over the Internet or other network.
Ethernet	A system for connecting a number of systems to form a local area network, with protocols to control the passing of information and to avoid simultaneous transmission by two or more system.
Multiprotocol Label Switching (MPLS)	A type of data-carrying technique for high-performance telecommunications networks.
Asymmetric Digital Subscriber Line (ADSL)	A type of DSL broadband communications technology used for connecting to the Internet.
Public Switched Telephone Network (PSTN)	An aggregate of the world's circuit-switched telephone networks that are operated by national, regional, or local telephony operators, providing infrastructure and services for public telecommunication.
Integrated Service Digital Network (ISDN)	A set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network.
FrameRelay	A standardised wide area network technology that specifies the physical and data link layers of digital telecommunications channels using a packet switching methodology.
Teleprotection	The protection and control functions transported across Telecommunications equipment, which ensure the reliable operation of the power system.
Open Systems Interconnection Model	A conceptual model that characterises and standardises the communication functions of a telecommunication or computing system without regard to its underlying internal structure and technology.
Data Link Layer	A layer defined within the OSI Model that provides transfer of data between directly connected telecommunications equipment.
Network Layer	A layer defined within the OSI Model that provides transfer of data between indirectly connected telecommunications equipment.
Transport Layer	A layer defined within the OSI Model that controls the state and reliability of Network Layer data transfers.

Appendix 3. Acronyms and Abbreviations

The following abbreviations and acronyms may appear in this Asset Management Plan.

Abbreviation or acronym	Definition
AIDM	Asset Inspection & Defect Management system
AMP	Asset Management Plan
Augex	Augmentation Expenditure
CBRM	Condition Based Risk Management
CB	Circuit Breaker
CT	Current Transformer
CVT	Capacitor Voltage Transformer
DEE	Dangerous Electrical Event
DGA	Dissolved Gas Analysis
DLA	Dielectric Loss Angle
EQL	Energy Queensland Limited
ESCOP	Electricity Safety Code of Practice
ESR	Queensland Electrical Safety Regulation (2013)
IoT	Internet of Things
ISCA	In-Service Condition Assessment
LDCM	Lines Defect Classification Manual
LV	Low Voltage
MU	Metering Unit
MVAr	Mega-VAr, unit of reactive power
NER	Neutral Earthing Resistor
NEX	Neutral Earthing Reactor
OLTC	On-load tap -changers
OSI	Open Systems Interconnection
OTI	Oil Temperature Indicators
PCB	Polychlorinated Biphenyls
POC	Point of Connection (between EQL assets and customer assets)
POEL	Privately owned Electric Line
PRD	Pressure Relief Device
QLD	Queensland
REPEX	Renewal Expenditure
RIN	Regulatory Information Notice
RMU	Ring Main Unit
SCAMS	Substation Contingency Asset Management System
SDCM	Substation Defect Classification Manual

Abbreviation or acronym	Definition
SHI	Security and Hazard Inspection
SM	Small
SVC	Static VAR Compensator
VT	Voltage Transformer
WCP	Water Content of Paper
WTI	Winding Temperature Indicators
WTP	Wet Transformer Profile