ABN 85 082 464 622

MANAGEMENT PLAN 2011

OVERHEAD SYSTEM AND STRUCTURES

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0	18 Feb 2011	Original Issue. (NW-#30161322-V3).	Prepared by	EC / ST
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1. PURPOSE

The purpose of this document is to describe, for Overhead, Structures and related assets:

- Aurora's approach to asset management, as reflected through its legislative and regulatory obligations and Network Management Strategy;
- The key projects and programs underpinning its activities for the period 2012/13-2016/17; and
- Forecast CAPEX and OPEX, including the basis upon which these forecasts are derived.

2. STRATEGY

The objective of the Network Management Strategy is:

To minimise cost of supply to the customer whilst:

a. Maintaining network performance;

b. Managing business operating risks; and

c. Complying with regulatory, contractual and legal responsibilities.

3. SCOPE

This document covers pole mounted transformers, overhead switchgear, conductors, fixtures and fittings, structures and associated earthing systems.

4. DESCRIPTION OF THE ASSETS

4.1 Pole Mounted Transformers

Pole mounted transformers are devices generally used to step up or step down voltages within the distribution system. The majority of distribution transformers installed within the distribution system, step down voltages from high voltage (HV) (44 kV, 33 kV, 22 kV or 11 kV) to low voltage (LV) (230/400 V), which the majority of customers use within their electrical installations.

Pole mounted transformers are mounted on a single or double pole structures. The physical size and weight of the unit limits pole mounted transformers to a maximum size of 500 kVA.

Pole mounted transformers contain mineral insulating oil for both electrical insulation of the internal components and cooling.

Single Wire Earth Return (SWER) systems are used in several relatively remote rural locations within the distribution system where there is light load.

In SWER systems, one wire is used as the phase conductor and the earth is used as the return conductor. SWER systems typically consist of a SWER isolating transformer and one or more SWER transformers.

The isolating transformer isolates the earth currents (zero sequence currents) of the SWER system from the three-phase main supply feeder. This limits the exposure to telephone interference and allows the main supply feeder to maintain its sensitive earth fault detection protection.

With the exception of Single Wire Earth Return (SWER) devices, pole mounted transformers have off-load tap changers. These allow the output of the transformer to be adjusted (with the transformer not connected to any load) to vary the level of output voltage by small increments (tap settings) to regulate output voltages to within acceptable limits.

Table 1 details the types of pole mounted transformers installed in the system.

Table 1: Pole Mounted Transformers installed in Aurora's distribution system as at August 2010.

Description	Number Installed
Single phase pole mounted transformers	14,899
Three phase pole mounted transformers	13,995
Single Wire Earth Return (SWER) isolating transformers	63
Single Wire Earth Return (SWER) transformers	393
Total	29,350

Figure 1 shows the age profile of the pole mounted transformers installed in the system.

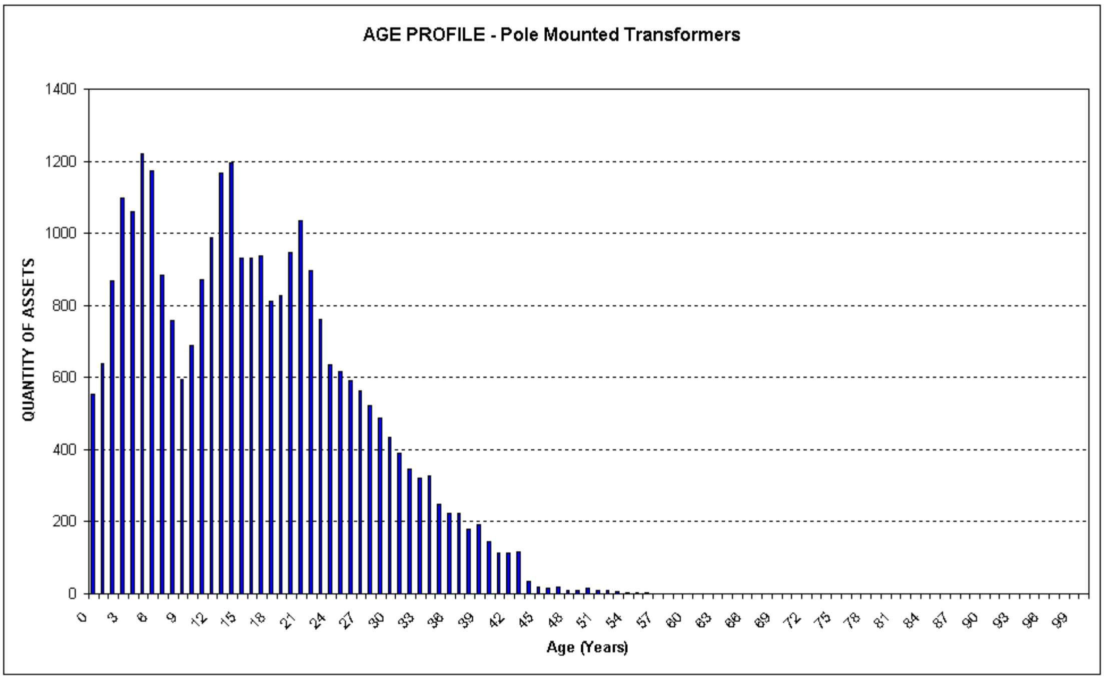

Figure 1: Age profile pole mounted transformers

4.2 Overhead Switchgear

Overhead switchgear is installed to provide isolation or disconnection of sections of HV or LV overhead line for the purposes of maintenance and the management of load and for protection purposes.

As a general rule the overhead switchgear is located on either side of significant loads to allow for operational switching and network management activities, such as transferring loads between HV feeders or isolating a faulted section of network.

Fuses are used to protect feeders, transformers and LV circuits.

Table 2 details the types of LV overhead switchgear installed in the system. Note that each site may contain one to three fuses or links, depending on whether it is a single or multi phase circuit or if it is a single phase device.

Table 2: LV switchgear sites installed on Aurora's overhead distribution system as at August 2010

Description	Number Installed Sites
Fuse Links	23,798
Links	3,860
No Switchgear	846
Unknown	125
Total	28,629

Table 3 details the types of HV overhead switchgear installed in the system.

Table 3: HV Switchgear sites installed on Aurora's distribution system as at August 2010

Description	Number Installed
HV links	2,093
Air Break Switches (ABS)	4,219
Expulsion Drop Out (EDO) fuses	6,665
Gas or vacuum enclosed switches	104
Auto-reclosers – oil insulated (OYT)	13
Auto-reclosers – gas insulated (ESR)	1
Auto-reclosers – gas insulated (NULEC)	274
Sectionalisers	214
Total	13,583

Figure 2 shows the age profile of the overhead switchgear installed in the system.

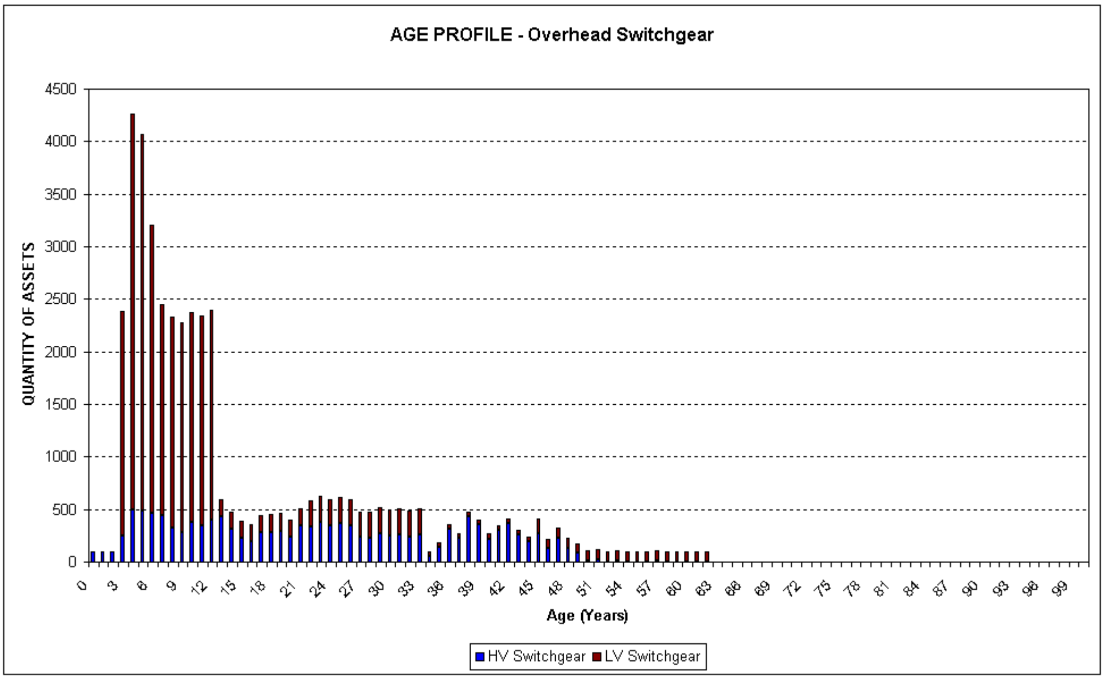

Figure 2: Age profile overhead switchgear

4.2.1 LV Links

LV links are used as isolation points at transformers and as a connection/disconnection point between LV circuits. When used between LV circuits, LV links are used as a paralleling point when transformers are taken out of service for maintenance to maintain supply to customers.

4.2.2 LV Switch Fuses

LV switch fuses can be used as both a link and a fuse. They are used as isolation points at transformers and to protect LV circuit from faults.

4.2.3 HV Links

HV links are single phase devices and have a single break action. They are installed as a set of three for use on three phase systems.

HV links are not rated for breaking current. They are used to enable a piece of equipment or line to be isolated from the rest of the system.

HV links may be mounted vertically, horizontally upright or under slung.

4.2.4 HV Air Break Switches (ABS)

Air Break Switches (ABS), also known as ganged isolators, are three phase devices and have a single break action. They have an operating handle that may be locked in either the open or closed position.

ABSs are not rated for breaking fault current but are designed to break load current. They are used to enable a piece of equipment or line to be isolated from the rest of the system.

Each ABS has its own earthing system. The operating handle and HV cross arm must be connected to the earthing system. The operating handle is mounted five metres above ground for operator safety and security.

4.2.5 Expulsion Drop Out (EDO) Fuses

Expulsion Drop Out (EDO) fuses consist of a porcelain insulator with a hinged fibre tube held in place by a fusible link. When the EDO experiences an over current, the fusible link melts releasing the hinged tube causing it to drop open to isolate the equipment it is protecting and at the same time give a clear indication of fuse operation.

EDOs are used to protect pole mounted transformers and spur lines.

4.2.6 Gas or Vacuum Enclosed HV Switches

Gas or vacuum enclosed switches are three phase switching devices with the ability to make and break load currents. They are not rated for breaking fault current.

Gas or vacuum enclosed switches are installed where there is a requirement to open or close switchgear when feeders are energised and have load on this, such as during paralleling operations.

4.2.7 Auto-Reclosers

Many faults in overhead systems are transient in nature. A transient fault is a fault that is no longer present if the power is disconnected for a short time. Causes of transient faults include momentary vegetation contact, windborne materials such as bark, bird or animal contact, conductors clashing due to high winds and lightning strikes.

Auto-reclosers, also known as reclosers, are combined protection and circuit breaker devices that are designed to attempt to restore power in the event of a transient fault.

On detecting a fault on a section of line, an auto-recloser will open to isolate the fault. It will then make a number of pre-programmed attempts to re-energise the line. If the transient fault has cleared, the auto-recloser will remained closed and normal operation of the line resumes, however, if the fault is a permanent fault, the auto-recloser will exhaust its count of re-energisation attempts and lock-out leaving the faulted line isolated.

Reclosers are generally installed on rural overhead feeders. They are installed with remote control and monitoring facilities.

4.2.8 Sectionalisers

Sectionalisers are devices that work in conjunction with auto-reclosers to attempt to restore supply back to some customers automatically in the event of a fault.

Sectionalisers are located downstream of auto-reclosers and monitor the fault current and circuit interruption of the upstream auto-reclosers. After a pre-programmed number of auto-recloser re-energisation attempts, the sectionaliser will open during the open period of the auto-recloser in an attempt to isolate a potentially faulty section of line. If the fault was on the section of line downstream from the sectionaliser, the next auto-reclose re-energisation attempt will successfully re-energise the section of line between the auto-recloser and the sectionaliser.

Sectionalisers are not rated for breaking current so they must open during the open cycle of the upstream auto-recloser.

4.3 Overhead Conductors and Cables

Overhead conductors provide the means for electricity to be transported over medium to long distances in urban and rural areas across the distribution network system.

Table 4 details the types of overhead conductor and cable installed in the system.

Table 4: Overhead conductors and cables installed in Aurora's distribution system as at August 2010

Description	Length Installed (km)
Bare Open Wire Conductors – Copper	2,402
Bare Open Wire Conductors – Aluminium	10,464
Bare Open Wire Conductors – Steel (GI and steel core)	5,891
Insulated Conductors – HV ABC	17.5
Insulated Conductors – LV ABC	1,634
Insulated Conductors – HV Covered Conductor	0.3
Pilot cables	142
Fibre optic cables	123
Total	20,409

Figure 3 shows the age profile the overhead conductors installed in the system.

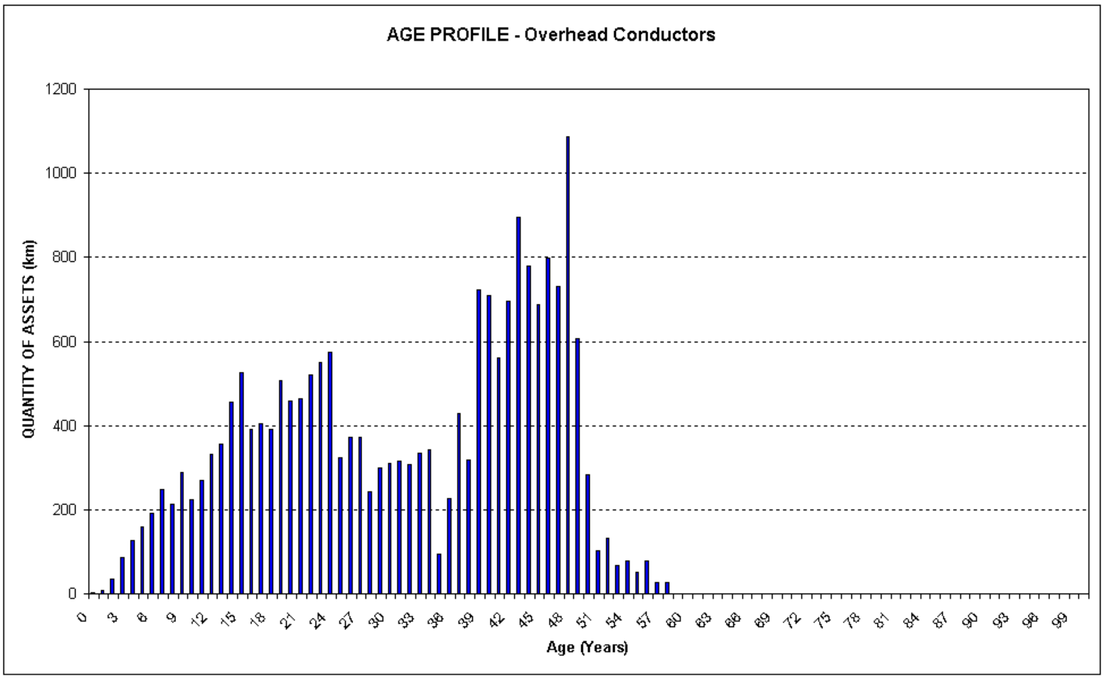

Figure 3 Age profile overhead conductors

The size of the cross sectional area of each strand or group of strands determines the current carrying capacity of the conductor – the larger the cross sectional area the greater the current capacity flow. Although there are many varying sizes of bare conductor, standardised sizes have been introduced which satisfy the network management of voltage levels and current flow in conjunction with the electrical equipment employed in the distribution system.

The varying types and sizes of overhead conductor is a legacy of the changing customer supply requirements, cost constraints, improvements and efficiencies in technology, the refinement of planning tools/models and design standards of the day.

4.3.1 Bare Open Wire Conductors

The most commonly used type of conductor installed in the overhead system is bare open wire type conductor. The support structures and pole top equipment are designed to keep conductors at a height that insulates them from the ground and general public.

HV bare open wire conductor is by far the easiest and most cost effective conductor to augment, replace and install of the conductors presently in use within the industry.

The current standard materials used as bare open wire conductors are:

- All Aluminium Conductor 19/3.25 AAC (Neptune)
- All Aluminium Conductor 7/4.50 AAC (Mercury)
- All Aluminium Alloy Conductor 7/3.00 AAAC (Fluorine)
- Steel Conductor 3/2.75 SC/GZ

Other legacy materials found in the overhead system but no longer installed include:

- Aluminium Conductor Steel Reinforced (ACSR/GZ): multi-strand conductor with a strengthening galvanized steel core
- Copper (Cu): multi-strand conductor
- Galvanised Iron (GI): both single strand (such as No.8 GI) and multi-strand (such as 3/12 GI)

4.3.2 Aerial Bundled Cable (ABC)

Aerial Bundled Cable (ABC) is an insulated overhead conductor of either two or three wire bundled or twisted configuration. Both HV and LV ABC are installed within the distribution system.

ABC can reduce safety and bushfire risks, minimise the vegetation clearing around the overhead powerlines and improve supply reliability through minimising the impacts of vegetation, birds, animals and windborne objects on the overhead powerlines.

LV ABC is Aurora's standard conductor for any new LV networks and the replacement of existing LV networks unless the LV ABC is unsuitable, such as for long single phase spans. In this situation, bare overhead LV conductor is used.

Due to problems with installation leading to greater costs of installation, HV ABC is primarily installed in selective locations, such as heavily vegetated areas or areas prone to wind and bird and animal affected areas to reduce the impact of these on the overhead system.

4.3.3 Covered Conductors

Covered Conductor differs from HVABC in that HVABC is a fully screen insulated cable consisting of three phases wrapped around a catenary wire while Covered Conductor (CC) is a single core unscreened self supporting cable with an XLPE insulation thickness of 2mm. If the insulation thickness is equivalent to that required for the rated voltage it is termed CCT (Covered Conductor) Thick. HVABC is touch safe while covered conductor, both CC and CCT, is not.

PVC is the predominant material used as the insulating cover on LV service cables.

Covered conductors are primarily used for the overhead service cables connecting the customer's installation to the LV distribution network. There is a small amount of LV covered conductor used elsewhere in the system.

The use of covered HV conductors is being investigated as a cost effective solution as it has potential to reduce the impact of vegetation, wind and wildlife on the overhead system. However, there are currently installation issues to be overcome before it can be used in the system.

4.3.4 Pilot Cables and Fibre Optic Cable

Pilot cables are used for protection and control between various distribution substations within Hobart's central business district.

Fibre optic cables are used for protection and control between Transend Networks' 110/33 kV substations and Aurora Energy's urban zone substations.

4.3.5 Earthing Conductors

Earthing conductors are used to connect non-current-carrying metallic parts of overhead system equipment, such as pole mounted transformer tanks and switchgear operating handles, to the HV earthing system (refer Section 4.6). They provide a low impedance path for the flow of earth fault current into the ground for the reliable operation of protection devices, and they help to control voltage rises associated with faults.

4.4 Fixtures and Fittings

4.4.1 Insulators

The insulators provide an insulated means of attaching the conductors to the poles. The type of insulator, size and make used are dependent on the level of voltage of the conductors, the design requirements of the overhead line and various external influences such as pollution, weather conditions, and geographic location.

Generally HV and LV insulators are porcelain or glass and bolt to the cross arm or pole by the means of a steel pin or bolt.

4.4.2 Cross arms

Cross arms are used to connect the insulators to the structure and provide adequate clearance between conductors.

HV cross arms are steel while the LV cross arms are predominantly wooden.

HV cross arms are steel as it offers the structural integrity to withstand the high conductor load tensions and associated loads imposed.

LV cross arms are predominantly manufactured from timber as this medium is cost effective and offers insulation qualities to allow live line activities to be performed safely.

4.4.3 Conductor Fittings

Conductor fittings are used to secure conductors to their supports and for connections between conductors. Various types of fittings are used depending on the size and type of conductor to be joined, the geographical and electrical location within the network and electrical loading of the conductors.

The general methods of connection include welds, compression, bolted or tension methods.

Bare overhead conductors are attached to insulators using conductor ties. The ties are generally the same material as the conductor.

4.4.4 Fault Indicators

Fault indicators are mounted on conductors in strategic locations within the distribution system to aid in fault location. When the unit detects an over-current, a light on the unit starts flashing to allow an operator patrolling the line to see that the fault is down stream of that location.

4.4.5 Surge Arresters

Surge arresters are installed to prevent damage to equipment in the event of a direct lightning strike on the overhead system.

Generally surge arresters are installed on specific equipment, such as pole mounted transformers, however the surge arresters may also be placed in the overhead system at strategic locations prone to lightning strike.

HV ABC installations and where underground cable connects to the overhead system are examples of locations where lightning arresters would be installed.

4.4.6 Bird Diverters

Swans, geese, waterfowl and other large birds commonly collide with conductors. Bird diverters are installed to make conductors more visible to birds. Birds cause over 400 outages a year on Aurora's distribution system.

4.4.7 Aircraft Warning Markers

Aircraft warning markers are installed on certain overhead conductors and equipment to warn aircraft pilots about the presence of high objects. Under AS/NZ 3891.1-2008 (reference 14) requires any conductor installed more than 90 metres above the ground or with a span length longer than 1500 metres to be marked with Aircraft warning markers. This standard also requires any overhead line installed within specified limits of a CASA registered air port to be marked.

AS/NZ3891.2-2008 (reference 15) specifies the responsibilities of pilots regarding line marking.

4.4.8 Live Line Clamps

In the past, live line clamps were used to connect new transformers directly to HV feeders without requiring an outage. This connection was intended to be a temporary connection and to be changed to a 'D-clamp' at the next planned outage. However, records were not well kept of installations connected using live line clamps and many were not changed to D-clamps and it is estimated that there are approximately 10,000 live line clamps still connected (according to the WASP defect pool).

The connection of a live line clamp directly onto a live tensioned conductor can result in arcing, eroding individual strands of the conductor and greatly reducing its strength. The risk is greater for Galvanised Iron (GI) conductor as this arcing can remove the galvanising, which exposes the iron to moisture build up underneath the clamp. This results in corrosion of the conductor, which will lead to conductor failure or the fusing of the conductor to the clamp.

4.5 Structures

Structures provide support, insulation and adequate clearances between the overhead conductors, overhead switchgear and pole mounted transformers and the ground, vegetation and building infrastructure.

There are four main types of structure are used in the distribution system:

1. Wood poles (natural and treated);
2. Steel and concrete poles (commonly known as Stobie poles);
3. Spun concrete poles; and
4. Steel structures, including:
    a. Steel lattice poles;
    b. Steel lattice towers;

c. Railway section (RSJ) steel poles;
d. Round steel service poles; and
e. Square section steel service poles.

Accessories associated with structures are:

1. Stays;
2. Stakes;
3. Pole Operating Platforms;
4. Fauna guards (such as possum guards, cattle/horse guards and bird perches)
5. Anti-climbing barriers;
6. Easements and way-leaves; and
7. Access tracks.

There are some structures that are joint use with other services such as communications cables and road lighting.

Table 5 details the types of structures installed in the system.

Table 5: Structures installed in Aurora's distribution system as at August 2010

Description	Number Installed (Aurora owned)
Wood (Natural) Poles	4540
Wood (Treated) Poles	197075
Steel and Concrete (Stobie) Poles	6617
Spun Concrete Poles	57
Steel Lattice Poles	1355
Steel Lattice Towers	177
Railway Section (RSJ) Steel Poles	234
Steel Service Poles	12849
Total	222,904

Figure 4 shows the age profile of the structures installed in the system.

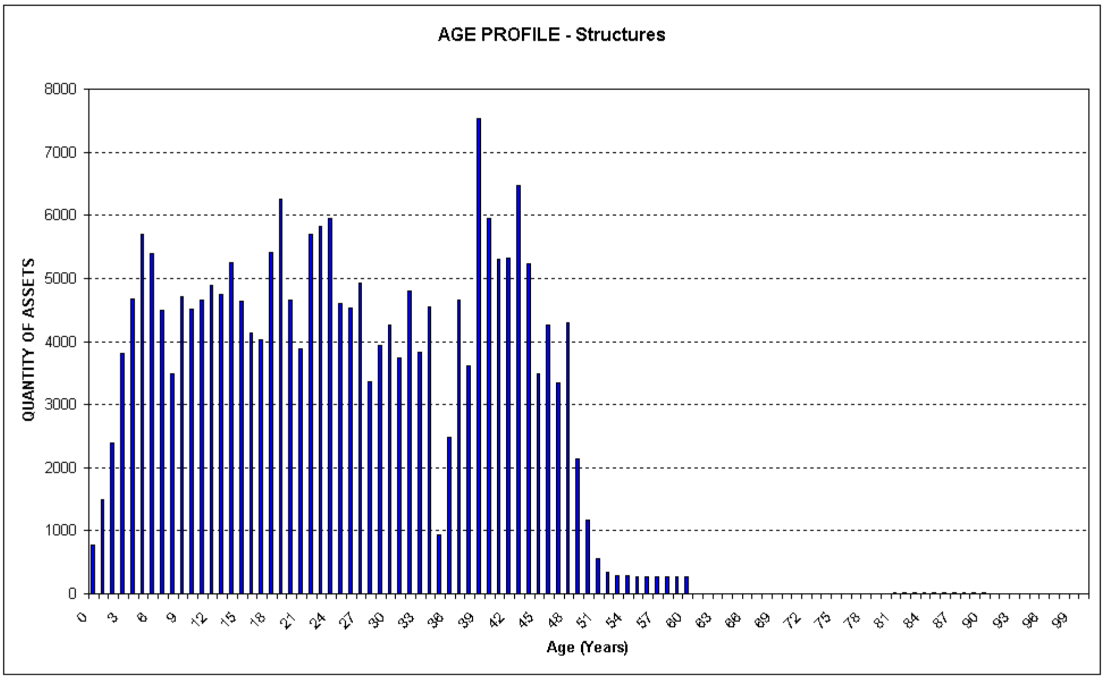

Figure 4 Age profile structures

4.5.1 Wooden Poles

Natural Wood Poles

Natural wood poles come from an untreated eucalypt sourced from Tasmania. Aurora sourced natural wood poles were of the 'ironwood' (Eucalyptus siberius) species procured under contract from the St Mary's district until 1994. These were originally sourced from old growth forest but in later years moved to regrowth.

It was soon discovered that regrowth wood had pole integrity issues due to an increased susceptibility to heart rot. This has resulted in historical failures of natural wood poles with a life as little as seven years.

Natural wood poles have no preservative and therefore the sap wood is prone to deteriorate very quickly especially below ground level. The sapwood is not included in the calculation of pole strength on these poles.

Copper-Chrome-Arsenate (CCA) Wood Poles

The treated wood poles used in the distribution system are harvested and treated locally. These poles are typically Natural Durability Class 3 and 4 timbers (as per AS5604 Timber – Natural Durability Ratings), as there are no Natural Durability Class 1 and 2 poles grown within Tasmania.

Natural Durability Class 3 and 4 timbers are less dense and more prone to decay and have a shorter probably life expectancy than the Natural Durability Class 1 and 2 timbers typically used in mainland Australia.

The treatment used on the poles is pressure impregnated Copper-Chrome Arsenate (CCA). The average treatment applied has increased over time, as indicated in Table 6.

Table 6: Level of CCA treatment

	Average Treatment (kg/m^3)	Minimum Treatment (kg/m^3)
Pre-1970	10	6.5
1971-1980	12	8
1981-1994	15	10
Post-1994	24	18

Wood poles are purchased with a metal pole cap attached over the top of the pole to reduce the ingress of water from the top of the pole through the pole centre assisting pole decay.

CCA wood poles are considered to be cost effective and also afford a significant insulation medium for bare overhead lines.

Analysis has been performed comparing the annual equivalent cost for Class 1 and 2 wooden poles, Class 3 and 4 wooden poles, concrete poles and steel poles. The analysis demonstrates that class 3 and 4 CCA wood poles are the most cost effective option for Aurora. Refer to NW-#30103252 Structures – Annual Equivalent Calculation (reference 13).

4.5.2 Concrete and Steel, Spun-concrete and Steel Structures

These types of poles or structures have a longer life than wood poles and require minimal maintenance other than the painting or regalvanising of the steelwork. However they have a higher capital cost are require more careful handling during installation than wood poles.

Additionally, steel and concrete poles require all conductive components to be earthed to ensure greater public safety, effective protection and safe operational activities while working on or near the pole.

They also require greater insulation considerations between the conductors and the structure, particularly in areas where bird and wildlife interactions are an issue.

Railway section (RSJ) steel poles are second hand railway steel sections that were used in the past for service poles, cross-over poles and private poles.

Steel section poles are predominately used as service poles on the LV system as they have a small footprint on the streetscape and are easily manhandled in difficult situations.

4.5.3 Stays

Poles and structures are graded by their ability to withstand the forces placed on them by conductors and pole mounted equipment. Where the natural strength of the pole or structure is inadequate to withstand these forces, additional measures such as stays and guys are used in conjunction with the pole or structure.

4.5.4 Stakes

Wooden poles deteriorate at a greater rate below the ground line than above. Thus, the above ground section may have many years of useful service left once the below ground section has deteriorated.

Stakes (or ground-line reinforcing) may be installed on wood poles to strengthen the pole at and below ground level and prolong the service life of the pole by at least 15 years.

4.5.5 Pole Operating Platforms

Pole operating platforms provide a safe working platform for overhead line workers working on the overhead system. Elevated work platforms also provide the same function.

4.5.6 Fauna Guards

Fauna guards are accessories installed on a structure to prevent animals and birds interfering with electricity assets and include:

- Possum guards;
- Cattle/horse guards; and
- Bird perches.

Possum guards are installed on wooden poles carrying uninsulated HV conductors and equipment to prevent possums from climbing up the poles. When a pole is stayed, stay sighters are installed on the stay to prevent possums from climbing the stay.

Cattle/horse guards are installed on stayed poles located in areas access by livestock to prevent the livestock from scratching themselves against the pole stay.

Certain birds such as raptors (Eagles, Hawks and Kites) tend to use poles and cross arms to perch and survey the surrounding area to hunt and prey. Bird perches are installed on steel poles to provide a safe location on the pole for the bird to land without risk of contact with live conductors.

4.5.7 Anti-climbing Barriers and Signage

Anti-climbing barriers and signage are required for steel lattice tower to discourage and prevent unauthorised access onto these structures.

ENA Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines C(b)1 (reference 2), Section 8.4.3 requires that:

> *Provision shall be made on all climbable structures for the fixing of signage and devices to ensure the protection of the public from hazards associated with access to electrical works, and to provide public awareness of operational safety issues*

4.5.8 Access Tracks

Due to the wide variety of terrain that Aurora's distribution network covers, the construction and maintenance of access tracks are vital to ensure Aurora's employees can safely access distribution assets for routine maintenance as well as emergency fault situations. Repairs to track surfaces and drainage structures enable safer travel with improved response times for outages.

There are also specifically designated clean and unclean sites, farms and areas with respect to weed and disease around the state. This heightens the need to exercise care when travelling between these areas with respect to the spread of weeds and disease. Without appropriate care, Aurora's activities can contribute to the spread of weeds, such as gorse outbreaks in gorse-free areas within Aurora's easements.

4.5.9 Easements and Way-leaves

To ensure appropriate access for operational and maintenance activities on the overhead system and structures, specific easements and way-leaves are established to cover the route of the overhead line and access to and along that route. These easements are generally established for the purpose of distribution of electricity and its associated electrical infrastructure.

Not all easements or way-leaves have been placed on property titles, however the Electrical Transitions Act 1996 (reference 16) was established for easements existing prior to November 1996.

The Electrical Easements Act 2000 (reference 17) ratified this act. All easements post November 1996 are required to be formally placed on property titles where the asset is owned by Aurora Energy and it crosses over private property.

4.6 Earthing System

Pole mounted transformers, HV lightning arresters and the exposed metalwork of all HV equipment is connected to an earthing system. The earthing system is essential for maintaining personnel and public safety and for correct operation of protection equipment. The fault level, protection clearing time and site soil resistivity dictate the extent of the earthing required.

The earthing system for overhead equipment is typically a series of earth rods driven into the ground and connected by copper conductor.

The earthing is of particular importance in maintaining supply and for safety with a SWER reticulation system as the earth is used as the return current path.

5. FACTORS INFLUENCING ASSET MANAGEMENT STRATEGIES

The principle factors influencing asset management strategies are classified as per objectives set out in Section 2.

5.1 Minimise Cost of Supply to the Customer

- Ensuring cost effective trade-offs are made between pro-active and reactive maintenance practices;
- Undertaking maintenance activities that cost effectively ensure a reasonable service life is achieved from the asset;
- Capturing adequate information on the assets to facilitate informed decision making;
- Pursuing more cost effective options to replacements, such as pole staking; and
- Ensuring all risks are identified and have adequate management plans integrated into the business' practices.

5.2 Maintaining Network Performance

- Targeting asset management activities appropriately to the different parts of the network that have varying impacts on consumer service levels to ensure that the most cost effective solution is achieved;
- Ensuring the general operational condition of the assets is maintained to an acceptable level for reliable function of switchgear when required; and
- Targeting activities in areas where targets are not being met.

5.3 Managing Business Operating Risks

- Ensuring conductors maintain safe clearances to prevent contact;
- Ensuring assets do not start a fire in identified high fire risk areas; and
- Ensuring adequate inspections are undertaken to minimise risk of pole or conductor failure.

5.4 Complying with Regulatory, Contractual and Legal Responsibilities

The following is a brief description of the specific regulatory obligations recently introduced that directly influence Aurora's management of overhead and structural assets.

A list of the legislation, regulations, standards and codes of practices directly relevant to the management of Overhead System and Structures is provided in Section 14.

5.4.1 Changes to the Occupational Licensing Act 2005

Changes to the Occupational Licensing Act 2005 (reference 18) that became effective on 19 January 2009 require Aurora to be compliant with C(b)1 (reference 2) in the construction and operation of its distribution network. Before this date, C(b)1 was taken as standard industry practice for design and construction of distribution networks in Australia.

5.4.2 Sulphur Hexafluoride (SF_6)

Aurora currently has over 300 pole mounted switchgear sites with SF_6 insulation.

In recent times concerns with the impact this green house producing gas has on the environment has resulted in the introduction of requirements for the reporting and disposal of SF_6.

Aurora is required to comply with The National Greenhouse and Energy Reporting Act 2008 (reference 19), which set out a national framework for corporations to report greenhouse gas emissions and energy consumption and production from 1 July 2008.

Disposal of SF_6 is managed in accordance with Aurora's Environmental procedure EW-M12-01 Disposal of SF_6 (reference 20) which reflects the requirements of the National Environment Protection Management Measure (NEPM) and the Environmental Management Pollution Control Act 1994 (references 21 and 22).

5.4.3 Polychlorinated Biphenyls (PCBs)

Aurora manages PCBs in accordance with Aurora's Environmental procedure EM-M09 Management of PCB's (reference 23), which reflects the requirements of the Australian and New Zealand Environment and Conservation Council (ANZECC) Polychlorinated Biphenyls Management Plan (reference 24). Both plans satisfy the legislative requirements of the TAS Environmental Protection & Pollution Act 1994 and the NEPM standards Act (references 25 and 26).

Polychlorinated biphenyls (PCBs) were used in transformers and capacitors amongst other things from the 1930s to the 1970s. However, they were shown to be toxic and carcinogenic and have been banned in Australia in the 1970s.

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As part of the routine switchgear maintenance, if asset records indicate that the status of the oil in a transformer is 'unknown' then a sample of oil is taken from the transformer for PCB testing. If the PCB test results indicate PCB levels equal to or greater than 50 ppm, the transformer is proposed for removal from the system.

6. MANAGEMENT PLAN

6.1 Treatment Trade-offs

6.1.1 Preventative versus Corrective Maintenance

There is a fundamental requirement for Aurora to periodically inspect its assets to appropriately and effectively target preventative maintenance programs and to ensure the physical state and condition of the asset does not represent a hazard to the public.

Other than visiting the assets, there is no other economic solution to satisfy this requirement. Land based inspection is the only practical way to monitor decay rates in poles, but there are various monitoring techniques can be utilised. Aerial and land based surveys of conductors, fixtures and switchgear are both possible.

Corrective maintenance on poles incurs a considerably higher cost than preventative maintenance, and can impact consumer service levels significantly. Given that weather conditions exceed design standards from time to time, a portion of corrective maintenance is always expected. The key trade-off Aurora monitors is the cost incurred inspecting poles versus the premium incurred from corrective maintenance, and more importantly the level of impact on consumer service levels.

For some assets such as surge arrestors and overhead LV ABC cables, deterioration of components are very difficult to identify and/or provide preventative maintenance strategies. In these situations corrective maintenance and/or asset replacement is considered a viable alternative (subject to assessing fire and other risk factors).

6.1.2 Asset Replacement

Planned asset replacements are driven by condition based assessments from the Aurora's preventative maintenance programs. Where weather conditions are extreme, or third parties cause damage to overhead and structural assets, reactive replacements are required.

A key initiative Aurora employs to defer asset replacement is the practice of pole staking. This practice is believed to extend the life of the asset by up to and in excess of 15 years.

OH transformers and switchgear that are removed from the network due to other work activities are also assessed for refurbishment and subsequent redeployment back into the network.

6.1.3 Non Network Solutions

Consideration of mobile generation to minimise consumer disruption on failure of overhead assets is sometimes a viable alternative to investing in reinforcement and redundancy assets. The nature and scale of the connected load and consumer type are important when considering this alternative.

6.2 Preventative Maintenance Programs

6.2.1 Structures Inspection and Monitoring

Aurora's inspection and monitoring program consist of four components:

1. Inspection and testing of structures;
2. Sample inspection of steel towers;
3. Non-destructive evaluation; and
4. Graffiti removal – agreements with external parties.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

Inspection and Testing of Structures

Inspection of structures is undertaken on a 3.5 year cycle in accordance with Network Policy *NN R AM 05 Inspection and Maintenance of Distribution Overhead Lines* (reference 5).

The inspection cycle for other Australian utilities is currently a four to four and a half year cycle. The main reason for this difference is the class of wood used for power poles. The majority of poles installed on the mainland are of Class 1 and 2, which means that they are extremely dense and less prone to decay. Tasmanian timbers on the other hand are sourced locally and are of Class 3 and 4 timbers as there are no Class 1 and 2 grown within the state.

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The results of the tests undertaken during this inspection determine whether a pole is:

1. Serviceable – considered to be in an adequate condition to safely remain in service until the next pole inspection;
2. Impaired – not considered to be in an adequate condition to safely remain in service until the next pole inspection, but suitable to be considered for staking (it may then be condemned if it does not meet the detailed staking criteria); or
3. Condemned – not considered to be in an adequate condition to safely remain in service until the next pole inspection and not suitable for staking.

To slow the rate of deterioration of wood poles, the application of boron pole saver rods and bandages to treat wooden poles for heart and soft rot are undertaken as part of the pole inspection program.

Figure 4 in Section 4.5 shows the age profile of wooden poles and identifies that going into the next determination period a large number of wooden poles move into this range; so it is expected that these poles will need to be replaced.

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As overhead lines and equipment are inspected as part of the pole inspection, the inspection cycle is a compromise between asset defect detection and pole condemning.

Appendix A.1 shows the age distribution of defective poles identified over the last decade shows a pole age of late 30s to early 40s as the average condemning/failure age for wooden poles.

In addition there are approximately 4500 natural wooden poles in the system, which have unpredictable characteristics and have been known to fail at early ages (under 10 years). These poles are all between 15 and 25 years old (at 2010).

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Future pole replacement will be based on:

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2. Age profile of current poles (Figure 4) with significant increases in poles greater than 40 years old during the determination period
3. Expected failure of natural wood poles, which are unpredictable and reaching their expected lifetime.

Sample Inspection and Treatment of Steel Towers

Aurora has a small population of extreme high voltage steel lattice towers in its system. The majority of towers were installed in the late 1950's and are approaching the end of their nominal asset life. Aurora undertakes sample inspections to monitor their condition for proactive maintenance works and undertakes minor remedial action to defer replacement expenditure.

Major remedial action is undertaken under RESTK Reinforce Below Ground Portion of Tower Leg (Section 6.4.4).

In 2006, a dedicated inspection program (performed by Incospec of South Australia) assessed the condition of the legs as requiring remedial action. The above ground sections were found to be in good condition. Refer to Incospec report (reference 3).

Non-Destructive Evaluation

Current testing methods to detect the progression of the decay in wood poles are destructive (refer Network Procedure *NP R AM 27.1 Pole Inspection and Maintenance (Part 1 – Wood Poles)* – reference 6). Three holes are drilled near and below ground line to detect the level of decay. The below ground test holes require the removal of material around the pole, including concrete and paved surfaces.

Aurora is currently investigating non-destructive methods of testing as part of an industry wide initiative from the Energy Networks Association Power Poles and Cross Arms Committee. However, benefits associated with non-destructive technologies will need to be assessed against their cost to ensure that Aurora is investing in the most cost effective activity.

Graffiti Removal – Agreements with External Parties

Aurora has a policy of removing any graffiti that is offensive to the community namely if it is derogatory to a particular race or section of the community or depicts offensive words or drawings. However, several community organisations and councils have a zero tolerance to graffiti and lobby for the removal of all graffiti from Aurora assets.

To address this issue, Aurora has negotiated with the Hobart City Council to contribute $5,000 per year to the council to remove graffiti from Aurora structures and assets in the HCC environs.

Aurora also supplies material (such as paints) and supervision to the Police Young Offenders Program and various Progress Associations to assist in the removal of graffiti.

6.2.2 OH System Feeder Inspections

The overhead system contributes to over 60 per cent of total asset failure contribution to Aurora's SAIDI and SAIFI. A ground and aerial auditing and inspection program is required to allow Aurora to effectively target maintenance and replacement activities. This program covers activities such as:

1. Investigating outages caused by failures such as broken ties, insulation failures or conductor clashing;
2. Determining the condition of large lengths of the network within a tight time frame where there may be access issues for ground crews, such as after a storm or bushfires; and
3. Specifically gathering condition information when asset failure trends have been identified.

There has been a major change to this inspection program to improve the cost effectiveness of Aurora's inspection programs. Previously there were four separate inspection programs in place that were not utilised each year due to no business requirement or the utilisation of internal resources to undertake the inspections, which are no longer available.

Aurora has consolidated these programs into a single program with the flexibility to target inspections. The proposed expenditure has decreased due to the efficiency gains.

6.2.3 OH Feeder High Vehicle Load Inspection

The high load route inspection program is used to ensure Aurora's infrastructure isn't damaged by transportation of high load, which is triggered by requests from the public. This task is generally undertaken by an Aurora preferred contractor under the request of the customer, however, Aurora reserves a small amount of funds to address the infrequent situations when customers bypass this process.

The cost of maintaining this small inspection program to protect Aurora's asset and the members of the public is seen as less than the cost to reactively repair the assets if damaged.

Aurora records approximately 30 instances every year where third party vehicles contact/pull down overhead services.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.2.4 OH Transformers – Load and Condition Monitoring

This program covers the activities associated with testing and recording the load on pole mounted distribution transformers greater than 200 kVA and over 80 percent loaded for capacity planning purposes and the identification of load unbalance issues over the regulatory period. This also includes onsite/same time visual checks of the assets and connections.

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Condition information enables Aurora to proactively renew or maintain the assets, minimising the amount of reactive replacement.

The System Operations group previously managed this program. This program has been in place for a number of years but has been underutilised in the past. Aurora proposes to undertake this inspection program to determine the value of the information before assessing whether the program should be ongoing.

6.2.5 OH Feeders Thermal Inspections

This program covers the activities associated with testing and recording the conditions of the network using a thermal imaging device to identify potential weak spots, defects or constraints within the Network.

There are two components to this program:

1. Defined thermal inspections; and
2. General thermal inspections.

Defined Thermal Inspections

This program covers the annual use of external contractors to thermally image Aurora's critical feeders (feeders that contribute significantly to system SAIDI and SAIFI) and sub-transmission feeders. These inspections are undertaken during the months leading up to the winter period, namely March through to June.

Thermal inspections are required to identify weak spots and defects on the critical components of the network before as set failures so that reactive maintenance can be undertaken with less disruption to customers and at lower cost.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

This program was previously managed by the System Operations group.

General Thermal Inspections

This program covers the use of Aurora's field staff to patrol lines with hand held thermal imaging cameras after faults and switching operations on Aurora's network that may have weakened components of the overhead network.

These thermal inspections identify weak spots and defects so that reactive maintenance can be undertaken with less disruption to customers and at lower cost.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

This program was previously managed by the System Operations group.

6.2.6 OH Transformer Earthing Inspection and Monitoring

The aim of this program is to audit the condition of overhead substation and switchgear earth connections to improve Aurora's asset condition information and ensure compliance to AS 2067 Substations and high voltage installations exceeding 1 kV a.c and ENA EG 0 Power System Earthing Guide (references 27 and 28).

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This audit will also identify sites for replacement where earths have been stolen or vandalised. In 09/10, Aurora recorded over 50 sites where transformer earths had been stolen or vandalised.

The proposed expenditure is greater than historical spend due to previous underutilisation of the program. Aurora sees the need to increase expenditure in the future due to the increase in earth thefts and to ensure compliance to AS 2067 and ENA EG 0. Aurora proposes to undertake this inspection program to determine the condition of the assets to determine the scale of the replacement program.

6.2.7 Fire Mitigation Asset Inspections

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There are two components to this program:

1. Asset inspection of feeders in high fire danger areas; and
2. Audits of work completed on feeders in high fire danger areas.

Asset inspection of feeders in high fire danger areas

As the pole inspection process (refer Section 6.2.1) is focussed on the area immediately surrounding the pole and does not include a mid-span inspection, a specific fire mitigation asset inspection is undertaken annually.

The inspection is also undertaken to specifically target assets that are recognised fire start risks that may have been given a lower priority in the routine line inspection and to identify any asset component defects that may have occurred since the last routine inspection cycle

This inspection is undertaken by specialised staff and focuses on asset issues known to contribute to fire starts. These inspections feed into the fire mitigation asset repair (refer Section 6.3.2) and replacement programs (refer Section 7.1).

For more detailed information on the selection of areas for this inspection program see NW-#30043347 *Management Plan Bushfire Mitigation (Asset Programs)* (reference 9).

Audits of work completed on feeders in high fire danger areas

This program is an annual audit of the work completed as part of the fire mitigation asset repair and replacement programs to ensure the work has been completed within the required time frames.

This is a new inspection program to ensure the quality of Aurora's fire mitigation works.

6.2.8 Access Track Management

There are two components to this program:

1. Access track maintenance; and
2. Weed management.

Access Track Maintenance

The aim of this program is to maintain access tracks to an adequate standard that Aurora staff can safely access Aurora's assets.

Experience within Aurora has shown existing access tracks need to be maintained approximately every four years for optimum cost versus benefit and to stop them degrading to the stage where they require extensive works.

There are no major changes to this program however, the proposed expenditure has increased compared to historical spend due to the increased number of access tracks requiring maintenance from the previous regulatory period.

Weed Management

There are specifically designated clean and unclean sites, farms and areas with respect to weed and disease around the state. Although Aurora has strict weed and disease management procedures in place when travelling between these areas, the aim of this program is to reactively address situations where Aurora's activities have contributed to the spread of weeds, such as gorse outbreaks in gorse-free areas within Aurora's easements.

This is a new program to address an emerging issue.

6.2.9 Leaning Poles

The aim of this program is to address the issue of leaning poles in Aurora's system. A pole is considered leaning, and is a reportable defect when it is leaning more than 6º from vertical (or approximately four pole head widths out of vertical).

When a pole is leaning between 6º and 10º from vertical, there is a higher risk of conductor clashing, but the pole itself is structurally sound. A lean of greater than 10º indicates that the foundations of the pole are potentially compromised and the pole may be in danger of collapsing.

Leaning wood poles are mainly due to problems associated with ground and foundation strengths, backfill medium, compactness at foot and heel of the pole and inadequate counterforce infrastructure (stays etc).

Between 2007 and 2009, an average of 227 leaning pole defects have been identified each year as part of the routine asset inspection cycle.

Currently a defect pool exists of 500 poles, and analysis of these defects has identified a rate of approximately 150 new leaning per year entering the system. This category of work was previously done under overhead asset repairs (AROCO), hence the backlog of defects due to other higher priority tasks being completed first.

6.2.10 Repair Steel and Concrete Poles

This program aims to repair the below ground section of direct buried steel and concrete poles. Steel and concrete poles (known as Stobie poles) are a composite pole constructed of two steel channel sections held apart by strategically positioned bolts with a concrete infill. They are strong in the major axis and very weak in the minor axis.

These poles were installed predominately from the 1950s through to the 1970s. They are very expensive to manufacture and are susceptible to corrosion at or just below ground line as the steelwork is generally only protected by enamel paint. However they can be repaired in situ by welding a steel plate across the affected area.

Repairing the below section of direct buried Steel and Concrete poles is cost effective as it will extend their lives by 15 to 20 years.

They are very good in fire prone areas but have a high bird interaction impact due to their conductivity.

They perform poorly in coastal environments where the salt laden air attacks the steel section above ground.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.2.11 Insulator Washing and Pollution Mitigation

The aim of this program is to prevent insulation break down of the overhead insulator due to pollution build up in high pollutant areas such as industrial areas or near the coast. Rain normally effectively cleans the insulators however, after a prolonged dry spell the insulation can start to break down, which can result in pole top fires.

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The proposed expenditure is greater than historical spend due to previous underutilisation of the program.

In recent years this program has been underutilised due to the work force not being fully trained to perform this task. New equipment and training has been provided to crews so this program can be fully utilised. The annual expenditure may vary year to year depending on the weather as this program is mainly required when there has been a lengthy dry spell (3-4 months without rain).

6.3 Corrective Maintenance

6.3.1 Decommission Assets

Aurora owned assets from time to time are decommissioned and disconnected from electrical system. The reason for decommissioning is varied, but recently has been driven by a change of land use where a farm has been converted to a tree plantation. Aurora removes the assets from the network as leaving the assets standing incurs ongoing costs in inspection treatment and vegetation clearing.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.3.2 Asset Repair – Fire Mitigation

This program is for the repair of minor asset defects that are known fire starts, such as restraining slack conductors or installing LV spreaders to prevent conductor clashing, that are identified during routine asset inspections and fire mitigation asset inspections.

Defects that cannot be simply repaired under the fire mitigation as set replacement programs (refer Section 7.1). For more detailed information regarding defects repaired under this program, see NW-#30043347 *Management Plan Bushfire Mitigation (Asset Programs)* (reference 9).

Replacements of EDO fuse tubes in high and very high fire danger areas have been removed from this program due to a targeted replacement program however, the proposed expenditure is to remain consistent with historical spend as EDO fuse tubes are only a component of the program.

6.3.3 Oil Management

Aurora has over 30,000 transformers and over 300 oil filled switchgear in service in the distribution system. Predominately 28,000 of these transformers are pole mounted, each containing oil quantities ranging from 45 litres through to 720 litres. When the assets reach the end of their useful life the oil has to be removed and disposed of.

Pole mounted and ground mounted oil filled assets are disposed of under this category due to the greater quantities of pole mounted equipment being processed annually.

Disposal of SF6 equipment is processed under Ground Mounted Substations Asset Repair Recovery and Disposal of Redundant SF6 Switchgear due to the larger volumes of SF6 insulated switchgear in the ground mounted system. See Management Plan 2011: Ground Mounted Substations (reference 1) for more information on SF6 disposal.

Aurora is required to dispose of oil and oil-contaminated assets in accordance with Australian Standards. This program funds Aurora's Oil Farms who manage the removal and disposal of oil from redundant oil-filled assets.

The primary objective is to recover oil from assets that reached the end of their useful life along with response to oil spills, test for PCB's and disposal according to environmental requirements (including obtaining permits and arranging transport) and disposal of oil free equipment.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.3.4 OH System Asset Repairs

This program covers minor asset repairs that have been identified and have the potential to cause asset failure in the future or shorten the expected life of the asset. Public risk and reliability are the main drivers.

The majority of these defects are reported through the Pole inspection program (AIOHS) and include minor work involving asset repair such as refixing loose material, replacing possum guards, repairing operating platforms, etc.

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Repair of leaning poles and removal of live line clamps have been removed from the asset repair pool and are being addresses through targeted asset repair and asset replacement programs due to the large volumes of these defects in the system.

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Aurora is also undertaking a review of its defect pool.

6.3.5 OH System Low Conductor Clearance

This program covers simple repair tasks such as the re-tensioning of slack spans of LV and HV conductor to address conductor clearance issues. Where a more complex solution is required (such as the installation of a pole), this work is undertaken as an asset replacement task (see sections 6.4.6, 6.4.24)

Aurora experiences approximately 30 incidents every year where third party vehicles contact/pull down overhead services.

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6.3.6 OH Switchgear Asset Repair

There are two components to this program:

1. General asset repair of overhead switchgear; and
2. Recloser and fault indicator maintenance.

General Asset Repair of Overhead Switchgear

This program covers the minor repair of overhead switchgear such as replacing terminations or air break switches, relocating switchgear, repairs to recloser pole top control cubicles, etc.

Replacements of EDO fuse tubes have been removed from this program due to the creation of a targeted replacement program to address operational issues with the devices associated with corrosion, exposure and weathering.

The proposed expenditure is less than historical spend due to the creation of a targeted EDO fuse tube replacement program.

Recloser and Fault Indicator Maintenance

This program covers the replacement of battery units in the 1,300+ reclosers and fault indicators in Aurora's overhead network. The batteries on these units are designed to last for approximately five years. Battery supply to these devices is essential for communication and operation of the device during fault conditions when the network supply is off.

Aurora has experienced communication and operation failures to reclosers during extreme weather situations due to old batteries in the devices that have delayed the restoration of power.

The proposed expenditure is greater than historical spend due to more reclosers and fault indicators entering the system and approaching their five year battery life.

6.4 Asset Replacement

A number of key risks drive the need for asset replacement in these asset classes.

6.4.1 Install Wildlife Protection on Transformers

This aim of this program is to protect overhead assets from damage due to wildlife contact by insulating live components and parts. The separation distances between conductors and pole top hardware are generally adequate to prevent current tracking down the pole to the ground. However, birds and animals occasionally bridge this gap, resulting in phase-to-phase contact of the conductors and the electrocution and potential combustion of the animal.

This program is based on asset failures and outage information. Aurora records approximately 500 outages caused birds and animals every year (includes mid-span collisions as well).

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.2 Replace Transformer Earths

The aim of this program is to proactively replace transformer earths that are in poor condition or damaged and reactively replace transformer earths that are stolen or vandalised.

The transformer earths to be replaced are identified through two sources:

1. Earths identified as being in poor condition through asset inspection and monitoring programs (AIOTX); and
2. Stolen copper earths (refer Section 6.2.9).

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2009/10 and onwards has seen a significant increase in the amount of copper earth thefts. As a result sites targeted by copper thieves now have the earths covered and stapled to the pole when they are replaced. Records of copper theft from previous years are variable as this was not an area of focus for the business.

The proposed expenditure is greater than historical spend due to previous underutilisation of the program and to address the issues around earthing theft and vandalism. Aurora proposes to undertake the transformer earth inspection program (section 6.2.6) to determine the condition of the assets, identify sites for repair and the future scale of this program.

6.4.3 Access Track Creation and Rebuilding

The aim of this program is to address situations where the condition of an access track is so poor that it cannot be safely used without major repairs, such as rebuilding river crossings, or where no existing access track exists.

Aurora's track maintenance program prior to the 2008-2012 Pricing Determination was insufficient and, as a result, a number of established tracks were lost due to overgrown vegetation and erosion from waterways. Extensive work was undertaken during the 2008-2012 Pricing Determination to begin rebuilding these tracks and additional tracks for new sections of the distribution network. This work is still ongoing.

This program has been in place for a number of years but as part of Replace HV Feeders (Safety) (section 6.4.22).

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.4 Pole Staking

There are two components to this program:

1. Install pole stake – reinforce ground line of unserviceable poles; and
2. Reinforce below ground portion tower leg.

Install Pole Stake – Reinforce Ground Line of Impaired Poles

The purpose of this program is to defer replacement of poles by staking suitable poles. As wooden poles deteriorate at a greater rate below ground level than above reinforcement at ground level using staking technique defers the replacement of the decayed wood pole by up to and in excess of 15 years.

Whole of life analysis has indicated that staking is a cost effective method of extending the life if a wooden pole (reference 7).

Wood poles are staked as per Network Policy *NN R AM 11 Wood pole reinstatement by ground-line reinforcement* (reference 8).

After staking, testing of the pole continues on the usual 3.5 year cycle, however additional testing is undertaken further up the pole to ensure appropriate strengths are maintained above the reinforcement.

Analysis of the number of poles staked each financial year show that after a decrease in 2005/2006, there has been a relatively constant trend of pole staking in subsequent years. This indicates that the defects are being appropriately managed and the inspection cycle is prudent. The rise in condemning poles will also include a certain percentage of the staked population, which is contributing to the increase in that trend.

There are no major changes to this program and expenditure in the next regulatory period is based on an assumed continuation of a constant staking rate and an extra 50 poles per year to account for both the continuing increase of the pole population and an expected increase in defect identification.

Defect identification will increase due to a large number of poles moving into the higher risk portion of the age profile during the determination period.

Reinforce Below Ground Portion Tower leg

The aim of this program is to undertake major remedial works on the below ground portion of Aurora's extreme high voltage steel towers. As with wood poles, steel towers deteriorate below ground at a faster rate than above ground.

The remedial action proposed is the replacement of the below ground section of the legs. The alternative is to replace the entire steel tower structure, which is very costly. The remedial action costs only a fraction of the amount to replace the entire tower and extends the life of the tower in the order of twenty to thirty years.

This program has been in place for a number of years but was underutilised and the issues that were raised by the inspection undertaken in 2006 largely unaddressed. Aurora proposes to re-run an inspection to determine the extent of remedial work (section 6.2.1).

6.4.5 Install Anti-climbing Barriers and Signage

The aim of this program is to install anti-climbing barriers and signage on certain types of overhead equipment to deter public access to assets and comply with C(b)1 (reference 2).

The program is prioritised is based on proximity to the general public. An audit is currently under way (2010/11) to determine the scale of this program however it is not expected that there will be any major changes to this program and the proposed expenditure is to remain consistent with historical spend.

Aurora aims to achieve full compliance by 2016/2017.

6.4.6 Replace/Relocate Low LV Conductors

This program covers the relocation or replacement of LV overhead conductor to address low clearances associated with road crossings and plant contact that cannot be repaired under the reactive maintenance program (section 6.3.5) such as the installation of a pole to fix the clearance issue.

Aurora experiences approximately 30 incidents every year where third party vehicles contact/pull down overhead services.

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6.4.7 Replace/Relocate LV OH due to Building Clearances

This program covers relocation or replacement LV overhead conductor because of issues with building clearances e.g. when new buildings are erected that infringe on Aurora's clearance, that cannot be repaired under the reactive maintenance program (section 6.3.5).

This program has two components:

1. Relocating or replacing with LV ABC; and
2. Replacing with underground cable.

Aurora experiences approximately 30 incidents every year where third party vehicles contact/pull down overhead services.

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6.4.8 Replace LV Links with LV Fuses (Fuse Reach)

The aim of this program is to proactively evaluate and redesign/repair substandard LV sites to ensure that under fault conditions the LV network is appropriately protected. This can be either through replacing LV links with LV fuses or redesigning the system due to overly long runs of LV.

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Aurora records approximately 100 outages caused by or related to LV fuses every year.

The proposed expenditure is greater than historical spend due to underutilisation of the program. The program has previously been mainly reactive due to the data available at the time, going forward Aurora has reviewed its LV Fuse Reach Management Plan to proactively address this issue.

6.4.9 Replace LV feeders due to Safety

The aim of this program is for the replacement of sections of LV feeders that, whilst they comply with the standard of the day they were installed, present a risk to public safety, such as LV running through areas of changed land use (plantation to agriculture), or vertical LV spans that have a higher risk of clashing due to excessive span length.

The proposed expenditure is greater than historical spend due to underutilisation of the program. This program has been underutilised in the past due to the work being completed under other work categories.

6.4.10 Replace LV Feeders due to Condition

This program is for replacement of poor condition or substandard construction LV feeders as identified through Aurora's asset inspections and audits.

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There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.11 Pole Replacements

Wooden poles, whether natural or treated, are prone to natural deterioration. Soft rot attacks the outside of the pole and occurs from the ground line to a depth of 300 to 400 mm below the ground. Heart rot is a fungal attack on the interior of the pole and generally occurs within 300mm of the ground line.

The rate of wood pole deterioration depends on the species of timber, the initial preservative treatment, installation location, soil conditions, method of inspection, drilling, excavation and reinstatement. Decay occurs when both moisture and oxygen are present.

This program has two components:

1. Replace condemned pole; and
2. Replace Poles MRBA Storms

Replace Condemned Pole

The aim of this program is to replace poles that are classified as condemned by Aurora's pole inspection program (refer Section 6.2.1). These condemned poles require replacement within a set period not exceeding 4 months.

The driver for this program is public safety. Aurora is responsible to ensure that a pole at the end of its life is removed from service before it fails.

Approximately 25% of impaired poles are replaced the others are staked. The volumes ar e bas ed on hi storical da ta an d c ondition i nformation t hat i s gathered about the poles during audits (safety factor, amount of rot).

There ar e no major c hanges t o t his pr ogram an d ex penditure i n t he n ext regulatory period is based on the:

1. Current trend of condemning poles; and
2. Age profile of current poles with significant increases in poles >40 years old during the determination period

Replace Poles MRBA (extreme events such as storms)

This i s a r eactive work pr ogram t o c over t he c apitalisation of po le replacements und ertaken und er f ault dur ing major events such as during a storm or bushfire.

The work is initially performed under the fault and emergency budget and later transferred to this program.

This is a pre-existing program and there are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.12 Replace HV Copper Conductor

The aim of this program is to remove substandard condition copper conductor from the overhead system.

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Analysis of conductor failures (reference 4) has shown that the percentage of copper conductor failures in the network is higher than any other conductor type. Copper conductors make up 15% of the total failures while only representing 8.6% of total conductors.

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This program has been in place for a number of years but as part of Replace HV Feeders (Safety) (section 6.4.22).

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.13 Replace HV Galvanised Iron (GI) Conductor

The aim of this program is to remove substandard condition GI conductor from the overhead system and to replace sections of overhead GI conductor around coastal areas.

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Galvanised Iron (GI) conductor came into service in the 1940s. Aurora stopped installation of single strand No. 8 GI in the 1970s and the imperial 3/12 GI was replaced with the metric 3/2.75 GI around 1976, which is the present day Aurora standard for rural conductors.

C(b)1 (reference 2) rates GI as a very poor conductor in marine environments. When subjected to wind borne salt spray and sea fogs containing salt contaminants that form salt crystals when deposited on steel conductors. A galvanic cell is formed and removal of the zinc coating results over time. Once the zinc coating has been removed, severe corrosion of the steel results leading to loss of mechanical strength and eventual conductor failure.

The risk of public safety as a result of conductor failure in marine environments is exacerbated by the fact that most of these conductors are at the end of long feeders and the ground has a high resistance (sand) making it highly probable that the protection will not see the event as a fault and isolate the line.

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This is a pre-existing program and there are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.14 Transformer Replacement Programs

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6.4.15 Replace Transformer 'H'-pole structures

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The replacement solution is single pole substation or may have to move to a ground mounted substation if the load is large.

There are no major changes to this program but the proposed expenditure is larger due to targeting more structures.

6.4.16 Switchgear Replacement (REOHS)

This program has 6 components:

1. Replace ABS/HV Links;
2. Replace complete EDO at site (due to obsolete equipment);
3. Replace EDO fuse tubes;
4. Replace EDO with Boric Acid (to address high fault levels);
5. Replace LV links with fuses (to address public safety); and
6. Replace OH switchgear – Replace sectionaliser (ABB and AK).

Replace ABS/HV Links

The aim of this program is to replace air break switches and HV links that are in poor condition as identified during Aurora's asset inspection programs, replace devices that fail in service or replace devices where other business drivers require a three phase switching device or high current switching.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

Replace Complete EDO at Site Due to Obsolete Equipment

This program is related to the HV EDO fuse tube replacement program and is required when the existing fuse carrier cannot accept the current fuse tubes, or the EDO unit is in a poor condition.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

Replace EDO Fuse Tubes to Ensure Correct Operation

The aim of this program is to ensure that EDO fuse tubes operate correctly and do not start fires. EDOs fuses in poor condition have a tendency to hang up and consequently cause fires.

Aurora records approximately 200 outages where HV fuses operate as protection every year. In 2009/10, HV switchgear contributed 5 minutes (8 percent) and 0.05 interruptions (9 percent) to the total asset related failure SAIDI and SAIFI contribution of 62 minutes and 0.51 interruptions. The majority of these HV outages were caused by HV EDO fuses.

This is a new program to address an emerging issue. The aim of this program is to ensure that by 2020 there are no EDO fuse tubes in the system that are greater than ten years old. Ten years was chosen as the preliminary asset life of the fuse tubes for replacement however, condition monitoring of new tubes will be undertaken to determine whether this life span is valid.

This program covers fuse tubes outside of the fire danger areas.

Replace EDO with Fire Safe Alternatives (such as Boric Acid) to Address High Fault Levels

The aim of this program is to address the issues associated with EDO fuses operating in high fault level areas and expelling molten metal through the replacement of the complete EDO unit with a new boric acid fuse unit.

A review of the protection on Aurora's distribution system undertaken by Hill Michael Consulting in 2010 (reference 10) recommended that the EDO fuses should not be installed in areas where the fault level is greater than 2kA to limit the risk of starting fires under operation of the device.

It is proposed to replace control stations that in areas of high fault levels (>6 kA) with fire safe alternatives, such as boric acid fuses. Boric acid fuses only expel gases and not plasma and particles like EDOs, are more resilient to lightning strikes and do not 'hang up' like EDOs.

This is a new program to address an emerging issue and covers sites outside of fire danger areas. There is a separate program to address this issue inside fire danger areas.

6.4.17 Replace LV Links with Fuses to Address Public Safety

The aim of this program is to reduce the risk associated with circuits connected by LV links by replacing the LV links on transformers with an LV fuse sized to the size of the transformer – there is no design component to this work. This ensures there is some form of protection on the circuit.

This program is related to the Fuse Reach Program (refer Section 6.4.8) which also aims to reduce the risk associated with LV links and fuses. However, this program differs from the Fuse Reach Program in that the Fuse Reach Program requires the fuse to be sized to the LV circuit it is connected to (and not the transformer), which requires a design component to analyse the LV circuit.

This is a new program that seeks to reduce the risk of the site until a proper analysis can be undertaken under the Fuse Reach Program. Sites will be prioritised so that sites near vegetation, large transformers and new transformers are replaced as it is expected that older transformers will have the links replaced with fuses when the transformer is replaced.

6.4.18 Changeover/Upgrade Service on Telstra Poles (RESTE)

This program covers the upgrade and reconfiguration of any LV that is attached to Telstra owned poles and, if major work is required or a problem exists with the pole, Aurora will negotiate transfer of ownership of the asset.

While these poles are maintained appropriately, upgrades and reconfigurations may occur in which Aurora-owned LV or other assets are to be attached to the Telstra pole. In such cases Aurora takes over ownership of the pole so the appropriate standards and policies can be applied to it with regard to installation, access inspections and maintenance.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.19 Replace Recloser & or Control Box

This program covers the replacement of reclosers in Aurora's overhead system due to the condition of the asset. Aurora's current reclosers only have a manufacturer assessed asset life of 20 years. Replacement of reclosers will be undertaken based on condition assessments and as driven by other business drivers.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.20 Replace HV Insulators

The program to replace HV insulators aims to replace insulators in poor condition that have been identified during asset inspections.

Porcelain or glass insulators are susceptible to cracking, chipping and breaking (e.g. as a result of vandalism - shooting or rock throwing). When this occurs there is a breakdown of the insulating properties and capability of the insulator leading to current tracking from the insulator to ground, failure of the asset and network protection operating.

Older brown coloured 22 kV insulators that may develop a breakdown of the insulation properties and cause current tracking from the conductor through the pole to earth under certain conditions. When these insulators are identified during maintenance work they are replaced and disposed of.

Pollution such as salt, dirt, mineral dust from around industrial and mining sites, can cause a breakdown in the insulation property of the insulator and cause current tracking from the conductor through the pole to earth under weather conditions during long dry spells. Washing, cleaning or applying pollution deterrent products can reduce the impact.

In salt environments, coastal regions, where salt pollution is present, rusting and expansion of the insulator mounting pins can cause cracking or deterioration of the porcelain insulators.

CONFIDENTIAL

The proposed expenditure is greater than historical spend due to Aurora proposing to increase the importance of this program due to data analysis indicating HV insulators to be a prominent cause of outages and pole top fires.

6.4.21 Replace/Relocate HV due to Vegetation Issues

The aim of this program is to address the issue of high vegetation maintenance costs in certain areas. Historically, there have been cases where it is more efficient to relocate assets around vegetation rather than managing the vegetation near the assets such as areas where vegetation is protected (national parks) or where there are community or environmental considerations or where there are onerous vegetation management requirements due to bushfire risk management.

This program has been in place for a number of years but as part of Replace HV Feeders (Safety) and Fire Mitigation asset replacements.

There are no major changes to this program and the proposed expenditure is to remain consistent with historical spend.

6.4.22 Replace HV Feeders (Safety)

This program covers situations where spans of HV conductors are required to be moved or replaced because their location or condition poses a safety risk. The safety issue is resolved by relocating, undergrounding or augmenting the HV conductor.

Historically this program has included the copper and GI conductor, however replacement of these conductors has been moved into separate programs to allow for targeted replacements.

The proposed expenditure of this program, the replacement of copper conductor and the replacement of GI conductor is to remain consistent with historical spend.

6.4.23 Replace HV Live Line Clamps (Safety)

The aim of this program is to replace HV live line clamps with D Clamps.

CONFIDENTIAL

This is a new program to address the size of the defect pool and the risk of conductor failure.

6.4.24 Replace/relocate HV OH (Low Clearance) (REHCR)

This program covers the relocation or replacement of HV overhead conductor to address low clearance associated with road crossings and plant contact that cannot be repaired under the reactive maintenance program (section 6.3.5) such as the installation of a pole to fix the clearance issue.

Low HV conductors pose a significant public safety risk and are addressed as soon as possible.

CONFIDENTIAL

There are no major changes to this program and the proposed expenditure is decreased compared to historical spend.

7. SPECIFIC ISSUES

7.1 Fire Mitigation

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Based on analysis of Aurora's asset fire starts (reference 12), this program has three components:

1. Replacing EDO fuse tubes at transformer sites in high and very high fire danger areas;

2. Replacing EDO fuses with fire safe alternatives (such as Boric Acid fuses) at control stations in high and very high fire danger areas; and
3. Undertaking bushfire mitigation works on HV and LV overhead conductor in high and very high bushfire areas.

For more detailed information regarding each of these programs, see NW-#30043347 *Management Plan Bushfire Mitigation (Asset Programs)* (reference 9).

There have been changes to the focus of this program following analysis of asset fire starts and the proposed expenditure is greater than historical spend to reflect this change.

7.2 Endangered Species

The separation distances between the conductors and components of the pole top are generally sufficient to prevent current flowing onto the pole or structure and down to the ground. However, there are birds and animals that inadvertently bridge this gap and are electrocuted causing electrical protection to operate and thus affecting supply to customers.

Ground animals such as possums climb on to poles and birds such as swans, geese, water fowl, raptors and crows can collide with power lines. On collision, these animals will get electrocuted and sometimes protection systems will operate to de-energise the line, which can cause interruption of supply to customers.

Bird collisions are more likely to occur where power lines are erected across flight paths, from roosting or nesting areas to feeding areas. Other high risk areas are close to bushland.

Certain birds like eagles, hawks and kites tend to use poles and cross arms to perch and survey the surrounding area to hunt and prey. Poles located on the brow of a hill overlooking wide grassy areas or opposite water are very probable perching sites. Also, poles situated in flat open areas where the pole is the only tall structure.

Aurora has an agreement in place with the Department of Parks and Wildlife to install bird perches and insulate the tops of steel lattice towers in endangered species nesting areas to reduce the risk of electrocution. Areas and poles for treatment are identified in conjunction with the Department before work is undertaken.

8. REVIEW OF HISTORICAL PRACTICES

Aurora's asset management practices on the overhead and structures asset classes have been stable for a number of years. However, although there is a robust condition based replacement process for structures, condition based replacements of overhead assets can be improved. Better understanding of the condition of the overhead assets is required; hence the historic inspection process will be reviewed to support this.

Review of operational expenditure on the overhead and structures asset classes has shown that asset repairs on the overhead system are increasing at an unsustainable rate. The main contributor to this appears to be Aurora's spending on asset defect repairs, prompting a review of Aurora's defect management processes. Structures operational expenditure remains fairly stable albeit slowly increasing with the increasing number of assets.

Review of capital expenditure on the overhead and structures asset classes has shown that overhead conductor replacement due to condition has increased significantly. However, the impact of these replacement programs can be seen in Aurora's system performance with a decrease in the contribution of conductor related outages.

Unfortunately connection failures, insulator failures, switchgear and pole top fires remain fairly consistent. These failures are the driver for a number of new focuses.

9. PROPOSED OPEX PLAN

It is proposed to continue the current asset management practices without significant change however, to focus more effort on asset inspections to improve our understanding of the condition of overhead assets.

Table 12 shows the 2009/10 actual OPEX spend on the overhead asset class, the proposed 2010/11 spend and the proposed OPEX spend in the next regulatory period.

Table 12 Overhead Asset Class OPEX Spend ($M)

	2009/10	2010/11	2012-2017
	Actual	**Proposed**	**Proposed**
Asset Inspection	0.2	0.7	0.4
Maintenance	0.5	0.6	0.9
Repair	3.8	3.2	2.9

The differences in expenditure in Table 12 are due to:

- Efficiencies and refinements of the asset inspection programs leading to a decrease in asset inspection spend;
- Increase in the amount of track maintenance being undertaken leading to an increase in maintenance spend; and
- The removal of some asset repair programs into other targeted programs leading to a decrease in asset repair spend.

Table 13 shows the 2009/10 actual OPEX spend on the structures asset class, the proposed 2010/11 spend and the proposed OPEX spend in the next regulatory period.

Table 13 Structures Asset Class OPEX Spend ($M)

	2009/10 Actual	2010/11 Proposed	2012-2017 Proposed
Asset Inspection	4.2	3.6	3.8
Maintenance	0.0002	0.02	0.2

The differences in expenditure for the structures asset class in Table 13 are due to the creation of new leaning pole program leading to an increase in maintenance.

10. PROPOSED CAPEX PLAN

Figure 5 below shows the outputs of a capital expenditure model for the overhead system, taking into account condition, risk and age. The model forecasts capital investment of $480M over the next regulatory period, using Aurora's chosen asset lives. Using the regulated asset life of overhead lines increased the forecast capital expenditure to $650M.

Aurora's proposed capital expenditure for the next regulatory period is $70M.

This spend is significantly less than the model forecast due to Aurora's risk and condition based approach to asset replacement and maintenance, which is targeting specific asset failures as opposed to doing a general replacement.

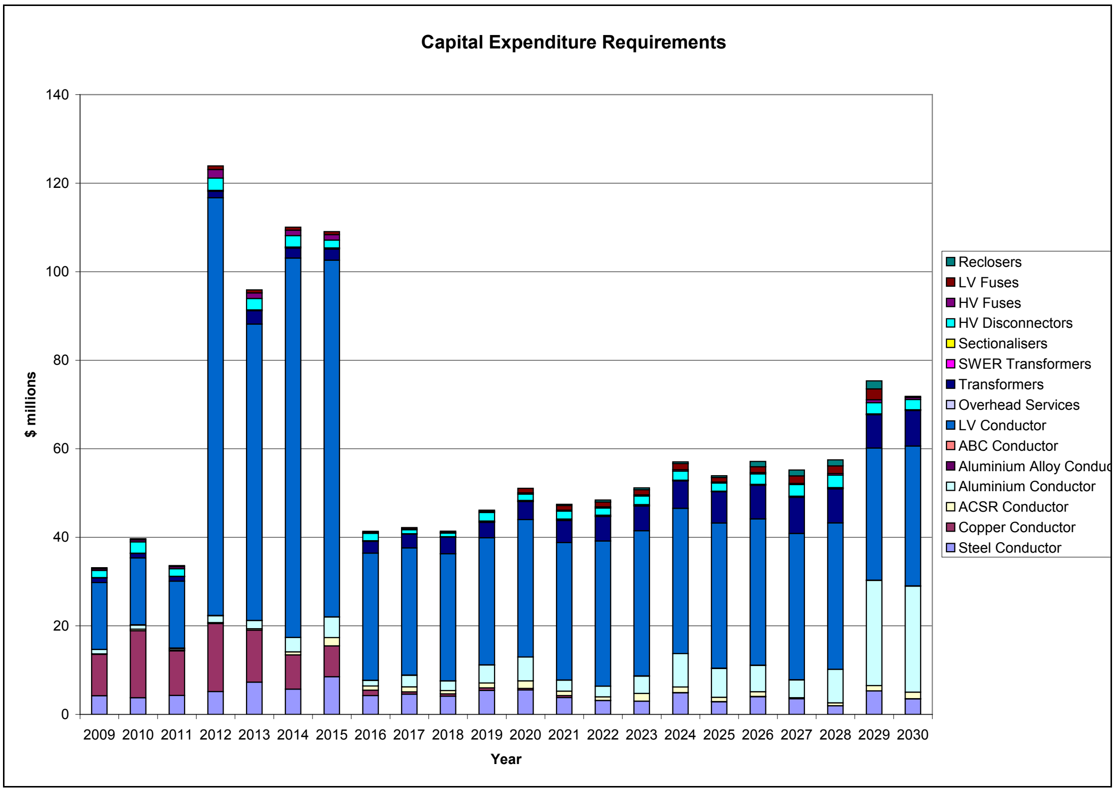

Figure 5 Overhead System CAPEX Model Output

Table 14 shows the 2009/10 actual CAPEX spend on the overhead asset class, the proposed 2010/11 spend and the proposed CAPEX spend in the next regulatory period.

Table 14 Overhead System CAPEX Spend ($M)

	2009/10 Actual	2010/11 Proposed	2012-2017 Proposed
Conductors - LV (condition)	1.3	1.4	0.9
Conductors - HV (condition)	5.8	3.9	3.2
Conductors - Compliance	2.3	2.7	2.4
OH Switchgear	0.4	0.8	1.3
OH Substations	3.1	3.7	2.4

The differences in expenditure in Table 14 are due to:

- Efficiency improvements in work scheduling and tasks leading to an overall decrease in all CAPEX programs;
- An increase in the switchgear program to address operational and fire start issues with HV EDOs.

Figure 6 below shows the outputs of a capital expenditure model for the structures asset class, taking into account condition, risk and age. The model forecasts capital investment of $290M over the next regulatory period.

Aurora's proposed capital expenditure for the next regulatory period is $49M.

This spend is less than the model forecast due to Aurora's risk and condition based approach to asset replacement and maintenance that has shown the number of pole failures in service in not increasing.

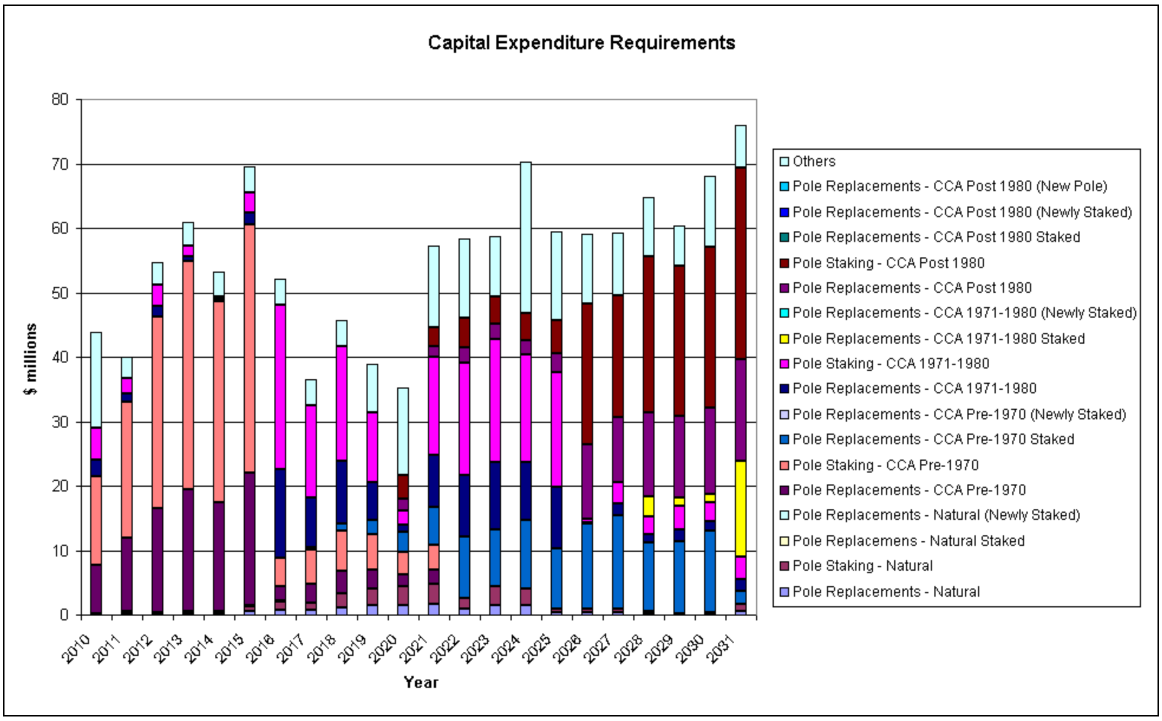

Figure 6 Structures CAPEX Model Output

Table 15 shows the 2009/10 actual CAPEX spend on structures, the proposed 2010/11 spend and the proposed CAPEX spend in the next regulatory period.

Table 15 Structures CAPEX Spend ($M)

	2009/10	2010/11	2012-2017
	Actual	Proposed	Proposed
Pole replacement	7.8	6.4	7.1
Pole staking	1.7	1.4	1.4

The differences in expenditure in Table 15 are due to a forecast increase in pole replacements due to aging pole population.

11. CAPEX–OPEX TRADE OFFS

Structures:
Inspection OH - (& treatment) Structures (3.5 year cycle) (OPEX) has a direct impact on Replace Condemned Pole (CAPEX) and Install pole stake - Reinforce ground line of unserviceable poles (CAPEX). By inspecting the poles replacements can be made based on condition and preventative treatment can be applied to prolong the life of the poles.

Sample inspection and treatment of steel towers (OPEX) and Repair Steel & Concrete Poles (OPEX) have a direct impact on Maintenance OH - Reinforce below ground portion Tower leg (CAPEX).

Overhead:
Asset inspection of feeders in high fire danger areas (OPEX) and Asset Repair - Fire Mitigation (Restrain conductors, install spreaders) (OPEX) have

a direct impact on Undertake HV and LV overhead conductor fire mitigation works in very high and high fire danger areas (CAPEX). Inspections are performed so work can be undertaken on defects based on priority that have potential to start a fire over the upcoming fire season. By undertaking asset repairs such as restraining conductors it defers the capital costs of replacing conductors.

Asset Repair OH Switchgear (OPEX) has a direct impact on Replace OH Switchgear - Replace sectionaliser - ABB and AK (CAPEX). By undertaking asset repairs it can defer the capital costs of replacing the switchgear.

Maintain OH Switchgear- Reclosers and Fault Indicators (OPEX) has a direct impact on Replace Nulec Recloser & or Control Box (CAPEX). By undertaking maintenance on reclosers and fault indicators it can defer the capital costs of replacing them.

Maintain Access Track (OPEX) has a direct impact on Access Track Create and Rebuild (CAPEX). By maintaining access tracks it reduced the need to recreate the tracks for future access.

OH Transformers inspection & monitoring (earthing) (OPEX) has a direct impact on Replace Transformer Earths (CAPEX). This allows Aurora to replace transformer earths based on condition rather than age. This is for safety and to remove the risk of the unnecessary replacement of earths.

Insulator washing & pollution mitigation (OPEX) has a direct impact on Replace HV Insulators (CAPEX). Although the main driver behind insulator washing is to prevent pole-top fires, by washing insulators in areas of pollutant build up it prolongs the life of the insulators deferring the capital cost of replacement.

OH system feeder inspections (switchgear, conductor, feeder - aerial and ground) (OPEX) and OH System asset repair (defects) (OPEX) have a direct impact on the following CAPEX programs; Replace HV Feeders (Safety), Replace LV Fdrs (safety),
Replace LV Feeders (Substandard), Replace LV links with fuses to address public safety, Replace Transformers (leaking/condition), Replace Transformers Neutral

Replace HV Live Line Clamps (Safety), and Replace all complete EDO at site due to obsolete equipment. By undertaking feeder inspections replacements can be made based on condition and where appropriate repairs can be made on defects to defer the capital costs of replacement.

12. ASSET MANAGEMENT INFORMATION

Aurora maintains records of overhead assets through the periodic routine testing and inspection programs providing the following information. The equipment details and attributes are predominantly recorded within FRAMME / WASP. These being the two integrated asset management systems, however there are smaller data-sets in MS Access and Excel that currently store other information relating to the asset and its condition.

Recorded information includes:

- Identification number (unique identifier),
- Location / site / geographical details;
- Asset / equipment details (size, make, model, type, rating, installed date;
- Equipment attributes and operational numbering;
- Operational details (connectivity, protection and equipment settings, number of operations - trips, trip and lockouts etc)
- System performance details (reliability, causes, power quality recorded data etc);
- System monitoring information / data (load – cyclic, maximum demand, load balance);
- Asset condition data and remaining residual life (general and limited);
- Oil condition, contamination levels;
- Age of asset and components, installed / refurbished date;
- Age of related equipment;
- Unit rates or agreed costs i.e. inspection, treatment refurbishment and replacement costs;
- Maintenance details / action;
- Maintenance program progress; and,
- Maintenance history (general and limited).

Data to and from the field is managed electronically enabling frequent updating of the data in our integrated GIS and asset database.

13. RESPONSIBILITIES

Maintenance and implementation of this management plan is the responsibility of the Thread Leader – Overhead System and Structures.

Approval of this management plan is the responsibility of the Group Manager – Asset Performance and Information.

14. REFERENCES

1. Management Plan 2011: Ground Mounted Substations (NW-#30160765)
2. ENA Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines (C(b)1)
3. Incospec Needles Tower Line inspection 2006 (NW-10238018)
4. REGMI – Replace GI – Failure Analysis (NW-#30098436)

5. Network Policy: Inspection and Maintenance of Distribution Overhead Lines (NN R AM 05)
6. Network Procedure: Pole Inspection and Maintenance (Part 1 – Wood Poles) (NP R AM 27.1)
7. Structures: Annual Equivalent Calculation (NW-# 30103252)
8. Network Policy: Wood Pole Reinstatement by Ground-Line Reinforcement (NN R AM 11)
9. Bushfire Mitigation (Asset Programs) Management Plan (NW-#30043347)
10. Distribution Protection Review – Hill Michael Report (NW-#30093787)
11. Substandard Conductor Audit Spreadsheet (NW-#30128007)
12. Fire Analysis (NW-#30111032)
13. Structures – Annual Equivalent Calculation (NW-#30103252)
14. AS 3891.1-2008 Air navigation - Cables and their supporting structures - Marking and safety requirements - Permanent marking of overhead cables and their supporting structures for other than planned low-level flying
15. AS 3891.2-2008 Air navigation - Cables and their supporting structures - Marking and safety requirements - Marking of overhead cables for planned low-level flying operations
16. Electrical Transitions Act 1996
17. Electrical Easements Act 2000
18. Occupational Licensing Act 2005
19. The National Greenhouse and Energy Reporting Act 2008
20. EW-M12-01 Disposal of SF_6
21. National Environment Protection Management Measure (NEPM)
22. Environmental Management Pollution Control Act 1994
23. EM-M09 Management of PCB’s
24. Australian and New Zealand Environment and Conservation Council (ANZECC) Polychlorinated Biphenyls Management Plan
25. TAS Environmental Protection & Pollution Act 1994
26. NEPM standards Act
27. AS2067 Substations and high voltage installations exceeding 1 kV a.c.
28. ENA EG-0 Power System Earthing Guide

Appendix A Age Profiles

A.1 Age of Condemned/Failed Poles (from 2000 to 2010)