Asset Specific Plan

OH Lines and Pole Hardware

Generated Date: 2014-05-29

Table of Contents

1 Purpose

This document forms the ActewAGL Asset Specific Plan for the OH Lines and Pole Hardware suite of assets within ActewAGL Distribution. It is intended to define the specific approach to, and principles for, the management of the nominated assets within ActewAGL Distribution.

It provides a justified and evidence based Asset Specific Plan that is used to forecast the volumes and types of intervention and associated costs considered necessary to achieve the defined level of infrastructure, system or asset capability or output, for OH Lines and Pole Hardware. As such it provides a whole-life, whole-system based intervention and cost analysis for these assets.

This document and the principles captured within it are derived from and consistent with the overall ActewAGL Asset Management Policy and form a key element of the ActewAGL Distribution Asset Management Plan.

It is a live document which forms the framework for the implementation of Asset Management relating to OH Lines and Pole Hardware. It is intended to define the approach to Asset Management taken by ActewAGL Distribution to the management of these assets for both internal and external communication.

2 Good Practice Alignment

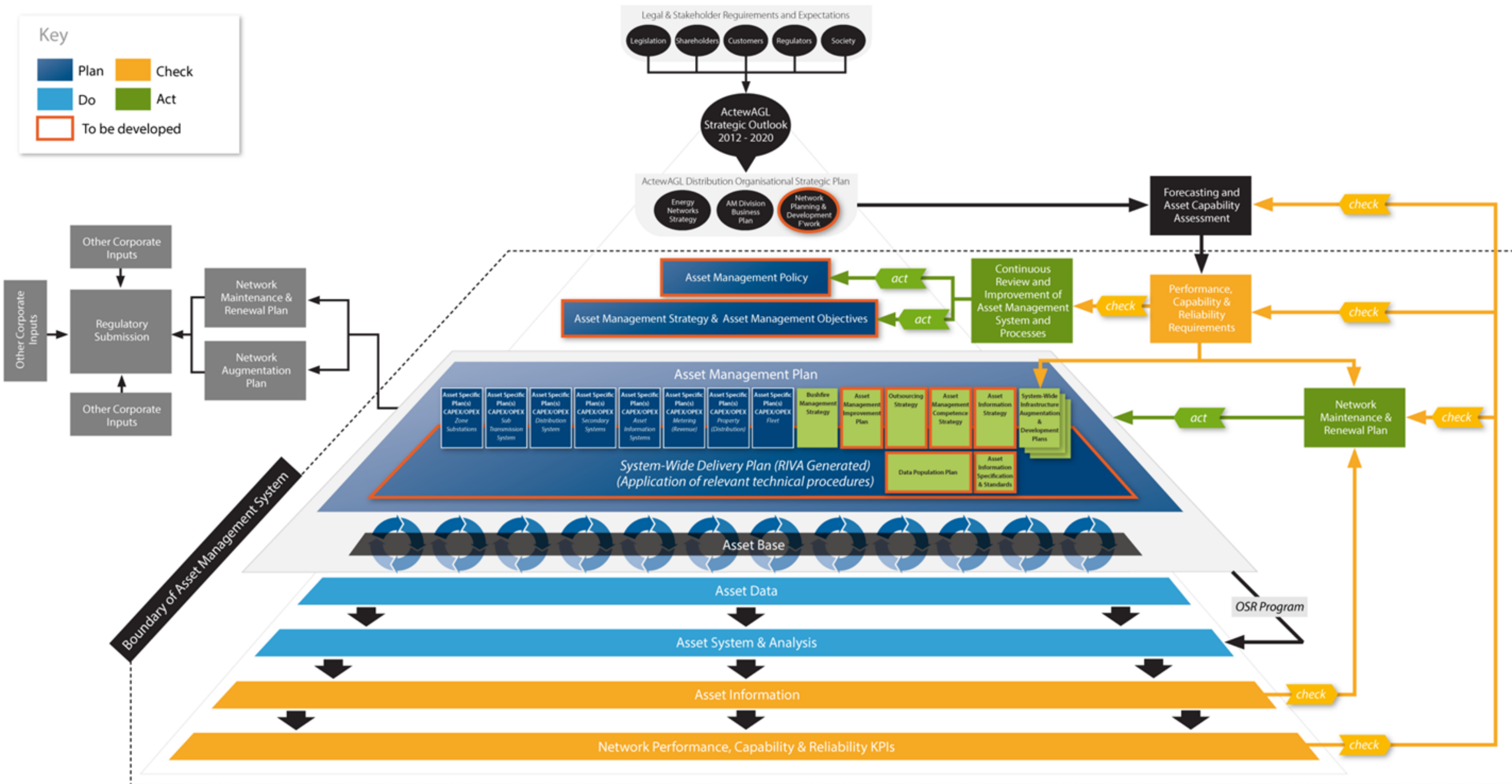
This document has been developed based on good practice guidance from internationally recognised sources, including the Global Forum on Maintenance and Asset Management (GFMAM) and the Institute of Asset Management (IAM). It has been specifically developed to comply with the relevant clauses of BSI PAS 55:2008 and the emerging requirements of ISO55000.

3 Corporate Alignment

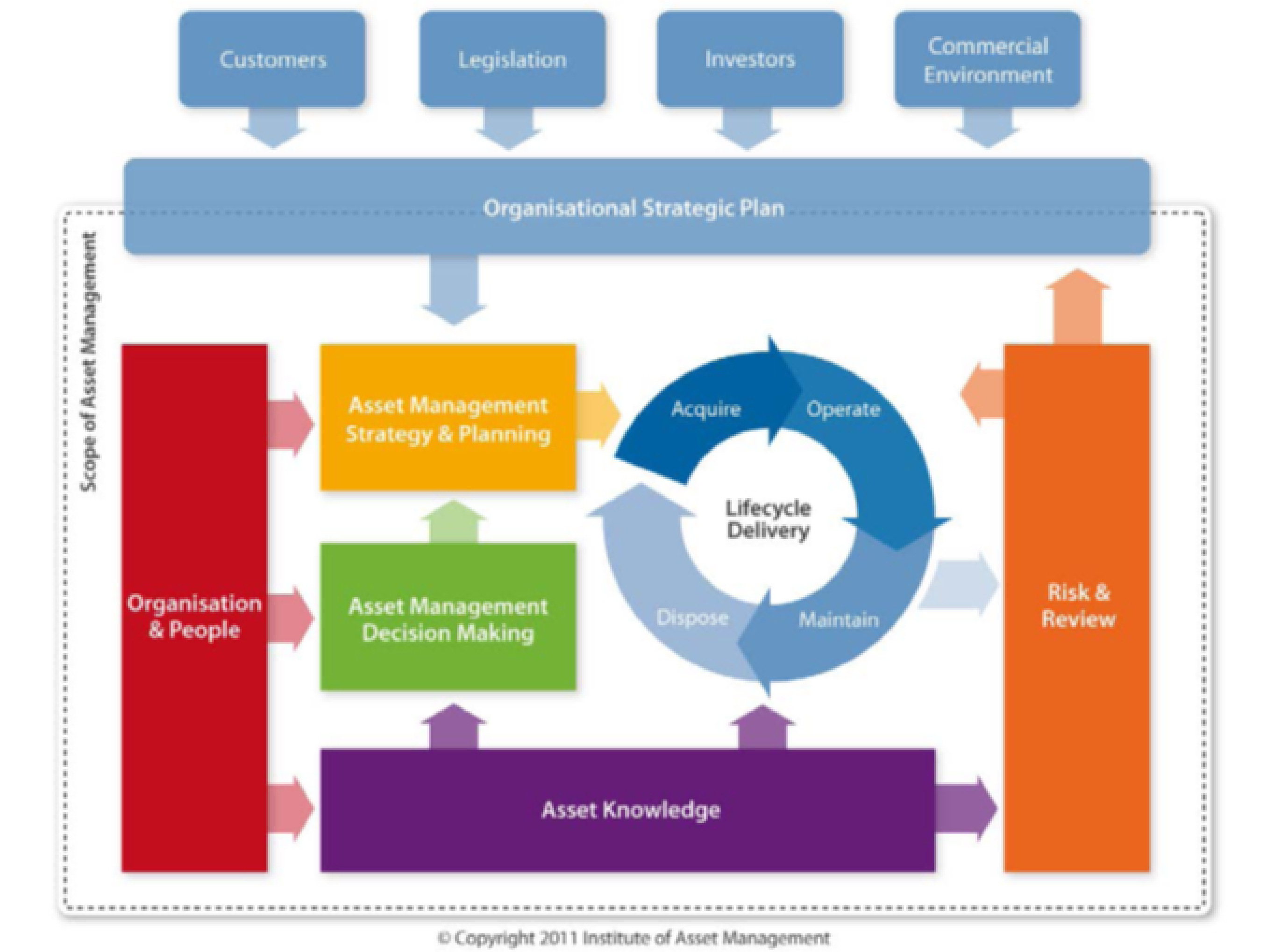
This Asset Specific Plan forms a key element of the Asset Management Strategy, as applied to the asset class "OH Lines and Pole Hardware". The Asset Management Strategy contains the overarching principles and objectives for the management of this asset class.

By employing a comprehensive and transparent approach to Asset Management, this Asset Specific Plan provides the evidence for, and justifies the inspection, maintenance and renewal regimes that support the delivery of the required outputs (e.g. safety and asset, system or infrastructure capacity, capability and service reliability, and availability) in conjunction with the Network Augmentation Plan. It also demonstrates that this is planned to be achieved, where appropriate, at minimum whole-life, whole-system cost.

This document's role within the overall Asset Management Framework is shown overleaf.


Key
Plan
Check
Do
Act
To be developed
Legal & Stakeholder Requirements and Expectations
Legislation
Shareholders
Customers
Regulators
Society
ActewAGL Strategic Outlook 2012 - 2020
ActewAGL Distribution Organisational Strategic Plan
Energy Networks Strategy
AM Division Business Plan
Network Planning & Development F'work
Forecasting and Asset Capability Assessment
Other Corporate Inputs
Regulatory Submission
Other Corporate Inputs
Other Corporate Inputs
Network Maintenance & Renewal Plan
Network Augmentation Plan
Asset Management Policy
Asset Management Strategy & Asset Management Objectives
act
act
Continuous Review and Improvement of Asset Management System and Processes
check
Performance, Capability & Reliability Requirements
check
check
Asset Management Plan
Asset Specific Plan(s) CAPEX/OPEX Zone Substations
Asset Specific Plan(s) CAPEX/OPEX Sub Transmission System
Asset Specific Plan(s) CAPEX/OPEX Distribution System
Asset Specific Plan(s) CAPEX/OPEX Secondary Systems
Asset Specific Plan(s) CAPEX/OPEX Asset Information Systems
Asset Specific Plan(s) CAPEX/OPEX Metering (Revenue)
Asset Specific Plan(s) CAPEX/OPEX Property (Distribution)
Asset Specific Plan(s) CAPEX/OPEX Fleet
Bushfire Management Strategy
Asset Management Improvement Plan
Outsourcing Strategy
Asset Management Competence Strategy
Asset Information Strategy
System-Wide Infrastructure Augmentation & Development Plans
System-Wide Delivery Plan (RIVA Generated)
(Application of relevant technical procedures)
Data Population Plan
Asset Information Specification & Standards
act
Network Maintenance & Renewal Plan
check
Asset Base
Boundary of Asset Management System
Asset Data
OSR Program
Asset System & Analysis
Asset Information
check
Network Performance, Capability & Reliability KPIs
check

4 Scope - Asset Management Activities



The diagram above represents a conceptual model, intended to describe the overall scope of Asset Management and the high level groups of activity that are included within this discipline. The Model highlights the fact that Asset Management is about the integration of these groups of activity and not just the activities in isolation. It also emphasises the critical issue that Asset Management is there to serve the goals of the organisation. The "line of sight" from an organisation's goals to its Asset Management activities or "alignment" that is promoted in PAS55 is a concept that is carried through to this asset specific plan.

5 OH Lines and Pole Hardware Assets

This section contains a subsection for each OH Lines and Pole Hardware asset.

5.1 Asset Classification

System/Non-System:	System
Asset Group:	Overhead Distribution
Asset Class:	OH Lines and Pole Hardware
Asset Type:	OH Lines
Asset Rating:	High Voltage and Low Voltage

5.2 Brief Description

The ActewAGL owned overhead distribution network consists of high voltage, low voltage and service overhead lines, poles and pole top hardware. The scope of this document covers overhead distribution lines and pole top hardware. Poles are covered in the Poles asset specific plan and overhead service conductors are covered in the overhead service asset specific plan. Pole top hardware consists of the pole stays, distribution crossarms, support brackets, insulators, hand ties, armour rods, vibration dampers, aircraft warning markers, spacers and other ActewAGL owned accessories attached to a pole or overhead conductor.

The maintenance and management of all approved third party attachments such as TransACT and Telstra's communication assets and ACT Government streetlights is at the owner's responsibility.

ActewAGL's high voltage overhead distribution network lines consists of 46.6% All Aluminium conductor (AAC), 13.6% Aluminium conductor steel reinforced conductor (ACSR), 18.5% hard drawn copper conductor (HDC) and 21.2% steel conductors.

Majority of the low voltage overhead lines are either AAC or HDC (94.1% of the low voltage network). The aerial bundled conductor is also used in the low voltage network to address clearance issues. Only 5% of the low voltage network is aerial bundled conductor (ABC). The remainder of the low voltage network is steel conductor. The percentage of these conductor types for both high voltage and low voltage is unlikely to change significantly in the next five years.

Most of the distribution crossarms in service are wood. Other crossarm material types include, composite (fibreglass), steel (bracket for holding overhead switchgears and transformers) and laminated wooden crossarms. Laminated wooden crossarms only exist in limited numbers. All new crossarms are now composite (fibreglass).

Other Hardware such as armour rods, deadend grips, hand ties, spacers, vibration dampers, all have important functions that contribute to the reliability of the overhead network.

5.3 Asset Function

Aircraft marker ball: The function of aircraft marker ball is to provide visual warning to legal and low flying aircraft of the powerline locations.

Conductor: The function of a conductor is to carry current from point to point.

Crossarm: The function of a crossarm is to support insulators, conductors and other equipment up to the maximum design loading and to maintain conductor clearances.

Hand Ties: The function of a hand tie is to secure the conductor to the pin or post insulator.

Insulator: The function of an insulator is to support the conductor. Insulators withstand normal operating voltage, lightning and switching surge so that the conductor does not short circuit to earth.

Spacer: The function of a spacer is to prevent conductors from clashing during windy conditions and where vegetation comes into contact with conductors.

Vibration Damper: The function of vibration dampers is to reduce aeolian vibration damage by disrupting and negating the conductor motion produced by the wind.

5.4 Asset Interfaces

Overhead HV conductors transfer electrical power from Zone Substations to Distribution Substations. Overhead LV lines (and LV underground mains cables) convey electrical power mainly in the direction from Distribution Substations to customers.

The crossarm is physically bolted or strapped to the distribution pole. The insulator is bolted onto the crossarm. An armour rod is wrapped around the overhead conductor where it is positioned onto the insulator and the conductor with the armour rod is secured onto the pin or post insulators with hand ties.

For termination poles, a deadend grip is used to secure the conductor onto the strain insulator assembly.

A crossarm or steel bracket is also used to support or hang overhead switchgear such as air break switches and dropout fuses.

Vibration dampers are physically installed on the overhead conductor and directly interface with the conductor.

5.5 Data Sources

Data sources include the GIS and WASP databases which provide the asset information on the conductor and crossarms.

5.5.1 Data Quality

The Operational Systems Replacement (OSR) project will provide one source of truth for all asset data. This is expected to be achieved in 2014. In the meantime with multiple data sources, discrepancies do occur, and there are limited processes to find and correct these discrepancies.

Some data fields are very difficult to completely populate, especially for old assets - for example, Date Commissioned, Conductor Type, Conductor size.

Data Completeness: Essential data in WASP is 100% complete, however, overall data is about 80% complete. Where a commissioning date is not directly available, the year for the suburb is used. Physical verification is also used to validate some of the important conflicting information.

Data Accuracy: Essential data in WASP is 100% accurate, however, overall data is about 90% accurate.

It is believed that the quality of the data is suitable for the purpose of generating work volume estimates. Any discrepancies are considered non-material for this purpose.

5.6 Asset Base

Conductor Type	Overhead Line Route Length (km)
Overhead low voltage mains	1166.6
Overhead 11 kV	984.8
Overhead 22 kV	34.2

6 Service and Performance Requirements

6.1 Availability

Overhead power lines are designed to have a high level of service availability. When distribution overhead power lines trip out, in virtually all cases, customers loose supply.

6.2 Reliability

The minimum network distribution reliability requirements are documented in EN 4.4 P07 - Distribution Network Reliability & Standard Supply Arrangement.

Conductors and pole top hardware are designed, maintained and operated to achieve the network distribution reliability requirements.

6.3 Capacity

In the past, there were more than one mains conductor?s sizes installed in the network. Typically the size chosen depended on the location relative to the Zone substation for the HV feeders, or to the distribution substation for the LV mains. About 20 years ago, a business case demonstrated savings could result from standardising on a single overhead mains conductor size. Since then, all urban mains conductors installed have been 19/3.25 AAC. The only subsequent change was to also have 150mm2 ABC conductors to solve clearance issues. There are several specialised conductors still used on rural lines which generally have much longer spans than urban lines.

6.4 Asset Utilisation

Pole Top Hardware is designed to have 100% utilisation with respect to the asset function to support the overhead conductors and other equipment up to the maximum design load.

The utilisation of the overhead conductor capacity depends on a number of factors including the feeder, the type of loading, the location of the feeder section with respect to the zone substation, the ambient temperature, the wind speed, solar radiation and the time of the day.

6.5 Asset Criticality

Overhead lines and pole top hardware have a critical function in maintaining the integrity of the overhead network.

If an overhead line or pole top hardware fails, there will be a risk to public safety and the customers will in most cases lose power. The impact of failure on electricity supply depends on the location and voltage level.

6.6 Geographical Criticality

Pole top hardware or overhead conductor failure in bushfire mitigation area can potentially cause a fire.

7 Asset Failure Modes

This section provides tabularised and prioritised details for failure rates by asset type failure mode or best available data.

7.1 Deterioration Drivers

Wood Crossarm

· Fungal rot of wood due to moisture

· Insect infestation - Termites & Bee hives

· Unseasoned timber used for crossarm - wood dries causing splitting, cracking, and twisting

· Short time over loading due to fallen tree branches

· Lightning strike

· Incorrect construction such as incorrect applications of washers etc can result in the cross arm becoming loose on the pole and rotates causing conductors to clash

· Cross arm fire caused by electrical failure of insulators

· Loosen hardware due to temperature cycling and timber sinking

· Corroded hardware

Fibreglass crossarm

· UV radiation

· Variable manufacturer quality

· Incorrect installation

· Short time over loading due to fallen tree branches

· Incorrect construction such as incorrect applications of washers etc can result in the cross arm becoming loose on the pole and rotates causing conductors to clash

Overhead Conductor and accessories (Hand ties & Armour rods)

· Conductor overloading causing annealing effect

· Variable manufacturer quality

· Incorrect installation

· Material stress caused by vibration or over tension

· Aeolian vibration

· Galloping

· Sway Oscillation

· Unbalance Loading

Surge Diverter & Insulators

· Lightning strike & switching surges

· Bird nesting

· Incorrect installation

· Animal or Bird damaging polymeric rain sheds (For polymeric insulator and rainsheds)

· Environmental factors such as pollution

· Moisture ingress (for Silicon carbide surge diverters)

7.2 Failure Modes

These are the failure modes associated with each of the asset types.

OH Lines

FAILURE MODES						
TYPE	**DESCRIPTION**	**OCCURRENCE**	**SEVERITY**	**DETECTION**	**RPN**	**UNIT COST**
Physical Mortality	Asset deterioration	Inevitable Failures	Very High	Almost Certain	200	
Bush Fire	Bush fire destroying supports and lines	Relatively Few Failures	Very High	Almost Certain	50	
Aeolian Vibration	The aeolian vibration on long span, high tension and aluminium conductors causing fatigue breakage of conductor strands, or severe abrasion, and/or loosen other hardware. Consequence is a line down which poses a risk to public safety, employee safety, start bushfire and a loss of supply.	Relatively Few Failures	Moderate	Likely	37.5	
Sway oscillation	Conductor motion caused by gust which leads the conductor to sway in horizontal plane and causes conductor abrasion and potential conductor clashing.	Relatively Few Failures	Moderate	Almost Certain	25	
Thermal overload	Thermal overload of conductor causing the conductor to sag more than the clearance requirements. Low clearance poses a risk to public safety, employee safety and can start fires.	Relatively Few Failures	Moderate	Almost Certain	25	
Galloping	Galloping is conductor motion in vertical plane which usually occurs with ice formation on conductor. Results in breaking crossarms, toppling poles or structures, conductor clashes, or conductor failure. Probability of galloping is very low because ice is unlikely to form in ACT.	No Known Occurrences	Moderate	Almost Certain	10	

7.3 Consequences

The consequence of an overhead conductor, crossarm and other hardware failure will pose a risk to public safety, risk to employees, potential start of bushfire, and the loss of supply.

8 Maintenance and Replacement Strategies

8.1 Description of Strategies

Condition Monitoring

Three routine overhead line and pole top hardware inspection are performed.

1. Pole and line inspection

2. Thermovision survey

3. Helicopter aerial inspection

High voltage rural overhead lines are inspected for vegetation every year in March. At the same time, high resolution photographs of the pole top are taken to determine the condition of the pole top hardware. High voltage urban overhead lines are inspected for vegetation every two years. At the same time, high resolution photographs of the pole top are taken to determine the condition of the pole top hardware.

Ground inspection of overhead line and pole top hardware is completed at the same time as the pole inspection in accordance with EN 4.02 P13 - Pole and Line Inspection Procedure. All poles and overhead asset inspection are completed in accordance with FSW 203 - Pole and Line Inspection Manual.

Thermovision surveys are performed on 100 selected overhead feeders every year. 80 overhead feeders are surveyed every winter and 20 overhead feeders are surveyed every summer. These feeders are selected based on the loading of the feeder, the total overhead line length and the past failures due to hot spots.

Neutral Integrity Testing Program (Condition Monitoring)

There are a number of safety incidents every year involving customers receiving electric shocks caused by problems with O/H neutral integrity. As trial, ActewAGL have allowed over coming 2 years a neutral integrity test program as per AS 4741 for 30 selected locations in each year in order to establish the need for an effective ongoing test regime.

Rural Pole top upgrade (Planned Maintenance)

The rural pole top upgrade program was initiated in 2009 to replace deteriorating crossarms and install vibration dampers, armour rods and preformed distribution ties on all rural high voltage overhead lines. This program of work was triggered following the experience of other Australian power utilities where conductor failures have started bushfires. The objective of this program is to reduce the bushfire risk by renewing the pole top hardware. Since 2009, the rural pole top upgrade program has been completed on the following feeders:

· Reid feeder from Tidbinbilla Road to the end of the feeder at Corin Dam

· Cotter 22kV feeder

For the next five years, the targeted rural high voltage feeders for rural pole top upgrade are:

· Cotter 11kV feeder

· Lower Molongo East & West feeder

· Black Mountain feeder

· Mugga feeder

· Homann feeder

Pole Top Hardware Renewal/Crossarm replacement (Planned Maintenance)

Some poles require the renewal of pole top hardware during the pole's service life. The requirements for pole top hardware renewal are identified from the pole inspections and high resolution aerial pole top photograph. With the renewal of the pole top hardware on the suitable poles, it is typically expected that the pole will achieve maximum service life.

Overhead line and pole top hardware defect repair (Unplanned Maintenance)

The pole top hardware with deteriorating condition and defects requiring attention before the next inspection cycle are identified from the pole inspection. The defects are prioritised based on the risk to the public safety, employee safety, network reliability and asset integrity. All dangerous defects which can harm the public, employee or asset are addressed immediately. All defects that present an unacceptable hazard to public safety, employee safety and asset integrity are addressed before the next inspection cycle. This includes defects such as broken ties, bird nests on pole tops, low clearances and broken insulators.

Remote Area Power Supply (RAPS)

There are two locations (Gudgenby and Corin) where ActewAGL intends to remove a total 16km of HV overhead line, and supply the customers with ActewAGL owned and operated Remote Area Power Systems (RAPS). Being a regulated business ActewAGL Distribution is required to continue to supply these customers.

The justification and installation cost of the RAPS has been discussed and budgeted in the 'Bushfire Mitigation - Remote Area Power Supply - Network Augmentation Plan'.

A separate $159k OPEX has been budgeted for to remove a total of 16km of HV overhead lines and asset, and $30k every year for maintaining the two Remote Area Power Supplies.

Cast Iron LV Pothead

Cast Iron LV potheads were generally installed before the 1970s and are located in the older suburbs such as Forrest, Griffith and Narrabundah. There have been a few cases where these potheads have failed and exploded. In the last 5 years, the average failure rate has been about 2 per year. These potheads are replaced on an opportunity basis as part of pole and cross-arm replacement work, and the number has now reduced to about 500. These remaining potheads have now been prioritised for replacement based on an assessment for their failure risk/consequence. (The highest priority has been given to those in public areas, near schools, childcare facilities and other high pedestrian activity areas). All these potheads are planned to be replaced over the coming 10 years @ 50 per year.

In summary, for the O/H lines and the pole top hardware reactive budget is $2.1 million every year which is based on the yearly average actual expenditure for reactive call out work. This includes:

- 231 arcing services
- 67 brown outs
- 1331 damaged assets
- 2 drop out fuses
- 44 electric shocks
- 60 spark/fire/explosions
- 130 wires down
- 1773 no supply call outs
- 831 part supply call outs
- 1226 miscellaneous electrical faults

The O/H lines and pole top hardware unplanned maintenance budget comprises:

- 15 replace LV pot heads identified from pole inspections
- 225 crossarm replacements identified from pole inspections
- 20 re-tension conductors due to low spans identified from pole inspections or customer complaints
- 30 replace conductors due to low spans identified from pole inspections or customer complaints

- 150 install spacers on LV mains identified from pole inspections or due to tree into lines incidents
- 10 install pole stays identified from pole inspections

The O/H lines and pole top hardware planned maintenance budget comprises:

- 1 overhead span on aircraft marker requested by ESA every year.
- $159k for the removal of overhead lines at Gudgenby Homestead and Corin Dam once the RAPS is installed.
- $30k for maintaining Remote Area Power Supply every year.
- Rural pole top upgrade - 220 pole tops in FY14/15, 525 pole tops in FY15/16 & FY16/17, 250 pole tops in FY17/18 and 525 pole tops in FY19/20.

The O/H lines and pole top hardware condition monitoring budget comprises:

- 100 feeders for thermovision survey every year.
- Helicopter aerial inspection of the rural overhead lines every year and urban overhead lines every two years.

8.2 Minimum Whole-of-Life Whole-of-System Cost

The software product, Riva DS, was used to evaluate the minimum, whole-life, whole-system cost approach to determine the optimal intervention options and scenarios.

8.3 Alternative Scenarios

Not applicable.

8.4 Asset Costs

Unit costs for work on this asset class have been estimated by Program Development Branch. Details of the estimate are available in \\jeeves\energynetwk\Program of Work\future pow\AMP Reg Submission.

8.4.1 Planned Maintenance

UNIT COSTS			
ASSET TYPE	**TASK**	**COST BASIS**	**UNIT COST**
Cross-arms	Replace LV Pothead	This work is identified from pole inspection.	$4,138
Cross-arms	Upgrade Rural Pole Top (FY14/15)	The rural pole top upgrade program was initiated in 2009 to install vibration dampers, armour rods, preformed distribution ties on all rural high voltage overhead lines with high bushfire risk. Capital constraint in 2014/15 lead to reduction of numbers. This work comes from a planned list of feeders.	$1,897
Cross-arms	Upgrade Rural Pole Top (FY15/16 - FY16/17)	The rural pole top upgrade program was initiated in 2009 to install vibration dampers, armour rods, preformed distribution ties on all rural high voltage overhead lines with high bushfire risk. This work comes from a planned list of feeders.	$1,897

Cross-arms	Upgrade Rural Pole Top (FY17/18)	The rural pole top upgrade program was initiated in 2009 to install vibration dampers, armour rods, preformed distribution ties on all rural high voltage overhead lines with high bushfire risk. Reduction of numbers due to capital constraint in 2017/18. This work comes from a planned list of feeders.	$1,897
Cross-arms	Upgrade Rural Pole Top (FY19/20 - Onwards)	The rural pole top upgrade program was initiated in 2009 to install vibration dampers, armour rods, preformed distribution ties on all rural high voltage overhead lines with high bushfire risk. This work comes from a planned list of feeders.	$1,897
OH Lines	Install aircraft markers	Install aircraft markers in five spans every five year where there is planned low flying operation. Cost is based on two live line crews for one full day. This work is triggered by request from the ACT Government, ESA or compliance with the regulation.	$3,219
OH Lines and Pole Hardware	Maintain Remote Area Power Supply	(Planned) Operation and Maintenance cost of remote power supplies at $30,000 per site.	$15,000
OH Lines and Pole Hardware	Remove Overhead & Poles due to Remote Area Power Supply	(Planned) The remove cost of overhead line at Corin and Gudgenby - 106 poles to be removed @ $1,500 per pole. Capital cost is budgeted in the Bushfire Mitigation - Network Augmentation Plans. This work is initiated by Bushfire Mitigation - Network Augmentation Plans.	$1,500

8.4.2 Unplanned Maintenance

UNIT COSTS

ASSET TYPE	TASK	COST BASIS	UNIT COST
Cross-arms	Renew Pole Top/Replace Crossarm	Unplanned crossarm replacements identified from pole inspections in the past has averaged 225 every year.	$5,027
OH Lines	Install low voltage spacer	Provision for installation of spacers across long spans of LV OH conductors. This work is identified from urban pole inspections.	$478
OH Lines	Replace conductor due to low clearance	Replace bare overhead conductors with aerial bundle conductors due to low clearance identified from pole inspections or compliance.	$8,713
OH Lines	Retension conductors due to low clearance	Retension conductor to provide clearance identified from pole inspections or compliance. Based on historical cost of WP 47307 completed 24/10/2012.	$2,931
OH Lines and Pole Hardware	Repair Overhead Line & Pole Top Hardware Reactively	(Reactive) Based on the historical cost of reactive maintenance to return electricity supply to customer. This work is initiated from reactive call out.	$2,100,000
Pole stays	Install Pole Stay	Install pole stays on ten terminating or angled poles to prevent pole from leaning.	$4,955

8.4.3 Condition Monitoring

UNIT COSTS

ASSET TYPE	TASK	COST BASIS	UNIT COST
OH Lines	Neutral Integrity	Neutral Integrity Testing on our electricity network. Investigation into condition assessment program and performing assessment on our network. 1 hour for distribution fitter crew to test neutral, in addition, test 30 neutrals to confirm test	$30,099

	Testing	programme. 1 month for asset strategy & planning to research, develop method and test programme to pilot trial neutral testing of services.	
OH Lines	Thermovision survey	100 selected feeder, 20 in the summer and 80 in the winter. At $2,512 per high voltage overhead feeders. Based on a planned list of feeders every year.	$2,512
OH Lines and Pole Hardware	Aerial Survey on Rural and Urban Pole Top	(Planned) Previous quotation suggests the cost of perform aerial asset inspection (excluding LiDAR) survey of all urban and rural HV lines cost approximately $127k. Urban aerial inspection is only performed every two years. Rural aerial inspection only (excluding LiDAR) is estimated to cost $64k. Therefore, (127k x 5 + 63 x 5)/10 = 95k every year. This work is initiated from planned vegetation and overhead distribution asset strategy.	$95,000

8.4.4 Asset Unit Costs

UNIT COSTS		
ASSET TYPE	**TASK**	**$/metre**
DistributionConductors	Replacement Cost	$100

8.5 Rationalisation Opportunities

Since the mid 1980's, all new green field sites are underground reticulated. Underground reticulation originally came about in the Australian Capital Territory when developers were willing to pay a higher capital contribution to reticulate with underground network instead of overhead. This reflected the wishes of the block purchasers who were prepared to pay more for their blocks and houses so that they would have better amenity through not having overhead power lines. A policy was developed as a result where all new green field sites were underground reticulated. This arrangement suited ACTEA/ ACTEW as the ongoing maintenance costs are lower, and the reliability is higher.

There have been several studies since then to determine the cost of undergrounding ActewAGL's existing urban overhead network. The findings from each of these studies showed that it is generally not economical.

The overhead network is slowly contracting by a rate of about 0.4% per annum based on the reduction of the pole population. If this rate were to continue, then the overhead network will remain in service for the foreseeable future.

There have been several changes to standard designs to improve performance of the overhead network, and some examples follow:

- New cross-arms are made of materials that do not rot and are not affected by termites. Currently we buy fibreglass crossarms.
- All new and extended buildings are serviced via new underground cable.
- All new overhead service cables are insulated with XLPE plastic which is expected to have twice the service life of the earlier PVC insulation. Bare overhead conductor will normally outlast all the other line components. Sections of this conductor will occasionally be removed and replaced with Aerial Bundled Conductor or an underground cable due to clearance issues.

8.5.1 Other Options

Not applicable.

8.5.2 Feasibility and Business Case

Not applicable.

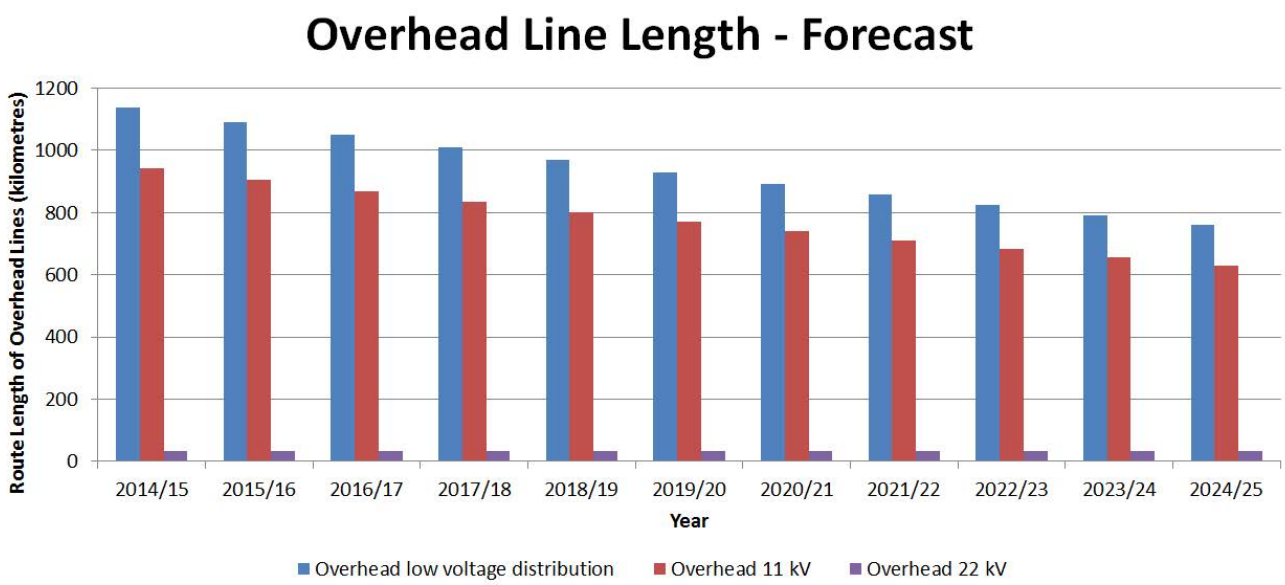
8.6 Disposal Plan

All redundant assets are either recovered for re-use or disposed to eliminate any hazard on site which may pose a risk to the community.

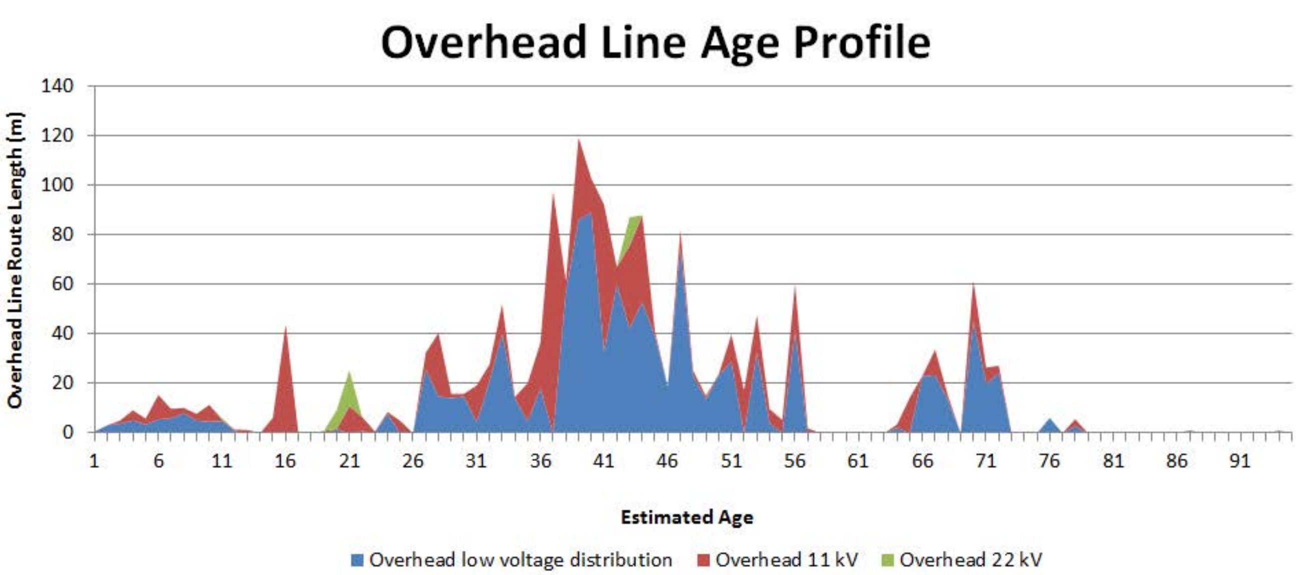
Redundant overhead lines are inspected and assessed to determine whether it can be re-used and recovered back to store. All copper and steel conductors and damaged aluminium conductors are recovered for scrap/recycle.
The disposal plan for all assets is documented in the policy document, "Recovery and disposal of reclaimed network assets".
Information for the control of waste materials at Greenway Services Centre is available in Electricity Networks procedure EN4.9P5 Waste Disposal.

9. Asset Condition and Expenditure Forecast

9.1 Projected Asset Count



9.2 Age Profile of Assets

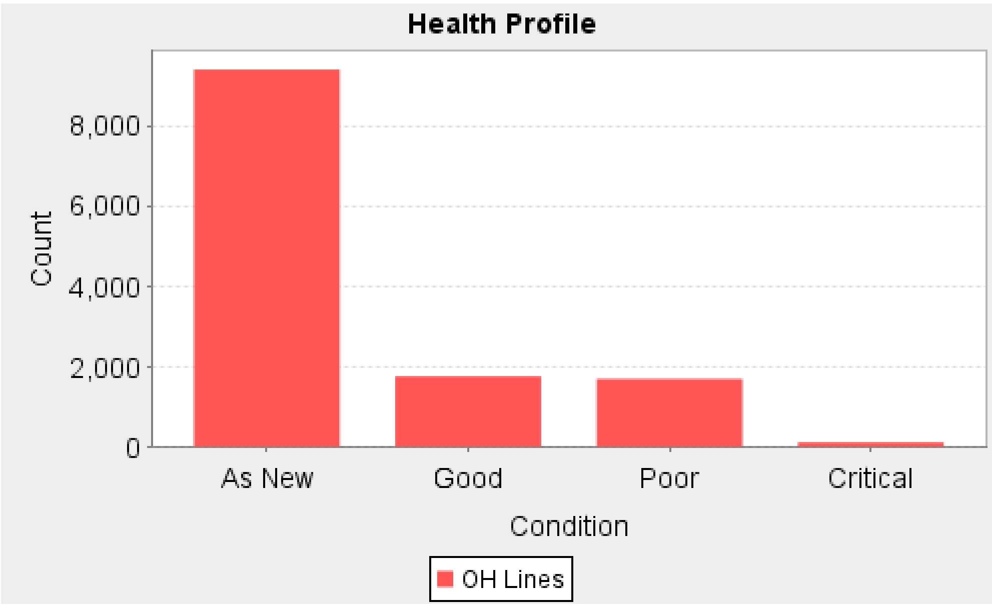


Note: Over 350km route length of overhead conductors have unknown age

9.3 Health Profile

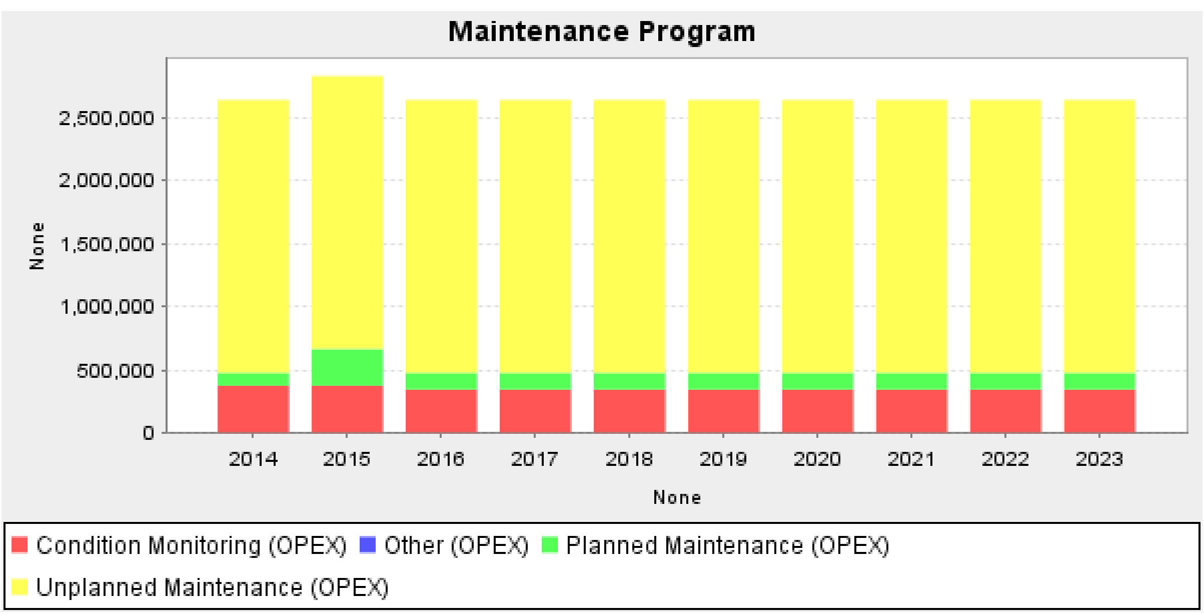
Health profile is determined by combining the asset condition rating with its criticality rating. Condition is determined by the asset's capacity to meet requirements, the asset reliability and its level of obsolescence. Obsolescence will be determined by maintenance requirements and availability of support from manufacturers. Criticality is determined from operational, safety and environmental consequences due to asset failure.

OH Lines and Pole Hardware:



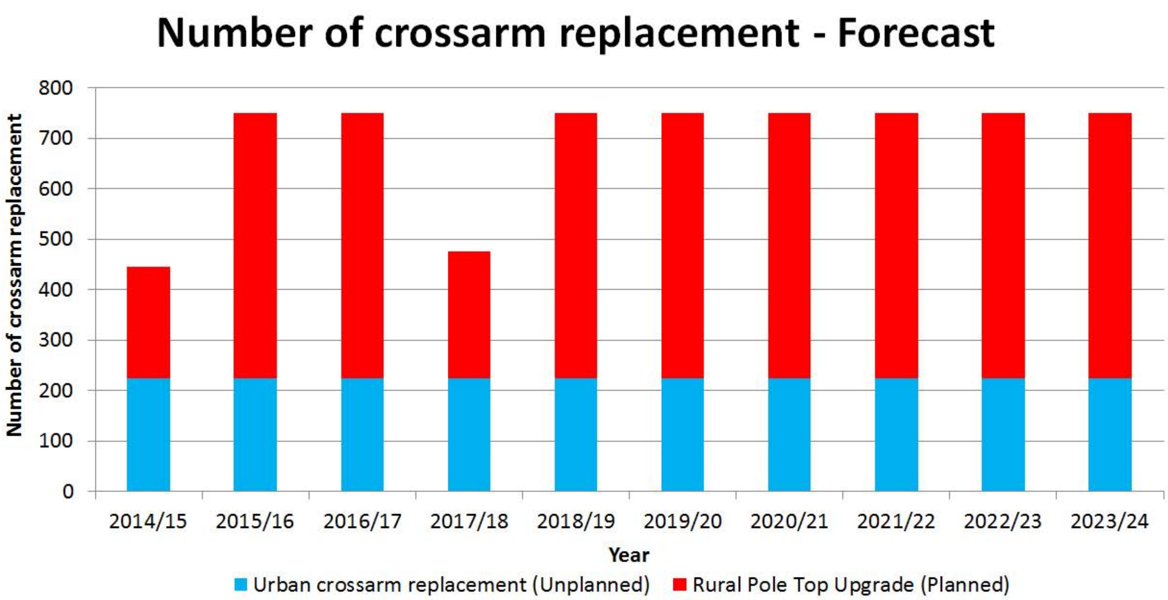
*Health Score: As New(100-95), Good(95-75), Poor(75-50), Critical(50-0)

9.4 Maintenance Program



9.5 Replacement Program

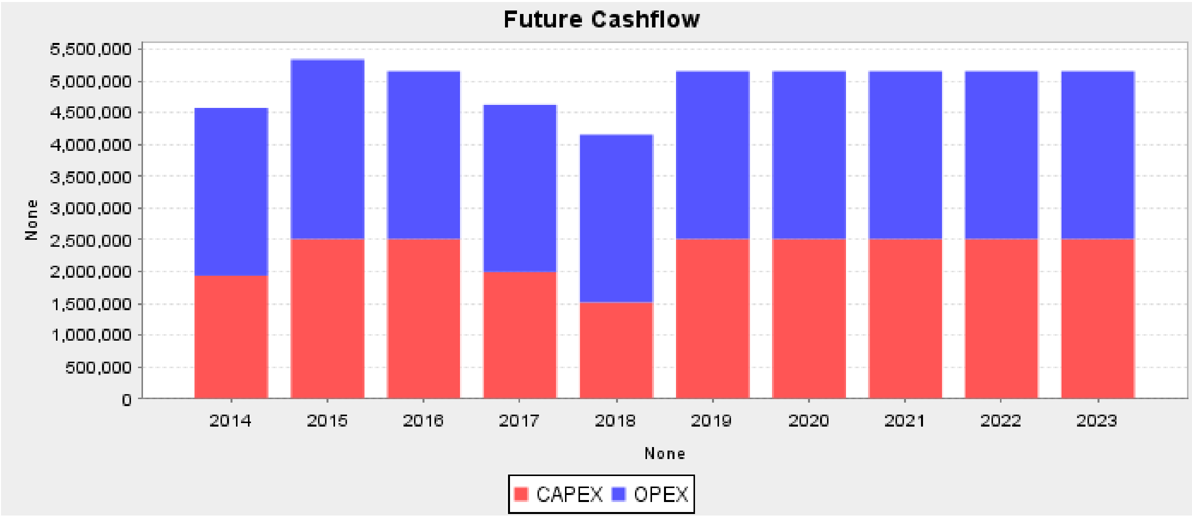
This is a summary of the units being replaced or refurbished each year. In general, assets with the lowest health will be scheduled for earliest replacements.



9.6 Forward Cashflow

This cashflow is based on the replacement and refurbishment program and is shown in 2012 dollars. The average annual funding requirement is .

Expenditure	10 yr total	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Replacement total (CAPEX)	$23,032,405	$1,934,274	$2,512,859	$2,512,859	$1,991,184	$1,516,934	$2,512,859	$2,512,859	$2,512,859	$2,512,859	$2,512,859
Maintenance total (OPEX)	$26,571,898	$2,638,369	$2,827,369	$2,638,270	$2,638,270	$2,638,270	$2,638,270	$2,638,270	$2,638,270	$2,638,270	$2,638,270
Condition monitoring (OPEX)	$3,522,198	$376,299	$376,299	$346,200	$346,200	$346,200	$346,200	$346,200	$346,200	$346,200	$346,200
Planned maintenance (OPEX)	$1,463,500	$103,450	$292,450	$133,450	$133,450	$133,450	$133,450	$133,450	$133,450	$133,450	$133,450
Unplanned maintenance (OPEX)	$21,586,200	$2,158,620	$2,158,620	$2,158,620	$2,158,620	$2,158,620	$2,158,620	$2,158,620	$2,158,620	$2,158,620	$2,158,620



10 Performance Monitoring

The failure statistics of crossarms and conductors failures are recorded. Where it is suspected of repeated failure, failure investigation is completed to determine the root cause of the failure. The finds from the root cause analysis will provide continuous improvement to asset management, standards and installation workmanship.