Attachment 5.09

2014 Replacement plan review

January 2015

Ausgrid revised regulatory proposal attachment

1 Introduction

Ausgrid has completed a review of all proposed Replacement and Duty of Care programs that were included in the 2013 Replacement and Duty of Care Plan. This has led to a reduction in capital expenditure requirements to just over $1 billion (nominal excluding overheads) for the five years from 2014-2019.

There have been a number of improvements in the planning process for the Replacement and Duty of Care programs. These improvements that have allowed Ausgrid to improve the way in which it identifies and targets risk and has resulted in a change in forecast volume and timing for many sub-programs.

Key process and analysis improvements include:

- Further development of the Capital Program Optimisation tool developed by Evans & Peck in 2010 to provide more relevant risk quantification from failure mode consequence analysis, including incorporation of the corporate risk framework.
- Greater use of quantified risk assessment in preference to subjective risk assessments.
- Refined top down assessment for validation of program level expenditures

The largest change to the revised program has resulted from the subject matter expert review of the programs at a more granular level. This has been facilitated by new analysis that further considers the range of consequences associated with various asset failure modes. In addition, as part of the bottom up program reviews, individual program assumptions have been reassessed which has enabled improved targeting of higher risk assets for Replacement and Duty of Care programs. This has enabled us to maintain the risk profile at lower cost.

This report also includes a response to the issues raised by the AER in its draft decision of November 2014 as Appendix 2.

The outcomes of this review have been incorporated into Ausgrid's revised regulatory submission due in January 2015.

2 Background

2.1 The Replacement and Duty of Care Plan

Ausgrid's Replacement and Duty of Care Plan comprises a large number of individual sub-programs that are intended to define the investment requirements to deal with risks related to existing network assets. It includes proactive programs of work covering multiple smaller individual investments, and reactive investments resulting from inspection processes or in-service failures.

Risks are identified primarily through the monitoring that is part of the Maintenance Planning cycle. This identifies the point when it may be more appropriate to consider renewal rather than a continued repair and maintain approach. Risks are also identified by the inspections and failure reporting processes, plus through review of asset status against other risk parameters, including regulatory change.

Investment to replace or modify an existing asset is made either:

- to meet specific obligations and standards; or
- justified based on an assessment of the risk (e.g. determined from condition assessments and historical performance) compared to the cost required to mitigate that risk.

Risks considered within the analysis include safety, environmental, reliability, financial (e.g. property damage and liability claims), and reputation (e.g. adverse publicity) risks.

Investment is recommended based on a cost-benefit assessment of credible alternatives taking into account all relevant costs, risks and benefits over the lifecycle of the asset.

The 2014 plan consists of a collection of ACAPS (Asset Condition and Planning Summary) documents, and the adjustments and considerations of this review.

2.2 Annual Planning Review Process

The broad approach to the annual review includes the following steps:

1. Collecting all new failure information, asset data from inspections and maintenance, program completion levels (actual and forecast) and newly identified risks since the last plan.

2. Reviewing and analysing each sub-program to understand the impact on the forecast cost of the program and the risks being managed.

3. Developing revised proposals for each sub-program

4. Identifying and developing any new programs that are required

5. Reviewing the resulting programs against quantified risk cost measures to ensure costs are proportionate.

6. Identifying any step changes or abnormals using top-down analysis techniques, including trend analysis at the program level.

7. Preparing revised inputs for prioritisation modelling in the overall Portfolio Investment Plan
8. Preparing documentation (this document) to explain the changes, and document the outcomes

3 Key input and process changes since the 2013 plan

The key changes to inputs and processes for the 2014 review include:

- Additional asset performance information, which has led to a higher level of condition certainty. Minimising this uncertainty has in turn allowed Ausgrid to refine its programs.
- Wider consideration of hierarchy of control measures including potential maintenance options and other controls. This includes improvements in maintenance practices which have reduced the risks and/or costs in performing some maintenance tasks.
- Greater understanding of absolute and relative risk assessments has provided insights into potential trade-offs that were previously less apparent.
- Focus on subdividing asset categories into sub-categories to identify those with different risk parameters to enable more refined targeting.

3.1 Improved failure mode consequence analysis

Ausgrid has improved its risk assessment process for a range of programs by considering a more complete range of possible consequence outcomes for each asset failure mode and appropriately weighting these against their likelihood. The improved consequence analysis utilises the corporate risk framework rather than the operational risk framework. The enhanced consequence analysis estimates the annual asset risk cost and can be compared to the capital cost of alternative remediation options. This approach provides greater transparency into the risk costs associated with each group of network assets, easier comparison between different risk profiles, and has proved useful in verifying the benefits associated with each of the proposed programs.

The use of this improved risk assessment has improved the Replacement and Duty of Care planning process as it provides new information to assist in review of the proposed programs. The initial program planning for the 2013 plan utilised a process to estimate the cost of failure and incorporated it into an NPV calculation to determine the least cost effective mitigation option. This was then further validated by using the Capital Program Optimisation tool developed by Evans & Peck to derive a cost-benefit ratio.

The new consequences analysis approach provides greater insight than the previous tool, which was used only to add confidence post planning. It provides greater insight into the magnitude of the benefits realised by an investment through consideration of the annual risk cost. This information has been used to provide insights into risk and consequence drivers, validate the bottom up analysis and or support decisions made to revise the key investment programs. For example, the annual risk cost of the tower painting and refurbishment program was estimated to be $30.3M p.a. compared to a unit rate of $135,000. The difference in the scale of the two figures suggests this program is highly cost beneficial.

Ausgrid has reviewed the requirements for a number of the programs at a more granular level using this approach. Coupled with an assessment of the qualitative risks, Ausgrid has been able to use this as a tool to better focus its replacement plans.

Appendix A contains the risk consequence analysis for or several high value proactive Replacement and Duty of Care programs.

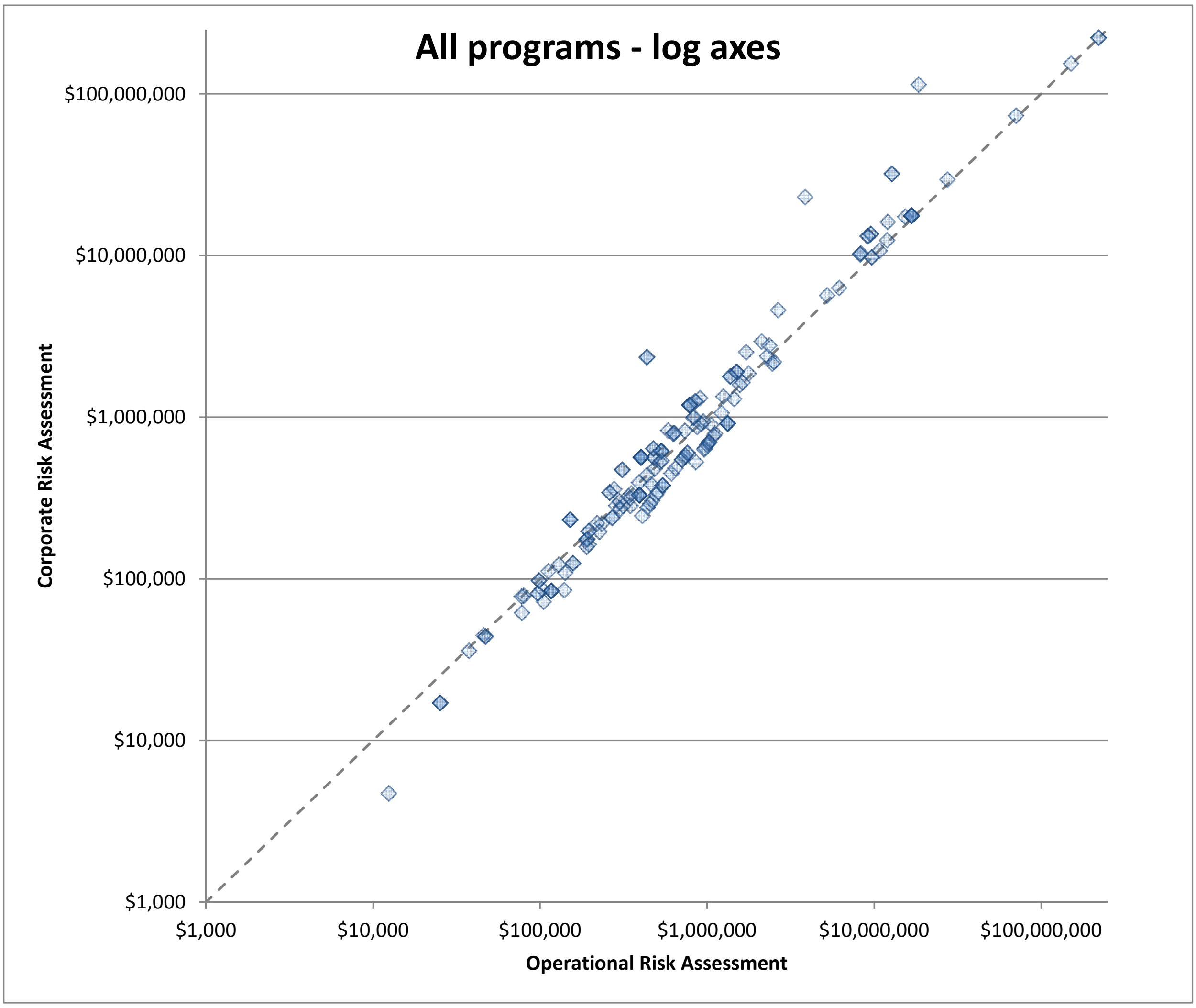
3.2 Consideration of the corporate risk framework

The 2013 Replacement and Duty of Care Plan was developed based on an operational risk matrix, based on Ausgrid's Maintenance Requirements Analysis Manual.

In July 2014, Ausgrid implemented a new corporate integrated risk management framework which is common across Ausgrid, Endeavour Energy and Essential Energy to facilitate a common approach to managing risk and an alignment of business risk categories, hazardous events and a common risk matrix.

To extend our understanding of relative risks, we undertook an assessment of the relationship between the new corporate and the operational risk matrix found that there is a consistent correlation between the outcomes. The exception to this is in the areas of higher consequence, where the quantified risk under the corporate framework is higher, implying that the operational risk matrix is less conservative for major consequence risks.

The chart below shows the assessed risk for each program based on the operational risk framework and the corporate risk framework.



For the programs where we undertook quantification of failure mode consequence for this review, we used the corporate risk framework.

3.3 Sub-categorisation and review of programs in preparation for Portfolio Investment Plan review.

In preparation for the annual review of the investment portfolio for Board Gate 1 approval, we split the assets in many programs into sub-categories based on risk wherever we had information that would enable us to better target our risk management investments plans.

This provided a basis for revision of many programs, as we were able to exclude a subset of lower risk assets from the population and achieve similar risk management outcomes at lower cost.

4 Detailed Summary of the Revised Replacement and Duty of Care Programs

The following tables contain the outcomes of the replacement and duty of care planning review.

Major changes include:

- Pole Replacement Program – reduced $41 million based on a review of currently observed inspection failure rate, revised expectation of average life extension afforded by staking and review of hierarchy of controls
- Consac Cable program – reduced by $36 million by extending and delaying the planned replacement program based on more reactive approach, better targeting of planned replacements and cost benefit reviews of program alternatives.
- LV Overhead services – reduced by $28 million by moving to a greater proportion of reactive replacements

In addition, we have identified a large number of small changes to programs across the spectrum that add up to a significant total reduction in expenditure of over $300 million.

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
DOC_11.03.01	Distribution Chamber Substation Program	$25,842,047	$12,636,655	$10,471,978	-$13,205,392	Revised based on assessment of program at a more granular level.
DOC_11.03.02	Perimeter Fencing - ZN	$4,663,863	$4,570,095	$3,960,579	-$93,768	No material changes.
DOC_11.03.02-1	Perimeter Fencing - TS	$1,865,545	$1,820,332	$1,577,545	-$45,213	
REP_01.03.10	Kiosk Steel Housings	$2,101,832	$2,118,844	$1,643,259	$17,012	
REP_02.02.54	CLC Controllers - ZN	$299,428	$293,436	$241,655	-$5,991	
REP_02.03.12	Post CTs - ZN	$308,699	$303,098	$249,916	-$5,601	
REP_03.03.03	Essantee 33kV Isolators - TS	$100,342	$98,551	$75,832	-$1,791	
REP_03.03.05	Protection Relays - TS Reactive	$2,760,464	$2,689,332	$1,817,246	-$71,132	
REP_03.03.09	Post CTs - TS	$3,738,161	$3,739,949	$3,078,827	$1,788	
REP_04.03.05	LV UG Service Termination Boxes (No.)	$200,265	$164,912	$109,544	-$35,353	
REP_05.02.04	Air Break Switches (ABS) - (Reactive)	$295,236	$289,505	$216,608	-$5,731	
REP_05.02.07-3	Refurb 132kV OH Feeders	$1,638,627	$1,615,447	$1,197,234	-$23,180	
DOC_11.03.03	Tower Anti-climb Devices	$7,044,664	$3,053,620	$2,070,727	-$3,991,044	Programs that have been revised based on subject matter expert review to evaluate these programs and propose a number of alternate program scenarios which were assessed and revised as part of the top down PIP
DOC_11.03.11	Water Crossing Assessments & Signs	$1,391,222	$1,099,794	$911,135	-$291,428	
DOC_11.03.24	Fire Mitigation - ZN	$4,425,370	$3,708,078	$3,212,037	-$717,292	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
DOC_11.03.28	Distribution Substation Fire Assessment	$3,828,104	$3,252,411	$2,693,942	-$575,693	process.
DOC_11.03.30	UG Substations Cascade modernisation	$30,838,701	$29,600,315	$26,051,314	-$1,238,386	
DOC_11.03.39	LV Board Screening - Kiosk Type DCs	$3,481,650	$2,802,332	$2,321,266	-$679,318	
DOC_11.03.42	Reactive Electrical Safety - DC	$2,899,511	$2,399,655	$1,987,006	-$499,856	
DOC_11.03.45	Reactive Electrical Safety - TS	$1,324,961	$1,087,000	$941,652	-$237,961	
DOC_11.03.46	Reactive Electrical Safety - ZN	$2,649,922	$2,071,075	$1,793,922	-$578,847	
DOC_11.03.47	Reactive OH&S Projects - DM	$10,685,465	$9,698,753	$8,036,054	-$986,712	
DOC_11.03.48	Reactive OH&S Projects - DC	$5,339,058	$4,916,254	$4,072,510	-$422,804	
DOC_11.03.49	Reactive OH&S Projects - TM	$1,067,871	$840,449	$702,408	-$227,422	
DOC_11.03.60	Reactive Asbestos Projects - TS	$1,059,969	$854,161	$739,914	-$205,808	
DOC_11.03.61	Reactive Asbestos Projects - ZN	$2,649,922	$2,096,806	$1,816,268	-$553,116	
DOC_11.03.66	Fire Fighting Water Storage Tanks - ZN	$582,983	$455,637	$394,663	-$127,346	
DOC_11.03.67	Fire Fighting Water Storage Tanks - TS	$1,324,961	$1,035,538	$896,961	-$289,423	
DOC_11.04.03	Noisy Tx Replacement - ZN	$11,871,917	$9,783,154	$8,457,774	-$2,088,763	
DOC_11.04.03-2	Noisy Tx Replacement - DC	$1,322,245	$1,038,011	$781,742	-$284,234	
DOC_11.04.05-1	Reactive Environmental Projects - TS	$1,059,969	$465,677	$403,475	-$594,291	
DOC_11.04.05-2	Reactive Environmental Projects - ZN	$1,854,945	$621,364	$538,213	-$1,233,581	
DOC_11.05.05	Electronic Security - TS	$20,199,087	$14,962,652	$12,956,155	-$5,236,436	
DOC_11.05.07	Reactive Infrastructure Risk Projects - TS	$530,443	$468,699	$375,303	-$61,744	
DOC_11.05.08	Reactive Infrastructure Risk Projects - ZN	$1,326,107	$1,301,307	$1,042,397	-$24,800	
REP_01.02.09	Metal Industries Ring Main Isolators	$369,914	$262,861	$188,561	-$107,053	
REP_01.02.51	Compact LV Boards - Hunter	$6,580,428	$4,124,178	$2,929,177	-$2,456,249	
REP_01.02.52	Obsolete RMIs & FSs	$3,816,291	$2,129,001	$1,522,562	-$1,687,290	
REP_01.03.01	Low Voltage OCB Subs	$12,764,353	$11,263,686	$8,966,603	-$1,500,667	
REP_01.03.03	High Voltage C Type OCB Subs	$3,382,036	$2,517,222	$2,002,054	-$864,814	
REP_01.03.17	Hazemeyer RMIs - Harsh Environment	$4,297,211	$1,661,882	$1,398,817	-$2,635,329	
REP_01.04.05	Distribution Substation Buildings & Grounds	$4,010,342	$3,168,623	$2,980,775	-$841,719	
REP_02.02.06	System Spare Transformers - ZN	$8,062,857	$7,777,002	$7,777,002	-$285,855	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
REP_02.02.49	Lighting Spires - ZN	$735,110	$626,121	$454,216	-$108,989	
REP_02.02.53	Transformer Replacement (utilising existing holdings) - ZN	$6,563,932	$5,721,350	$3,992,689	-$842,581	
REP_02.03.01	132 kV Circuit Breakers - ZN	$7,126,286	$4,496,015	$3,664,957	-$2,630,271	
REP_02.03.02	132kV Motorised I & E Switches - ZN	$9,785,894	$8,395,660	$6,612,047	-$1,390,234	
REP_02.03.03	66kV Circuit Breakers - ZN	$2,843,435	$134,035	$108,909	-$2,709,400	
REP_02.03.04	33kV Circuit Breakers - General - ZN	$1,134,174	$908,737	$716,340	-$225,437	
REP_02.03.13	Spares Storage Facilities - ZN	$3,695,006	$2,483,828	$2,158,389	-$1,211,178	
REP_02.04.04	System Spare Equipment - ZN	$2,487,687	$65,617	$65,617	-$2,422,070	
REP_02.04.09	Earthing Equipment - ZN	$352,785	$277,330	$227,262	-$75,455	
REP_02.04.10	Zone Substation Reactive Replacement Programme - ZN	$4,541,633	$3,756,663	$3,054,106	-$784,969	
REP_03.02.05	System Spare Transformer - TS	$4,270,847	$2,148,413	$2,148,413	-$2,122,435	
REP_03.02.06	Earthing system - TS	$586,350	$105,098	$71,056	-$481,252	
REP_03.02.30	33KV I&ES - TS	$2,440,015	$1,985,452	$1,524,568	-$454,563	
REP_03.02.33	132/66kV Non-Motorised I & E Switches - TS	$7,893,100	$6,353,833	$5,105,205	-$1,539,267	
REP_03.02.36	PINC/MPLS Core - TS	$6,362,324	$6,264,178	$5,926,544	-$98,146	
REP_03.02.37	Lighting Spires - TS	$840,126	$708,461	$513,932	-$131,665	
REP_03.02.39	Protection Schemes - TS	$4,679,790	$2,911,860	$2,114,384	-$1,767,930	
REP_03.02.42	Transformer Replacement (utilising existing holdings) - TS	$2,200,567	$1,285,649	$905,025	-$914,917	
REP_03.03.02	132kV Motorised I & E Switches - TS	$6,939,582	$5,891,335	$4,650,594	-$1,048,247	
REP_03.03.08	Batteries and Battery Charging Equipment -TS	$2,288,892	$2,011,378	$1,654,841	-$277,514	
REP_03.03.10	132/66kV Bushings - TS	$4,596,731	$4,411,997	$3,344,744	-$184,733	
REP_03.04.02	66kV Circuit Breakers - TS	$1,828,382	$925,091	$750,555	-$903,291	
REP_03.04.03	33 kV Circuit Breakers - General - TS	$6,860,395	$5,786,087	$4,558,399	-$1,074,309	
REP_03.04.04	System Spares Equipment - TS	$1,969,538	$360,785	$360,785	-$1,608,753	
REP_03.04.05	STS Building Refurbishment	$3,325,351	$2,870,282	$2,638,877	-$455,069	
REP_03.04.06	STS Roof Refurbishment	$6,069,272	$5,194,369	$4,464,023	-$874,903	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
REP_03.04.07	Surge Arrestors - TS	$2,923,102	$2,390,434	$1,719,436	-$532,668	
REP_03.04.08	Oil Drainage System - TS	$219,033	$169,924	$156,257	-$49,109	
REP_03.04.09	Sub-Transmission Substation Reactive Replacement Projects	$5,545,622	$4,466,385	$3,138,945	-$1,079,236	
REP_03.04.10	Earthing Equipment - TS	$243,300	$191,262	$156,733	-$52,038	
REP_04.02.06	Low Voltage HDPE Cables (km)	$24,072,544	$7,617,942	$6,433,201	-$16,454,602	
REP_04.02.08	Replace LV Spreaders in Bushfire Areas (No.)	$1,572,278	$1,245,521	$844,930	-$326,757	
REP_04.02.32	11kV Essantee ABS HS641 (No.)	$6,986,829	$4,172,769	$2,986,605	-$2,814,060	
REP_04.02.36	11kV Taplin ABS D571 (No.)	$4,696,065	$2,212,656	$1,583,894	-$2,483,409	
REP_04.02.43	11kV ABS Haycolec (No.)	$3,252,884	$2,265,932	$1,622,116	-$986,952	
REP_04.02.44	11kV ABS Non-Haycolec (No.)	$12,026,508	$10,370,863	$7,421,821	-$1,655,645	
REP_04.02.45	11kV Under Slung Link (No.)	$2,405,302	$2,133,890	$1,527,207	-$271,412	
REP_04.02.46	HV OH Mains (ACSR/Quince) (km)	$13,528,628	$10,742,608	$7,001,042	-$2,786,020	
REP_04.03.07	11kV Ground/Pole Regulators (No.)	$1,608,949	$1,280,292	$956,742	-$328,657	
REP_04.04.09	System Spares - DM (No.)	$521,158	$412,180	$379,205	-$108,978	
REP_05.02.03	Replace Earthing - Sub-Trans Feeders	$20,581,242	$7,490,975	$5,312,309	-$13,090,267	
REP_05.03.01	Transmission Mains Reactive Replacement (<$50K)	$11,007,699	$9,724,419	$8,091,916	-$1,283,280	
REP_05.02.25	Insulator Replacement - 66KV Pole Lines	$592,270	$465,851	$348,060	-$126,419	
REP_02.04.05	Zone Substation Building Refurbishment/Replacement Works	$4,580,454	$4,653,603	$4,279,061	$73,150	
DOC_11.03.07	Substations with Exposed 11kV	$17,331,393	$14,808,232	$12,265,323	-$2,523,160	Revised program to target highest risk locations in the current regulatory period and defer investment in lower risk sites.
REP_01.02.01	2 Pole Substations - Std	$9,681,537	$10,774,660	$8,354,176	$1,093,124	Revised based on roll forward of project due in the
DOC_11.03.08	Façade Mounted ABC	$0	$1,266,180	$1,049,985	$1,266,180	
DOC_11.04.01-1	Oil Containment - TS	$2,622,518	$7,331,271	$6,364,738	$4,708,753	
REP_01.02.04	Cubicle Substations	$0	$1,508,235	$1,204,022	$1,508,235	
REP_01.02.05	GEC DFC / DDFC Switchgear	$0	$986,191	$698,273	$986,191	
REP_01.02.06	Ex St George Outdoor Enclosure Substations	$0	$846,025	$715,312	$846,025	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
REP_01.03.02	Low Voltage ACB Subs	$1,701,947	$2,241,981	$1,734,302	$540,033	
REP_01.03.08	Newcastle Cottage Substations	$0	$1,324,336	$1,037,066	$1,324,336	
REP_01.04.10	ECONO Housing Outdoor Enclosure Type Substations	$0	$781,703	$641,933	$781,703	
REP_02.02.43	CFC LIDs - ZN	$546,127	$615,657	$494,793	$69,530	
REP_02.03.05	132/66kV Bushings - ZN	$4,607,723	$4,472,481	$3,389,697	-$135,242	
DOC_11.03.06	Sydney CBD Pits Structural Repair	$0	$14,243,458	$12,090,824	$14,243,458	
REP_01.04.02	Refurbishment of Pole Transformer Substations	$5,299,866	$6,861,055	$4,378,634	$1,561,189	Review of failure rates and revised based on roll forward of project due in the previous regulatory period.
REP_01.04.03	Distribution Centre Reactive Replacement (< $50k)	$14,872,328	$17,631,750	$11,253,083	$2,759,422	Revised based on roll forward of project due in the previous regulatory period and increased to off-set deferrals in planned programs.
REP_01.04.11	Pole Substations with limited life poles	$28,597,942	$30,728,798	$22,278,647	$2,130,855	Revised based on roll forward of project due in the previous regulatory period and increased to off-set deferrals in planned programs.
DOC_11.03.10	Brick Wall OE Substations	$11,765,664	$9,930,513	$8,224,204	-$1,835,151	Further investigation of hierarchy of control measures to manage individual site risks including repair/upgrading to meet minimum BCA requirements.
DOC_11.03.11-1	Water Crossings - DM	$787,005	$1,035,760	$879,799	$248,754	Increased program based on roll forward of committed projects planned in the previous regulatory period.
DOC_11.03.11-2	Water Crossings - TM	$624,886	$1,163,794	$1,000,228	$538,908	Increased program based on roll forward of committed projects planned in the previous regulatory period.
DOC_11.03.25	Smoke Detection Installation - ZN	$5,626,904	$2,071,075	$1,793,922	-$3,555,829	Further investigation of hierarchy of control measures to manage individual site risks including repair/upgrading to meet minimum BCA requirements.
DOC_11.03.26	Fire Hydrants - ZN	$9,115,732	$4,628,983	$4,009,208	-$4,486,749	Further investigation of hierarchy of control measures to manage individual site risks including repair/upgrading to meet minimum BCA requirements.
DOC_11.03.32	Fire Mitigation - TS	$2,655,222	$2,420,102	$2,096,298	-$235,120	No material changes. Completion rates from last period incorporated.
DOC_11.03.33	Fire Hydrants - TS	$6,693,703	$4,796,804	$4,154,232	-$1,896,899	Further investigation of hierarchy of control measures to manage individual site risks including repair/upgrading to meet minimum BCA requirements.
DOC_11.03.34	Low Mains - DM	$22,956,293	$22,294,361	$16,565,473	-$661,932	No material changes. Review of failure rates.
DOC_11.03.35	Low Mains - TM	$1,207,140	$1,200,742	$905,359	-$6,398	No material changes. Review of failure rates.
DOC_11.03.36	Reactive OH&S Projects - ZN	$2,649,922	$1,138,462	$986,343	-$1,511,460	Further investigation of hierarchy of control measures to manage individual site risks including repair options.
DOC_11.03.37	Reactive OH&S Projects - TS	$1,324,961	$5,918,929	$5,136,399	$4,593,968	Increased program based on roll forward of committed projects planned in the previous regulatory period.
DOC_11.03.38	Optical Arc Fault Protection Trial	$17,451,728	$8,687,766	$7,194,749	-$8,763,962	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
DOC_11.03.41	Relocate Poles in RTA Blackspots - TM	$876,429	$561,748	$445,293	-$314,681	Revised program based on latest crash data provided by the RMS.
DOC_11.03.40	Relocate Poles in RTA Blackspots - DM	$4,487,895	$4,384,397	$3,632,884	-$103,498	
DOC_11.03.43	Reactive Electrical Safety - DM	$2,465,605	$4,385,874	$3,724,178	$1,920,269	Increased program based on roll forward of committed projects planned in the previous regulatory period.
DOC_11.03.44	Reactive Electrical Safety - TM	$1,394,604	$2,398,057	$2,004,988	$1,003,453	
DOC_11.03.50	Substation Fencing Upgrade - DC	$7,746,687	$4,748,296	$3,933,089	-$2,998,391	Further investigation of hierarchy of control measures to manage individual site risks including repair options.
DOC_11.03.51	Smoke Detection Installation - TS	$2,209,718	$1,957,873	$1,697,166	-$251,845	No material changes. Completion rates from last period incorporated.
DOC_11.03.52	Asbestos Fire Doors - DC	$7,201,259	$306,936	$260,838	-$6,894,323	New asbestos testing of fire door has resulted in an increased number of doors being confirmed as not containing asbestos. The revised program focuses on the currently committed sites with future replacement to be funded from the associate reactive asbestos program.
DOC_11.03.53	Asbestos Fire Doors - TS	$348,943	$27,275	$23,686	-$321,668	
DOC_11.03.54	Asbestos Fire Doors - ZN	$1,977,815	$27,275	$23,686	-$1,950,540	
DOC_11.03.55	Install PIR relays in the Sydney CBD	$4,893,958	$3,809,865	$3,157,218	-$1,084,093	Further investigation of hierarchy of control measures to manage individual site risks including replacement trade-off with network protector program.
DOC_11.03.56	LV Board Screening - Chamber Type DCs	$3,345,983	$3,155,449	$2,613,663	-$190,534	No material changes. Review of sites.
DOC_11.03.57	Reactive Asbestos Projects - DC	$3,980,195	$2,109,409	$1,789,882	-$1,870,786	Further investigation of hierarchy of control measures to manage individual site risks including repair options.
DOC_11.03.58	Reactive Asbestos Projects - DM	$3,754,781	$2,129,683	$1,807,816	-$1,625,098	
DOC_11.03.59	Reactive Asbestos Projects - TM	$530,471	$447,978	$384,369	-$82,493	
DOC_11.03.63	AC & DC Boards - ZN	$518,935	$398,738	$274,517	-$120,197	Alternate risk mitigation options to be further considered. This will include assessment of all hierarchy of control measures on a needs basis.
DOC_11.03.64	AC & DC Boards - TS	$45,453	$44,994	$31,000	-$458	No material changes. Completion rates from last period incorporated.
DOC_11.03.65	Mackellar Chamber Substation Safety - DC	$7,433,657	$3,931,958	$3,256,535	-$3,501,700	Review hierarchy of control measures and timing of delivery to manage individual site risks including repair options.
DOC_11.03.69	Siemens 8DN8 Circuitry Modification - ZN	$0	$2,391,997	$1,732,962	$2,391,997	Review of individual site risks within program and their potential network impacts. Deferral of select sites based on likelihood of an event.
DOC_11.03.70	Siemens 8DN8 Circuitry Modification - TS	$0	$917,228	$664,638	$917,228	
DOC_11.04.01	Oil Containment - ZN	$33,268,601	$30,533,102	$26,442,963	-$2,735,499	Review of individual site risks within program and their potential network impacts. Deferral of select sites based on site equipment condition and likelihood of an environmental event.
DOC_11.04.05	Reactive Environmental Projects - DC	$2,669,529	$838,116	$694,127	-$1,831,413	Alternate risk mitigation options to be further considered. This will include assessment of all hierarchy of control

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
						measures on a needs basis.
DOC_11.05.01	Electronic Security - ZN	$2,410,126	$1,673,370	$1,452,300	-$736,756	Deferral and review of hierarchy of control measures and timing of delivery to manage individual site risks.
DOC_11.05.04	Under Frequency Load Shedding	$0	$1,283,494	$1,113,145	$1,283,494	Additional sites identified.
REP_01.02.02	A,B & C Type Kiosks	$11,631,609	$4,455,659	$3,791,145	-$7,175,950	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_01.02.41	UHCC Substation	$3,165,803	$2,408,781	$1,861,959	-$757,022	
REP_01.02.42	OE Subs (chainwire)	$6,369,490	$4,115,848	$3,475,759	-$2,253,642	
REP_01.02.43	HV OCB Subs	$12,706,898	$8,409,409	$6,636,437	-$4,297,489	
REP_01.02.44	STGW Kiosks	$5,697,701	$3,168,860	$2,674,774	-$2,528,841	
REP_01.02.45	Statter_ALM_Godfrey HV Fuse Switches	$3,883,992	$2,180,660	$1,820,013	-$1,703,332	
REP_01.02.46	Chamber DC Subs - Newcastle	$2,157,224	$441,763	$318,226	-$1,715,461	
REP_01.02.47	Reyrolle JKSS RMIs C_EB	$4,273,661	$4,050,962	$2,896,187	-$222,699	No material changes. Completion rates from last period incorporated.
REP_01.02.48	Obsolete Subs	$25,582,260	$11,576,558	$9,775,292	-$14,005,702	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_01.02.49	KM Kiosks - Mackellar	$5,490,741	$1,723,620	$1,458,339	-$3,767,121	
REP_01.02.50	ABB SD I & E Switches	$2,112,749	$1,940,039	$1,390,450	-$172,710	No material changes. Completion rates from last period incorporated.
REP_01.03.04	Single Circuit Breaker Switchgear (West F100)	$13,279,074	$7,797,215	$6,206,363	-$5,481,860	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_01.03.06	Network Protectors (West CM2/22) per NP	$10,202,738	$10,146,950	$7,062,166	-$55,789	No material changes. Completion rates from last period incorporated.
REP_01.03.07	400kVA Sydney CBD Conservator Type per Tx	$5,955,287	$6,063,968	$4,476,389	$108,680	No material changes. Re-prioritisation of sites.
REP_01.03.09	Newcastle City (triplex) Substations	$9,891,069	$1,854,540	$1,480,282	-$8,036,529	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_01.03.11	G' Type LV Board Timber Housings	$2,518,420	$437,817	$303,701	-$2,080,604	
REP_01.03.12	3000A Distribution Transformer Links	$5,608,004	$416,417	$321,893	-$5,191,587	Review of risk assessment and hierarchy of controls
REP_01.03.13	Bass & Saunders Isolation & Earthing Switchgear	$14,318,474	$12,776,907	$8,894,260	-$1,541,567	No material changes. Re-prioritisation of sites.
REP_01.03.15	Maitland Kiosks	$833,086	$688,950	$541,452	-$144,136	Targeted locations based on individual risk and tangible

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
REP_01.03.16	Muswellbrook Kiosks	$3,898,678	$1,993,655	$1,582,780	-$1,905,023	benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_01.04.01	Long & Crawford T3GF3 Ring Main Isolators	$2,230,129	$2,171,634	$1,843,781	-$58,495	No material change. Review of failure rates.
REP_01.04.07	SF6 Switchgear - Low Gas	$1,778,714	$1,448,886	$1,130,151	-$329,828	Re-prioritisation of sites.
REP_01.04.12	Distribution Substation Heritage Buildings	$3,218,734	$2,099,342	$1,974,885	-$1,119,392	Revised based on a review of heritage lists.
REP_01.04.13	System Spares Equipment - DC Subs	$1,309,921	$133,120	$122,470	-$1,176,801	Review of inventory.
REP_02.02.01	11kV Air Insulated Switchboards - Vacuum CB - ZN	$10,156,382	$11,646,993	$9,265,825	$1,490,612	Ramp up in individual OCB conversion to reduce risk exposure due to deferral of whole switchboard replacements following Area Plan reviews.
REP_02.02.05	33kV Bulk Oil OD Circuit Breakers - ZN	$11,306,551	$10,792,852	$8,516,816	-$513,699	Review of hierarchy of control measures to manage site specific risks. Further synergy expected with delays of other interdependent investment at individual sites.
REP_02.02.09	Earthing system - ZN	$1,172,700	$1,041,546	$704,179	-$131,154	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_02.02.35	33KV Essantee I&Es - ZN	$5,499,755	$2,758,044	$2,120,461	-$2,741,711	Review of hierarchy of control measures to manage site specific risks. Further synergy expected with delays of other interdependent investment at individual sites.
REP_02.02.41	Post VTs - ZN	$2,220,423	$1,786,413	$1,383,672	-$434,010	More informed test results reducing uncertainty.
REP_02.02.42	Substation Roof - ZN	$8,349,352	$6,878,512	$5,909,369	-$1,470,841	Re-prioritisation of sites.
REP_02.02.44	11kV Capacitor Bank - ZN	$3,011,832	$1,642,457	$1,547,742	-$1,369,375	Targeted locations based on individual risk and tangible benefits to network requirements.
REP_02.02.45	132/66kV Non-Motorised I & E Switches - ZN	$5,260,011	$4,505,004	$3,620,672	-$755,008	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair options.
REP_02.02.46	SCADA Schemes including Comp Control Boards - ZN	$7,235,539	$2,200,057	$1,715,279	-$5,035,482	Review of hierarchy of control measures and timing of delivery to manage individual site risks, including repair options.
REP_02.02.47	Steel Structures - ZN	$3,684,407	$3,559,366	$2,928,656	-$125,041	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair/spare strategy options.
REP_02.02.48	PINC/MPLS Edge - ZN	$8,543,659	$5,749,844	$5,138,155	-$2,793,815	Review of hierarchy of control measures and timing of delivery to manage individual site risks, including repair
REP_02.02.51	Protection Schemes - ZN	$4,679,790	$1,401,093	$1,015,821	-$3,278,697	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
						options.
REP_02.02.57	Spares - ZN	$0	$1,586,011	$1,146,751	$1,586,011	New program due to no existing program for zone equipment spares.
REP_02.03.06	132 kV Fault Thrower - ZN	$1,249,672	$609,798	$456,058	-$639,875	Targeted locations based on individual risk and tangible benefits to network requirements.
REP_02.03.07	Protection Relays - ZN Reactive	$6,024,004	$5,444,046	$3,676,818	-$579,958	Review of hierarchy of control measures and timing of delivery to manage individual site risks, including repair options.
REP_02.03.08	Replace Distance Relays with Line Diff Protection - ZN	$7,518,758	$458,100	$332,111	-$7,060,659	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair/spare strategy options.
REP_02.03.10	Voltage Regulation Equipment - ZN	$18,888,942	$5,320,604	$3,620,254	-$13,568,338	
REP_02.03.11	Batteries and Battery Charging Equipment - ZN	$4,351,622	$3,877,330	$3,189,799	-$474,292	Review of hierarchy of control measures and timing of delivery to manage individual site risks, including repair options.
REP_02.04.07	Controlled Load - ZN	$2,687,629	$1,194,691	$1,009,965	-$1,492,939	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair/spare strategy options.
REP_02.04.08	Surge Arrestors - ZN	$3,674,757	$1,423,811	$1,024,124	-$2,250,946	Targeted locations based on individual risk and tangible benefits to network requirements.
REP_03.02.03	33kV Bulk Oil OD Circuit Breakers - TS	$6,650,065	$6,459,071	$5,086,826	-$190,994	No material changes. Completion rates from last period incorporated.
REP_03.02.27	Post VTs - TS	$4,179,383	$3,930,862	$3,047,953	-$248,521	No material changes. Completion rates from last period incorporated.
REP_03.02.32	CFC Lids - TS	$1,540,991	$1,460,054	$1,172,750	-$80,937	No material changes. Completion rates from last period incorporated.
REP_03.02.34	SCADA Schemes including Comp Control Boards - TS	$2,409,864	$0	$0	-$2,409,864	Review of hierarchy of control measures and timing of delivery to manage individual site risks including repair options.
REP_03.02.35	Steel Structures - TS	$4,605,509	$4,263,182	$3,508,761	-$342,327	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair/spare strategy options.
REP_03.03.01	132kV Circuit Breakers - General - TS	$8,476,457	$8,313,432	$6,775,694	-$163,025	No material changes. Review of failure rates
REP_03.03.04	33/66kV Capacitor Banks - TS	$6,023,198	$1,564,831	$1,275,806	-$4,458,368	Review of hierarchy of control measures and timing of delivery to manage individual site risks including repair options.

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
REP_03.03.06	Replace Distance Relays with Line Diff Protection - TS	$8,398,949	$0	$0	-$8,398,949	Revised based on further investigation of hierarchy of control measures to manage individual site risks including repair/spare strategy options.
REP_04.02.01	Steel Mains (km)	$20,220,847	$16,056,815	$10,471,423	-$4,164,032	Synergy alignment of asset type and review of hierarchy of control measures to alternate programs of Duty of Care 'Low Mains' and 'Long Spans'.
REP_04.02.02	Pole Replacement Programme (No.)	$296,111,549	$254,951,635	$172,850,920	-$41,159,914	Delayed onset of expectation of increasing staked pole failures later in the period, revised based on current rate of inspection failures and review of the hierarchy of control measures including a revision of the pole inspection standard.
REP_04.02.04	Low Voltage (LV) Overhead Services (No.)	$54,085,580	$26,344,781	$16,984,340	-$27,740,799	Deferral in the number of planned replacements – expected increase in age based degradation.
REP_04.02.05	LV Consac Cables (km)	$94,345,616	$58,511,850	$49,410,893	-$35,833,767	Deferral of replacement will result in a moderate increases in failures, repairs and increasing reactive replacement.
REP_04.02.34	Condemned Poles - Reinforcement (No.)	$12,624,335	$10,310,755	$10,310,755	-$2,313,580	Minor deferral with a review of the hierarchy of control measures including a revision of the pole inspection standard.
REP_04.02.35	Steel Round Pillars (No.)	$4,188,968	$2,513,124	$1,789,949	-$1,675,843	Deferral due to revised development of new maintenance strategy.
REP_04.02.38	LV UG Link Boxes (No.)	$4,750,139	$3,035,309	$2,267,118	-$1,714,830	Deferral with an increasing likelihood in the number of repairs and reactive replacements.
REP_04.02.42	LV OH ABC Link Boxes (No.)	$1,063,240	$675,863	$481,310	-$387,377	
REP_04.03.02	Re-Establishment of 11kV Overhead Feeder Access Tracks (km)	$6,427,066	$2,526,973	$2,093,300	-$3,900,094	Deferral in planned quantities with an offset in reactive quantities increasing.
REP_04.04.01	Low Voltage (LV) Overhead Mains - Bare Wire to ABC (km)	$26,375,834	$15,561,618	$10,361,698	-$10,814,216	Deferral with an increasing likelihood in the number of repairs and reactive replacements.
REP_04.04.02	11/5kV Undergound Mains (km)	$21,275,191	$15,130,999	$14,724,612	-$6,144,192	
REP_04.04.03	Low Voltage (LV) Underground Mains (km)	$17,686,605	$17,279,905	$15,714,217	-$406,700	
REP_04.04.04	LV Underground Services (No.)	$2,968,313	$181,266	$129,454	-$2,787,047	
REP_04.04.05	11kV UG Ductline - CBD (km)	$3,207,119	$5,011,729	$4,255,302	$1,804,610	Increased based on revised forecast
REP_04.04.07	Capital Works - Natural Disasters, Storms and Bushfires	$6,410,283	$2,519,166	$2,087,313	-$3,891,117	Deferral with an increasing likelihood in the number of repairs and reactive replacements.
REP_04.04.10	11/22kV Overhead Mains (km)	$6,738,966	$6,130,592	$4,301,010	-$608,374	
REP_04.04.11	Distibution Mains Reactive Replacement (<$50k) (No.)	$7,440,856	$7,559,574	$5,685,230	$118,718	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
REP_05.02.01-1	132kV and 66kV Tower Survey	$856,543	$842,913	$501,388	-$13,630	Targeted locations based on individual risk and tangible benefits to network requirements. Further investigation of hierarchy of control measures to manage individual site risks including repair/modification options.
REP_05.02.01-3	Tower Painting & Refurbishment	$17,312,226	$13,366,473	$12,401,343	-$3,945,753	
REP_05.02.01-4	Tower Grillage System	$555,149	$30,362	$28,174	-$524,787	
REP_05.02.01-5	Tower Replacement	$4,956,520	$3,630,496	$3,368,384	-$1,326,024	
REP_05.02.02-1	Refurbish Access Tracks - 33kV Lines	$608,293	$993,267	$871,420	$384,974	Increased based on revised forecast
REP_05.02.02-2	Refurbish Access Tracks - 66kV Lines	$405,528	$675,155	$592,335	$269,627	
REP_05.02.02-3	Refurbish Access Tracks - 132kV Lines	$405,528	$1,771,567	$1,554,269	$1,366,039	
REP_05.02.05-1	Insulator Replacement - 132kV Tower	$1,143,173	$239,060	$164,888	-$904,112	Deferral of planned replacement with an increase in reactive replacement.
REP_05.02.05-2	Insulator Replacement - 132kV Wood Pole	$2,295,596	$1,829,516	$1,439,115	-$466,079	
REP_05.02.06	Pole Replacement Sub-Program	$34,910,400	$26,769,629	$22,374,418	-$8,140,771	Minor deferral with a review of the hierarchy of control measures including a revision of the pole inspection standard.
REP_05.02.07-1	Refurb 33kV OH Feeders	$16,076,869	$21,001,079	$15,084,254	$4,924,210	Increased based on revised forecast
REP_05.02.08	Refurbish 132kV Cable Tunnel	$937,284	$657,644	$609,129	-$279,640	Deferral in first year of period, extending program by one year overall.
REP_05.02.12	Cable Pressure Alarm Replacement	$3,996,301	$2,255,366	$1,740,763	-$1,740,935	Review of hierarchy of control measures to manage site specific risks. Further synergy expected with delays of other interdependent investment at individual sites.
REP_05.02.13	Miscellaneous Sub-Trans Mains	$2,521,382	$4,587,119	$3,816,416	$2,065,738	Increased based on revised forecast
REP_05.02.14	System Spares - TM (OH & UG)	$2,039,092	$1,168,553	$1,075,068	-$870,539	Review of spares requirements and spares holdings to be undertaken.
REP_05.02.23	Insulator Replacement - 33KV Pole Lines	$1,054,375	$694,977	$517,560	-$359,398	Reduced due to synergy with 33kV OH Feeder Refurbishment program.
REP_05.02.24	Protection Pilots	$4,187,999	$2,063,569	$1,414,277	-$2,124,430	Deferral with an increasing likelihood in the number of repairs and reactive replacements.
REP_05.02.26	Ground Stays	$5,146,112	$7,018,957	$5,229,164	$1,872,845	Deferral with an increasing likelihood in the number of repairs and reactive replacements.
REP_05.02.28	Refurbish Earthing Electrodes - ST Feeder	$0	$626,915	$445,185	$626,915	New program
REP_05.02.29	Replace ST Feeder OHEW	$0	$9,964,209	$7,373,008	$9,964,209	Based on recent failures which have uncovered condition issues.
	Total (exclude support costs)	**$1,685,562,778**	**$1,299,975,243**	**$1,009,155,407**	**-$385,587,535**	
	Planning, GIS Data Capture and Switching	$90,455,327	$76,264,682	$53,361,401	-$14,190,645	

Program ID	Program Name	2013 Plan	2014 Plan		Variation (based on total costs)	Comments
		Total	Total $	Direct $		
	Total (include support costs)	**$1,776,018,105**	**$1,376,239,925**	**$1,062,516,808**	**-$399,778,180**	

APPENDIX A - Revised Risk Consequence Analysis

The following section documents the results of the revised risk consequence analysis for several high value proactive Replacement and Duty of Care programs. For each sub-program the risk associated with the asset planned to be addressed has been quantified on an annual basis. This can be compared against the proactive replacement cost. However a full cost benefits analysis needs to take into account a number of additional factors including the projected failure growth rate, period of time that a replacement mitigates the risk, overall effectiveness of the risk treatment and additional benefits associated with the replacement. Undertaking such analysis is complicated by the impact of prior replacements which have targeted assets in poor condition. While the following section does not represent a cost benefits analysis, the magnitude of the annual risk cost better informs and supports the bottom up justification of the proposed proactive investment program.

11kV Zone OCB Replacement

In quantifying the risks associated with the 11kV Zone Substation oil circuit breakers (OCBs) the risk cost for a single asset was found to be approximately $9,700 p.a. The risk cost was determined based on asset performance over the last 3 years. During this period a program of planned replacement for this asset class was being undertaken. The cost of planned replacement for a single 11kV OCB is $31,000.

While the risk cost appears relatively low against the replacement cost, the following non-quantified benefits should be considered:

- Asset performance over the last 3 years incorporates the previous levels of replacement (under repex and other capex drivers).
- Replacement is not like-for-like. Replacement of this asset is with a new technology (vacuum).
- Long term maintenance reductions. Oil circuit breakers require a more intense maintenance regime that includes regular circuit breaker overhauls compared with the new vacuum circuit breakers installed.
- Life extension of switchboards. The replacement of many of these oil circuit breakers leads to life extension of the 11kV switchboard. Ausgrid has delayed a number of switchboard replacements as an outcome of oil circuit breaker replacements.

These benefits do provide strong evidence to support the validity of this program and the risk quantification highlights the need for the program to continue. The following table shows risk quantification of the various failure modes and the range of consequences:

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Internal failure e.g. flashover, tank rupture	4%	Explosion and/or substantial fire resulting in rupture and/or damage of the circuit breaker or resulting in the exhaustion of oil from the overpressure device causing damage to the circuit breaker, surrounding equipment and/or external environment/people.	Unlikely	5	1	2	0	3	$31,162
		Loss of supply, Individual circuit breaker	Possible	0	0	0	2	1	
		Loss of supply, group of switchgear	Possible	0	0	0	40	3	
External failure e.g. gasket (failure to contain oil) failure	20%	Failure of the circuit breaker to contain oil causing damage to the circuit breaker, surrounding equipment and/or external environment/people.	Rare	0	2	0	0	0	$31,162
External failure e.g. bushing failure	6%	Catastrophic failure of an 11kV SRBP bushing causing damage to the circuit breaker, surrounding equipment and/or external environment/people.	Unlikely	5	1	2	0	0	$31,162
		Loss of supply, Individual circuit breaker	Possible	0	0	0	2	1	
		Loss of supply, group of switchgear	Possible	0	0	0	40	3	
Internal mechanism failure e.g. racking mechanism	70%	Loss of supply, Individual circuit breaker	Unlikely	2	0	0	2	1	$31,162
Quantified Risk	**$6490**	**$47**	**$61**	**$279**	**$2509**	**$282**	**Quantified Risk**	**$6490**	**$47**

LV Overhead Service Wire Replacement

The LV Overhead Services program is a continuation of the planned and reactive replacement program undertaken in previous regulatory control periods. The risk cost has been determined based on asset performance over the last 5 years.

In quantifying the risks of LV overhead services, the risk cost for a single asset was found to be approximately $2,704p.a compared to a planned replacement cost of $455.

The risk quantification and non-quantified benefits support the proposed replacement volumes for this program. Planned replacement will continue the focus on those with PVC insulation as highlighted as a priority risk by the NSW Department of Energy. Planned replacement will also continue to target those with specific service clamp styles which have known condition issues which lead to corrective or breakdown failure. All existing service wires are replaced with conductors with XLPE insulation which has a life expectancy of more than 30 years. Additional detailed information in regard to LV overhead service wires is available in ACAPS4010 which formed part of the original regulatory proposal.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Failure of service wire	72%	Electric shock	Rare	2	0	1	0.0238	1	$501
		Loss of supply	Almost certain	0	0	0	0.0238	0	
Service clamp failure	28%	Loss of supply	Almost certain	0	0	0	0.0238	0	$501
		POA arcing / fire	Likely	2	0	1	0	1	
Quantified Risk	100%			$2,238	-	$223	$12.54	$224	$5

LV CONSAC Cable Replacement

The CONSAC replacement program is a continuation of the planned and reactive replacement program undertaken in previous regulatory control periods. The risk cost has been determined based on asset performance over previous years. The risk cost and planned replacement costs used in the analysis are normalised to a 20 metre length. The risk cost was determined based on asset performance up to the end of FY12.

In quantifying the risks of LV CONSAC cable, the risk cost for a 20 metre length was found to be approximately $2,650 p.a compared to a planned replacement cost of $14,646. While the risk cost appears relatively low against the planned replacement cost, the following non-quantified benefits and asset considerations should be taken into account:

- Ausgrid has approximately 790km of CONSAC cable in service – replacement of only 20 metres following failure would result in CONSAC cable not being totally removed from the network until more than 250 years at current failure rates.
- Failure rates are growing at over 10% per year and are highly correlated with rainfall. The increasing failure rate is projected to increase to unsustainable failure rates which are beyond available resource levels (internal or external resources) to carry out repairs.
- The number of electrical shocks would also be expected to increase due to further age degradation of the aluminium sheath which is the neutral connection. The likelihood of electric shock to the public or a fatality caused by CONSAC neutral failure also increases as further degradation occurs over the cable population.

These intangible asset sustainability considerations have not been quantified as they are long term issues that cannot be reliably forecast. However, these do provide evidence to the validity of this planned and reactive replacement program.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
High resistance neutral	10%	Voltage unbalance / partial loss of supply	Likely	0	0	0	0.952	0	$19,479
		Electrical shock	Possible	2	0	1	0	1	
Open circuit neutral	10%	Voltage unbalance / partial loss of supply	Likely	0	0	1	0.952	1	$19,479
		Electrical shock	Possible	2	0	1	0	2	
		Fatality - electrocution	Rare	5	0	2	0	3	
Insulation failure	75%	Loss of supply	Almost certain	0	0	1	0.952	1	$19,479
Insulation degradation	5%	Voltage unbalance	Likely	0	0	0	0	0	-
		Partial loss of supply	Likely	0	0	1	0.952	1	$19,479
Risk Cost	100%			$968	$0	$665	$136	$810	$70

Steel Mains and ACSR ('Quince')

The Steel Mains program is a continuation of the planned and reactive replacement program undertaken in previous regulatory control periods. The ACSR ('Quince') program is a new planned and reactive replacement program. The risk cost and planned replacement costs used in the analysis are normalised to a 200 metre length. The risk cost has been determined based on asset performance over 3 years.

In quantifying the risks of Steel Mains and ACSR ('Quince'), the risk cost for a single asset was found to be approximately $368,352p.a/200m length, compared to a planned replacement cost of $14,000.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Conductor / connection failure	90%	Electrical shock	Unlikely	4	0	2	0	1	$16,800
		Loss of supply	Likely	0	0	1	12.32	0	-
		Fatality - electrocution	Rare	5	0	2	0	2	-
		Fire event	Possible	4	4	3	0	4	-
Steel tie failure	10%	Electrical shock	Unlikely	4	0	2	0	1	-
		Loss of supply	Likely	0	0	1	12.32	0	$16,800
		Fatality - electrocution	Rare	5	0	2	0	2	-
		Fire event	Possible	4	4	3	0	4	-
Risk Cost	100%			$150,203	$92,934	$31,446	$233	$93,316	$221

4.1

Steel Tower Refurbishment

The Steel Tower Refurbishment program is a continuation of the planned refurbishment program undertaken in the previous regulatory control period. The risk cost has been determined based on tower audit information in regard to defects associated with steel members.

In quantifying the risks of Steel Towers, the risk cost for a single asset was found to be approximately $30,283,030p.a compared to a planned refurbishment cost of $135,000.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Structural failure of tower	100%	Injury to public	Rare	3	0	1	0	1	0
		Loss of supply	Almost certain	0	0	0	3.024	0	$585,000
Risk Cost	100%			$47	$0	$0	$30.161M	$0	$121,558

Oil Containment Program

This sub-programme is required to upgrade Ausgrid's oil containment systems at substations with 1,2 & 3 stage oil tanks in order to address Ausgrid's environmental obligations set out in the Protection of the Environment Operations Act 1997.

The 1,2 and 3 stage oil tanks are known to discharge oil under a certain level of water inflow rate. This has been calculated to be approximately equivalent to the volume of water that flows into the tanks at a typical 3 transformer substation with a rain fail event greater than 1mm. The risk cost has been determined based on an understanding of the performance capabilities of the existing oil containment systems and meteorological data indicating the number of rain days that would exceed the performance capabilities of the existing systems.

In quantifying the risks of the existing non-compliant oil containment systems, the risk cost for a single asset was found to be approximately $4,729,283 per annum compared to a planned replacement cost of $468,000.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Non-compliant oil discharge	50%	Waterway contamination	Unlikely	0	3	2	0	2	$0
Leakage from oil pipeline	50%	Land contamination	Unlikely	0	2	1	0	2	$0
Risk Cost	100%			$0	$3,689,512	$368,951	$0	$670,820	$0

B&S I&E Replacement

The B&S I&E replacement program is a continuation of the existing planned prioritised program undertaken in previous regulatory period. In quantifying the risks, the risk cost for a single asset was found to be approximately $10,127 per annum compared to a planned replacement cost of $158,747.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
HV I&E Switchgear failure	100%	Substation fire	Unlikely	3	2	3	24.36	2	$ 190,496
Risk Cost	100%			$3,993	$399	$3,993	$209	$399	$1,134

Low Voltage OCB Substations

The LV OCB substations program is a continuation of the existing planned replacement program undertaken in previous regulatory period.

In quantifying the risks of the low voltage OCBs in distributions substations, the risk cost for a single asset was found to be approximately $137,282 per annum compared to a planned replacement cost of $277,940.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
LV Switchgear failure	99%	Loss of electricity supply	Possible	0	2	2	10.8	2	$383,652
	1%	Injury caused by fire & exploding equipment	Possible	3	2	2	10.8	2	$383,652
Risk Cost	100%			$2,719	$27,197	$27,197	$6,305	$27,197	$46,664

Kiosk Substations with exposed 11kV

The kiosk substations with exposed 11kV program is a continuation of the existing planned replacement program undertaken in previous regulatory period.

In quantifying the risks of the kiosks with exposed 11kV, the risk cost for a single asset was found to be approximately $25,418 per annum compared to a planned replacement cost of $158,300.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Inadvertent contact with exposed conductors by Ausgrid staff	50%	Electric shock	Possible	4	0	3	0	3	0
		Electrocution	Possible	5	0	3	0	3	0
Inadvertent contact with exposed conductors by general public	50%	Electric shock	Possible	4	0	3	0	3	0
		Electrocution	Possible	5	0	3	0	3	0
Risk Cost	100%			$17,312	$0	$2,630	$0	$5,474	$0

2 pole Substations

The 2 pole substations program is a continuation of the existing planned replacement program undertaken in previous regulatory period. In quantifying the risks of the existing 2 pole substations, the risk cost for a single asset was found to be approximately $1,066,636 per annum compared to a planned replacement cost of $235,675.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Structural failure	100%	Injury to general public	Possible	3	2	2	1.44	2	$ 0
		Damage to public & private property	Possible	0	2	2	1.44	2	$ 235,675
		Disruption of traffic	Likely	0	2	1	1.44	1	$ 0
Risk Cost	100%			$ 29,068	$145,344	$27,615	$ 4,492	27,615	$61,275

Network Protectors

The Network Protectors replacement program is a continuation of the existing planned prioritised program undertaken in previous regulatory period. In quantifying the risks, the risk cost for a single asset was found to be approximately $26,818 per annum compared to a planned replacement cost of $104,960.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Network Protector failure	100%	Loss of supply, disruption to CBD & injury to staff.	Unlikely	3	1	3	24.36	2	$104,960
Risk Cost	100%			$11,566	$116	$11,566	$605	$1,157	$1,810

Distribution Substation Security

A more detailed cost benefits analysis of Ausgrid's proposed distribution substation security program has resulted in a net reduction of the quantity of substations that need to be upgraded in the short term. Ausgrid's distribution substation security program was proposed to mitigate the public safety risk associated with unauthorised entry into its chamber type distributions substations. The original proposal was to upgrade the security at 1,185 substations 2015-19 regulatory period.

In preparing a revised proposal, Ausgrid has carried out a review of this program at a more granular level to further justify the proposed investment volumes and timing. This has involved conducting a more detailed risk assessment of the individual 14 different types of chamber substations on Ausgrid's network. Review of the individual types resulted in categorising the as either an outdoor type substation or an indoor type substations. The main difference between the two from a risk perspective is that there is a lower likelihood that the general public will have access to indoor style substations. In addition, the existing security hardware is less likely to be in a poor condition as it is not exposed to the elements.

In quantifying the risks of the associate with the remaining distribution substations included in the revised program, the risk cost for a single asset was found to be approximately $280,891 per annum compared to a planned security upgrade cost of $20,400.

Failure Mode	Proportion of failures	Consequence Description	Likelihood	Safety	Environment	Reputation	Loss of supply	Liability	Financial
Unauthorised Entry	99%	Theft of copper, copper portable earths.	Likely	2	1	1	1.5	1	$0
		Electric shock	Possible	4	0	2	1.5	3	$0
		Electrocution	Possible	5	0	3	1.5	4	$0
Substation Fire	1%	Entrapment of staff	Rare	5	0	3	1.5	3	$0
Risk Cost	100%			$200,834	$447	$16,860	$240	$62,510	$0

APPENDIX B - AER's November 2014 Draft Regulatory Decision - Replacement Planning

B.1 Repex modelling

In establishing its Replacement and Duty of Care programs Ausgrid evaluates an entire asset class to identify any subset of assets within that class that presents a higher risk. These subsets form the basis for Ausgrid's bottom-up risk based forecasting process. The likelihood and consequences are then applied to the subset, for risk evaluation and to form the sub-programs. This approach has benefits over REPEX modelling as it allows Ausgrid to target specific high risk subsets.

For example, 11kV oil circuit breakers in zone substations present a fire risk that in the event of a failure could lead to an entire switchboard failure and secondary damage to the building. This has occurred a number of times already on the Ausgrid network. There is also a considerable safety risk for staff working in and around this equipment. Ausgrid has considered 11kV oil circuit breakers in zones as a subset of 11kV zone circuit breakers. Ausgrid has not proposed a replacement strategy for its 11kV vacuum circuit breakers as these assets are not presenting a significant risk. Out of a total population of 273 different 11kV switchboards within zone substations, Ausgrid still has 85 zone substations with oil circuit breakers in service. Ausgrid's program for replacement is therefore specific to addressing this subset.

If a particular asset class is performing well and does not present a significant risk, then Ausgrid will not identify any subset of that asset class for further investigation. We therefore avoid replacing assets purely on the basis of age or historical spend. REPEX, on the other hand, utilising a calibrated forecasting method does not allow for a step change where a particular asset class has had little to no replacement carried out historically.

For example, overhead earth wire is an asset that has not been conditionally assessed previously and not considered for replacement. Recent incidents have led to an investigation into these assets and drove the need for a replacement program. However, as these assets were never replaced in the past, the AER's REPEX model would not forecast a need to replace these poor condition high-risk assets.

B.2 Appropriate use of the AER's REPEX model

The AER has used predictive modelling (REPEX), in order to provide a substitute allowance that it deems to be appropriate. Ausgrid have considered that some of its assets are suitable for predictive modelling based on the evaluation of age as a proxy for condition.

However, REPEX analysis is not appropriate to use as a standalone mechanism to make investment decisions and the predictive modelling employed by the AER should only be considered to validate programs that are suitable for this type of modelling. Ausgrid's bottom-up approach using sound and justified maintenance regimes based on applying Reliability Centred Maintenance (RCM) in order to identify asset risk and prioritise intervention remains the most effective mechanism to ensure asset risks are appropriately managed.

There are a number of Replacement and Duty of Care sub-programs that are not suitable to be modelled utilising REPEX. Programs that are not suitable for this type of modelling include programs that have the following attributes:

- Long individual project delivery timeframes[1];
- Assets which have a large number of components (complex);
- Assets with varying failure modes and technology types;
- Assets which present safety risks to employees and the general public, independent of age;
- Assets which are sensitive to environmental influences; and
- Assets which carry significant risk not directly related to age degradation.

Additionally, when providing asset age profiles for the 2014 RIN, Ausgrid was not asked to include all assets on its network in its age profiles. Therefore assets such as overhead earth wires were not considered. This also leads to incorrect outcomes when undertaking REPEX modelling. The AER has considered SCADA, network control and protection; pole top structures; and other REPEX as additional assets that were not included in its REPEX model. However, it has neglected a number of other assets which Ausgrid believes are equally unsuitable for modelling under REPEX and for which asset counts were not included in the RIN. For example, in relation to underground mains the AER has only included circuit length in its RIN. This excluded assets such as pillars and pits, underground link boxes and oil cable pressure alarms which all require capital investment in the 2014 – 19 regulatory period. This shortfall in asset consideration is consistent across most asset classes.

The AER appear to have not given due consideration for these issues. This has in turn led to unrealistic replacement lives used in its calibrated forecast method. 23 of the 152 RIN categories have calibrated replacement lives in excess of 60 years and 36 greater than 50. This includes expected lives of 134 years for 11kV fuses and 99 years for 66kV switches.

Nonetheless, Ausgrid has considered that some assets categories may be appropriately validated utilising predictive modelling. These programs are identified in a separate report entitled “Application of REPEX – Ausgrid 2014”.

B.3 Duty of Care

The AER does not appear to give appropriate consideration of Ausgrid’s Duty of Care program. This program covers investment that cannot be evaluated using high level metrics, such as those used by the AER.

The majority of Duty of Care programs are not age or time based. As such many of these programs are not appropriately forecast using a model such as REPEX. For example, we have identified a significant environmental risk from non-compliant oil containment systems. We have identified these non-compliant systems and have proposed a program of work. The need is not driven by age or asset condition and therefore does not allow for predictive modelling such as REPEX. Additionally, Ausgrid’s oil containment systems are not captured in our RIN template as assets in the age profiles.

We would consider an appropriate evaluation for Duty of Care programs would have been based on an engineering review of these requirements. However, no engineering review appears to have been undertaken and despite EMCa claiming they reviewed a number of Duty of Care ACAPS, there was no evidence of this in the findings of their report.

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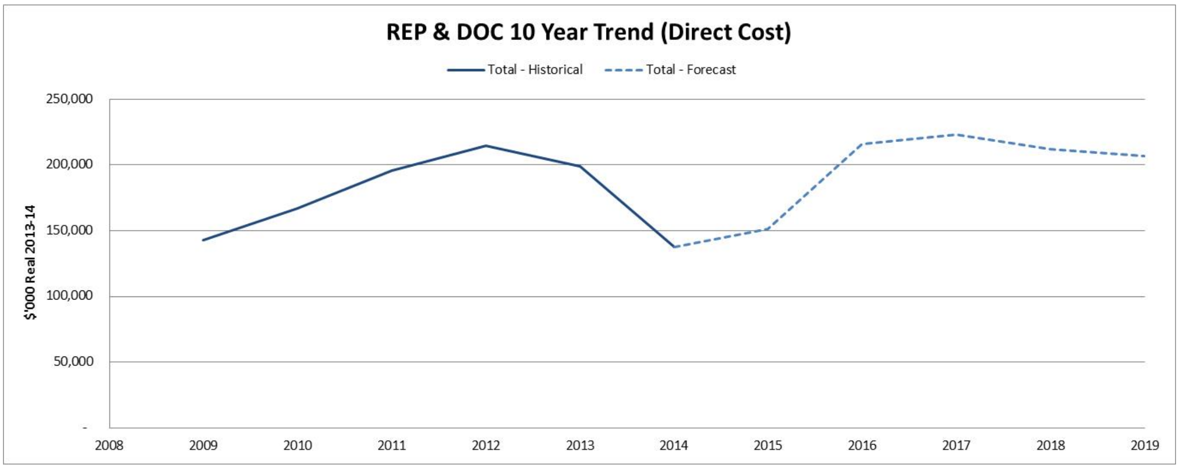
[1] Generally programs that have long delivery times are those that have been captured as part of Ausgrid’s Area Plans.

B.4 Trend Analysis of Programs unsuitable for Repex

For programs identified in the report "Application of REPEX – Ausgrid 2014" as unsuitable for application of REPEX, we have prepared the following trend analyses as a means of providing a level of top-down review.

Analysis of the overall investment trend of the unmodelled components of the revised Replacement and Duty of Care plan demonstrates it to be consistent with historical expenditure levels. In company with the detailed planning analysis, this provides a level of confidence that the proposed overall program is consistent with historic levels and therefore likely to represent a prudent and efficient expenditure.

The following graph shows the historical trend and revised proposed expenditure for the unmodelled component of the Replacement and Duty of Care plan



The dip in expenditure in 2013/14 and 2014/15 is a result of the reassessment and disruption effects of the major restructure Ausgrid has undergone. This effect is visible in most expenditure trends.

Detailed trend analysis for each of the sub-categories follows, along with a more detailed discussion of the drivers and identification of reasons where trends show changes from historic expenditure levels.

B.5 Key Revised Programs

A number of programs are documented in greater detail to provide a guide to the revised approach that Ausgrid has undertaken in its review process. For the purposes of evaluation against the AER draft determination, the sub-programs described below have been split up based on the broad categories used within the 2014 RIN.

Underground Cables

Included in this category are the CONSAC and HPDE planned, reactive replacement sub-programs and reactive underground mains which comprises a mix of length and unit replacements.

This category has been excluded from the REPEX validation modelling for a number of reasons. The CONSAC and HDPE sub-programs were created to address an increase in failure rates. This is despite these cable types being relatively young compared to many others on the network. The design of these assets has led to accelerated corrosion and premature condition issues. For more technical information refer to ACAPS4030 and ACAPS4031. Due to the relatively young age of these assets and their unique failure characteristics, these have been excluded from REPEX. The remaining sub-programs cover a mix of cables and associated equipment. These have also been excluded from REPEX due to the mixed between length assets and unit assets and the unavailability of this information in Ausgrid's RIN.

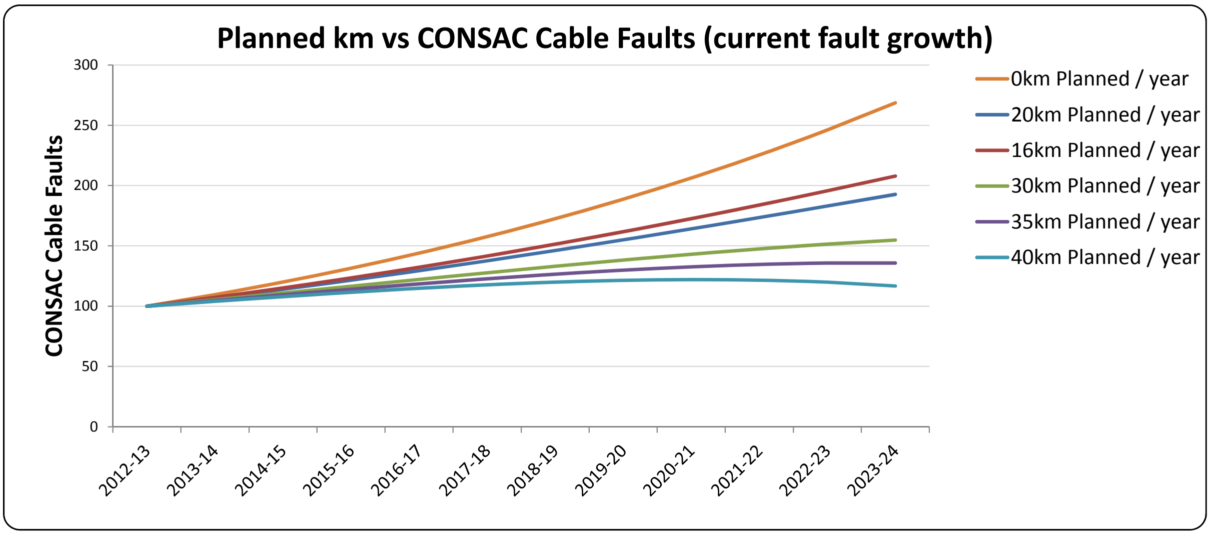
The sub-programs below represent the highest value programs in the asset category. The changes made to these sub-programs are indicative of the approach taken across all sub-programs captured in this category.

CONSAC and HDPE (REP_04.02.05, REP_04.02.06)

LV CONSAC cable replacement is the largest underground distribution mains investment program. This program has been revised downwards by 38% for planned replacement; however this is also expected to result in a minor increase in reactive replacement requirements for the 2014 – 19 regulatory period. Fault projections based on the current fault growth rate of 11% per annum (annual growth rate over 10 years) show that this reduction in planned replacement requirements will lead to an increase in the projected number of faults long term as the number of faults will continue to increase.

The figure below shows the projected number of faults compared to various CONSAC planned replacement lengths, with the 10 year average number of annual faults (approximately 100) as the starting level. These projections can vary depending on rainfall levels as there is a high correlation between increased rainfall and increased cable failures. The forecast shows that the failure rate will not start to decrease within 10 years unless planned replacement quantities greater than 35km per year are undertaken. While the planned replacement cost is relatively high compared to the risk cost (see Appendix 1), with approximately 790km of CONSAC cable in service on the network, asset sustainability is likely to become an issue due to this increasing failure rate if planned replacement at this level continues. Further details are available in ACAPS4030.

Figure 1 – CONSAC planned replacement vs cable faults



This deferral does not come without risk. It is evident from the figure above that the reduced replacement rate will lead to increased failures. However, this is a marginal difference through the current regulatory period. We believe we can appropriately balance this risk at the reduced replacement rate for the 2014 – 19 period. This however is likely to ramp up in future periods, putting at risk the long term benefit for customers. We have considered this and believe the reduction is still appropriate.

Reactive UG Mains (REP_04.02.35; REP_04.02.38; REP_04.04.02; REP_04.04.03; REP_04.04.04; and REP_04.04.05)

Other than the two cable types explained above, Ausgrid did not propose other targeted condition or age based replacement programs for either LV or HV underground cables, instead relying on reactive replacement provisions based on historical expenditure and replacement quantities as explained in ACAPS4032 and ACAPS4020 respectively. These reactive programs were not intended to reduce the average age of the distribution cable population as we feel this would be not be economically prudent or indeed achievable – the programs were instead focussed on condition based replacement requirements identified following breakdown failures or other drivers, and also in accordance with our mostly ‘run to failure’ strategy for these assets. Having reviewed previous expenditure levels and failure rates, reductions in these reactive programs have been identified, particularly for the LV Underground Services program. These reductions will result in an operations expenditure trade-off whereby condition issues which may have resulted in conductor replacement previously will need to be repaired to remain serviceable.

In regard to underground distribution mains equipment, Ausgrid only proposed two new reactive programs for high priority asset replacement during 2015-19. The first program was for steel round pillars and the second was for replacement of LV underground link boxes. Both have been reduced for the revised proposal. Both programs are explained further in ACAPS4040.

Steel round pillar program revisions have occurred after public safety incidents caused Ausgrid to perform intrusive assessment and repairs of all pillars of this type during 2014. The assessment has resulted in an increase in reactive replacements in the first year of the period, but the level of reactive replacement is expected to decrease over the remainder of the 2016-19 period. In parallel with this, additional maintenance will be undertaken on this type of pillar in the future (‘safe to touch’ testing) and this will further decrease replacement requirements.

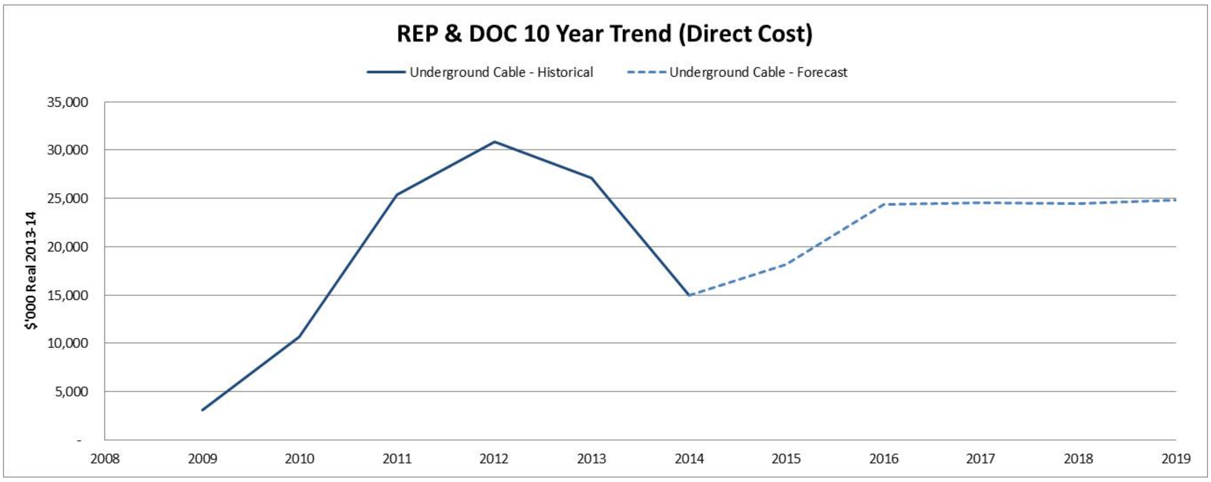
The program for reactive replacement of LV underground link boxes was created due to a number of high risk failures. This program has been reduced by approximately 36% for the revised proposal. The consequence of this reduction is expected to be additional corrective maintenance requirements when corrective failures are identified to mitigate high risk failure events as opposed to replacement of degraded equipment. Breakdown failures will continue to require replacement of the existing link box due to the damage caused by the failure.

These deferrals do not come without risk. Repair options for steel round pillars and underground link boxes will change to a less effective control on the hierarchy of controls. The review of capex / opex consideration has not been reflected back in our system opex submission. It is expected that the variation in this program will be absorbed by our system opex. This will create greater upward pressure on system opex. This will also lead to poor condition assets remaining in service for longer potentially having long term impact on customers. In turn, failure rates will increase as the asset class ages. However, improved governance will lead to improved data capture, reducing uncertainty allowing for a more targeted program. We believe these deferrals provide an acceptable risk balance.

It should be noted that assets such as these were not included in the RIN and therefore excluded from REPEX modelling undertaken by the AER.

Expenditure Trend Analysis

Analysis of the investment trend shows the revised proposed expenditure is consistent with historical levels of expenditure trend in this category. As the expenditure profile in the 2015-19 period trends is consistently below the peak levels of expenditure set in 2012, it is reasonable that there would be no major impediments to the successful delivery of this program. This validates that the revised level of expenditure in this category is appropriate.



SCADA, network control and protection

This asset category includes a number of protection relay and scheme replacement programs, voltage regulation, SCADA and MPLS. These assets were excluded from the REPEX model in the AER's draft decision. There is insufficient historical data to undertake a REPEX analysis on this category. Additionally, assets such as these do not exhibit a wear-out characteristic, making failure patterns unpredictable.

The sub-programs below represent the highest value programs in the asset category. The changes made to these sub-programs are indicative of the approach taken across all sub-programs captured in this category.

Voltage Regulation (REP_02.03.10)

In the previous regulatory period, Ausgrid carried out an engineering assessment of Voltage Regulation Equipment in sub-transmission substations. This assessment identified the need to replace voltage regulation schemes installed within the sub-transmission substation network. This assessment was underpinned by the high risks associated with the breakdown of voltage regulation schemes in the transmission network and the subsequent cascading flow-on of failure events and consequences into zone substation assets (chain of events). Many of the zone substation assets that were identified as part of the Voltage Regulation replacement program are of the same technology type and vintage as those assets that were identified and replaced within the sub -transmission substations. The historical need for replacement was justified based on the failure and risks associated with the like equipment and schemes located within the sub transmission substations. We have reassessed the risks at a more granular level and have determined a reduced reactive program to manage these risks.

This deferral does not come without risk. A push to more reactive replacement has allowed Ausgrid to defer its total program expenditure, but will increase the risk of failures and may lead to a reduction in performance metrics such as SAIDI and SAIFI. However, in our review the marginal difference in risk between substations was recognised and led to a program reduction that was appropriate.

Distance Relays (REP_02.03.08 & REP_03.03.06)

Significant replacement work has occurred in the previous regulatory submission to replace poor performing Distance Relay schemes in both zone and sub-transmission substations with Line Differential Protection schemes. Due to the reduction in population of poor performing Distance Relay assets a further review of the risks associated with these assets has been undertaken. This review has identified that a combination of improved maintenance processes and practices with a reduced reactive relay replacement program on assessment of end of life is now considered prudent to manage these assets in the longer term.

This removal of the planned program funding does not come without risk. A push to more reactive replacement has allowed Ausgrid to defer its total program expenditure, but will increase the risk of failures and may lead to a reduction in performance metrics such as SAIDI and SAIFI. However, in our review the marginal difference in risk between substations was recognised and led to a program reduction that was appropriate.

SCADA Schemes (REP_02.02.46 & REP_03.02.34)

Zone and sub-transmission substation SCADA control schemes have been previously funded in the 2009-14 regulatory period from general substation reactive funding. Due to a limited spend in previous regulatory periods on this aging asset class a further engineering assessment of this asset class was undertaken and decisions were made to allow for a dedicated reactive program to manage end of life issues with certain Scada and Composite control schemes within zone and sub-transmission substations. After a recent risk review of these assets it has been deemed appropriate to continue with reduced reactive programs to manage these assets over their remaining life. The review has shown that a lower spend requirement is justified and this has been reflected in a revised reactive program.

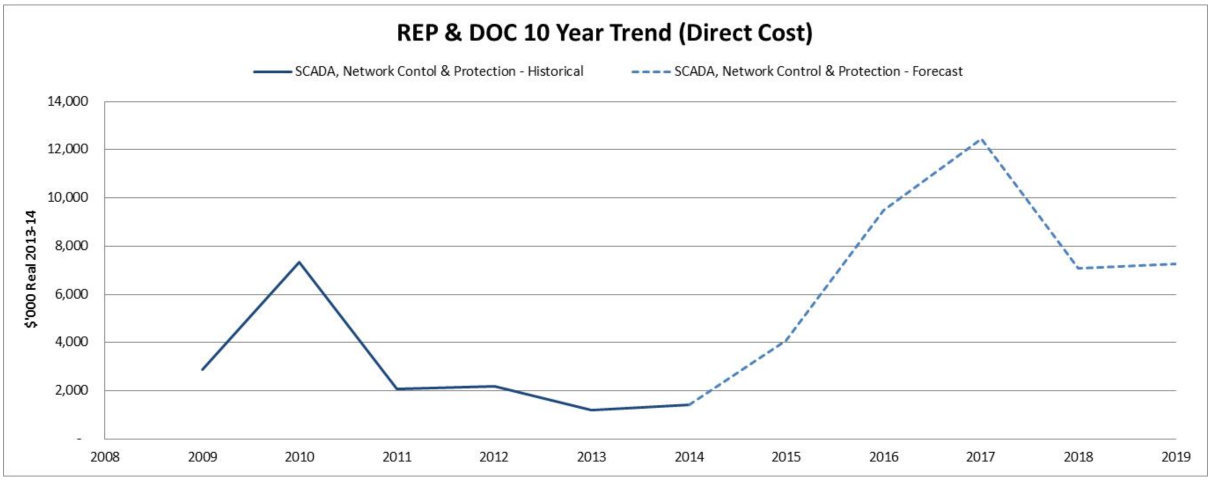
This deferral does not come without risk. A push to more reactive replacement has allowed Ausgrid to defer its total program expenditure, but will increase the risk of failures and may lead to a reduction in performance metrics such as SAIDI and SAIFI. However, in our review the marginal difference in risk between substations was recognised and led to a program reduction that was appropriate.

CLC Controllers (REP_02.02.54)

Consumer Load Control (CLC) controllers have been previously funded in the 2009-14 regulatory period from OPEX budgets when reactive replacement was required. This was an incorrect process from an assessment of these asset failures over the 2009-14 regulatory period and the high risk that of CLC plant equipment failure due to a failure of the controller it was considered appropriate to initiate a CAPEX reactive program to manage these assets. After a further risk review of controller sub-categories the program has been confirmed to align with the original proposed program documented in ACAPS2005 Zone Substations – Customer Load Control Equipment.

Expenditure Trend Analysis

The following trend analysis shows the difference in investment profile historically against the 2015-19 regulatory period.



Analysis of the investment trend shows an increased level of proposed expenditure above the historical expenditure. There are a several issues associated with the analysis of this trend.

1. There are a number of data issues associated with this asset category that make the trend analysis difficult to interpret appropriately.
2. Expenditure in the 2009-15 in this asset category is likely to be significantly higher than is apparent due to works being previously funded under general reactive replacement programs that are not included in this category.
3. Historical expenditure from 2011 to 2014 reflects below trend levels of investment and the proposed expenditure in the 2015-19 period addresses this backlog of investment in 2016-17 with the forward level returning to historical trend levels.
4. The catalyst for the increase expenditure is based on a combination of drivers including the following:
    - There is no longer manufacturer's support for some of these assets.
    - Ausgrid has begun to exhaust its own spare parts pool for many of the assets.

- Ausgrid has a large fleet of assets that are no longer supportable and will require replacement upon failure rather than repair as has occurred in the past.

While the trend analysis in the category does not validate the revised proposed level of investment based on a historical trend analysis, the bottom up analysis has been reviewed and determined to be justified on this basis.

4.2 Pole Top Structures

Pole top structures include air break switches, ground stays and underslung links. These assets have been removed from REPEX as there was not appropriate history captured in the 2014 RIN to allow for this type of modelling. These assets were excluded from the REPEX model in the AER's draft decision.

The sub-programs below represent the highest value programs in the asset category. The changes made to these sub-programs are indicative of the approach taken across all sub-programs captured in this category.

Ground Stays (REP_05.02.26)

In regard to ground stays, the planned replacement program has been reduced and the reactive replacement quantities have been increased. The quantity of planned ground stay replacements (which were for particular Upper Hunter ground stays with known corrosion issues as explained in ACAPS5004) has been reduced in the current period. Following a number of failures of this type of ground stay around 2008 a trial of ultrasonic testing technology for the steel rods in the stays produced mixed results in regard to positive identification of poor rod condition. Many of the higher priority ground stay replacements were carried out at this time based on those test results as no other means of identification of stay rod condition was available other than by doing full excavation of the stay. Our original proposal was aimed at removing the remainder of this type of stay on dual feeder pole lines during this period due to their known condition issues. The reduction in the planned quantity will result in a lengthening of the program for removal of this type of ground stay spanning two regulatory periods.

While the quantity of planned ground stay replacements has been reduced, the quantity of reactive replacements has been increased but not to the extent of planned replacement reductions. Following a failure of a ground stay in the Central Coast area during 2014 (which was of different design to the Upper Hunter type), our pole inspection standard NS-145 was modified to ensure that ground stays are more effectively assessed during the 5 year maintenance cycle. This change in NS-145 is expected to increase the quantity of reactive replacements required each year and may also result in additional corrective maintenance expenditure.

This deferral does not come without risk. We have anticipated improved maintenance effectiveness from the change in NS-145. This improved effectiveness has been offset by a shorter window of opportunity before failure to identify and replace highly corroded ground stays.

Steel Mains & HV ACSR (REP_04.02.01)

The Steel mains and HV ACSR (Quince) replacement programs have also been reviewed, resulting in a decrease in the forecast quantity of both programs. Both programs are primarily intended to mitigate both bushfire and public safety risks caused by failure of the conductor due to age / environment related corrosion. Steel mains replacement is continuing from the previous period; however HV ACSR (Quince) is a new program created due to increasing levels of conductor degradation being identified. Both programs provide a high risk cost benefit outcome (see Appendix A). The Steel mains reactive program has been adjusted to assist with risk mitigation requirements for steel mains failure also being undertaken by the Duty of Care ‘Low Mains’ program or the newly created (after submission of the initial Regulatory Proposal) Duty of Care ‘Long Spans’ program for mains spans greater than 300 metres in length. These two Duty of Care programs will include some replacement of steel mains as a higher priority than they would be under the condition based replacement program if:

- the conductor clearance to ground is lower than current industry design requirements causing increased public safety risk.
- the excessive span length means that conductor ‘blow out’ with high winds may result in the conductor touching vegetation causing increased bushfire ignition risk.

Deliverability of the revised Steel mains and HV ACSR (Quince) programs is considered achievable using internal resources due to the decrease in augmentation or other work compared to the previous period and more effective assessment of conductor condition using high resolution photography from aerial patrols compared to ground based inspection.

This deferral does not come without risk. The Duty of Care programs identified have not been revised as we are relying on additional synergies between programs (overlapping drivers). However, the ‘Low Mains’ program is reactive based on results of ongoing line inspections. As such the full extent of program overlap is uncertain. We have taken the assumption that due to that fact that our steel mains have significant condition issues, that the overlap is semi-predictable allowing us to consider steel mains as being of high risk in the ‘Low Mains’ program.

Expenditure Trend Analysis

Due to the unavailability of data, no trend analysis has been undertaken for pole top structures. However, it should be noted that the AER recognised Ausgrid’s proposal for the 2014-19 regulatory period as acceptable in this category.

132kV OH Mains

132kV overhead conductor includes overhead earth wire, water crossings and access tracks. Capital investment in these programs takes considerable time to deliver and is not suitable for REPEX modelling. Additionally, the largest investment sub-program (overhead earth wire) does not result in the replacement of the 132kV feeder and was not included as a separate category within the RIN.

The sub-programs below represent the highest value programs in the asset category. The changes made to these sub-programs are indicative of the approach taken across all sub-programs captured in this category.

Overhead Earth Wire (REP_05.02.29)

The planned replacement program for overhead earth wires (‘OHEW’s’) on 132kV tower lines has been increased due to condition issues recently identified. Recent condition issues caused by age related corrosion have been found on tower lines 926 and 927. Together, these two lines are more than 20kms in length. Replacement of these OHEW’s takes considerable time to plan and enact due to the towers supporting two different 132kV feeders – this means that multiple network outages need to be arranged and additional safety precautions undertaken. This work is in addition to other established condition driven OHEW replacement on feeders in the Newcastle Region and other areas. Reactive replacement quantities for OHEW have not been revised.

As noted previously, assets such as overhead earth wire were not included as an asset category in the RIN. Ausgrid is proposing to ramp up replacement of this asset. By undertaking REPEX using the calibrated forecast method and RIN data, the AER have not allowed for programs like this in their draft determination.

Additionally, replacement of this asset does not reset the age of the 132kV feeders. This highlights a significant flaw with the age profile asset health indicator used by the AER in its draft determination.[2]

Transmission Access Tracks (REP_04.03.02)

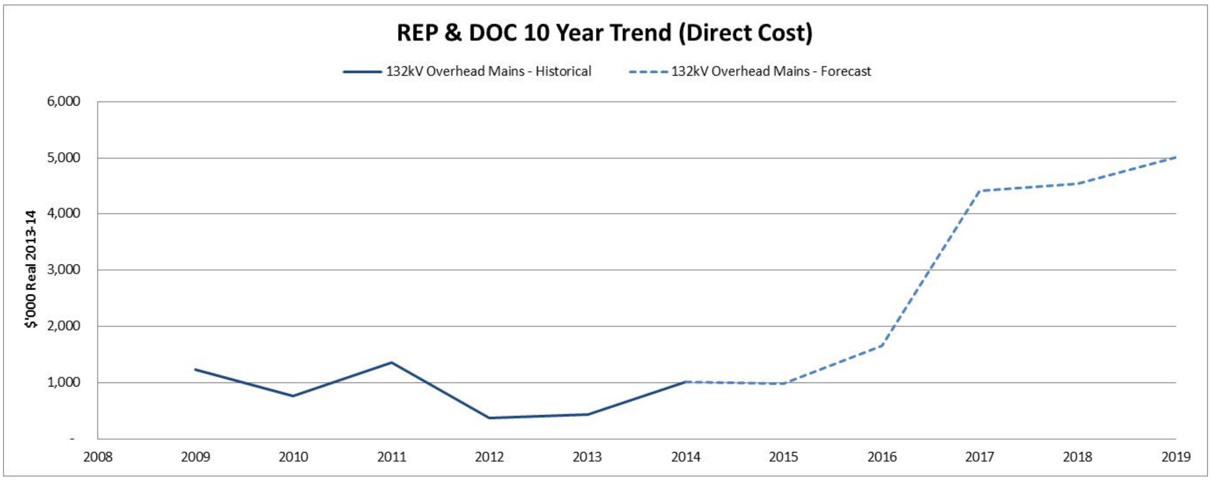
Reactive access track refurbishment programs for 33, 66 and 132kV feeders have all been increased. Increased development within the Sydney area and construction on traditionally vacant land often means that access tracks and access points to our sub-transmission pole and tower lines will be lost unless access or right of ways are purchased or legal tenure obtained by other method. A number of recent locations have become evident and are being procured to ensure Ausgrid can still access our assets, particularly in emergency conditions. It is expected that this requirement will continue over the 2015-19 and subsequent periods and this program provides provision for this as well as reactive access track refurbishment.

Expenditure Trend Analysis

Trend analysis shows that there is a significant increase in expenditure in the 2015-19 period well above historical levels. The increases are driven by improved asset condition information which has resulted in the development of the overhead earthwire replacements programs following the identification of significant corrosion issues. As this is a new program and Ausgrid has not previously undertaken replacement of overhead earthwires on 132kV overhead there is no historical trend for this component. As such trend analysis is not an appropriate assessment approach for this category at this level of detail. However, the increase in expenditure does not adversely affect the overall trend analysis at the aggregate non-repexable Replacement and Duty of Care program level. Additionally, a review of the bottom up assessment has been completed which supports the proposed expenditure in this category.

The following trend analysis shows the difference in investment profile historically against the 2015-19 regulatory period.

[2] Draft Decision Attachment 6: Capital Expenditure p6-58 Figure A-13



Duty of Care Plan

This category includes all Duty of Care programs that do not appropriately fit into one of the other categories above. This category comprises of the majority of Duty of Care programs. These have been excluded from REPEX as they do not age based replacement driven needs and often do not result in the renewal of an asset.

The sub-programs below represent the highest value programs in the asset category. The changes made to these sub-programs are indicative of the approach taken across all sub-programs captured in this category.

Distribution Substation Security (DOC_11.01.01)

Ausgrid's distribution substation security program was proposed to mitigate the public safety risk associated with unauthorised entry into its chamber type distributions substations by upgrading the security of the doors and windows. This program continues on from the previous period and originally proposed to upgrade the security at remaining substations in the 2015-19 regulatory period.

In preparing a revised proposal, Ausgrid has carried out a review of this program at a more granular level to further justify the proposed investment volumes and timing. This has involved conducting a more detailed assessment of the individual 14 different types of chamber substations on Ausgrid's network. Review of the individual substation types at a greater level of detail has enabled Ausgrid to identify several chamber substation types that exhibit lower risk of unauthorised entry than the general population due to difference in their physical location.

This deferral does not come without risk. The ongoing risk of unauthorised entry has been accepted on the basis of the risk exposure at lower risk sites.

Underground Substation Cascade (DOC_11.03.30)

Ausgrid currently has 64 underground substations in service that supply load in the Sydney CBD. These substations were built underneath the roadway and were constructed between the 1930's and 1960's. The underground substations have now reached a considerable age and are beyond their standard life posing a range of risks to staff health and safety. In addition these substations are classified as confined spaces, requiring special arrangements for access which increases their operation and maintenance costs. The specific safety and environmental risks include the following:

- Difficulty in removing an injured worker from the substation.
- Oil containment.
- Asbestos enclosed low voltage boards.
- Lead paint.
- Rusting of friable asbestos filled fire doors.
- Access via vertical ladders.
- Confined spaces.

Ausgrid's preference is to decommission underground substations wherever possible, however, this is not considered technically feasible for a number of substations in the Sydney CBD as this option requires new building developments to provide a room in the basement for a new replacement substation. Instead Ausgrid has developed an alternative strategy to redevelop existing decommissioned underground substations to enable these higher risk substations to be decommissioned. This strategy will enable Ausgrid to mitigate all safety risks to staff and the general public as far as reasonably practicable, as required by WH&S legislation.

Due to the safety risks to staff and significant ongoing costs, Ausgrid has not revised this proposed capital program.

Fire Hydrants – Zone & Subtransmission (DOC_11.03.26 & DOC_11.03.33)

Fire hydrants are required at Substations under the Building Code of Australia (BCA) which is a legislative requirement. BCA compliance is not retrospectively applicable; however, substations must comply with standards/requirements applicable at the time of installation. Over time there has been degradation in the both the condition and operating context of these assets by the development of residential properties adjacent to these substations leading to an increase in their risk profile.

In addition, both Sydney and Hunter Water have made reductions to the water pressure and flow rates of the street water mains that supply Ausgrid's fire hydrants systems. As a result of these reductions, the fire hydrants at some sites will no longer meet their original design performance levels and must be upgraded to comply with statutory requirements.

The condition of the fire hydrant pipe work at many substations has deteriorated to a point where it can no longer be maintained. This deterioration in condition implies a failure to meet statutory requirements and the water pressure required for firefighting purposes. At some locations, asbestos clad water pipes have been found in the substation hydrant system. The poor condition of the fire hydrant pipes has become a limiting factor to delivering desired water pressure due to the risk of bursting a water pipe in an energised substation leading to additional hazards. Testing to 1700KPa, as required by the Australian Standards, has led to failures as a result of the poor condition of the fire hydrant pipe.

Ausgrid has reviewed the proposed fire hydrant upgrade program by conducting a more detailed assessment of the sites requiring upgrade. This has resulted in a reduction of the number of forecast hydrant upgrades over the current regulatory period.

The deferral of the additional sites does not come without risks, however these risks may be managed through alternative risk controls funded by other substation fire related programs such as the Fire Mitigation – ZN & STS programs.

Oil Containment Program (DOC_11.04.01 & DOC_11.04.01-1)

This program is required to address Ausgrid's obligations set out in the *Protection of the Environment Operations Act 1997, Section 120.* The section titled "Prohibition of pollution of waters" states that "A person who pollutes any waters is guilty of an offence". Penalties for breach are as follows:

Tier 1: Willful or negligent activities	• $5 million for corporation • $ Up to 7 Years Jail
Tier 2: Strict Liability	• $2 million for corporation • $500,000 for individual
Tier 3: On the spot fine	• $15, 000 for the individual or corporation

Ausgrid believes that the proposed oil containment program is justified for a number of reasons including the following:

Non-compliant oil containment systems

DECCW (formerly known as the EPA) are aware that Ausgrid's 1, 2 and 3 stage oil containment tanks are non-complaint with the POEO Act. Every time there is a rainfall event greater than 1mm/24hrs there is a potential breach at the affected sites. To manage this non-compliance, Ausgrid has developed a strategy that works towards achieving compliance.

Favourable treatment by Environmental Regulator (DECCW)

Ausgrid oil containment program demonstrates its commitment to achieving full compliance at all zone & sub-transmission substations and allows Ausgrid the opportunity to determine the most cost effective approach to achieving compliance. Failure to demonstrate this commitment is likely to result in the environmental regulator taking regulatory action which could result in either a Pollution Reduction Program being mandated or the requirement for all sites to be licenced. The requirements under a pollution reduction program or conditions of an environmental licence are likely to be even more onerous and thus costly to implement than Ausgrid's approach proposed in its AER submission.

Not appropriate for Repex Analysis

As discussed earlier, expenditure required to upgrade the oil containment systems at Ausgrid's major substations cannot be adequately modelled utilising REPEX analysis as this is a significant investment that is not associated with asset age or historical expenditure. Similarly, economic benchmarking at the high level is also inappropriate for the purpose of assessing expenditure to address compliance issues. Other utilities, have differences in their state based environmental regulations, different state based environmental regulators and may not have the same legacy asset design issues. For this reason it is appropriate that the AER consider this program on the basis of its own merits.

Options Analysis

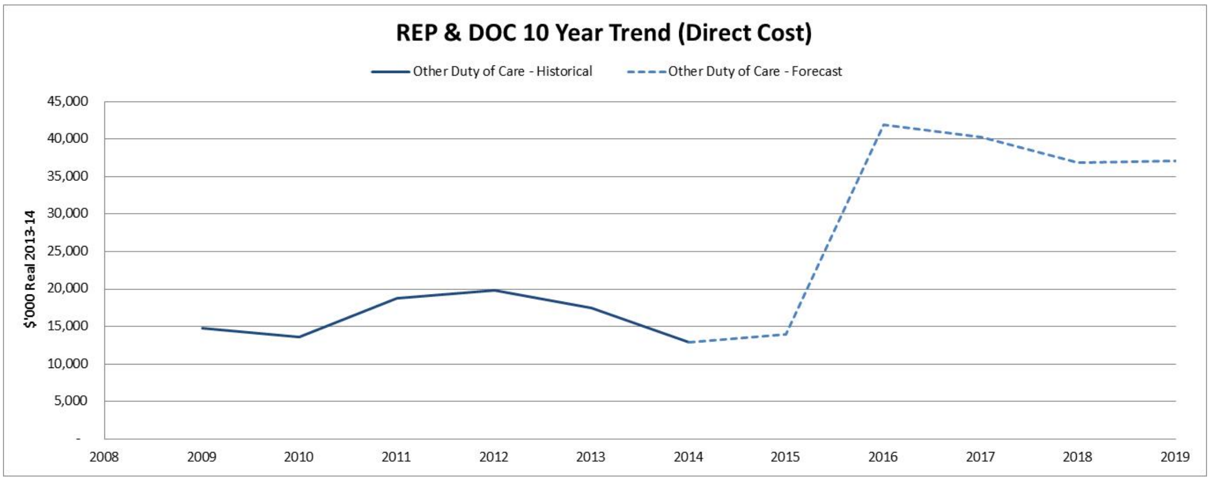
Ausgrid has undertaken extensive options analysis for the oil containment program. The AER's consultants have criticised Ausgrid's for providing inadequate options. The ACAPS supporting the submissions demonstrate that Ausgrid has in fact considered eleven (11) different technical options to achieve compliance.

Expenditure Trend Analysis

Analysis of the investment trend shows an increased level of proposed expenditure above the historical expenditure. Expenditure in 2015/16 is in line with previous historical expenditure due to continuation of programs from the previous period, however there a significant increase in expenditure occurs from 2016 onwards. This increase is justified based on the following

1. There are a number of new sub-programs starting in the 2015-19 period that will not significantly contribute to an increased level of expenditure until 2016 when delivery is ramped up as a result of new construction contracts entering the execution phase.
2. A large percentage of the Duty of Care program will be delivered by via contract and there is a delivery plan in place delver the proposed plan. New contracts are being established in preparation for increased delivery in the years 2016 onwards.
3. Above trend levels increase in expenditure in the years 2016-2019 is due to the roll forward of the backlog of undelivered programs in the previous regulatory period due to the organisations focus on the major area plan projects.
4. There are reduced opportunities for defer expenditure due to increased focus on workplace safety as a result of the introduction of the new WH&S legislation. Due to previous delays in the delivery of oil containment program, deferral of expenditure will not be view favourably by the environmental regulatory (potentially triggering regulatory action resulting the imposition of licence requirements).
5. The key driver for these programs remains workplace safety, public safety and environmental compliance which are supported by Ausgrid’s bottom up analysis.
6. The Duty of Care programs typically address low likelihood but high consequence risk events which have mandated risk mitigation requirements to be reduced to as low as reasonably practicable (via the legislated hierarchy of controls). Failure to do so could result in adverse consequences and additional charges of negligence. This requires Ausgrid to address its backlog of outstanding Duty of Care programs which are support by the revised bottom up assessment reviews.

The following trend analysis shows the difference in investment profile historically against the 2015-19 regulatory period.



Unmodelled Replacement Programs

All sub-programs that did not fit one of the asset categories within the RIN and were not Duty of Care sub-programs were captured in this category. These include replacement of kiosk and outdoor enclosure housings, voltage and current transformers, substation roofs, spares and earthing replacements. Due to the mix of assets, the replacement of asset components and the mix of expected asset lives these have been excluded from REPEX modelling.

The sub-program below represents the highest value program in the asset category. The changes made to these sub-programs are indicative of the approach taken across all sub-programs captured in this category.

Tower Refurbishment or Replacement (REP_05.02.01)

In the previous regulatory period, Ausgrid carried out an extensive engineering assessment of all steel towers which identified design and condition issues which were prioritised for mitigation in order of their level of risk. Many tower refurbishment or replacement options were considered in the engineering assessment to ensure that these high risk assets remained suitable for continued service.

The steel tower painting and refurbishment program provides a life extension to existing towers with identified condition issues and returns them to a state similar to their original condition. All towers will undergo work under this program. The revised quantities have led to a decrease in planned refurbishments this period and will lengthen the period required to refurbish all towers. All towers will still undergo line and climbing inspections on a five year cycle and these assessments may lead to a revised refurbishment order depending on what is found. This program provides a high risk cost benefit outcome (see Appendix A) primarily due to the load at risk with a failure and the length of time that would be required to return a tower to a serviceable condition following failure.

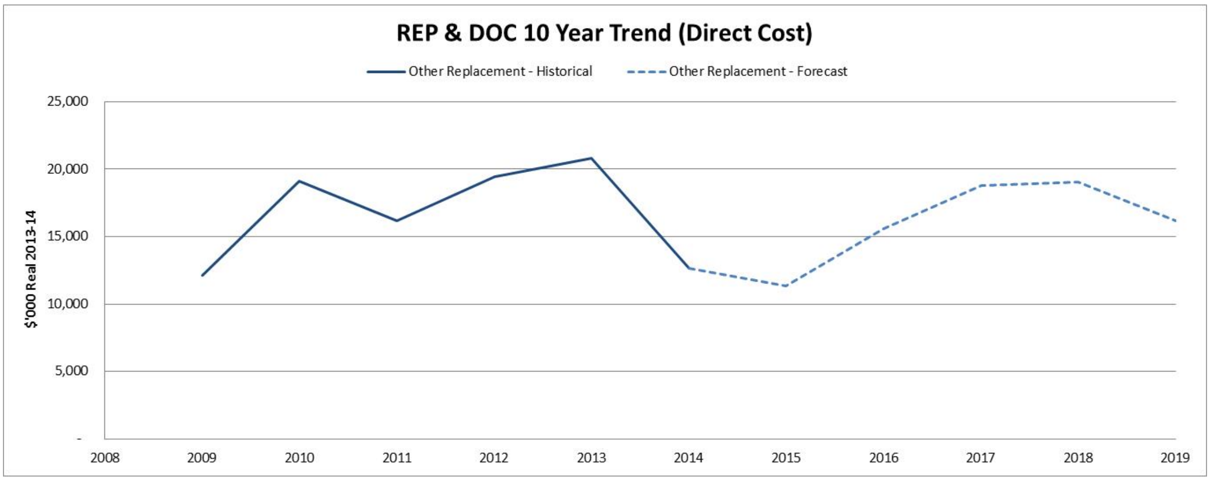
The tower replacement program has also been revised. This program is for planned replacement of DS-2 and DS-4 towers due to known design limitations which means under certain conductor failure scenarios they may not have sufficient strength to withstand the unbalanced conductor load following the failure and may collapse. Ausgrid has approximately 40 of these towers. Although there have been reductions proposed, further options in regard to strengthening of these towers is currently being considered by Ausgrid Structural Engineers and this may lead to further efficiencies if design modifications are possible and the resulting lifecycle cost is lower than full tower replacement.

This deferral does not come without risk. We are currently investigating alternatives to mitigate the risks of tower failure which will extend the life of the tower but not to the same level as replacement. Some design issues will carry through due to these alternate options. We believe these deferrals provide an unacceptable risk balance.

Expenditure Trend Analysis

Analysis of the other replacement programs that a not modelled in the repex shows that the revised proposed expenditure is consistent with the historical expenditure trend. This validates that the revised level of expenditure in this category supported by the revised bottom up program reviews is both deliverable based on historical achievements and sustainable.

The following trend analysis shows the difference in investment profile historically against the 2015-19 regulatory period.



Modelled Programs

Assets that were suitable for modelling in REPEX include poles, circuit breakers, kiosks, transformers and low voltage overhead mains. This category includes the majority of Ausgrid's proposed program for the 2014-19 regulatory period. Ausgrid accepts that these assets are suitable for predictive modelling based on their relatively similar design, large population and consistent level of historical age based replacement.

The following trend analysis shows the difference in investment profile historically against the 2015-19 regulatory period.