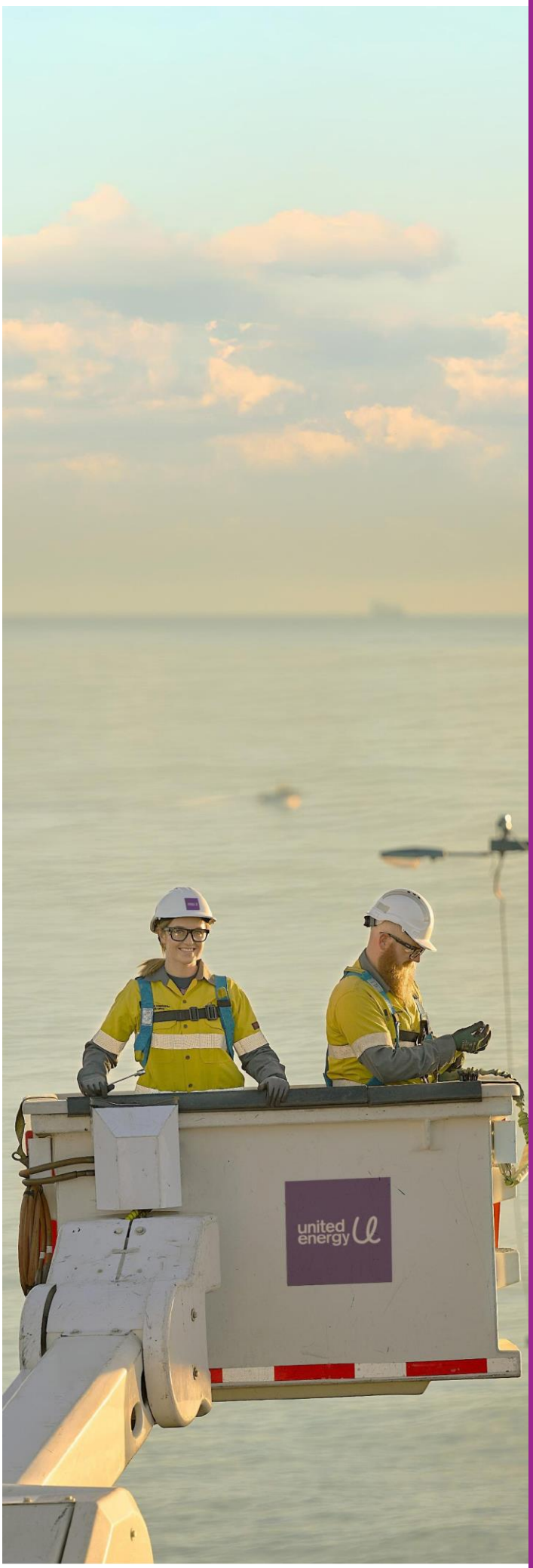

AUGMENTATION

FAULT LEVEL MITIGATION

UE BUS 3.02 – PUBLIC

2026–31 REGULATORY PROPOSAL

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1. Overview

A fault is an event where an abnormally high current occurs caused by a short circuit somewhere in our network. A fault may involve a single or multiple phases and/or ground. In a ground/earth fault, charge flows into the earth, along a neutral or earth-return wire.

This business case focuses on addressing increasing fault levels in the Ballarat, Altona, Ford, Laverton and Koroit areas where fault level limit exceedance is forecast in sections of the network during the 2026–31 regulatory period.

Addressing fault level limit compliance breaches will reduce the chance of severe electric shocks when faults have occurred or lines have fallen to the ground, improving safety for our staff and the general public.

Augmentations at Dandenong South, Springvale and Springvale West are proposed to meet fault level compliance limits.

The type of works proposed include installing neutral earthing resistors, auto close schemes, reactors and circuit breakers. The total capital investment costs for the business case are outlined in table 1.

TABLE 1 EXPENDITURE FORECASTS FOR PREFERRED OPTION ($M 2026)

CAPITAL EXPENDITURE FORECAST	FY27	FY28	FY29	FY30	FY31	TOTAL
Augment DSH by installing new reactors	2.0	-	-	-	-	2.0
Augment SV and SVW by installing new reactors	1.5	-	-	-	-	1.5
Capital expenditure	**3.5**	**-**	**-**	**-**	**-**	**3.5**

2. Background

A fault is an event where an abnormally high current occurs caused by a short circuit somewhere in our network. A fault may involve a single or multiple phases and/or ground. In a ground/earth fault, charge flows into the earth, along a neutral or earth-return wire.

We calculate prospective fault current to ensure it is within allowable regulatory limits, limits of the electrical equipment installed and to enable the selection and setting of the protective devices that can detect a fault condition. Devices such as circuit breakers, automatic circuit reclosers, sectionalisers and fuses can act to interrupt the fault current to protect the electrical plant and avoid significant and sustained outages as a result of plant damage.

Fault levels are determined according to several factors including:

- generation of all sizes
- impedance of transmission and distribution network equipment
- load, including motors
- voltage level.

Fault level mitigation programs are becoming increasingly common on our network through increasing transmission fault levels and as the level of embedded generation being directly connected to the network increases.

3. Identified need

Under Clause 5.13.1 of the National Electricity Rules (NER), we have an obligation to identify and mitigate limitations on our network where design fault levels will be exceeded. Generally, where no other limitation exists, our design fault levels are consistent with the limits included in the Electricity Distribution Code of Practice (EDCoP) and shown in table 2 below.

Failure to mitigate fault level exceedance can result in catastrophic asset failures (either our asset or our customers' asset) and 'step and touch' safety risks for site staff and the general public due to faults or fallen overhead lines and equipment.

'Step' potential occurs when there is a voltage difference between a person's feet while standing or walking near a fault, potentially causing a dangerous current to flow through the body. 'Touch' potential arises when a person touches an energised object while standing on the ground, creating a voltage difference between the hand and feet, which can also result in a harmful current flow. Both scenarios can lead to severe electric shocks.

Neutral earthing resistors and neutral earthing reactors are plant added to the transformer neutral earthing system to restrict earth fault currents.

The need to address fault level issues is compliance driven.

TABLE 2 DISTRIBUTION SYSTEM FAULT LEVELS

VOLTAGE LEVEL (KV)	SYSTEM FAULT LEVEL (KA)
66	21.9
22	13.1
11	18.4
6.6	21.9
<1	50

We annually evaluate the three phase and phase to ground fault levels at each zone substation and compare them to the lowest of plant rating, any connection agreement and our design fault level.

Under our distribution system augmentation planning policy, when zone substation fault levels are predicted to exceed the limits detailed in table 2, mitigation strategies need to be employed.

A strategy that can be employed quickly and relatively cheaply is the implementation of a normally open auto close (NOAC) scheme. A NOAC scheme is the first option considered when assessing fault level mitigation strategies. If a NOAC scheme cannot mitigate the risk, augmentation options such as

neutral earthing resistors, neutral earthing reactors, line reactors, and higher impedance transformers are then considered.[1]

The forecast fault level exceedance for each substation in the program of works is detailed in table 3.

TABLE 3 FORECAST FAULT LEVEL EXCEEDANCE

ZONE SUBSTATION	IDENTIFIED NEED	YEAR OF EXCEEDANCE
DSH	Both the three-phase and phase-phase fault levels at Dandenong South (DSH) zone substation 22kV bus are forecast to reach the limit of 13.1kA	2027
SV	When both SVTS and SV/SVW are abnormal, the three-phase fault level at SV zone substation 22kV bus are forecast to reach the limit of 13.1kA	2027
SVW	When both SVTS and SV/SVW are abnormal, the three-phase fault level at SV zone substation 22kV bus are forecast to reach the limit of 13.1kA	2027

As a compliance requirement, the selection of fault level mitigation options is determined on a least-cost, technically feasible basis.

[1] Neutral earthing resistors and neutral earthing reactors are plant added to the transformer neutral earthing system to restrict earth fault currents.

4. Dandenong South

The identified need is to mitigate limitations on our network where design fault levels will be exceeded. Fault levels on the Dandenong South (DSH) 22kV bus are forecast to reach the limit of 13.1 kA in 2027, impacting the connection of new embedded generation.

4.1 Assessment of credible options

Several options were considered to meet the identified compliance need, and a summary of the costs calculated for feasible options is provided in table 4.

TABLE 4 OPTIONS CONSIDERED AND COST SUMMARY ($M 2026)

DESCRIPTION OF WORKS	ASSESSMENT	PV COST
Option 1 (base case): no capital investment or change to existing practices.	The forecast fault levels at DSH will exceed limits in the 2026–31 regulatory period. This option fails to address the identified need to meet our fault level compliance obligations.	-
Option 2: augment DSH by installing new reactors.	This option addresses fault level non-compliance of the DSH by installing two new 22kV series reactors. This is the least-cost option for maintaining fault level compliance.	-2.3
Option 3: installation of new series reactors at East Rowville Terminal Station (ERTS)	This option would address the fault level non-compliance through the installation of five new 66kV series reactors at ERTS. Costs have been assumed for simplicity given it is not the least cost option.	-7.0

4.2 Preferred option

The preferred option to address the identified need is option 2, as this is the least-cost to comply.

The forecast expenditure for option 2 is shown in table 5.

TABLE 5 EXPENDITURE FORECASTS FOR PREFERRED OPTION ($M 2026)

EXPENDITURE FORECAST	FY27	FY28	FY29	FY30	FY31	TOTAL
Augment DSH by installing new reactors	2.0	-	-	-	-	2.0

5. Springvale & Springvale West

The identified need is to mitigate limitations on our network where design fault levels will be exceeded. Fault levels on the Springvale (SV) 22kV bus and Springvale West (SVW) 22kV bus are forecast to reach their limits of 13.1 kA in 2027, impacting the connection of new embedded generation.

5.1 Assessment of credible options

Several options were considered to meet the identified compliance need, and a summary of the costs calculated for feasible options is provided in table 6.

TABLE 6 OPTIONS CONSIDERED AND COST SUMMARY ($M 2026)

DESCRIPTION OF WORKS	ASSESSMENT	PV COST
Option 1 (base case): no capital investment or change to existing practices.	The forecast fault levels at SV and SVW will exceed limits in the 2026–31 regulatory period. This option fails to address the identified need to meet our fault level compliance obligations.	-
Option 2: augment SV and SVW by installing new reactors.	This option addresses fault level non-compliance of the SV and SVW by installing new series reactors on each of the Springvale Terminal Station (SVTS)-SV and SVTS-SVW 66kV lines in series with the existing reactors. This is the least-cost option for maintaining fault level compliance.	-1.5
Option 3: installation of a 5th 66/22kV transformer	The installation of a 5th 66/22kV transformer with normally open ties to the 22kV SV and SVW 22kV busses. The new transformer could be switched to either station during an outage. Costs have been assumed for simplicity given it is not the least cost option.	In excess of $10m

5.2 Preferred option

The preferred option to address the identified need is option 2, as this is the least-cost to comply. The forecast expenditure for option 2 is shown in table 7.

TABLE 7 EXPENDITURE FORECASTS FOR PREFERRED OPTION ($M 2026)

EXPENDITURE FORECAST	FY27	FY28	FY29	FY30	FY31	TOTAL
Augment SV and SVW by installing new reactors	1.5	-	-	-	-	1.5

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