RIN05

Repex model description

Ausgrid

Content

1 INTRODUCTION

Purpose

In this attachment Ausgrid provides information relevant to the application of the Australian Energy Regulator's (AER) replacement assessment approach (repex model). The purpose of Ausgrid in providing this information is to:

- satisfy its compliance obligations relating to each of the repex model questions set out in Section 5 of Schedule 1 to the AER's Reset Regulatory Information Notice (RIN)
- provide additional information which is not required by the Reset RIN but which Ausgrid considers will aid the AER in performing its regulatory functions.

The repex model is a series of MS Excel workbooks developed by the AER which, when populated, can provide guidance about an electricity distributor's replacement needs.

Ausgrid considers the repex model to be a useful tool. In recognition of this, Ausgrid has integrated it into its internal planning processes. Ausgrid considers the repex model is a high level validation of the engineering analysis used to establish the replacement volumes and expenditure required to safely and reliably operate its electricity network.

In accordance with the AER's *Expenditure Forecast Assessment Guideline*[1], Ausgrid expects that the AER will have regard to its repex model when assessing its forecast replacement capital expenditure for the 2019-24 regulatory control period. This attachment has been prepared in line with this expectation.

As well as satisfying its obligations under the Reset RIN, Ausgrid expects this attachment will provide the information needed to apply, calibrate and interpret the repex model in a way that is appropriately adjusted to Ausgrid's circumstances.

The structure of this attachment is as follows:

- Introduction (section 1)
- Ausgrid's approach (section 2)
- Asset categorisation (section 3)
- Age profile (section 4)
- Drivers and unit costs (section 5)
- Asset replacement statistics (section 6)
- Appendix A: Description of assets
- Appendix B: Main replacement drivers
- Appendix C: Factors impacting network replacement expenditure requirements
- Appendix D: Compliance checklist against Schedule 1 of Reset RIN.

[1] AER Expenditure Forecast Assessment Guideline 2013, November 2013

2 AUSGRID'S APPROACH

Ausgrid's approach to managing its assets is designed to promote the long term interests of its customers, shareholders, people and communities by delivering three key goals:

1. Safety – improve safety performance for the public, customers and workers
2. Reliability – maintain current levels of network reliability and security
3. Sustainability – ensure business sustainability by making it efficient, affordable and competitive so that it can meet future challenges.

Ausgrid's asset management system effectively manages the electricity network and related assets through the complete asset life cycle. To achieve its required outcomes Ausgrid's decision making framework employs risk management techniques in order to provide an appropriate balance of risk, cost and performance that meets the needs of its customers and stakeholders.

In applying the principles of asset management to develop its maintenance strategies Ausgrid uses Failure Mode Effect and Criticality Analysis (FMECA) to assess the effects and consequences associated with asset failure. Based on risk analysis Ausgrid will eliminate safety hazards 'so far as is reasonably practicable' (SFAIRP), if it is not reasonably practicable to eliminate safety hazards reduce them to as low reasonably practicable (ALARP) in-line with legislative and regulatory obligations. Ausgrid's decision making is aimed at meeting the needs of its customers and stakeholders and promotes the objectives of the National Electricity Objective (NEO).

During the operating and maintain phase of an asset's lifecycle, Ausgrid undertakes inspection, testing and condition monitoring to assess whether the assets are performing correctly. This activity will also identify whether there are any potential defects which may require rectification. Ausgrid also undertakes preventative maintenance tasks, which are aimed at preserving asset functionality and condition integrity. These tasks are generally low cost and undertaken in conjunction with inspections, testing and condition monitoring. Ausgrid's planned maintenance program utilises Condition Based Maintenance (CBM) to determine whether corrective maintenance (repairs) or capital replacement is required in order to address asset defects (i.e. risk mitigation).

For some asset classes, where the condition is unknown or cannot be determined effectively, age may be used to support the replacement decision. As condition and age both relate to time, this is an appropriate approach when a condition assessment (maintenance) is not effective or efficient.

The replacement decision for some assets is less reliant on failure characteristics and therefore optimal timing for asset replacement cannot be solely reliant on condition. As such, Ausgrid has a number of asset replacement programs driven by emerging issues unrelated to the condition of the asset. These programs target assets with inherent design deficiencies and/or configuration issues.

Ausgrid does, where appropriate, analyse the failures of transformers (zone and STS only), 11kV switchboards and 132kV self-contained fluid filled (SCFF) cables to assign a specific probability distribution to inform replacement. Other assets continue to be managed with an industry accepted replacement assessment approach. With the availability of greater data and further analysis, Ausgrid will consider applying a probability distribution to support replacement needs for additional assets. Refer to Ausgrid's Replacement Attachment 5.09 for further details on our approach.

3 ASSET CATEGORISATION

The repex model requires Ausgrid's asset base to be broken down into a number of discrete categories as defined in the RIN reporting requirements. This categorisation is required to reflect variations in asset lives and unit costs between different asset types.

Information about each individual asset category corresponding to the asset groups set out in the AER's repex model template is addressed below. Among other things, this includes a description of boundary issues and the assumptions made to determine age profile quantities set out according to the description of each asset category in Appendix A. Information detailing the exact data extraction methodology and processing (i.e. the detailed asset categorisation required for reporting) is contained within Ausgrid's Annual RIN Basis of Preparation (BOP) documentation[2].

3.1 Boundary issues

At the highest level the information contained within the repex model excludes all privately owned assets and those covered by alternate control services.

The generalised descriptions in Table 1 and Table 2 serve as a summary of the significant inclusions and exclusions. Ausgrid has detailed information of the categorisation in its Annual RIN Basis of Preparation (BOP) documentation[2].

The repex model relies on three key inputs:

1. Age profile,
2. Expenditure, and
3. Volume replaced.

Ausgrid has the following broad boundary issues:

- Asset categories can be a mix of linear and discrete assets (i.e. measured in kms or units);
- Ausgrid has a number of programs for which there is no asset category. These include civil assets, earthing systems and smaller electrical assets such as bushings and surge arrestors;
- A number of programs relate to meeting compliance obligations such as environmental legislation (oil containment) and licence conditions (under frequency load shedding) unrelated to the age of the asset; refer to Appendix B: Main replacement drivers for additional detail;
- Not all assets are replaced "like for like", which affects in particular, the expenditure related to the replacement;
- Ausgrid has a number of life extension related programs which do not lead to the retirement of the existing asset; refer to Appendix C: Factors impacting network replacement expenditure requirements for additional detail;
- A single RIN category may capture a wide range of varying assets with significant differences in cost;
- Some programs overlap into multiple RIN categories requiring an allocation of expenditure and volumes replaced to be apportioned to the appropriate RIN category i.e. a kiosk replacement includes switchgear and transformer assets; and,
- Replacement of discrete components of a complex asset for example pillars along a distributor, are not always included in the volume of pillar replacements when the

[2] Basis of Preparation 2016/17 Response to Category Analysis RIN, October 2017

project being undertaken is the replacement of the distributor. As a result the age profile may not align to the annual volumes replaced.

Detailed allocation of historical and proposed expenditure and volumes replaced are not included within this document, however, these can be provided upon request.

Repex Model categories

These asset groups for the majority of associated expenditure are applicable for modelling with repex due to their materiality and degrading condition that can be correlated to varying degrees with an age based approach such as repex.

Table 1 - Boundaries issues for repex model asset groups and categories

Asset	Includes	Excludes
Poles	All Ausgrid owned poles (including stay poles) used to deliver network services. All Ausgrid owned towers and tower components including foundations. Asset categories are assigned by operating voltage and material type as required.	Dedicated public lighting poles, ground anchors and private poles. Conductors and feeder earthing assets are covered in other RIN categories.
Pole top structures	All Ausgrid owned cross arms, insulators, terminations mounted on poles to deliver network services are counted as a single pole top structure per pole. Asset categories reflect the operating voltages. Includes stay wires for ground stay poles.	Overhead conductor components or any other asset (air break switches or links, reclosers, transformers etc.) attached to the pole.
Staking wooden poles	All Ausgrid owned wooden poles that are suitable for structural reinforcement using a galvanised steel reinforcing member.	The further reinforcement or replacement of poles that have existing structural reinforcement.
Overhead conductors	All Ausgrid owned overhead conductors used to deliver network services. Asset categories are assigned according to operating voltages.	Private lines, service lines, earthing conductors, spreaders, other conductor fittings, LV dedicated conductors (age profile only), pole top structures or conductors with fibre optic cables which are used for protection or communication functions. Earth wires are also excluded from overhead conductors.
Underground cables	All Ausgrid owned underground cables, joints and terminations used to deliver network services. Asset categories are assigned according to operating voltages.	Underground service cables, cable pits, ducts, pillars, public lighting cables, and fibre optic or copper pilot cables used for protection or communication functions.

Asset	Includes	Excludes
Service lines	All Ausgrid owned overhead service lines and underground service cables which provide a physical link between the distribution network and a customer's premises. Asset categories are assigned according to operating voltage where overhead construction are classified as simple and underground as complex.	Privately owned lines and LV dedicated conductors, as well as 'direct distributor' connections which are large supplies to a customer directly fed from the output of a distribution substation.
Transformers	All Ausgrid owned distribution and subtransmission power transformers, standalone instrument transformers such as current transformers or voltage transformers, 132/66kV bushings and power reactors (one per phase). Asset categories are assigned according to configuration as required.	Instrument transformers such as current transformers or voltage transformers where they are incorporated into other assets e.g. instrument transformers within switchgear. Reactors contained within customer load control injection equipment.
Switchgear	All Ausgrid owned high voltage and low voltage circuit breakers, ring main and fuse switch units, isolating / earthing switches, air break switches, enclosed load break switches, reclosers, sectionalisers, links (substation, overhead and underground) and fuses. Asset categories are assigned according to operating voltages and type.	Excludes switchgear covered in other RIN categories.
Public lighting	Classified as an Alternate Control Service and not modelled using repex.	
SCADA, Network Control and Protection Systems	All Ausgrid owned protection, voltage regulation and control relays, Supervisory control and data acquisition (SCADA) remote terminal units (RTUs), fibre optic / copper pilot cables used for protection and / or communications functions, batteries and battery chargers, customer load control injection equipment, wholesale metering points and SCADA master station assets.	DC systems, the panels etc. on which relays are mounted, local SCADA control boards / terminals in substations and secondary wiring for these assets.

Other asset categories

These categories for the majority of associated expenditure are not applicable for modelling with repex as they do not align to the current asset category definitions or are not replaced due to condition issues and therefore cannot be correlated to age as they are driven by compliance requirements such as WHS or environmental legislation.

Table 2 - Boundaries issues for Other asset categories

Asset	Includes	Excludes
Distribution substations	All Ausgrid owned distribution substation housings, refurbishment of pole substations, buildings and grounds and other electrical assets not covered by other RIN asset categories. Programs mapped to this category are predominately civil related.	Distribution substation assets covered in other RIN categories.
Distribution voltage regulation	All Ausgrid owned assets which provide voltage support (power factor correction by pole capacitors or voltage correction by voltage regulators) to the 11kV distribution network.	Tap changers in transformers / capacitor banks in zone or subtransmission substations.
Overhead conductors	All Ausgrid owned subtransmission feeder overhead earth wires and reactive overhead work which could not be mapped back to a single asset category.	Pole, pole top structures and conductors covered in other RIN categories.
Transformers	All Ausgrid owned neutral earthing resistors and bushings.	Transformers covered in other RIN categories.
Underground cables	All Ausgrid owned underground 11kV duct lines located in the Sydney central business district, pillars and reactive underground work which could not be mapped back to a single asset category.	Underground cables covered in other RIN categories.
Zone and subtransmission substations	All Ausgrid owned zone and subtransmission civil structures such as fencing, roofing, earthing, buildings, fire systems, cable covers and lightning spires. This also includes assets not covered by a RIN category such as surge arrestors and earthing equipment. Reactive replacement projects and a portion of Area Plan projects which could not be mapped back to a RIN category are also included.	Zone and subtransmission substation assets covered in other RIN categories.
Land (i.e. strategic system property)	System land associated with replacement projects.	Non-system land and system land associated with other drivers.

Asset	Includes	Excludes
Distribution substations – not age related	All other distribution civil and environmental assets and programs not related to the age of the asset such as fire doors and asbestos related works.	Distribution substation assets covered in other RIN categories.
Overhead conductors – not age related	This includes overhead assets that are impacted during extreme weather/storm or bushfire conditions or natural disasters. Access tracks work for 33kV and 132kV lines are also included in this category.	Overhead conductor assets covered in other RIN categories.
Zone and subtransmission substations – not age related	All Ausgrid owned zone and subtransmission substation WHS, environmental or compliance work such as fire mitigation, asbestos, oil containment, security and low gas alarm refurbishment work. This also includes a portion of reactive WHS works such as electrical safety and infrastructure risk.	Zone and subtransmission substation assets covered in other RIN categories.
Field devices – not age related	All Ausgrid owned protection devices for optical arc fault detection and under frequency load shedding compliance related programs.	Field device assets covered in other RIN categories.
Underground cables – not age related	All Ausgrid owned underground cable reactive health, safety or environmental work including asbestos related works.	Underground cables and assets covered in other RIN categories.

4 AGE PROFILE

Ausgrid applied a range of assumptions to determine age profile quantities and these are summarised in the following sections. Assumptions can generally be applied across all asset categories for a given asset group. Where assumptions are specific to an asset category this is noted.

Mean and standard deviations used in the RIN for input into the repex model are calculated using individual asset volumes removed from service. Whilst this approach has the ability to model a large proportion of assets on the network, there are other more appropriate methods for specific assets; zone and STS substation transformers, 11kV zone substation switchboards and 132kV SCFF cables all have failure modelling and failure characteristics with more accurate prediction models.

Unless otherwise noted asset age and volumes used to generate the age profiles are sourced from either the geographic information system (GIS) or the enterprise asset management database (SAP). Information detailing the exact data extraction methodology and processing (i.e. the detailed asset categorisation required for reporting) is contained within Annual RIN Basis of Preparation (BOP) documentation[3].

4.1 Poles

The asset age profile for poles includes all Ausgrid owned assets of this type – age data has been sourced from SAP. Public lighting poles are able to be separated from 'Poles' in SAP and have been separated into the 'Public lighting' asset category. Towers are also included in this category.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Pole data does not include poles or towers held in store or for spares
- Poles with an installation date prior to 1980 have been assumed to have an age based on a suburb age methodology due to the absence of pole discs on most poles pre-1980 , and that records of installation were not retained prior to the late 1990s. Whilst this is assumed to provide a relatively good estimate of the global population profile, individual and local population ages can be inaccurate
- Pole voltage data has been categorised by the highest conductor voltage on the pole. For example, if a pole carries 33kV and 11kV conductors then the pole will be assigned as a 33kV pole.

4.2 Pole top structures

The asset age profile for pole top structures only includes the information in regard to the pole top structures associated with Ausgrid owned assets of this type – age data has been sourced from GIS. There are many variations for a pole top structure installation on a pole in Ausgrid which provides a very challenging process of recording the volume and age of the pole top structures and has only been recently applied.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

[3] Basis of Preparation 2016/17 Response to Category Analysis RIN, October 2017

- A pole that has multiple circuits of the same voltage is assumed to only have one cross arm for that circuit voltage
- Poles that have aerial bundled (ABC) conductors installed have been assumed to have only one cross arm for that conductor voltage
- The asset age for pole top structure will be assumed to be the same as the associated pole it is installed on
- Additional pole top structures like supports for protection assets have not been included as Ausgrid does not record asset information to a granular level of detail for this type of pole top structure. Pole top substations are addressed elsewhere.

4.3 Staking wooden poles

The asset age profile for staking wooden poles only includes the information in regard to the Ausgrid owned assets for poles that have been reinforced with what Ausgrid refers to as a 'nail' or 'splint'. The master data for these assets does not currently contain the date of installation of the nail (stake). This category also includes towers that have been refurbished.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Pole age is obtained from the 'notification' data in SAP (i.e. the record of work for the 'nailing' activity)
- Tower age is obtained from the 'notification' data in SAP (i.e. the record of work for the refurbishment)
- The remaining pole assets for which an installation date cannot be determined have been evenly assigned an installation year between 1997 and 2002, as this is the period for which pole nailing (staking) was in effect in Ausgrid but prior to the installation data being stored within the assets system
- Staking wooden poles data does not include assets (and components) held in store or for spares.

4.4 Overhead conductors

The asset age profile for overhead conductors only includes the information in regard to the Ausgrid owned assets – age data is sourced from GIS. Ausgrid does not record asset information to a granular level of detail for spreaders or other conductor fittings. Service lines, public lighting conductors and fibre optic pilot cables are able to be separated from 'conductors' in SAP and have been separated in the asset category age profile information as explained in section 3.1.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Conductor data does not include conductors held in store or for spares.

4.5 Underground cables

The asset age profile for underground cables only includes the information in regard to the Ausgrid owned cables and age data has been sourced from GIS. Pits, joints, pillars and terminations are not included. It is assumed that the cable age profile is indicative of the age profile of these components as they were mostly installed at the same time as the cable.

Service cables, public lighting cables and pilot cables are able to be separated from 'underground cables' in SAP and have been separated in the asset category age profile information as explained in section 3.1.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Underground cable data does not include cables held in store or for spares.

4.6 Service lines

The age profile for service lines was obtained by extracting asset information for Ausgrid owned services (those not identified as private installations), and age data is sourced from GIS. Where multiple segments of service line supply the one customer, these are still only counted as one service. This GIS information is merged with customer information retrieved from the Metering Business System (MBS) via the National Metering Identifier (NMI) of the supply point connected to the service line. The customer type attributed to the NMI in MBS was then used to classify the service line allowing distinction of those that are for residential or commercial/industrial connections.

Commissioning dates attached to the service line in GIS have been used to determine the installation year, however, in the absence of data for this, the installation date of the corresponding meter in MBS has been used. Where the installation year has been provided as prior to 1911, the count of services has been redistributed proportionately to the years from 1911 to 2000. All service lines have been classified as simple type, as the classification of complex type is related to the actions undertaken during the original connection and thus have no relevance to its classification in situ. However, the data has been broken down into sub-categories to distinguish overhead and underground services.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Where multiple segments of a service line supplies one customer, these segments are counted as a single customer
- When commission dates for a service line are not available, Ausgrid assumed that a service line is the same age as customer's meter
- Where an installation year provided is prior to 1911, the count of services has been redistributed proportionally to the years from 1911 to 2000.

4.7 Transformers

The asset age profile for transformers includes all Ausgrid owned assets of this type and age data has been sourced from SAP.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Transformer data does not include transformers held in store or for spares.

4.8 Switchgear

The asset age profile for switchgear includes all Ausgrid owned high voltage and low voltage circuit breakers, ring main and fuse switch units, isolating / earthing switches, air break switches, enclosed load break switches, reclosers, sectionalisers, links (substation,

overhead and underground) and fuses in accordance with the RIN Appendix F Definitions. The age data has been sourced from SAP.

Where the switchgear is constructed from separate major components the age profile is based on the primary switching component (e.g. circuit breaker).

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- Switchgear data does not include switchgear held in store or for spares.

4.9 Public lighting

The category for Public Lighting is not modelled with repex as it is classified as an Alternative Control Service.

4.10 SCADA, Network Control and Protection Systems

Age profile data for SCADA, network control and protection includes all Ausgrid owned assets of these types. Some data in this category is not currently retained in any asset system. SCADA, network control and protection devices have previously not been modelled with repex. Age profiles for this asset category is submitted to enable these assets to be benchmarked using repex. Electromechanical protection devices have been separately identified from non-electromechanical (modern) protection devices (electronic, digital) since these devices have significantly different design lives and age profiles.

The following assumptions were applied in addition to the asset descriptions in Appendix A and boundary definitions defined in section 3.1 to determine age profile quantities:

- For RTUs, data for assets with a commissioning date prior to 1985 is considered inaccurate as they were mostly likely aligned to control system assets which had been replaced. Assets commissioning dates prior to 1985 have been allocated based on historical contract data available and distributed across the years from 1985 to 1995 - the period for which SCADA retrofits to existing substations were undertaken.
- The total length of optical fibre has been obtained from the PNI database. The profile used in the Reset RIN submission for optical fibre was retained for years up to the previous RIN, but with the total quantity differential being accounted for in the reporting RIN year. Previous years were estimated based on a fibre optic rollout program which commenced in FY2005.
- The asset age profiles for copper pilots have been determined from GIS.
- The age profiles for master station assets have been obtained from the actual equipment acquisition dates retained in purchasing documentation.
- Local network wiring assets include all secondary wiring in a major substation including power supplies to secondary equipment. Estimation was done by breaking assets into multicore and single core wire, estimating lengths for each substation based on the ‘scaling factor’ for each substation, and then applying the substation age to achieve a profile.
- Communication site infrastructure information has been obtained from a list of Ausgrid radio sites installed in the reporting year.

4.11 Other

Ausgrid is able to generate age profiles for some asset groups included within Other. However, as described above, assets within the category of Other either:

Do not align to the current repex category definitions, such as civil assets;

Are not suitable for repex analysis as they do not relate to the degradation of the asset i.e. 'not age related' and can generally be attributed to compliance requirements under WHS and environmental legislation;

As such while an age profile is provided, this is not used in undertaking repex analysis.

5 DRIVERS AND UNIT COSTS

Detailed information related to the drivers and unit costs including historical performance and strategic direction are captured within its capex Attachment 5.13 and 5.14. Further information regarding the nature of the activity undertaken for each unit of expenditure is included in these attachments corresponding to the asset category level project or program of work.

5.1 Drivers of replacement

The main drivers of replacement for each of the asset categories modelled under repex are summarised in Appendix B: Main replacement drivers. The drivers of replacement for each asset category are typically consistent for the majority of asset categories within each asset group. The replacements associated with major projects, generated from the area planning process, are described in Attachment 5.01 Description of proposed capital expenditure and subsequent attachments.

Asset condition largely drives replacement decisions and considers asset metrics including age, environmental factors, inspection, test results and technical engineering risk assessment. The risk factors associated with asset condition will depend on each asset and can also be a function of the asset location. For example consideration of the asset location when assessing the risk of initiating a bushfire will be a function of the asset location in relation to the declared bushfire prone vegetation areas.

Obsolescence can drive asset replacement and considers lack of service, support and spares, typically due to changes in the IT infrastructure, technology and functionality, as well as evolving business needs. Assets with software and electronic components (typically SCADA and network control and protection equipment) are the primary candidates for obsolescence. This is because they are prone to frequent technology changes and updates to operate as a functioning and interconnected system. Manufacturers will typically only provide support for communication switching equipment for a defined time frame, after which it is more cost effective and better risk management to replace these assets rather than maintain them in service. It is essential that manufacturer support is available, as an operational and well-supported data communications network is important for efficient and secure network operation.

5.2 Changes to replacement drivers

The following paragraphs and Appendix C: Factors impacting network replacement expenditure requirements outline the material changes to the drivers of replacement for the asset groups in the current and forthcoming regulatory periods. The effect of each of the impacts below is detailed at the asset category level in the program justifications found in Attachment 5.13 and 5.14.

5.2.1 Statutory

As a combined transmission and distribution network service provider Ausgrid operates to a number of safety standards so that assets remain in good order and comply with legislative requirements, in particular their health and safety obligations under the WHS Act 2011 and the Electricity Supply (Safety and Network Management) Regulation 2014 (NSW). Ausgrid is also bound to operate by its legislative obligations consistent with the National Electricity Law (NEL) and the Electricity Supply Act 1995 (NSW).

Changes to the National Electricity Rules have impacted our transmission metering replacement forecast. Please refer to Attachment 5.13.I.

5.2.2 Internal factors

A continued focus will be placed on governing the investment program in order to ensure both prudence and efficiency. The governance controls in place manage the scale of the program through risk-based prioritisation, the scope of investment through regular in-field and administrative reviews, and the delivery effectiveness and efficiency through comparative market testing and regular monitoring and reporting.

5.2.3 External factors

Increasing government and industry investment in public infrastructure within NSW will require significant focus to ensure Ausgrid's business activities are planned and coordinated with these public infrastructure investments.

Development in NSW infrastructure is expected to increase economic activity and reliance on Ausgrid's assets, infrastructure and service delivery. Ausgrid will proactively engage with industry partners (including government bodies and industry consortiums) to efficiently deliver robust infrastructure, sustaining economic growth in its major centres, as well as supporting population growth toward almost 6 million people in Sydney.

Annual consumption has stabilised after a period of per customer decline as a result of customer price elasticity, energy efficiency programs, increasing embedded generation, manufacturing decline and other emerging technologies. Customers are more aware of their energy use and have more options available to better manage their energy consumption, and therefore costs.

The cost of solar generation and energy storage technologies are falling, continuing the uptake of embedded generation and also beginning to provide cost effective alternatives to network connection for a small number of customers. The change in energy storage prices will also drive an increase in the availability of reasonably priced electric vehicles (EVs), and either increase asset utilisation or create spot peaks in network demand, depending upon the application of network tariffs and load management systems.

While solar generation within Ausgrid's network area has one of the lowest penetration rates in Australia, government policy with the Solar Bonus Scheme (SBS) drove a rapid uptake of solar generation technology across the state. The financial benefits provided to customers from the SBS ceased on 31 December 2016. This may result in further changes in product selection and technology usage by customers and potentially challenges for Ausgrid considering the potential volume and timing of changes, and the need for a robust network to manage the associated change in power flows.

Changes will be required in the approaches taken to replacement decisions and construction to ensure Ausgrid is able to manage future options while continuing to monitor and operate the network. These changes further reinforce the need to ensure appropriate control and protection is maintained to manage the changing use of the largely unchanged distribution network.

5.3 Unit cost

Replacement unit costs have not been explicitly requested by the AER as part of the Reset RIN. Ausgrid did, however, undertake repex analysis at the asset group and asset category level provided in regulatory RIN template 2.2. This analysis assists in providing a top down evaluation of the proposed capital replacement. While Ausgrid supports the use of repex in

providing a top down evaluation, its application has limitations related to the unit cost inconsistency that affects the model accuracy as:

- Not all replacement needs can be linked to age (or deterioration of asset condition over time),
- The RIN template excludes many asset categories (e.g. non-electrical assets such as fire systems, perimeters and buildings),
- Asset deterioration is rarely linear with age and, while age generally provides a reasonable proxy for condition, in some asset classes (e.g. 11kV fuse switches) inherent design issues, obsolescence and known failure modes result in unacceptable risks which require asset replacement earlier than suggested by age alone, and
- The RIN categories used for repex can represent very broad asset groupings with substantial variation in the asset taxonomy such as installation location and type (overhead or underground) and technology (oil, gas or air insulation).

Based on the items listed above, programs were evaluated to determine which were suitable for repex analysis as detailed in this document. Programs were aligned to the asset groups and asset categories defined in the RIN template to enable consistency and benchmarking.

Ausgrid assumes that the AER will therefore:

- calculate replacement unit costs for each asset category using data provided in regulatory RIN template 2.2, and
- estimate replacement unit cost for the repex model using total replacement expenditure divided by the total replacement volumes as per the repex model calibration and instructions[4].

Generally, expenditure costs included in historic replacement provide for a complete replacement of an asset with its modern equivalent or a substitute asset. Section 3.1 details the broader boundary issues associated with the determination of unit costs within the repex model.

Ausgrid's options assessment draws on accurate data on the costs of different solutions at the unit level. This in turn provides a higher level of confidence on the forecast cost of replacements and in assessing cost benefit trade off at the asset level.

Further unit cost information is provided for all key programs in Attachment 5.13.

[4] AER Replacement Expenditure Model Handbook, November 2013, p. 20.

6 ASSET REPLACEMENT STATISTICS

This section provides an estimate of the proportion of assets replaced for each year of the current regulatory control period. The proportions have been calculated based on the asset definitions and boundary condition issues detailed in this document.

When recording project data, where an augmentation driver exists for projects that include replacement of assets, these projects have been captured as augmentation projects. This can result in some marginal errors in the estimation of asset replacement captured under augmentation projects.

6.1 Replacements due to asset ageing

Ausgrid generally replaces assets based on the asset condition and not age. However, as asset degradation generally relates to exposure over time, age provides for an appropriate substitute for high level forecasting of condition based replacement needs. Age is therefore used as a replacement of condition within this section.

Asset replacement volumes due to asset ageing only include assets replaced under replacement projects. These are consistent with expenditure reported regulatory RIN template 2.2 . The estimate does not include the number of assets that were replaced under augmentation or customer initiated project codes.

Table 3 summarises the volumes of assets replaced due to asset ageing as a percentage of the total asset population. This is reported at the RIN asset group level to average out the variability found when reporting at the RIN asset category level.

Table 3 - Replacements due to asset ageing

Asset	2013-14	2014-15	2015-16	2016-17
Poles	< 1%	< 1%	< 1%	0%†
Pole top structures	0%†	0%†	0%†	0%†
Staking wooden poles	11.4%	5.4%	4.6%	4.2%
Overhead conductors	< 1%	0%†	< 1%	1.1%
Underground cables	3.6%	0%†	0%†	0%†
Service lines	2.1%	2.3%	2.1%	1.8%
Transformers	< 1%	< 1%	< 1%	0%†
Switchgear	1.0%	< 1%	< 1%	< 1%

Asset	2013-14	2014-15	2015-16	2016-17
Public lighting (lamps)	Alternate Control Service.			
Public lighting (poles)	Alternate Control Service.			
SCADA, Network Control and Protection Systems	1.7%	1.3%	< 1%	< 1%
Other	17.4%	6.8%	8.7%	10.2%

† - insignificant replacement proportion.

6.2 Replacement due to other factors

The number of assets replaced due to reasons other than age/condition (i.e. not age related) was calculated by subtracting age related asset replacements volumes from decommissioned asset volumes for each financial year. Where this difference resulted in a net positive volume of decommissioned assets, these were reported as assets replaced for reasons other than condition or age.

Table 4 details the replacement volumes as a percentage of the total asset category volume.

Reporting on the volume of assets decommissioned for some asset classes has been inconsistent and were less than the reported volume of asset replacements due to condition. In these cases, it was assumed that no assets were replaced for reasons other than condition or age.

For some asset categories, the difference between the volume of assets replaced and decommissioned was negative for individual years but positive number for other financial years. This is explained by the misalignment in timing of the reporting between asset replacement and decommissioning. For example, when an asset that has been replaced is physically taken out of service but kept in the store as a spare before being decommissioned in a different financial year. In these cases, the following steps were taken to adjust data and apply an overall average percentage:

Total number of asset decommissioned across the four years (FY14 - FY17) was calculated

Total number of assets replaced due to other reasons across the four years (FY14 - FY17) was calculated

Percentage of total decommissioned assets that are replaced due to other reasons was calculated using the data from the previous steps

This percentage was applied to the number of decommissioned assets to calculate the number of assets replaced due to other reasons for each financial year.

Table 4 - Assets replaced due to other factors

Asset	2013-14	2014-15	2015-16	2016-17
Poles	2.1%	0%†	< 1%	< 1%
Pole top structures	0%†	0%†	0%†	0%†
Staking wooden poles	0%†	0%†	0%†	0%†
Overhead conductors	0%†	0%†	0%†	0%†
Underground cables	0%†	0%†	0%†	0%†
Service lines	0%†	0%†	0%†	0%†
Transformers	0%†	< 1%	< 1%	< 1%
Switchgear	1.1%	< 1%	< 1%	< 1%
Public lighting (lamps)	Alternate Control Service.			
Public lighting (poles)	Alternate Control Service.			
SCADA, Network Control and Protection Systems	0%†	0%†	0%†	0%†
Other	0%†	0%†	0%†	0%†

† - insignificant replacement proportion.

6.3 Additional assets due to network augmentation, extension, development

As indicated above, subsequent drivers are allocated to the remaining costs of a project, once the costs of the primary driver have been removed. The number of replacements in this category are within the limits of data accuracy for the current period due to the low level of expenditure on augmentation, extension or network development.

Table 5 details the replacement volumes as a percentage of the total asset category volume for completeness.

Table 5 - Assets replaced through augmentation, extension, development of the network

Asset	2013-14	2014-15	2015-16	2016-17
Poles	0%†	0%†	0%†	0%†
Pole top structures	0%†	0%†	0%†	0%†
Staking wooden poles	0%†	0%†	0%†	0%†
Overhead conductors	0%†	0%†	0%†	0%†
Underground cables	0%†	0%†	0%†	0%†
Service lines	0%†	0%†	0%†	0%†
Transformers	0%†	0%†	0%†	0%†
Switchgear	0%†	0%†	0%†	0%†
Public lighting (lamps)	Alternate Control Service.			
Public lighting (poles)	Alternate Control Service.			
SCADA, Network Control and Protection Systems	0%†	0%†	0%†	0%†
Other	0%†	0%†	0%†	0%†

† - insignificant replacement proportion and data availability.

6.4 Additional assets due to other factors

No additional assets were replaced due to factors other than network augmentation, extension or development.

APPENDIX A: DESCRIPTION OF ASSETS

Asset	Description
Poles	Vertically oriented assets that provide load bearing structural support for overhead conductors or other lines assets.
Pole top structures	Horizontally oriented structures and their components that provide support for overhead conductors and related assets. Components include cross arms, insulators, terminations and ground stay wire mounted on poles.
Staking wooden poles	Timber structures that support the overhead network which have undergone structural reinforcement using a galvanised steel reinforcing member.
Overhead conductors	Assets for which their primary function is distributing power, above ground, within the distribution network.
Underground cables	Assets that have the primary function of distributing power, below ground, within the distribution network.
Service lines	Assets that provide a physical link between the distribution network and a customer's premises.
Transformers	Assets which transform electricity between voltage levels within the Ausgrid network.
Switchgear	Assets used to control, protect and isolate segments of the network.
Public lighting	Public lighting includes street lights on all major and minor traffic routes. Note: These assets are managed as Alternate Control Services.
SCADA, Network Control and Protection Systems	All Ausgrid owned fixed IT and associated support devices on the network side of gateway devices providing part of the network protection, monitoring and control system. Components include routers, relays, batteries, bridge, voltage regulation relays etc.
Distribution substation	A substation on a distribution network that transforms voltage of levels at or below 33 kV but above 1 kV to levels below 1 kV.

Asset	Description
Distribution voltage regulation	This asset category has been added into the regulatory RIN template 2.2 and 5.2 by Ausgrid and includes all Ausgrid owned asset locations which provide voltage support (power factor correction by pole capacitors or voltage correction by voltage regulators) to the 11kV distribution network. A definition for this asset category is not included in RIN Appendix F Definitions. Asset category boundary issues occur between this category and the pole and switchgear asset categories in regulatory RIN template 2.2 and 5.2 because these asset categories could be considered as asset sub-categories within an overarching 'Distribution voltage regulation' category. This has created difficulties for reporting repex expenditure against the separate asset categories, particularly in cases where a distribution voltage regulation asset is completely replaced, because existing financial systems and project cost allocation is not set up to provide this level of separate detail and therefore cost apportionment has been required. The 'Distribution voltage regulation' asset category excludes tap changers in transformers / capacitor banks in zone or subtransmission substations. Zone and subtransmission substation transformers are included in the 'Transformers' asset category.
Overhead conductors	General overhead conductors and other associated equipment.
Towers - > = 33 kV ; refurbishment	Vertically oriented metal structures that provide load bearing structural support for subtransmission overhead conductors (typically 132kV) and other associated line assets.
Transformers - Other	General zone and subtransmission substation transformer and other associated equipment.
Underground cables – Other	General underground cables and other associated equipment.
Zone and subtransmission substations - Other	General zone and subtransmission substation and civil equipment / structures.
Distribution substations – not age related	General distribution substation and civil equipment / structures that have been identified for work to be undertaken predominately due to health, safety or environmental drivers. General distribution substation and civil equipment system spares.
Overhead conductors – not age related	General overhead and civil equipment / structures that have been identified for work to be undertaken predominately due to health, safety, environmental or severe weather related drivers.
Zone and subtransmission substations – not age related	General zone and subtransmission substation and civil equipment / structures that have been identified for work to be undertaken predominately due to health, safety, environmental or compliance drivers. General zone and subtransmission substation and civil equipment system spares.
Field devices – not age related	General field devices (such as relays, batteries, SCADA RTUs) that have been identified for work to be undertaken predominately due to health, safety or environmental drivers.

Asset	Description
Underground cables – not age related	General underground and civil equipment / structures that have been identified for work to be undertaken predominately due to health, safety and environmental drivers. General distribution and transmission underground cables and associated equipment system spares.
Switchgear – not age related	General switchgear and associated equipment that have been identified for work to be undertaken predominately due to health, safety and environmental drivers.
Transformers – not age related	General transformer and associated equipment that have been identified for work to be undertaken predominately due to health, safety and environmental drivers. General zone and subtransmission transformer equipment system spares.
Land (i.e. strategic system property)	Expenditure on system land associated with replacement projects.

APPENDIX B: MAIN REPLACEMENT DRIVERS

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Poles	REP_04.02.02	POLES - < = 1 kV; WOOD - STAKED	Replacement of condemned distribution poles	Condition	Replacement
Poles	DOC_11.03.40	POLES - < = 1 KV; WOOD - UNSTAKED	Relocate Poles in Blackspots – Distribution poles	Community Safety Exposure	Replacement
Poles	REP_05.02.06	POLES - > 22 KV & < = 66 KV; WOOD - STAKED	Replacement of condemned subtransmission poles	Condition	Replacement
Poles	DOC_11.03.41	POLES - > 22 KV & < = 66 KV; WOOD - UNSTAKED	Relocate Poles in Blackspots – subtransmission poles	Community Safety Exposure	Replacement
Poles	REP_05.02.01-5	POLES - > 66 KV & < = 132 KV; STEEL	Tower replacement	Condition	Replacement
Pole top structures	REP_04.03.10	POLE TOP STRUCTURES - < = 1 KV	Replacement of distribution pole cross-arms (No.)	Condition	Life Extension
Pole top structures	REP_05.02.07-1	POLE TOP STRUCTURES - > 22 KV & < = 66 KV	Refurbish 33kV overhead feeders (No.)	Condition	Life Extension
Pole top structures	REP_05.02.07-3	POLE TOP STRUCTURES - > 66 KV & < = 132 KV	Refurbish 132kV overhead feeders (No.)	Condition	Replacement
Pole top structures	REP_05.02.26	POLE TOP STRUCTURES - OTHER	Replacement of subtransmission ground stays (No.)	Condition	Life Extension
Staking wooden poles	REP_04.02.34	STAKING WOODEN POLES - < = 1 KV	Reinforcement of condemned distribution poles	Condition	Life Extension

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Staking wooden poles	REP_04.02.34	STAKING WOODEN POLES - > 22 KV & < = 66 KV	Reinforcement of condemned subtransmission poles	Condition	Life Extension
Overhead conductors	DOC_11.03.34	OVERHEAD CONDUCTORS - < = 1 KV	Low mains – distribution	Compliance	Replacement
Overhead conductors	DOC_11.03.73	OVERHEAD CONDUCTORS - < = 1 KV	Dedicated LV circuit reconfiguration program	Condition	Replacement
Overhead conductors	REP_04.02.49	OVERHEAD CONDUCTORS - < = 1 KV	Overhead wiring community concerns	Community Safety Exposure	Replacement
Overhead conductors	REP_04.02.01	OVERHEAD CONDUCTORS - > 1 KV & < = 11 KV	Steel mains (km)	Condition	Replacement
Overhead conductors	REP_04.02.46	OVERHEAD CONDUCTORS - > 1 KV & < = 11 KV	High voltage overhead mains (ACSR/Quince)	Condition	Replacement
Overhead conductors	DOC_11.03.35	OVERHEAD CONDUCTORS - > 22 KV & < = 66 KV	Low mains – subtransmission	Compliance	Replacement
Overhead conductors	REP_05.02.07-4	OVERHEAD CONDUCTORS - > 22 KV & < = 66 KV	Refurbish 33kV overhead feeders (km)	Condition	Life Extension
Overhead conductors	REP_05.02.28	OVERHEAD CONDUCTORS - OTHER	Replace subtransmission feeder earth electrodes program	Condition	Life Extension
Underground cables	REP_04.02.05	UNDERGROUND CABLES - < = 1 KV	LV CONSAC mains (km)	Condition	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Underground cables	REP_04.02.06	UNDERGROUND CABLES - < = 1 KV	LV HDPE mains (km)	Condition	Replacement
Underground cables	REP_04.02.11	UNDERGROUND CABLES - > 1 KV & < = 11 KV	11kV Underground to overhead terminations (UGOHs) replacement	Condition	Replacement
Underground cables	REP_05.02.30	UNDERGROUND CABLES - > 22 KV & < = 33 KV	33kV Underground to overhead terminations (UGOHs) replacement	Condition	Replacement
Underground cables	REP_05.02.12	UNDERGROUND CABLES - OTHER	Cable pressure alarm replacement	Condition	Life Extension
Service lines	REP_04.02.04	SERVICE LINES - < = 11 KV ; RESIDENTIAL ; SIMPLE TYPE	Low voltage OH service replacement	Condition & Type	Replacement
Transformers	REP_01.03.07	TRANSFORMERS - GROUND OUTDOOR / INDOOR CHAMBER MOUNTED; < 22 KV ; > 60 KVA AND < = 600 KVA ; MULTIPLE PHASE	Sydney CBD Distribution Transformer Replacement	Condition	Replacement
Transformers	DOC_11.04.03	TRANSFORMERS - GROUND OUTDOOR / INDOOR CHAMBER MOUNTED; > = 22 KV & < = 33 KV ; < = 15 MVA	Noisy transformers – zone / subtransmission substations	Condition	Replacement
Transformers	REP_02.02.06	TRANSFORMERS - GROUND OUTDOOR / INDOOR CHAMBER MOUNTED; > = 22 KV & < = 33 KV ; < = 15 MVA	System spare transformer – zone	Spares (Emergency Recovery)	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Transformers	REP_02.02.53	TRANSFORMERS - GROUND OUTDOOR / INDOOR CHAMBER MOUNTED; > = 22 KV & < = 33 KV ; < = 15 MVA	Transformer replacement (utilising existing holdings) – zone	Condition	Replacement
Transformers	REP_03.02.05	TRANSFORMERS - GROUND OUTDOOR / INDOOR CHAMBER MOUNTED; > 66 KV & < = 132 KV ; < = 100 MVA	System spare transformer – subtransmission substations	Spares (Emergency Recovery)	Replacement
Transformers	REP_03.02.42	TRANSFORMERS - GROUND OUTDOOR / INDOOR CHAMBER MOUNTED; > 66 KV & < = 132 KV ; < = 100 MVA	Transformer replacement (utilising existing holdings) – subtransmission substations	Condition	Replacement
Transformers	REP_02.02.41	TRANSFORMERS - OTHER	Post-type voltage transformers – Zone substations	Condition	Replacement
Transformers	REP_02.03.12	TRANSFORMERS - OTHER	Post-type current transformers – Zone substations	Condition	Replacement
Transformers	REP_03.02.27	TRANSFORMERS - OTHER	Post-type voltage transformers – Subtransmission substations	Condition	Replacement
Transformers	REP_03.02.40	TRANSFORMERS - OTHER	Power reactors – Subtransmission substations	Condition	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Transformers	REP_03.03.09	TRANSFORMERS - OTHER	Post-type current transformers – Subtransmission substations	Condition	Replacement
Switchgear	REP_01.02.57	SWITCHGEAR - < = 11 KV ; FUSE	ABB 11kV series V expulsion drop out (EDO) fuse carriers	Condition	Replacement
Switchgear	REP_01.02.45	SWITCHGEAR - < = 11 KV ; SWITCH	Statter, ALM and Godfrey fuse switches	Condition	Replacement
Switchgear	REP_01.02.47	SWITCHGEAR - < = 11 KV ; SWITCH	Reyrolle JKSS ring main isolators with compound filled end boxes	Condition	Replacement
Switchgear	REP_01.02.52	SWITCHGEAR - < = 11 KV ; SWITCH	Obsolete oil-filled ring main units and fuse switches	Condition	Replacement
Switchgear	REP_01.03.13	SWITCHGEAR - < = 11 KV ; SWITCH	Bass, Clain and Saunders isolate and earth switches	Condition	Replacement
Switchgear	REP_01.03.17	SWITCHGEAR - < = 11 KV ; SWITCH	Hazemeyer ring main units – harsh environment	Condition	Replacement
Switchgear	REP_04.02.32	SWITCHGEAR - < = 11 KV ; SWITCH	11kV Essantee HS641 air break switches	Condition	Replacement
Switchgear	REP_04.02.36	SWITCHGEAR - < = 11 KV ; SWITCH	11kV Taplin D571 air break switches	Condition	Replacement
Switchgear	REP_04.02.43	SWITCHGEAR - < = 11 KV ; SWITCH	11kV Haycolec air break switches	Condition	Replacement
Switchgear	REP_01.02.43	SWITCHGEAR - < = 11 KV ; CIRCUIT BREAKER	High voltage (11kV) oil circuit breaker	Condition	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Switchgear	REP_01.03.02	SWITCHGEAR - < = 11 KV ; CIRCUIT BREAKER	Low voltage air circuit breakers	Condition & Obsolescence	Replacement
Switchgear	REP_01.03.04	SWITCHGEAR - < = 11 KV ; CIRCUIT BREAKER	Single circuit breaker switchgear	Condition	Replacement
Switchgear	REP_01.03.06	SWITCHGEAR - < = 11 KV ; CIRCUIT BREAKER	Network protectors	Condition & Obsolescence	Replacement
Switchgear	REP_02.02.35	SWITCHGEAR - > 22 KV & < = 33 KV ; SWITCH	33kV Essantee isolate and earth switches – zone substations	Condition	Replacement
Switchgear	REP_02.02.38	SWITCHGEAR - > 22 KV & < = 33 KV ; SWITCH	33kV Isolate and earth switches - zone substations	Condition	Replacement
Switchgear	REP_03.04.03	SWITCHGEAR - > 22 KV & < = 33 KV ; CIRCUIT BREAKER	33kV Circuit breakers – General – subtransmission substations	Condition	Replacement
Switchgear	REP_02.03.02	SWITCHGEAR - > 66 KV & < = 132 KV ; SWITCH	132kV Motorised I & E switches – zone substations	Condition	Replacement
Switchgear	REP_03.03.02	SWITCHGEAR - > 66 KV & < = 132 KV ; SWITCH	132kV Motorised I & E switches – subtransmission substations	Condition	Replacement
Switchgear	REP_02.03.01	SWITCHGEAR - > 66 KV & < = 132 KV ; CIRCUIT BREAKER	132kV Circuit breakers – General – zone substations	Condition	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Switchgear	REP_02.02.01	SWITCHGEAR - < = 11 KV ; SWITCHGEAR PANEL REFURBISHMENT	11kV air insulated switchboards – vacuum circuit breakers	Condition	Life Extension
Public Lighting	N/A	N/A	Not modelled with repex	N/A	Replacement
SCADA, Network Control and Protection Systems	REP_01.02.59	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	SCADA equipment – distribution substations	Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_01.02.60	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	Modems – distribution substations	Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_01.02.61	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	Intertripping schemes – distribution substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.02.46	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	SCADA schemes – zone substations	Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.02.62	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	SCADA equipment – zone substations	Obsolescence	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
SCADA, Network Control and Protection Systems	REP_02.03.11	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	Batteries and battery charging equipment – zone substations	Condition	Replacement
SCADA, Network Control and Protection Systems	REP_03.02.34	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	SCADA schemes – subtransmission substations	Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_03.02.61	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	SCADA equipment – subtransmission substations	Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_03.03.08	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	Batteries and battery charging equipment – subtransmission substations	Condition	Replacement
SCADA, Network Control and Protection Systems	REP_04.02.48	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - FIELD DEVICES	Modems – distribution substations	Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.02.64	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - AFLC	Audio frequency load control equipment – zone substations	Condition	Replacement
SCADA, Network Control and Protection Systems	REP_02.02.65	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - OTHER	Wholesale Metering Points	Compliance	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
SCADA, Network Control and Protection Systems	REP_02.02.51	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	Protection schemes – zone substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.02.60	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	11kV switchboard protection – zone substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.02.61	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	High impedance busbar protection – zone substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.03.08	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	Protection relays – zone substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_02.03.10	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	Voltage regulation equipment – zone substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_03.02.39	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	Protection schemes – subtransmission substations	Condition / Obsolescence	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
SCADA, Network Control and Protection Systems	REP_03.02.60	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	High impedance busbar protection – subtransmission substations	Condition / Obsolescence	Replacement
SCADA, Network Control and Protection Systems	REP_03.03.05	SCADA, NETWORK CONTROL AND PROTECTION SYSTEMS - ELECTROMECHANICAL RELAYS	Protection relays – subtransmission substations	Condition / Obsolescence	Replacement
Other	DOC_11.03.77	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Substation lock upgrade	Compliance	Life Extension
Other	REP_01.02.02	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	A, B and C type kiosks	Condition & Obsolescence	Replacement
Other	REP_01.02.41	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Upper Hunter County Council kiosks	Condition & Obsolescence	Replacement
Other	REP_01.02.42	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Outdoor enclosure substations	Condition	Replacement
Other	REP_01.02.49	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Mackellar kiosks	Condition & Obsolescence	Replacement
Other	REP_01.03.16	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Muswellbrook kiosks	Condition & Obsolescence	Replacement

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Other	REP_01.04.02	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Refurbishment of pole transformer substations	Condition	Life Extension
Other	REP_01.04.11	OTHER - DISTRIBUTION SUBSTATIONS - OTHER	Single pole top substations	Condition	Replacement
Other	REP_05.02.03	OTHER - OVERHEAD CONDUCTORS - OTHER	Refurbish earthing - subtransmission feeders	Condition	Life Extension
Other	REP_05.02.29	OTHER - OVERHEAD CONDUCTORS - OTHER	Replace subtransmission overhead earth wire	Condition	Life Extension
Other	REP_05.02.01-3	OTHER - TOWERS - > = 33 KV ; REFURBISHMENT	Tower refurbishment	Condition	Life Extension
Other	REP_02.02.59	OTHER - TRANSFORMERS - OTHER	Neutral earthing resistors – Subtransmission substations	Condition	Replacement
Other	REP_02.03.05	OTHER - TRANSFORMERS - OTHER	132kV/66kV bushings - zone substations	Condition	Replacement
Other	REP_03.03.10	OTHER - TRANSFORMERS - OTHER	132kV/66kV bushings - subtransmission substations	Condition	Replacement
Other	DOC_11.03.74	OTHER - UNDERGROUND CABLES - OTHER	Modification of Menai type LV pillars	Condition	Life Extension

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Other	DOC_11.03.02	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Perimeter fencing - zone substations	Condition & Compliance	Life Extension
Other	DOC_11.03.02-1	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Perimeter fencing - Subtransmission substations	Condition & Compliance	Life Extension
Other	DOC_11.03.26	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Fire hydrants - zone substations	Condition & Compliance	Life Extension
Other	DOC_11.03.33	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Fire hydrants - subtransmission substations	Condition & Compliance	Life Extension
Other	REP_02.02.42	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Substation roof - zone substations	Condition	Life Extension
Other	REP_02.02.43	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Pit lids - zone substations	Condition	Life Extension
Other	REP_02.04.05	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Building refurbishment/ replacement works - zone substations	Condition	Life Extension
Other	REP_03.04.06	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - OTHER	Substation roof - subtransmission substations	Condition	Life Extension

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Other	DOC_11.03.01	OTHER - DISTRIBUTION SUBSTATIONS - NOT AGE RELATED	Distribution chamber substation security	Condition & Compliance	Life Extension
Other	DOC_11.03.10	OTHER - DISTRIBUTION SUBSTATIONS - NOT AGE RELATED	Brick wall outdoor enclosure substations	Compliance	Life Extension
Other	DOC_11.03.50	OTHER - DISTRIBUTION SUBSTATIONS - NOT AGE RELATED	Substation fencing upgrade - distribution substations	Condition	Replacement
Other	DOC_11.03.52	OTHER - DISTRIBUTION SUBSTATIONS - NOT AGE RELATED	Asbestos fire doors - distribution substations	Condition & Compliance	Life Extension
Other	DOC_11.03.65	OTHER - DISTRIBUTION SUBSTATIONS - NOT AGE RELATED	Mackellar chamber substation safety - distribution substations	Compliance	Replacement
Other	DOC_11.03.25	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Smoke detection installation - zone substations	Compliance	Life Extension
Other	DOC_11.03.53	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Asbestos fire doors - subtransmission substations	Condition & Compliance	Life Extension
Other	DOC_11.03.54	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Asbestos fire doors - zone substations	Condition & Compliance	Life Extension

RIN Asset Group	Program REG id	RIN asset category	Program Description	Main Driver	Complete Replacement or Life Extension
Other	DOC_11.03.69	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Siemens 8DN8 circuitry modification - zone	Compliance	Life extension
Other	DOC_11.03.70	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Siemens 8DN8 circuitry modification - subtransmission	Compliance	Life Extension
Other	DOC_11.04.01	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Oil containment - zone substations	Condition & Compliance	Life Extension
Other	DOC_11.05.01	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Electronic security - zone substations	Condition	Life Extension
Other	DOC_11.05.05	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Electronic security - subtransmission substations	Condition	Life Extension
Other	DOC_11.05.09	OTHER - ZONE & SUBTRANSMISSION SUBSTATIONS - NOT AGE RELATED	Mandatory protection links	Compliance	Replacement
Other	DOC_11.03.38	OTHER - FIELD DEVICES - NOT AGE RELATED	Optical arc fault protection systems	Compliance	Replacement

APPENDIX C: FACTORS IMPACTING NETWORK REPLACEMENT EXPENDITURE REQUIREMENTS

RIN Asset group	Program description & identifier	Repex change factor	Description of factors that have changed or are forecast to change network replacement expenditure requirements
Poles	Replacement of condemned distribution poles REP_04.02.02	Asset	Reduction in pole replacement volumes from the previous regulatory period, with a minor increase in pole replacement volumes in the forthcoming period due to greater understanding in pole condition along with increasing failure rate.
Pole top structures	Replacement of distribution pole cross-arms (No.) REP_04.03.10	Asset	There is an implied change in this specific category is due to the introduction of the pole cross arm replacement program into this category. The need for replacement of pole top structures and ground stays has been triggered by identified condition issues in the current period.
Overhead conductors	Dedicated LV circuit reconfiguration program DOC_11.03.73	Asset	Ausgrid has initiated a program to reconfigure supply arrangements for dedicated LV overhead circuits supplying street lights by improving the functionality of the LV network. This program has been introduced to mitigate public safety risks associated with superseded circuit configurations.
	Overhead wiring community concerns REP_04.02.49	Asset	Ausgrid has been working closely with stakeholders, including local councils, to improve the way vegetation near overhead conductors and poles is managed in urban areas. A common theme from stakeholders was the need for Ausgrid to forge more effective partnerships with local councils to improve our vegetation management strategies and to ultimately align them with the strategies and priorities of our customers.
Underground cables	LV CONSAC mains (km) REP_04.02.05	Asset	Remaining cable lengths of Consac and HDPE type low voltage cables have decreased, increasing unit rates per km replaced due to the loss of economies of scale.
	LV HDPE mains (km) REP_04.02.06	Asset	

RIN Asset group	Program description & identifier	Repex change factor	Description of factors that have changed or are forecast to change network replacement expenditure requirements
Service lines	Low voltage OH service replacement REP_04.02.04	Asset	Continued replacement of high risk conductor construction types with an increasing focus on spatial risk prioritisation to remove the most at risk assets, particularly in bushfire prone areas.
Transformers	Sydney CBD Distribution Transformer Replacement REP_01.03.07	Asset & internal planning and asset management approaches	In the forthcoming period there is an increase in the replacement of Sydney CBD Conservator Type transformers and transformers that are being replaced as a part of the outdoor brick enclosure substation replacements to address the increasing risk of these poor condition and aged transformers (average age over 50yrs). Asset access issues including confined space requirements as well as the additional planning and traffic control requirements for the Sydney CBD has increased delivery effort and expenditure.
Transformers	Transformer replacement (utilising existing holdings) – subtransmission substations REP_03.02.42	Asset	Expenditure in the current period and the forthcoming period has changed due to the availability of major transformers and the need to only reconfigure the site and install the available transformer reducing the unit costs to deliver.
Switchgear	ABB 11kV series V expulsion drop out (EDO) fuse carriers REP_01.02.57	Asset	An early life failure mode has been identified that requires a significant increase in volume of replacement and associated expenditure to address this high risk asset type in the current and forthcoming regulatory period.
Switchgear	Bass, Clain and Saunders isolate and earth switches REP_01.03.13	Asset	The change in expenditure for the current and forthcoming period for this asset category is due to the increased need to replace old and degrading switchgear that has an increasing likelihood of failure and potential for serious injury to workers and the public. More than half of the contribution to the increase is the replacement

RIN Asset group	Program description & identifier	Repex change factor	Description of factors that have changed or are forecast to change network replacement expenditure requirements
	Obsolete oil-filled ring main units and fuse switches REP_01.02.52	Asset	of obsolete ring main isolators and oil filled fuse switches and Bass, Clain and Saunders isolate and earth switches.
SCADA, Network Control and Protection Systems	SCADA equipment – distribution substations REP_01.02.60	Technology	A significant number of SCADA remote terminal units and protection equipment has remained in use beyond its supported technical life and continue to degrade in performance as condition degrades. Modern replacements are more cost effective and deliver improvements in cybersecurity protections, general functionality and subsequently safety outcomes.
	SCADA equipment – zone substations REP_02.02.46	Technology	
	SCADA schemes – zone substations REP_02.02.62	Technology	
	SCADA schemes – subtransmission substations REP_03.02.34	Technology	
	SCADA equipment – subtransmission substations REP_03.02.61	Technology	

RIN Asset group	Program description & identifier	Repex change factor	Description of factors that have changed or are forecast to change network replacement expenditure requirements
SCADA, Network Control and Protection Systems	Modems – distribution substations REP_01.02.59	Technology	The change in expenditure is required as the entire population of Ausgrid's modems (as at 30 June 2017) relies on the 3G cellular network to transmit and receive digital information. Telstra's announcement presents a need for these modems to be replaced with modems capable of connecting with an available network technology such as fourth generation (4G).
	Recloser 3G Modems (3G Turnoff) REP_04.02.48	Technology	
Other	Wholesale Metering Points REP_02.02.65	Rules	Change in National Electricity Rules has meant Ausgrid is required to upgrade its Wholesale metering to comply with the 5 minute settlement requirements.
Other	Substation lock upgrade DOC_11.03.77	Technology	The change in expenditure (for the current and forthcoming period) is required as a security measure for the vulnerability of security with current lock and key system. The new system enables validation of access using the key in a real time.

APPENDIX D: COMPLIANCE CHECKLIST AGAINST SCHEDULE 1 OF RESET RIN

RIN Clause	Description under cl 5	Section Reference
5.1 (a) (i) (A)	In relation to information provided in Workbook 1 – Regulatory determination, regulatory template 2.2 and with respect to the AER's repex model, provide: (a) For individual asset categories in each asset group set out in the regulatory templates, provide in a separate document: (i) a description the asset category, including: (A) the assets included and any boundary issues (i.e. with other asset categories);	Section 3, Table 1 and Table 2 Appendix A
5.1 (a) (i) (B)	(B) an explanation of how these matters have been accounted for in determining quantities in the age profile;	Section 4
5.1 (a) (i) (C)	(C) an explanation of the main drivers for replacement (e.g. condition); and	Section 5.1 and Appendix B
5.1 (a) (i) (D)	(D) an explanation of whether the replacement unit cost provides for a complete replacement of the asset, or some other activity, including an extension of the asset's life (e.g. pole staking) and whether the costs of this extension or other activity are capitalised or not.	Appendix B (refer also Attachment 5.13 and 5.14)
5.1 (a) (ii) (A)	In relation to information provided in Workbook 1 – Regulatory determination, regulatory template 2.2 and with respect to the AER's repex model, provide: (ii) an estimate of the proportion of assets replaced for each year of the current regulatory control period, due to: (A) aging of existing assets (e.g. condition, obsolesce, etc.) that should be largely captured by this form of replacement modelling;	Section 6.1 and Table 3

RIN Clause	Description under cl 5	Section Reference
5.1 (a) (ii) (B)	(B) replacements due to other factors (and a description of those factors);	Section 6.2 and Table 4
5.1 (a) (ii) (C)	(C) additional assets due to the augmentation, extension, development of the network; and	Section 6.3 and Table 5
5.1 (a) (ii) (D)	(D) additional assets due to other factors (and a description of those factors).	Section 6.4
5.1 (b) (i)	In relation to information provided in Workbook 1 – Regulatory determination, regulatory template 2.2 and with respect to the AER's repex model, provide: (b) For the previous, current and forthcoming regulatory control periods, explain the drivers or factors that have changed network replacement expenditure requirements. Identify and quantify the relative effect of individual matters within the following categories: (i) rules, codes, licence conditions, statutory requirements;	Section 5 and Appendix C (refer also Attachment 5.13 and 5.14)
5.1 (b) (ii)	(ii) internal planning and asset management approaches;	Section 5 and Appendix C (refer also Attachment 5.13 and 5.14)
5.1 (b) (iii)	(iii) measurable asset factors that affect the need for expenditure in this category (e.g. age profiles, risk profiles, condition trend, etc.). Identify and quantify individual factors;	Section 5 and Appendix C (refer also Attachment 5.13 and 5.14)
5.1 (b) (iv)	(iv) the external factors that can be forecast and the outcome measured (e.g. demand growth, customer numbers) that affect the need for expenditure in this category. Identify and quantify individual factors, covering the forecasts and the outcome (external factors to be discussed here do not relate to changing obligations which are covered in paragraphs 11.3 and 11.8);	Section 5 and Appendix C (refer also Attachment 5.13 and 5.14)

RIN Clause	Description under cl 5	Section Reference
5.1 (b) (v) (A)	(v) technology/solutions to address needs, covering: (A) network; and	Section 5 and Appendix C (refer also Attachment 5.13 and 5.14)
5.1 (b) (v) (B)	(B) non-network.	Section 5 and Appendix C (refer also Attachment 5.13 and 5.14)
5.1 (b) (vi)	(vi) any other significant matters.	Not Applicable
5.1 (b) (vii)	(vii) Identify and provide information or documentation to justify and support any responses to paragraph 5.1(b) (i)-(vi). The information provided in response to paragraph 5.1(b) above should at least distinguish between the asset categories listed in Workbook 1 – Regulatory determination, regulatory template 2.2.	Ausgrid has provided documentation in support of the responses above in 5.1(b) (i)-(vi). Attachment 5.13 & 5.14 - Project justification for replacement and duty of care programs, 11kV switchboards, 33kV switchgear & subtransmission Cables.