Augex Fault Protection - Investment Case

Background

This program covers the requirement for distribution networks to have electrical protection which, in the event of a fault, safely isolates the faulty section of the network (Safety and Quality NER 6.5.7).

It also covers the investments required to maintain adequate switching, operational capabilities and performance of the network in areas where general load growth may have compromised them. This includes maintaining adequate load at risk levels for feeder sections and switching flexibility that may have been lost due to demand growth on parts of the network (meeting Demand NER 6.5.7).

There is a requirement to have adequate primary and backup electrical protection and adequate safety and device grading margins for HV and LV distribution lines.

During the current regulatory period Essential Energy established a formal Protection Review Program to identify the current state of the distribution feeder protection schemes. We have forecast the expenditure required using the average project cost and the number of projected projects.

Phase 1. The first phase is targeted at the 879 feeders (59% of feeders) which have at least one field recloser installed, and was aligned to the Recloser Maintenance Program. These are typically the longest feeders, and also the weakest by fault level and voltage profile.

Phase 2. The second phase is targeted at the remaining 592 feeders (41% of feeders). These are typically urban or short rural, highly interconnected, highly loaded, and with many connected customers.

Most of the fault level projects are due to identified noncompliance with CEOP8002.02 Distribution Protection Guidelines, specifically back up protection reach requirements.

Forecasting Approach

Phase 1. Of the 680 feeders reviewed as of July 2022, 436 projects have been generated – 64 projects per 100 feeders. The average cost of completed projects is $25,570. We have used these figures to forecast costs for the remainder of Phase 1.

($M)	Actuals		Forecast		
	2021	2022	2023	2024	2025
PRP Phase 1	$2.13	$4.46	$4.56	$3.26	$1.62

Phase 2. Based on a preliminary review, we are expecting 30 projects per 100 feeders. We have used this to forecast Phase 2 expenditure for the 2024-29 regulatory period.

($M)	Forecast				
	2025	2026	2027	2028	2029
PRP Phase 2	$0.91	$0.91	$0.91	$0.91	$0.91

Fault isolation and feeder load transfer ability (FLTA). It is assumed that these projects will continue at current rates, on average $2.0M p/a.

Investment Options

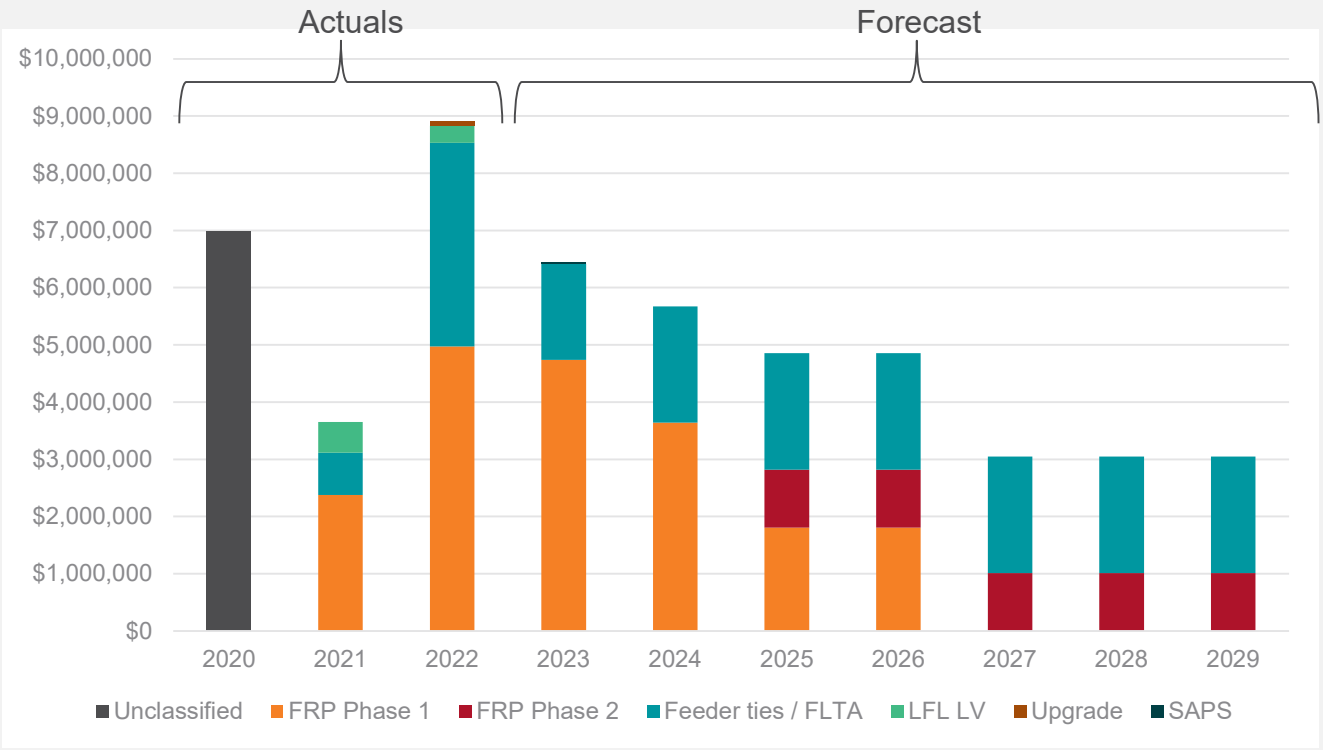
There are a number of options when improving fault level. These include:

- Installing a recloser with protection settings
- Network upgrade using low impedance conductor
- Reducing LV circuit length through adding transformers
- Negative Phase Sequence (NPS) protection on zone sub circuit breakers
- Feeder ties, switching and isolation points, to provide fault isolation and Feeder Load-Transfer Ability

	Projects	Average Cost
Recloser	175	$49,332
Gas switch	197	$26,874
Fuse	210	$11,671

10 Year Capex Forecast

The forecast expenditure to complete the Protection Review Program, as well as additional investments related to fault isolation and switching for feeder load transfer, are shown in the graph below. Forecast Augex Fault Protection expenditure for the 2024-29 period is $18.8M, averaging $3.8M per annum. The actual/forecast expenditure for 2019-24 is $31.0M.



Note: All values are in middle of the year 2023-24 real dollar terms

Justification

We are confident that our approach delivers an efficient and prudent level of investment because:

- **Clear, prudent drivers from Asset Management Objectives (as detailed in Attachment 10.1 SAMP) for Quality, Safety and Compliance:** Demonstrate network safety risk is managed SFAIRP, Deliver the sustained network performance our customers expect, & Maintain compliance with our network-related obligations.
- **Review and moderation:** Our forecasts have been moderated based on feedback and discussion; and
- **Efficiency:** All projects subject to NPV analysis prior to project development.

The major benefits expected from these investments are:

- **Reduced network risk:** A network that can immediately identify and isolate a fault reduces safety risk to life, reduces fire ignition risk, and prevents damage to assets.
- **Maintained service to customers:** feeder ties, load-transfer abilities and isolation points will allow us to isolate the faulted part of the network and restore power to more customers in a timely manner.

Forecast Augex Fault Protection expenditure for the 2024-29 period is $18.8M, with the reduction from 2019-24 actual/forecast expenditure of $31.0M due to the progression of the Protection Review Program, specifically the end of Phase 1.

Network Strategy – Protection: Summary

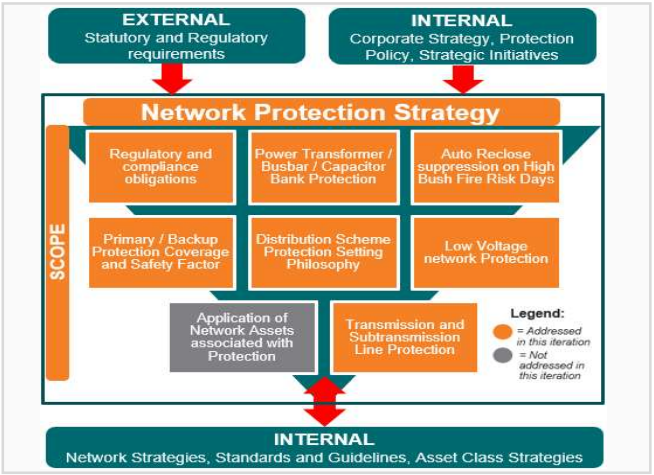
Essential Energy's Protection Strategy sets strategic direction to ensure that the outcomes from its Protection system are met.

Context

The purpose of Network Protection is to quickly detect and isolate faults on the network, thereby minimising danger to persons and livestock, the threat to the environment, further damage to the electricity network itself, and reduce the risk of network instability.

The Network Protection system comprises protection relays (including protection schemes utilising instrument transformer inputs and settings), circuit breakers, reclosers and fuses, operating at voltages ranging from 132kV down to low voltage.

Networks are going through transformational change requiring consideration of challenges relating to bidirectional energy flows, embedded DER, Microgrids, and changed energy uses. These create additional technical challenges for existing network protection systems which were designed for traditional network configurations.



Line of Sight

The Protection Strategy is an enabler for Essential Energy's Corporate Strategy, Pillar 1 - Strengthen the core business. The Asset Management Objectives (AMO) related to the strategy are AMO-03, AMO-06 and AMO-08. Subsequent Network Measures (NT) P1, P2 and P3 have been developed to align with the AMOs

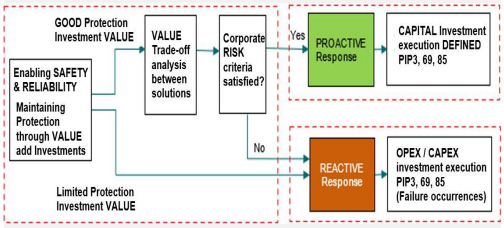
P1	P2	P3
Meet corporate targets for network value and expenditure	**Deliver the sustained network performance (safety, reliability, quality) our customers expect**	**Maintain compliance with our network-related obligations**

Performance and Targets

	Current Performance	Target Performance (Baseline 2021)
P1	▪ Existing value assessments don't always result in value positive investments for aged/legacy equipment to justify the delivery of protection system capital investments.	▪ Short-Medium term: Maximise value being delivered by updating and utilising the Appraisal Value Framework within the Investment creation process.
P2	▪ Primary protection non-compliance fault clearing times assessment on the EE network is currently inconsistent using the existing manual protection study assessment process.	▪ Medium term: Reduce assessment times with automated protection studies. Est. reduction of operational costs by ~10% (~$180,000 p.a.) ▪ Long term: Target 20% reduction (~$360,000 p.a.)
	▪ Access to real time fault data from Network Reclosers is limited (real time data required to enable faster network restoration time after a fault).	▪ Medium Term: 100% access to real time data from Network Reclosers
P3	▪ A small percentage of distribution primary protection non-compliance issues are not meeting expected network fault clearing standards.	▪ Short Term: Achieve 100% compliance for distribution network non compliances.
	▪ Setting change records for Protection Setting Advice (PSA),.are not being signed and returned in a timely manner once completed in the field.	▪ Medium Term: Ensure 100% of PSAs are signed within 15 working days upon completion of field setting and commissioning activities.
	▪ Limited completion of 132kV AEMO notification / approval for EE protection upgrades or setting alterations.	▪ Short Term: Achieve 100% 132kV AEMO notification / approval for EE protection upgrades or setting alterations.

Strategic Direction

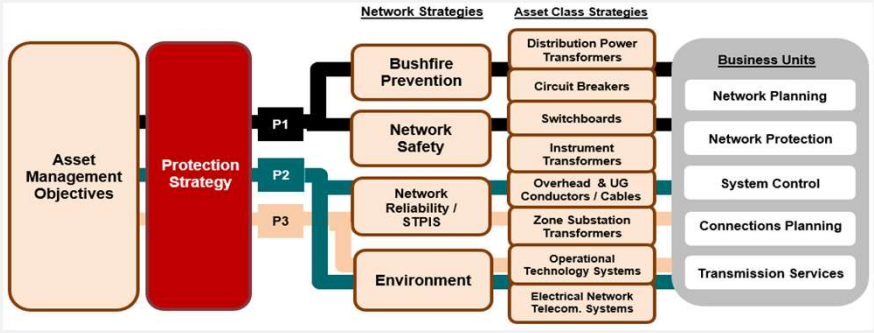
P1	P2	P3
Meet corporate targets for network value and expenditure ▪ *Continue* to optimise value and utilisation of network protection assets with formalised guidance to inform decision-making utilising the Essential Energy CECG1140: Appraisal Value Framework.	**Deliver the sustained network performance (safety, reliability, quality) our customers expect** ▪ Reduce the operational time taken for the manual protection assessment process with the use of automated network protection studies. ▪ Continue to improve implementation of Auto Reclose suppression / new SEF settings. ▪ Improve access to real time fault data availability. ▪ Increase the use of value positive line differential protection investments. ▪ Implement a standard approach to ring fed sub trans/transmission feeder AR schemes. ▪ Research and improve LV network protection coverage.	**Maintain compliance with our network-related obligations** ▪ Meet the requirements of the NER / NSW S&IR and application of EE Protection Policies CEOP8002.01, CEOP8002.02 and Generation Connections Protection Guidelines CEOP8012. ▪ *D*evelop a formalised system and workflow management tool to monitor and track performance. ▪ *D*evelop a framework to provide a consistent direction for protection systems and requirements.



The Protection System Strategy is supported by 14 implementation actions detailed in the strategy support document.

Implementation

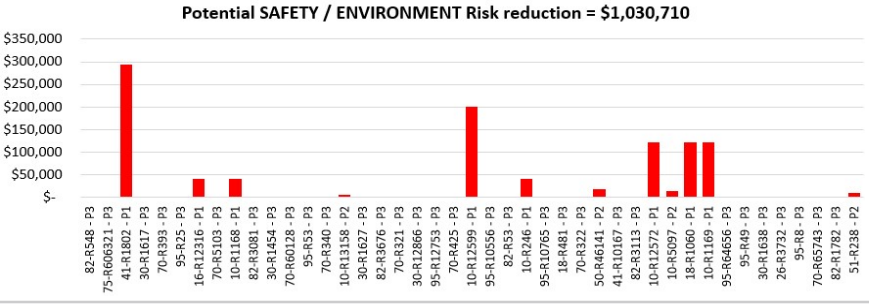
The figure to the right outlines the paths of implementation for each strategic direction and impact on other network strategies. Business units involved in implementing the strategic direction are shown at the right of the figure.



Potential Value

Potential SAFETY / ENVIRONMENT Risk reduction

Potential reduction in Safety / Environment Risk associated with Bushfire Ignition from Primary Protection non-compliance setting and project completion derived from the total safety/environmental risk value of $1,030,710



Potential OPEX reduction

Reduction in manual protection assessments by using automated load flow / fault analysis. Total assessment OPEX actuals is $1.8Mp.a. Medium Term reduction of 10% = $180K p.a., Long Term 20% = 360K.