

# Rapid Earth Fault Current Limiter (REFCL) Program

## Tranche 2 High Voltage (HV) Customer Engagement Overview

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**Tranche 2 High Voltage (HV) Customer Engagement Overview**

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### 1 Purpose and background

#### 1.1 Purpose

The purpose of this document is to detail AusNet Services' engagement approach for High Voltage (HV) customers affected by the installation of the Rapid Earth Fault Current Limiters (REFCL) at selected zone substations in the AusNet Services electricity distribution network.

#### 1.2 Background

AusNet Services' electricity distribution network operates in a geographical location which is exposed to extreme bushfire risk.

The 2009 Victorian Bushfire Royal Commission made several recommendations with respect to fires initiated from electricity distribution networks. Subsequently, the Victorian Government established the Powerline Bushfire Safety Program to research the optimal way to deploy REFCLs for bushfire prevention. This research led the Government to introduce *Electricity Safety (Bushfire Mitigation) Amendment Regulations 2016* which came into operation on 1 May 2016, amending the *Electricity Safety (Bushfire Mitigation) Regulations 2013* (**Regulations**).

For AusNet Services, the Regulations require each polyphase electric line originating from 22 selected zone substations to comply with mandated voltage reduction performance standards by 1 May 2023. In the timeframes specified in the Regulations, the installation of REFCLs is the only feasible technological solution.

The Regulations apply a point scoring system to establish milestones for completing the required works. Each selected zone substation is attributed a point score from 1 to 5, with the highest value attributed to those zone substations where fire mitigation measures would provide the greatest benefit.

AusNet Services is required to have REFCL compliant zone substations to accumulate:

- 30 points by 1 May 2019;
- 55 points by 1 May 2021; and
- 63 points by 1 May 2023.

#### 1.3 Tranches overview

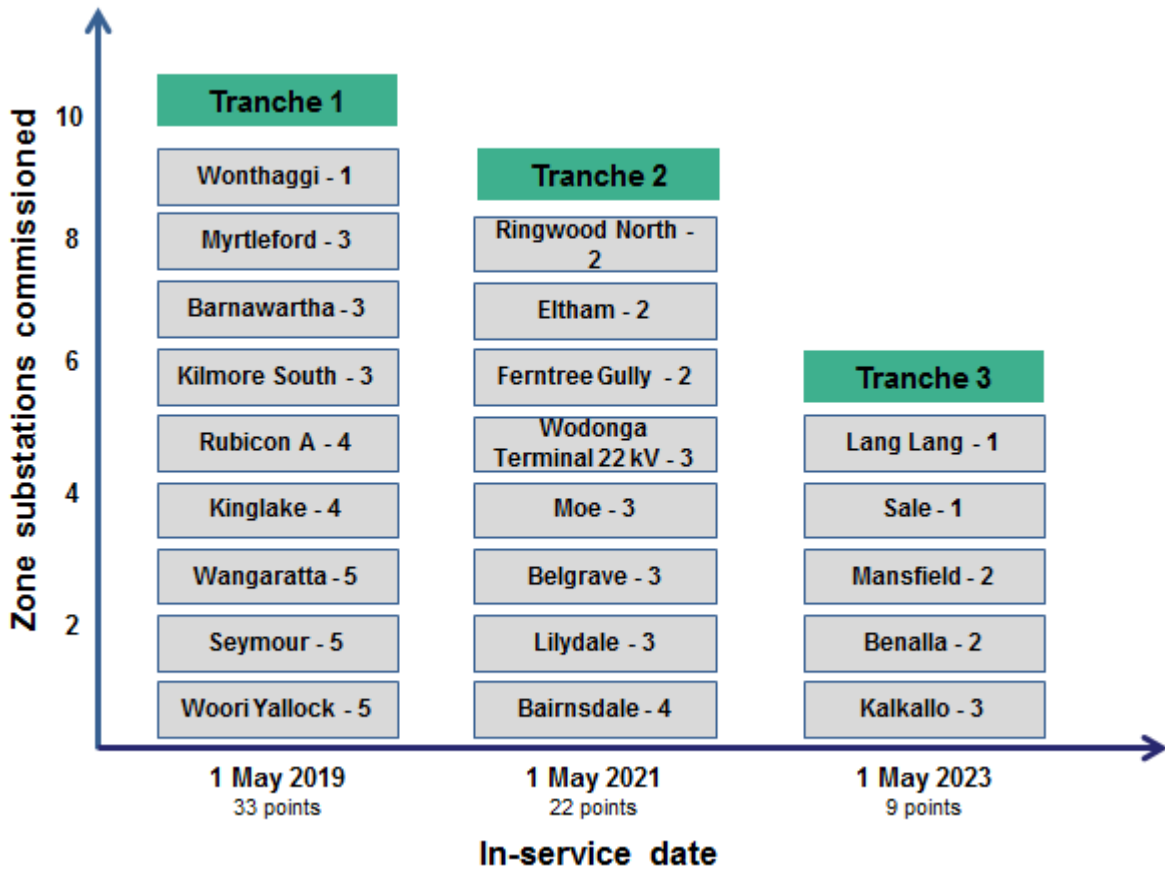
AusNet Services have allocated the 22 selected zone substations into 3 tranches:

- Tranche 1 contains 9 zone substations;
- Tranche 2 contains 8 zone substations; and
- Tranche 3 contains 5 zone substations.

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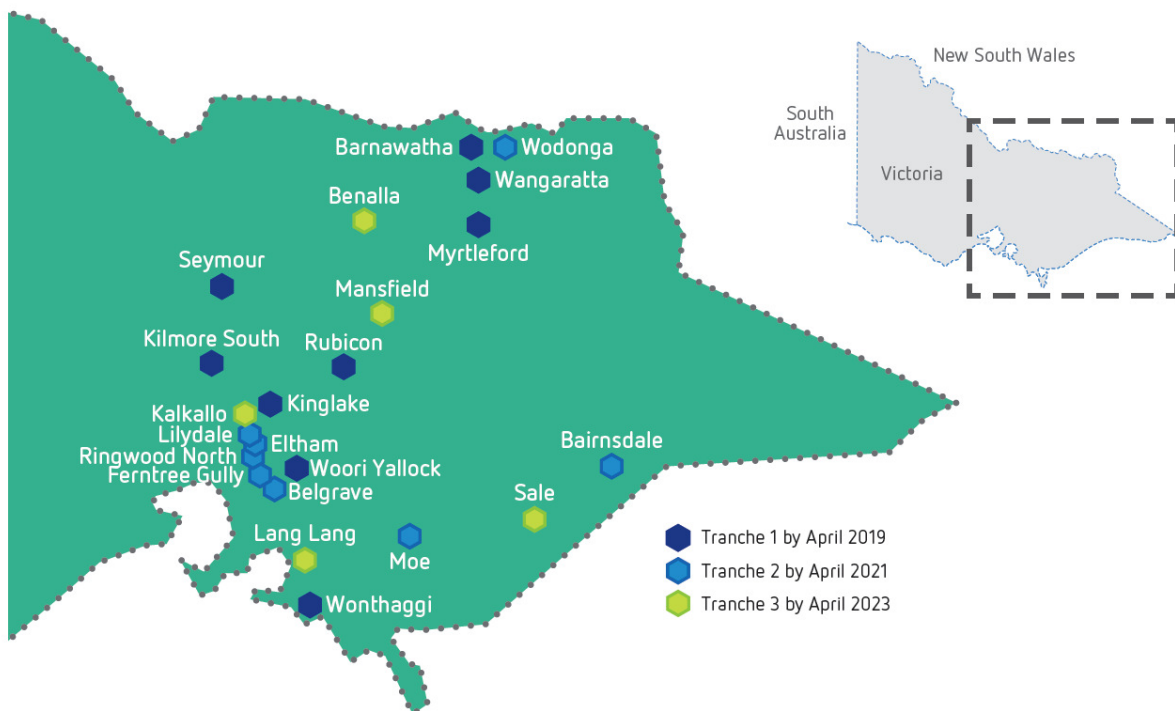
Figure 1 shows the zone substations by Tranche.

**Figure 1: AusNet Services REFCL Implementation by Tranche**



Source: AusNet Services

**Figure 2: Map depicting the AusNet Services REFCL zone substations by Tranche**



Source: AusNet Services

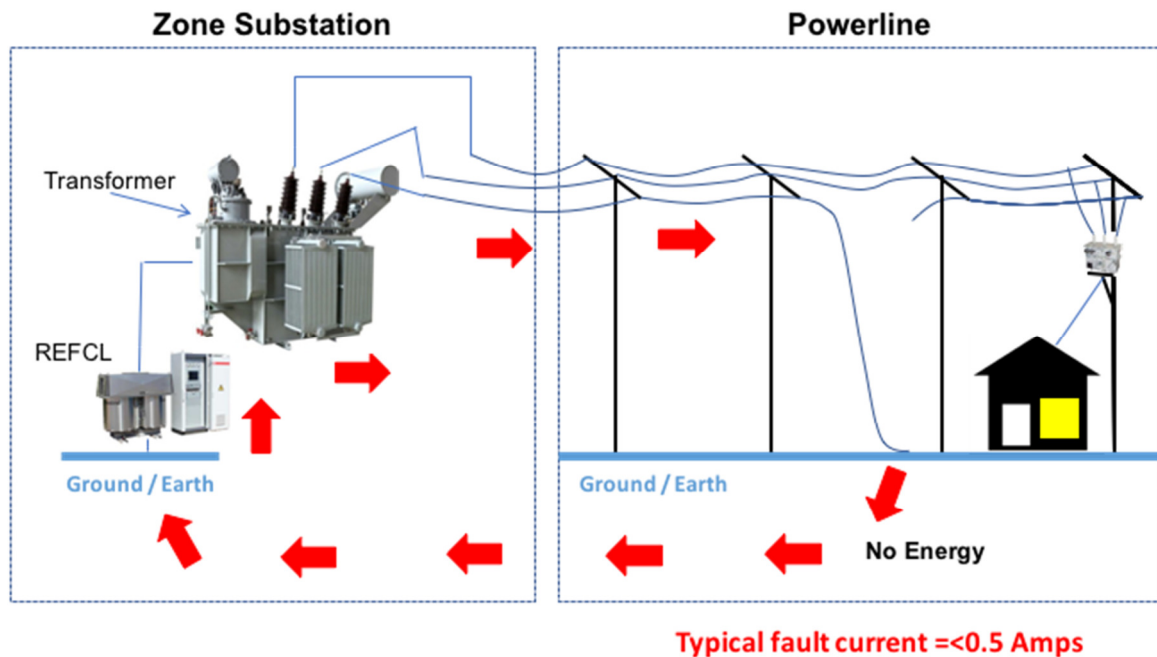
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## 2 REFCL implications for HV customers

### 2.1 REFCL technology overview

The REFCL scheme is an electricity network protection device which is designed to minimise the fault current (energy) dissipated from phase to earth (wire to ground) faults on the 22kV network in order to reduce the risk of fire ignition associated with network incidents as shown in Figure 3.

Figure 3: How does REFCL technology work?



Source: AusNet Services

The REFCL operates when a single phase-to-earth fault occurs. Its operation causes the phase voltage of the faulted phase to be reduced to near earth potential (zero volts), thereby working to eliminate the flow of fault current. To achieve this outcome, the REFCL is tuned to the inductance of the electrical network. This compensation results in phase to ground voltage on the faulted phase reducing to near 0 volts. The healthy phases could rise from 12.7kV to 24.2kV, being the nominal phase-phase voltage (22kV) plus 10 per cent.

While the REFCL is compensating for a fault, the healthy phases remain energised and customers remain on supply. However, there remains a risk that the energised phases may be in an unsafe condition depending on the nature of the network fault. Accordingly, a maximum compensating period will apply.

### 2.2 Implications for HV customers

With a REFCL in service during a phase to ground fault, the neutral voltage may increase up to 13.9kV consequently leading to elevated phase to ground voltages on the un-faulted two phases. These un-faulted phases are required to withstand 24.2 kV.

The REFCL also automatically adapts to network conditions while in service. This may result in individual phases voltages being increased by 20% (16.7 kV phase to ground) at a time for a total time period of 45 seconds. This may occur multiple times during a day.

The voltage changes only relate to phase-to-earth voltages. Phase-to-phase voltages are unaffected by REFCL operation. Given that only phase-to-earth voltages are changed by

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REFCL action, the only customers that can be affected are those that are supplied at high voltage (**HV**). Customers supplied at 240/415V are naturally isolated from variations in the HV phase to ground voltage by the 22kV/415V transformer.

HV customer's equipment would be exposed to higher voltages than they currently are, and potentially higher than their equipment is rated for.

Any resulting failure of HV customer's equipment during REFCL operation may induce a cross country fault negating any fire mitigation effect on the phase affected by the first fault as the REFCL attempted to compensate for the second fault. This situation could result in a fire ignition at the site of the first fault or second fault.

Furthermore, there are secondary effects that will incur varying impacts on HV customers with respect to, but not limited to, the following:

- Fault levels;
- Power quality;
- Earthing arrangements;
- Protection and control;
- Operating protocols;
- Connection agreements; and
- Physical arrangements at the point of connection.

These factors should be investigated by each REFCL-impacted HV customer to understand the full impact of REFCL operations on their HV electrical assets. For Tranche 2, AusNet Services is providing support to HV customers in the form of a suggested panel of technical advisers and if requested, reimbursement of the associated costs.

### 2.3 Solutions available to HV customers

There are three (3) technically acceptable engineering solutions available to our REFCL-impacted HV customers to ensure they are not adversely impacted by REFCL operations:

- Conversion to low voltage (**LV**);
- Primary assets hardening; or
- Installation of isolating transformer & Automatic Circuit Reclosers (**ACRs**);

The following sections provide a high level overview of each solution.

#### 2.3.1 Conversion to low voltage (LV) supply

The first engineering solution that prevents voltage stress on HV customer assets during REFCL operation is for the HV customer to convert their HV primary connection to LV.

AusNet Services will supply a transformer to convert 22kV voltage to 415V.

This solution is only viable if the customer's electricity load has reduced to a level where it is appropriate to be supplied at LV. This is most likely to occur where there is a change of use of the site. The maximum load that can be practically supplied at LV is 1000 KVA.

#### 2.3.2 Asset hardening solution

The second method that prevents voltage stress on HV customer assets during REFCL operation is to identify, and replace, the primary HV electrical assets that are not capable of

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being able to withstand an elevated voltage of 24.2kVrms for at least 3 continuous minutes. In some cases, customers' existing equipment may be capable of this performance.

### 2.3.3 Isolating substation solution

The third method of preventing voltage stress on HV customer assets during REFCL operation is to electrically isolate the HV customer's installation from AusNet Services' distribution network by installing an isolating substation close to the HV customer's point of connection.

This arrangement prevents the higher phase to ground voltages being presented to the customer's equipment but also has the effect that any earth fault downstream of isolating transformer will NOT be detected or cleared by the REFCL equipment. This means that the customer's equipment does not benefit from the reduced fire ignition risk provided by REFCL's.

An ACR is installed on either side of the isolating transformer, for protection and control purposes.

Depending on the size of the isolating transformer, the isolating substation solution and required footprint varies.

Note: the installation of an isolating substation results in short sections of underground polyphase electric lines, between the isolating transformer and the HV connection point, not being REFCL protected. As such, the following exemption applications are required:

- Energy Safe Victoria (**ESV**) grant exemptions under regulation 13 of the *Electricity Safety (Bushfire Mitigation) Regulations 2013* from the requirements of regulations 7(1)(ha) and 7(1)(hb); and
- ESV facilitate the progression of applications for exemption under section 120W(1) of the *Electricity Safety Act 1998* from compliance with section 120M of the *Electricity Safety Act 1998*.

Refer to REF 30-10: REFCL Program Customer Policy for REFCL Protected Networks (Load & Generator) for further information about these engineering solutions.

## 2.4 Breach of the Victorian Electricity Distribution Code obligations

REFCL operations results in voltage variations at the HV customers' supply points that exceed the level specified in clause 4.2.2 of the Victorian Electricity Distribution Code (**Code**).

The Essential Services Commission (**Commission**) is responsible for licensing Electricity Distributors in Victoria. As part of their licensing functions under the *Electricity Industry Act 2000 (Vic)*, they set licence conditions for distributors that include the requirement to comply with the Code.

On 27 February 2018, the Commission released the scope for their Review of Voltage Standards, the purpose of which is to support the introduction of REFCL technology into sections of the Victorian electricity grid.



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The project timeline is:

- Initial consultation: March 2018
- Draft decision: May 2018
- Consultation on draft decision: May – June 2018
- Final decision: August 2018

Until such time as the Code is amended to remove the conflict between the obligations under the Regulations and the Code, the obligation to implement an appropriate engineering solution at each REFCL impacted HV customer connection point lies with AusNet Services.

For an asset hardening solution to be implemented, a connection agreement variation must be executed between AusNet Services and the HV customer in accordance with clause 1.6 of the Code. This clause allows for the written variation of rights or obligations under the EDC, noting any agreement entered into under this clause must not reduce the rights or increase the obligations of the customer without giving benefits of equal value, whether financial or otherwise. This effectively means that AusNet Services is obliged to contribute to the customer's costs for hardening their equipment.

### 2.5 HV Customer Assistance Package

In late August 2017, the Victorian Energy Minister announced the intention of the Victorian Government to establish a High Voltage Customer Assistance Program (**HCAP**) that will provide funding to high voltage customers potentially impacted by the role-out of REFCLs.

A HCAP co-design workshop was held by the Department of Energy, Land, Water and Planning on 16 March 2018 with participants from the Victorian electricity distribution businesses and ESV.

Details of the HCAP are yet to be finalised.

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### 3 HV customer engagement

#### 3.1 HV customer lead

Given the impacts of REFCL operations on HV customers supplied by REFCL-enabled feeders, AusNet Services has appointed a dedicated REFCL Program HV customer lead.

The purpose of the role is to be the primary point of contact for the HV customers in relation to the REFCL implementation and to identify, and negotiate, the appropriate solution for each HV customer.

Each HV customer site is unique in terms of the nature and condition of the HV electrical assets, the site location and the preferred solution required to meet the required regulatory deadlines.

#### 3.2 HV customer engagement objectives

The key objectives for the REFCL Program HV customer engagement are to:

- Proactively engage with our impacted HV customers;
- Work with the HV customers to understand their HV electrical assets and future needs;
- Determine, together with the customer, an appropriate solution, whilst meeting the mandated deadlines;
- Negotiate the details of the implementation of the solution; and
- Ensure suitable contracts (usually an amendment to the respective connection agreement) are executed between both parties.

#### 3.3 HV customer engagement steps

The REFCL Program HV customer engagement steps undertaken include:

- Identifying the impacted HV customers and their HV connection points, by Tranche;
- contacting the impacted HV customers and confirm the appropriate customer contact(s) for engagement;
- establishing new, or enhancing existing, working relationships with key customer contacts;
- arranging an initial meeting to explain the implications of REFCL operations on HV customer electrical assets;
- understanding the nature of the HV customer electrical assets for each HV connection point;
- obtaining single line diagrams and other relevant information on the HV electrical assets;
- discussing the available engineering solutions to protect their HV electrical assets from REFCL operations;
- consider the findings of independent reviews of the HV electrical assets and implications for the REFCL operations;
- working collaboratively with the HV customer to determine which engineering solution is acceptable to the HV customer, whilst meeting the mandated deadlines;
- negotiating the commercial arrangements to implement the agreed solution;
- executing the applicable contracts;

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- managing the interaction with the customer during implementation of the solution; and
- ensuring that AusNet Services obligations under the contract are carried out.

AusNet Services is ensuring the impacted HV customers are aware of any consultation activities being undertaken by the Commission and/or DELWP in relation to the Review of voltage standards in the Code and HCAP, respectively.

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### 4 HV customer solution assessment framework

#### 4.1 Tranche 1 HV customer solution overview

Given the voltage standards in the prevailing Code, the AER CPA 1 determination approved the installation of isolating substations for tranche 1 HV customers.

Nevertheless, the REFCL Program has explored viable alternative options that:

- Still support the achievement of our regulatory obligations by the 1 May 2019 legislated deadline;
- are acceptable to our HV customers; and
- are more economic than the installation of isolating substations.

AusNet Services has worked closely with our Tranche 1 HV customers to determine the appropriate engineering solution to protect their HV electrical assets from REFCL operations.

A mixture of LV conversion, asset hardening and isolating substation engineering solutions have been identified and agreed with each HV customer, as follows:

- 1 connection point will be converted to a LV supply;
- 3 connection points will have their HV electrical assets hardened to withstand REFCL operations; and
- 8 connection points will have isolating substations installed to isolate their HV electrical assets from REFCL operations.

In the absence of any change to the Code at the time of preparing the Tranche 2 contingent project application, AusNet Services anticipates implementing a similar variety of solutions for Tranche 2.

#### 4.2 Solution assessment framework

To determine the most appropriate engineering solution to protect the HV assets from REFCL operations, it is imperative a comprehensive assessment of the nature and condition of the HV electrical assets at each HV connection point is undertaken. This will be undertaken by the customer or their appointed electrical engineering advisor.

Once the nature and condition of the HV electrical assets is determined, an assessment is undertaken to confirm which of the three available engineering solutions is the most economic, technically viable option.

This assessment includes:

- **Deliverability:** the engineering solution must be in place prior to the Tranche 2 legislated deadline (1 May 2021); and
- **Acceptability:** under the current Code, a connection agreement variation must be executed with the HV customer for an asset hardening solution.

#### 4.3 Challenges in determining the appropriate solution

Given of the uncertainty regarding the Commission's Review of voltage standards and the availability of a HCAP from the Victorian Government, a number of impacted HV customers have been reticent to commit time and expenditure to:

- conduct site visits to the impacted HV connection points;
- undertake a comprehensive assessment of their HV electrical assets; and/or

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- enter formal negotiations regarding the preferred solution for Tranche 2 HV connection points.

### 4.3.1 Asset condition review

To progress engagement with a number of Tranche 2 HV customers, AusNet Services has proposed to pay for asset condition reviews to be undertaken at nominated HV connection points, as follows:

- Contact details of three (3) independent consultants who can perform asset condition reviews have been provided to the nominated HV customers;
- The HV customer is able to select one of these independent consultants or select an alternate independent consultant to conduct the review; and
- On the receipt of a copy of the independent consultant's report, AusNet Services will reimburse the HV customer the cost of this review, up to an agreed monetary value.

### 4.3.2 Access to sites

A number of customers have struggled to engage in the process due to resource constraints.

Site visits need to be accompanied by company personnel and, in many cases, limited information can be gleaned from a site visit without the equipment being isolated and earthed, interrupting the customers operations.

### 4.3.3 Development of solutions

It has not been possible, by the submission date of the Tranche 2 contingent project application, to conclude final negotiations with customers as to the solution to be adopted.

The solutions proposed in the following sections are based upon the current knowledge of customers' HV electrical assets and discussions held with each HV customer to date.

AusNet Services is continuing to work with impacted HV customers to undertake detailed HV electrical asset surveys and to develop the most economical solution for each HV connection point.

AusNet Services will provide an update to the AER in good time ahead of the determination of the Tranche 2 contingent project application.

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### 5 Next Steps

AusNet Services are continuing to work closely with our REFCL-impacted HV customers to confirm the appropriate REFCL technical solution for each HV connection point.

As mentioned in section 4.3.1, AusNet Services is assisting a number of HV customers with the costs of undertaking independent assessments of the condition of their HV electrical assets.

Next steps to be undertaken include:

- Funding assistance for HV customers to undertake independent reviews of the condition of their HV electrical assets;
- Jointly reviewing the finding of the independent asset condition reviews;
- Undertaking any stability and/or protection studies as recommended by the independent asset reviews; and
- Determining the appropriate REFCL solution for each HV connection point.

In addition, we will ensure our REFCL-impacted HV customers are kept abreast of the progress of the ESC Voltage Standards Review (**ESC Review**) and the implications of the outcomes of the ESC Review.

Given the current uncertainty regarding the implications of the ESC Review on customer obligations, the independent HV electrical assets review to obtain more detailed HV electrical asset information and further customer engagement on available REFCL solutions, the final solution to be implemented at each Tranche 2 HV connection point may change to the proposed solution identified at this time.

AusNet Services will keep the AER informed of the outcomes from ongoing customer engagement activities and, as applicable, the revised REFCL solutions to be implemented at each HV connection point during the AER Tranche 2 contingent project application assessment process.