Load Control Investment Case

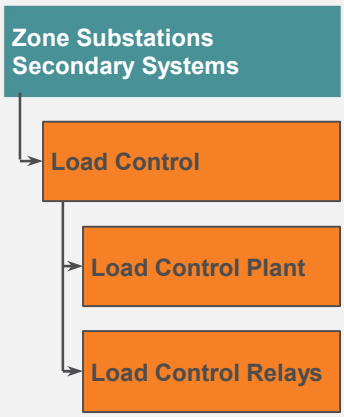
The Load Control investment case provides direction for the lifecycle management of load control plant used in zone substations and some bulk supply points, and load control relays mounted on customer switchboards.

Scope

This investment case addresses the assets that perform the Load Control function, which consist of:

- Load control plant used in zone substations, and some TransGrid bulk supply points (BSP); and
- Load control relays mounted on customer switchboards.

The investment is required to meet the capital expenditure objectives (NER 6.5.7) for quality, reliability and security of electricity supply and to meet regulatory and legislative obligations for Standard Control Services.



Forecast $FY24

The Load Control forecast accounts for **1.99%** of the total Repex portfolio for FY25 to FY29.

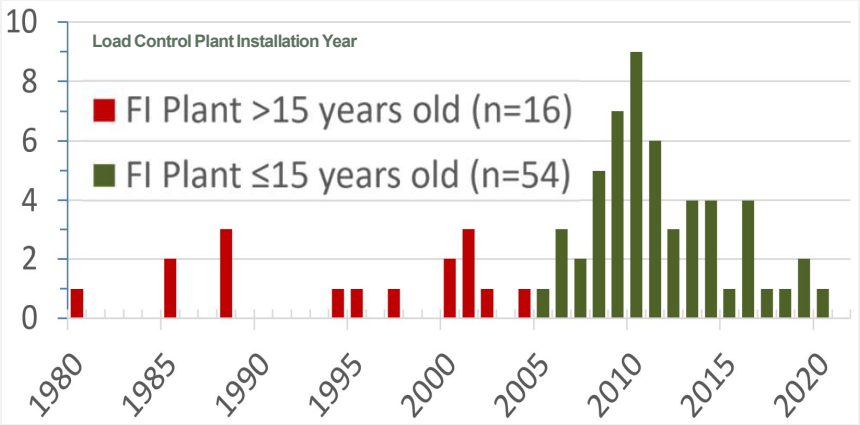
FY25	FY26	FY27	FY28	FY29
$4.5M	$4.5M	$4.5M	$4.5M	$4.5M

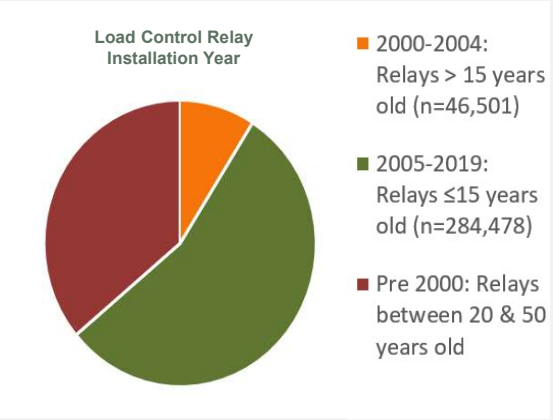
Asset Profile/Health

Asset Profile

Load Control assets consist of load control plant and load control relays, with significant variations in age and design between assets across the network (Design life of load control assets is 15-25 years). The primary purpose of load control assets is to enable controlled load supply to customers, at lower cost than standard tariffs. The secondary purpose is to provide commercial services, including system security and RERT (Reliability and Reserve Trader) capability.

The load control fleet consists of 70 frequency injection (FI) plant in operation, plus a small number of spares, and approximately 500,000 load control relays. Load control plant are a maintained asset with 69 of the 70 plant on a 3-yearly cycle and one rotary plant maintained annually. Load control relays are run-to-fail assets that are not maintained. The approach to date has been to replace 15,000-20,000 relays each year through the bulk relay replacement program. To date 330,000 relays have been replaced, with approximately 180,000 relays yet to be replaced.





This section provides an overview of the Load Control risk model. It is supported by documents and **6.03.02 Network Risk Management Manual, 6.03.03 Appraisal Value Framework and 6.03.04 System Capital Risk and Value Based Investment** methodology.

Probability of Failure – Plant

Using a two-year data set, the probability of an FI plant failing during the course of one year, in one of the failure modes by reason is shown below

Failure Reason	Probability of Failure
Weather event	11.674%
External factor	8.755%
Intrinsic fault/failure	8.082%
Maintenance	1.796%
No fault reason found	8.980%

Probability of Failure – Relay

Accurate probability of failure data across all failure modes is unavailable at this time. This is due in large part to load control relays being unmaintained run-to-fail assets, with only some failures being reported and/or identified

Year	2017	2018	2019
Number of relays failed	2,663	1,767	1,500
Population	479,238	476,854	474,482
Percentage of relay fleet	0.5557%	0.3706%	0.3161%

Consequence of Failure – Plant

The consequence from failure of a load control plant describes the impact of a functional failure. Consequences have been evaluated using the 6.03.03 Appraisal Value Framework.

Component	Consequence	
	Risk Value per failure ($)	Expected Risk Value per year ($)
Network	$1,080,150	$29,704,341
Safety	$4,800	$132,001
Reputation	$4,571	$125,703
Compliance	$1,200	$33,000
Total	$1,090,721	$29,995,116

Consequence of Failure – Relay

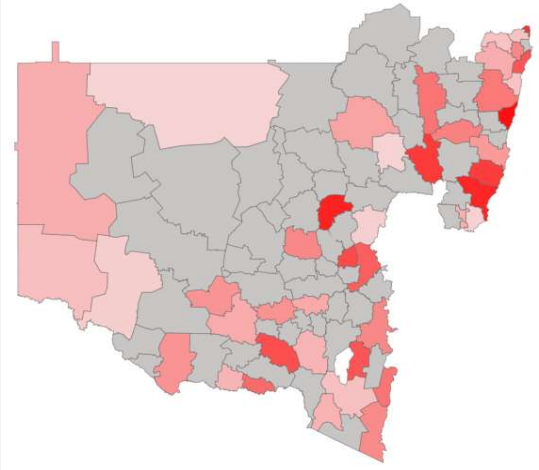
The consequence of failure of a load control relay describes the impact of a functional failure, with consequences evaluated using 6.03.03 Appraisal Value Framework. The table includes only the failure mode where relays fail OFF. This failure mode is the only one with negative customer consequences, and it is the only mode where there is available data. The probability of failure used in this calculation per relay is 0.55%, being the median failure rate per annum in this mode.

Component	Consequence	
	Risk Value per relay ($)	Risk Value per year across total fleet ($)
Network	$14.45	$6,650,101
Safety	$5.50	$2,607,000
Reputation	-	-
Compliance	-	-
Total	$19.95	$9,457,101

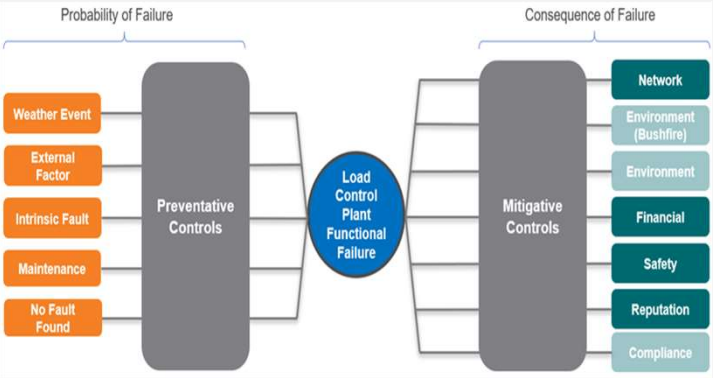
Load Control Relay distribution

The image to the right shows the distribution of Load Control Relays across the state. This distribution is also representative of the distribution of consequence across the state as each relay has roughly the same consequence of failure.

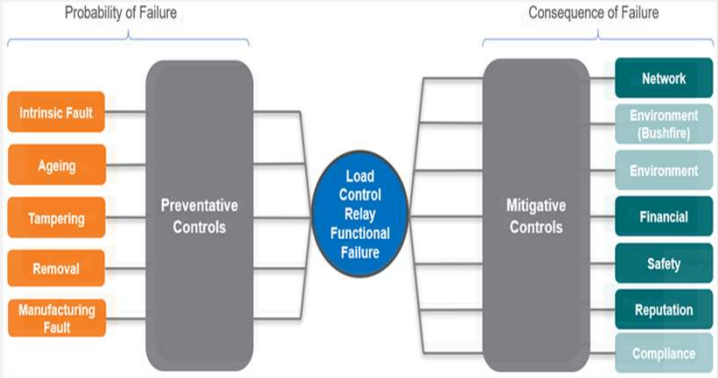
Future models will improve consequence of failure for relays. These improvements will be aimed to better determine relays that have higher consequence of failure.



Network Risk - Plant.
Represents the relationship between the drivers behind load control plant functional failures and the components used to determine the consequence of failure.



Network Risk – Relay
Represents the relationship between the drivers behind load control relay functional failures and the components used to determine the consequence of failure.



Forecasting Approach

The replacement Capex forecast (FY25-FY29) has been calculated using Essential Energy's optimisation software (Copperleaf). It utilises a risk based methodology to maximise the value of the investment portfolio within constraints established by Essential Energy that are consistent with our Corporate Risk Framework, Asset Management System, applicable standards, rules, regulations and licence conditions. To assure efficiency our portfolio has been constrained to meet customer and stakeholder expectations.

The replacement capex forecast has been developed in line with NER capital objectives, the objectives of our total replacement portfolio have been informed through extensive stakeholder engagement and consist of:

- Maintain reliability performance (network risk)
- Long term reduction of bushfire start risk by 20% over 20 years (2.5% FY25-29)
- Maintain safety performance

The probabilistic method has been tested and validated against Historical volumes to ensure that it is accurate at the population level. Forecast investment expenditure has been determined by multiplying the forecast replacement quantities of Load Control assets by applicable unit rates.

Investment	Annual Cost ($FY24)
Replacement FI Relays	$3.925M
Replacement FI Plant	$390k
Synchronisation of Multiple FI Plant	$39k
Mobile FI Plant Studies	$33k

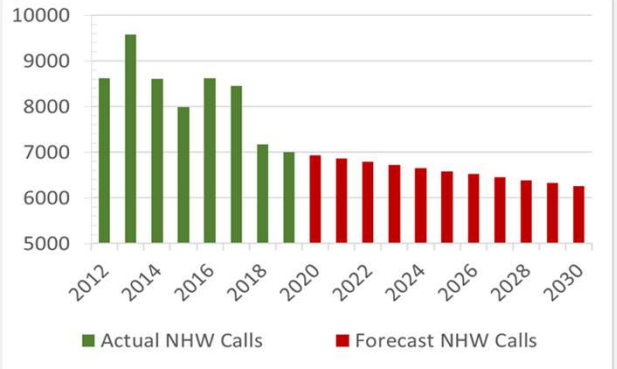
The majority of the forecast relay replacement program is Replacement of FI relays. This is calculated at 20,000 units per year, multiplied by the appropriate unit rate (as per Assumptions on page 4). This suggests a replacement rate of load control relays of 24 years. Additionally, a budget for one FI plant replacement per year has been included, out of a total of 70 units.

Options

Load Control frequency injection relay replacement expenditure has been modelled on replacing customer relays with current standard. By making this investment, customers who have load control such as hot water, will face fewer instances of 'no hot water' when these relays fail to operate. Another failure mode is where the relay does not respond to a turn off signal, and will power the hot water system all day.

Failure to make these investments would result in more customers experiencing 'no hot water'.

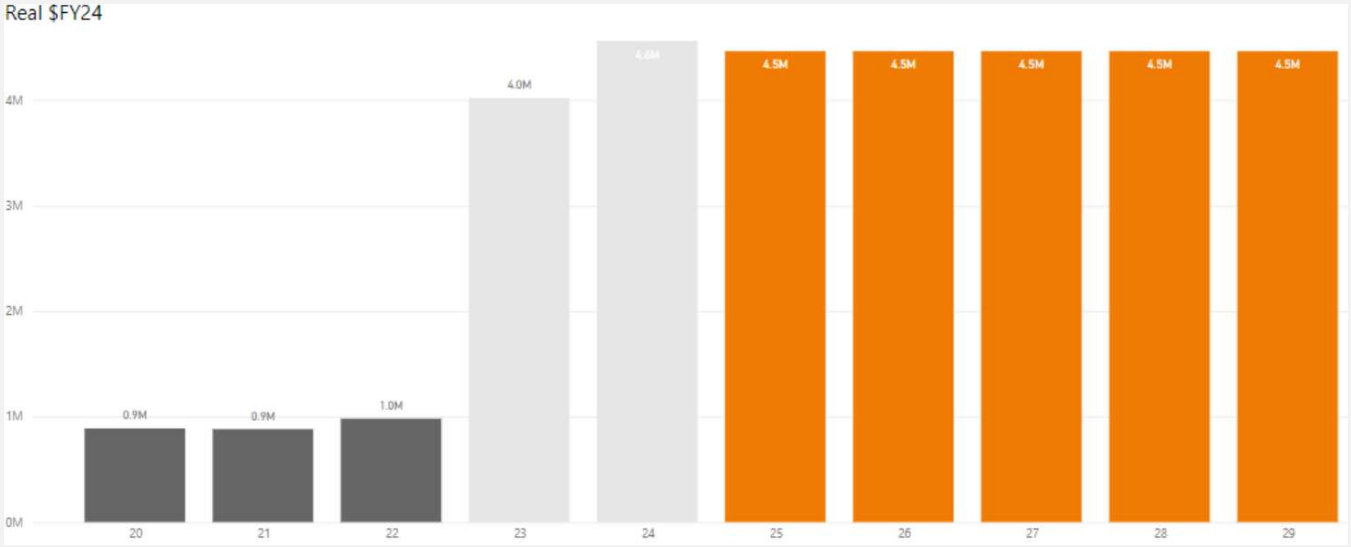
There is a non-network solution, which would involve retailers using smart meters to control their customers' hot water load. One disadvantage of the smart meter approach is that it removes Essential Energy's ability to curtail controlled load en masse in response to a direction by AEMO to curtail load.



10 Year Replacement Capex Forecast

Forecast replacement expenditure for Load Control across the 2024-29 period is $22.3M, averaging $4.5M per annum. Forecast expenditure for 19-24 period is $11.3M.

There was significantly less expenditure in FY20 – FY22 because the load control bulk relay replacement program was not included in the optimised works portfolio for these years in order to deliver other programs that were more critical in the short term.



Data source: Actuals: Internal delivery reports, Forecasts: Copperleaf
Note: All values are in FY2023-24 real dollar terms

Justification

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

- **Clear, prudent drivers from Asset Management Objectives** for Reliability, Quality, Safety and Compliance (as detailed in **Attachment 10.01 SAMP**) **:** Our forecast has been developed in line with the asset management objectives
- **NER Capex objectives**: form the basis of our proposal
- **Review and moderation:** Our forecasts have been tested and reviewed by our executive management and the Board, and the forecasts have been moderated based on feedback and discussion.

The major benefits expected from these load control investments are:

- **Maintain network risk**: through continuation of the Bulk Replacement program, we will proactively address locations of greatest risk across our network, and in a manner that minimises costs; and
- **Improved levels of service for our customers:** Maintaining the health of the Load Control fleet, and through addressing locations of highest risk, will result in fewer no hot water complaints.

Forecast replacement expenditure for Load Control across the 2024-29 period is $22.3M compared to actual/forecast expenditure for 19-24 period of $11.3M.

The proposed increase in volume of relay replacements from FY20 – FY22 is due to a return to a cyclic program of managing aging assets.

Assumptions

Description of Parameter/Assumption	Utilised Value
Annual reduction in number of controlled load customers	0.50%
Annual reduction in F&E calls due to improved reliability	0.50%
Annual no. of relays replaced in bulk (post 2024)	20,000
Installed cost per relay ($FY24)	$196

Strategic Direction

We Shall

Acquisition

Selection Criteria

Load Control Relays: Continue with FI as the default technology choice until such time as trials and investigations indicate an alternative technology is required and suited to the business.

Load Control Plant: Update the assessment process for the installation of new plant (new and replacements) to balance the needs of network planning (capacity requirements), network risk, plant age, reliability, and connection agreements.

Procurement

Load control plant is procured from qualified vendors against Essential Energy technical standards. Complete plant are generally procured via competitive tender, and system spares and replacements (e.g. plant controllers) are procured directly from vendors as needed.
Load control relays are purchased through two mechanisms within Essential Energy:
1) The warehouse purchases relays to be stored in-house for use and replacements for F&E installation, and also for free issuing to ASPs for installation on new customer switchboards; and
2) The load control team directly purchases bulk lots of relays for deployment through bulk relay replacement programs.

Ops & Maintenance

Preventative Maintenance (Inspections):

Load Control Relays: Continue with current operations regime of relays as unmaintained, run-to-failure assets, subject to interventions as required.

Load Control Plant: Continue the existing 3-yearly maintenance schedule for static plant and annual schedule for the one remaining motor-generator set.

Corrective Maintenance (Repairs):

Replacement of existing plant that has failed or reached end of life;
Bulk relay replacements, for the purpose of replacing aged relays.

Breakdown Maintenance:

Special purpose mobile FI plant that can be relocated as needed
Replacement of faulty relays by Essential Energy F&E

Interventions

Serviceability

Replace **load control plant and relays** at the end of their productive lives when they are not maintaining performance in line with minimum supply availability. Plant replacement decisions linked to assessment process as per new plant acquisition.

Bulk Relay Replacement: Target bulk relay replacement through assessment of need and value – balancing network planning (capacity requirements), local plant and relay capability, frequency/protocol changes, trends in the number of NHW calls, and surveys of relay condition and age.

Prioritisation

The bulk relay replacement program targets load control areas with a high proportion of aged relays, within which the program seeks to replace all relays in the area with the latest standard model. Records of recent relay replacement programs indicate that typically ~4,000 relays are changed out each time (per work package). To date ~300,000 relays have been replaced across the Essential Energy area under these programs.

Disposals

Individual Assets

The disposal of Load Control assets is managed in accordance with CEOP8074 Corporate Disposal Policy and CECM1000.74 SSHE Manual: Waste.

Asset Support

	Current Approach	Actions
Process & Information	Present data on load control relay installation / removal is incomplete, notification when a relay is installed is inconsistent, and failure data on load control relays is incomplete	Implement end-to-end process improvement for the issue of load control relays from Essential Energy warehouse to F&E and contractors. Details of failures should be recorded in a centralised system. Information to be recorded should include: date; relay make and model; estimated age; location (Premise No.); location (FI zone); and failure mode.
Tools	The load control asset class strategy does not yet have tools to support implementation. The actions below outline the development of tools that will lead to ongoing improvement in the way in which assets are managed across their lifecycle.	Develop real-time reporting of 'No Hot Water Calls' cross checked to load control plant and network assets and Smart Meter installations Develop real-time reporting from Smart Meter data to identify controlled load on at peak times (indicates failed ON/bypassed/removed/out of sync relays). Develop Spotfire / Power BI reports that can report in real-time
Supply Chain	Load control equipment using FI technologies will become increasingly difficult to source	Investigate, trial and evaluate technologies that could perform load control functionality with higher resolution control and visibility