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PROTECTION & CONTROL MANAGEMENT PLAN 2010 – 2017

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0	18 Feb 2011	Original Issue	Prepared by	AJF
			Reviewed by	BD'A
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1	12 April 2011	Updated work program section	Prepared by	AJF
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			Approved by	MJIG
2	4 May 2011	Inclusion of remote control	Prepared by	AJF
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1. PURPOSE

The purpose of this document is to describe the programs required to deliver the objectives in the Network Management Strategy (NW#-30065608) as it relates to the Protection and Control systems, and justify the forecast Capex and Opex proposed in the 2012/17 regulatory proposal.

2. OBJECTIVES

The objectives of the Network Management Strategy are to:

- Maintain Network performance (SAIDI/SAIFI) to consumers;
- Minimise cost of supply to the consumer; and
- Minimise business-operating risks.

3. SCOPE

This document outlines the implementation and management of the Protection and Control thread and associated Program of Work as applies to Aurora Energy's protection assets.

The protection and control assets cover zone substations, HV reclosers and sectionalisers, and HV underground and overhead network. The LV underground and overhead network has only protection requirements.

4. PROTECTION AND CONTROL ASSET DESCRIPTION

Aurora owns and operates the Tasmanian Electricity Distribution Network, and has protection and control assets from the upstream protection points to the service fuse at the customer point of connection.

Transend Networks Pty Ltd (Transend) owns and operates the primary feeder protection and control assets within terminal sub-stations as well as feeder circuit breakers. These protection schemes typically comprise over current, earth fault and sensitive earth fault detection schemes.

The focus of managing protection and control assets is to ensure that faults are rapidly detected and cleared to minimise asset damage and to maximise reliability benefits.

Due to its extent across the State and being a major determinant of supply reliability there has been a focus on the overhead network. The higher reliability of underground cabling has required a lesser reliability-based focus with an emphasis on fault detection and clearance design performance requirements.

The protection systems within zone substations have all been recently replaced or upgraded with modern electronic relays. The overhead system uses multi-level protection comprising protection within substations, modern electronic reclosers,

sectionalisers, and fuses. The coordination of this multi-level protection requires considerable management time to ensure adequate and accurate protection.

For many underground feeders there is only one level of HV protection located within zone and distribution substations that typically comprise differential schemes, over current, earth fault and sensitive earth fault detection schemes. The underground HV network protection includes legacy electro-mechanical relays as well as modern electronic relays. As the protection is unit based schemes there is a lesser need for management time to co-ordinate with lower voltage level protection.

5. FACTORS INFLUENCING ASSET MANAGEMENT STRATEGIES

Minimise cost of supply to the consumer

- Ensuring cost effective trade-offs are made between pro-active and reactive augmentation practices
- Capturing adequate information on the assets to facilitate informed decision making; and
- Ensuring all risks are identified and have adequate management plans integrated into the business' practices

Maintain Network Performance Targets

- Accurately discriminating protection systems isolate the faulted area, disconnecting the minimum number of customers, and minimises impacts on SAIDI and SAIFI. The coordination between protection devices needs to be monitored and maintained as the network grows and develops over time.
- Fast protection operation time will minimise asset damage and customer impacts from voltage dips due to reflected faults on the network.

Manage business-operating risks within Aurora's corporate risk management framework

- Protection Systems provide protection to assets to minimise the severity of damage under fault conditions.
- The operation of protection and control devices must remain safe under a growing and developing network.

Comply with regulatory, contractual and legal responsibilities

- The lead regulatory obligations to be met are National Electricity Rules clauses S5.1a.8, Fault clearance times & S5.1.9(c) Protection systems & fault clearance times. In addition to meeting these obligations protection and control is key to

maintaining the performance to the Reliability Standards in the Tasmanian Electricity Code.

6. MANAGEMENT PLAN

6.1 Treatment trade-offs

The following tradeoffs are considered through the management of Protection and Control.

6.1.1 Capex Vs Opex

The Control aspect of Protection and Control management provides opportunities to trade Operating expenses for Capital investment effectively. Remote controlling switches for network control can provide significant savings in operational costs versus manual switching.

Remote control is most cost effectively introduced through new equipment with factory fitted capabilities, and is becoming a common feature of new switchgear. Aurora expects this to be a standard feature of all new switchgear in the near future.

6.1.2 Inspection and monitoring

Modern electronic protection systems allow a fine degree of performance monitoring through the extensive event histories and remote monitoring. All the reclosers and remote control sectionalisers utilise the "Automatic Data Retrieval" process that downloads the event logs weekly and processes the information to determine protection system performance. A report is generated weekly that indicates the devices that have had protection coordination issues, and investigations carried out to remedy the issue.

Aurora intends to extend this system into the underground network as electronic devices are introduced and remotely monitored.

6.1.3 Renew Vs Retrofit

The implementation of remote control of zone and distribution substations, reclosers and switches can be achieved through either retrofitting of remote control equipment or replacement with equipment that has the facilities.

Where switchgear can be retrofitted with motorised spring chargers to provide remote control functionality (certain Schneider and Brown Boveri switchgear) they will be chosen for remote control projects associated under the Protection and Control program

Where retrofitting is not an option then remote control is implemented when asset management requirements necessitate asset replacement.

6.1.4 Non Network solutions

Protection systems provide an essential function in providing protection from the release of large amounts of damaging energy. In general there are no non-network solutions

that provide this protection function. Unfortunately the introduction of some non-network solutions such as embedded generation adversely impact protection systems through increased fault levels and changes in power flow direction.

6.1.5 New technology

Modern protection systems through their implementation in microprocessor-controlled relays are changing rapidly as new technological improvements continue. New technology will continue to be trialled by Aurora and implemented where cost/benefits exist.

7. PROTECTION AND CONTROL WORK PROGRAMS

The Network Protection & Control Strategy aims to improve and sustain the performance of Aurora's distribution system. Based upon the above discussions the work program comprises the following elements.

- OH Switchgear – install reclosers for heavily loaded spurs;
- Protection zone rectification;
- Replace OH switchgear- replace EDO sectionaliser with remote RL27s;
- Remote Control of frequently operated switches
- Review of accuracy of ground mounted substation protection single line diagrams; and
- Distribution SCADA.

7.1 Replace OH Switchgear – Additional Reclosers for Heavily Loaded Spurs

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A program has been initiated to replace affected fuses with pole-mounted reclosers. Additional benefits of pole mounted reclosers are that they can be better incorporated into a protection scheme for the whole feeder, are capable of remote control & event logging, and have the capability of handling low level earth faults. This program is required to maintain safety and reliability.

The sites are identified through a GIS (Geographical Information System) query that discovers all the sites that meet the above criteria, these sites are then individually investigated and prioritised by the amount of kVA and particulars of each location.

The sites are also compared against other switchgear replacements to avoid duplication.

The forecast volume is to replace five per annum. This forecast has identified the sites to be replaced in the next five years, but will be reviewed annually for currency each financial year.

NW-#30132724-Strategy Document - Distribution System Reclosers for Heavily Loaded Spurs

7.2 Protection Zone Rectification

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The designs applied to each identified area generally include the relocation of fuses, installation of air break switches and removal of extraneous fuses. The removal of extraneous fuses has the potential to reduce operation and maintenance costs; however, the number of fuses to be removed is a very small percentage of the total installed.

The forecast has been developed by applying the designs completed on the sample sites to the volumes determined through the GIS analysis. As each individual project is programmed for completion a comprehensive protection design will be carried out.

Aurora is in the process of reviewing the processes around the review and sign off of network designs. Aurora intends to use this review to ensure that further protection issues of this nature do not reoccur.

NW-#30133196-Protection Zone Rectification

7.3 Replace OH Switchgear- Replace EDO Sectionaliser with remote RL27s

Specific areas where EDO sectionalisers have been installed in critical or frequently operated locations are better suited to the higher performing electronic RL27 sectionaliser. This device provides additional functionality such as data logging of load, voltage and protection operation, remote switching, remote configuration of protection settings, and future automation.

An audit (NW-#30077460) of existing dropout sectionalisers revealed 80 sites that will benefit from upgraded switchgear. Sites are selected where the additional functionality can address multiple issues such as capacity constraints, and operational flexibility. The detailed forecast can be found in NW-#30133024-Strategy Document - Replace EDO Sectionalisers with RL27 LBS

7.4 Remote control switches

Switches are used in the distribution network to change the network configuration to isolate line sections for planned work, isolate faulted sections or transfer load between feeders or substations.

The operational cost in the field staff to operate these switches can exceed the cost of upgrading the switch to a remote controlled device, allowing operation from the Fault and Operations control room.

There is operational saving obtained from The Emergency and Unscheduled Power System program.

Overhead remote switches and fault indication show a clear benefit when utilised as a group. A group of one remote control switch and two fuse savers shows a positive Net Present Value when:

- the switch is operated more than three times per annum,
- the fuse savers save at least one fuse operation per annum,
- and any of the devices is utilised in one system reconfiguration annually.

These criteria are easily met, with many switches in the network being manually switched and fuse operations upwards of ten times per annum.

Ground mounted switchgear has the same benefits as overhead switchgear, but the remote controlling hardware provides additional operational saving by remotely monitoring load and switch operation.

The detailed forecast can be found in NW-#30183536-Procedural guideline- Remote Control Switches

7.5 Review of accuracy of ground mounted distribution substation protection single line diagrams

The accuracy and currency of the secondary system documentation for pre 1990 distribution substations is uncertain. Historically, documentation was maintained in a paper-based system until the late 1990s when it was moved to an electronic system. During that transition, the processes around updating secondary system documentation

with the 'as-builts' has resulted in there being several substations with no updated single line diagrams. This has affected Aurora's ability to carry out additional design and construction activities in these substations.

This program reviews and updates the secondary system documentation by reviewing existing documentation, reviewing records of work completed since the change in processes, and if necessary visiting substation sites to capture information where records cannot be found.

The volume of sites requiring documentation updates is estimated to be 45 as determined through assessing the work completed on those substations in the last fifteen years. The forecast is to update nine sites per year. They have been prioritised against the requirements of other programs; for example, the Remote Control Program program that will upgrade certain ground mounted substations with remote control functionality. To enable this work to be carried out, accurate secondary system documentation is needed.

7.6 Distribution SCADA

The program covers the costs to provide communications to network devices. The network devices are predominantly reclosers and remote controlled switches, however there is a small number of voltage regulators, pole mounted capacitors and ground-mounted switchgear in the process of receiving remote communications.

Aurora utilises Telstra NextG at present, and is moving from simple dial-up communications to "always on" wireless IP communications. This has a marginal cost increase but provides significant performance and functional increases.

The forecast has been developed by taking the existing volume of network devices, forecasting the number of new network devices through all the proposed programs and then apply a unit cost for NextG wireless IP communications per device. The forecast can be found in NW-#30116787-Estimated SIMs Cost.

8. SUMMARY OF PROPOSED EXPENDITURE

8.1 Introduction

This section contains a summary of the forecast expenditure to deliver the protection and control objectives.

8.2 Capex

Table 8.2-1 shows the proposed Capex.

All Capex programs have similar spends year on year and evenly spread over the five years.

	2012/13	2013/14	2014/15	2015/16	2016/17
Heavily Loaded Spurs	$260k	$260k	$255k	$255k	$255k
Protection Zone Rectification	$80k	$80k	$80k	$80k	$80k
Remote Control	$2,130k	$1,920k	$1,910	$1,885k	$1,880k
Replace EDO Sectionalisers with RL27	$495k	$485k	$485k	$480k	$475k
Protection drawing review	$25k	$25k	$25k	$25k	$25k
Total	$2,990k	$2,770k	$2,755k	$2,725k	$2,715k

Table 8.2-1 Forecast Annual Capex

8.3 Opex

Table 8.3-1 shows the Opex.

The single Opex programs have an increasing spend as the volume of network devices to be remote controlled and needing communications increases.

	2012/13	2013/14	2014/15	2015/16	2016/17
SCADA modem operating costs	$150k	$175k	$200k	$225k	$250k
Total	$150k	$175k	$200k	$225k	$250k

Table 8.3-1 Forecast Annual Opex

8.4 Comparison with Historical Spend

Aurora has previously managed all protection and control activities under the Reliability thread and associated program of work. As the activities under protection and control are now aimed at achieving other asset management and safety objectives, a separate Protection and Control thread has been established. Given this, it is difficult to look at historical comparisons at the thread level, and as such are discussed at individual program levels below.

8.4.1 Replace OH Switchgear – Additional Reclosers for Heavily Loaded Spurs

Heavily loaded spurs are expected to continue at the same rate within the present regulatory period, and are expected to continue in the medium term as load growth continues.

8.4.2 Protection Zone Rectification

This is a new program under the Protection and Control thread. As this program aims to address a new issue that has increased over time, Aurora intends to address all issues and complete this program in the coming regulatory period, and prevent any similar issues occurring through process review.

8.4.3 Remote Control

The remote control program has evolved from the “Feeder load transfer switch” program of the present regulatory control period.

This Remote control program is forecasting the equivalent of 51 overhead switches per annum, and increases from 17 in the 2011/12 financial year programme of work. This programme will drop to around 41 switches by the end of the coming regulatory period.

8.4.4 Replace OH Switchgear- Replace EDO Sectionaliser with remote RL27s

This program has been in place since 2008 and will continue at the same level in the coming regulatory period.

8.4.5 Review of accuracy of ground mounted substation protection single line diagrams

This program is new, and Aurora expects to complete this program in the coming five-year regulatory period.

8.4.6 Distribution SCADA operating costs, modem, comms

This program continues with the existing volumes of network devices and increases the forecast in line with increasing network devices. It is anticipated this area of network communications will continue to increase in the medium term.

9. REFERENCES

- NG R NO 01 – Guideline – Distribution System Electrical Protection
- DS D P 01 – Distribution System Protection Standard
- Network Management Strategy

Forecast references

- NW-#30132724-Strategy Document - Distribution System Reclosers for Heavily Loaded Spurs
- NW-#30133196-Protection Zone Rectification
- NW-#30183536-Procedural guideline- Remote Control Switches
- NW-#30133024-Strategy Document - Replace EDO Sectionalisers with RL27 LBS
- NW-#30116787-Estimated SIMs Cost.