PBSC Update
Powercor REFCL Program

April 2019
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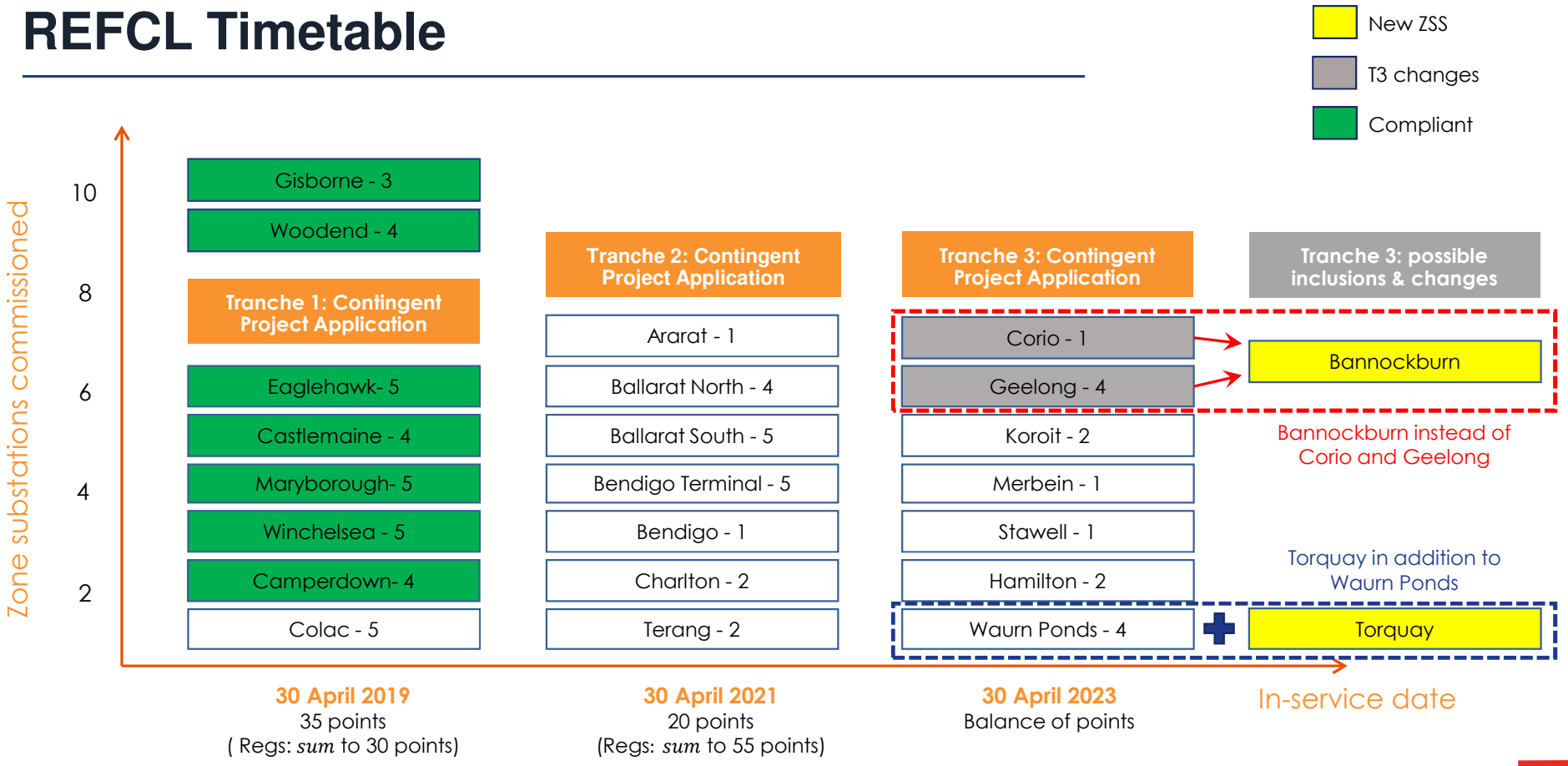
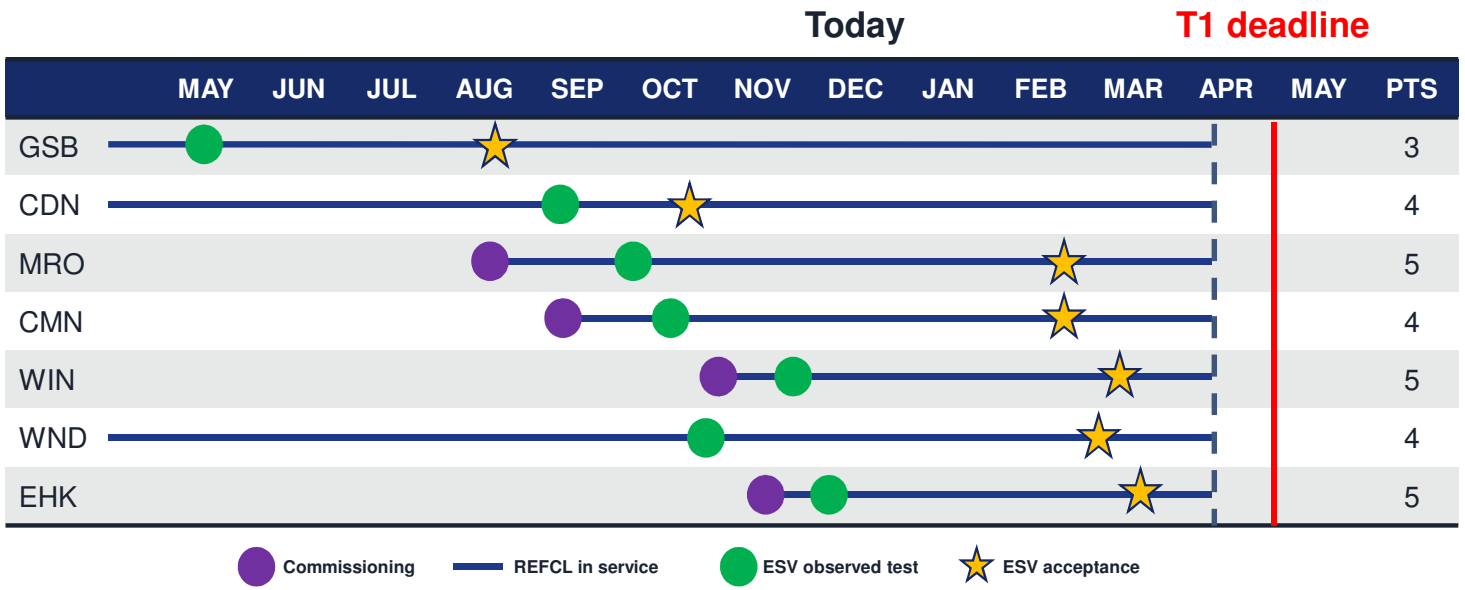
Contents

1. REFCL Timetable
2. REFCL T1 Deployment
3. REFCL Implementation update
4. REFCL Performance update
5. REFCL TFB day performance
6. REFCL 2019 and T2 update
7. SWER ACR Deployment status
8. Powerline Replacement Fund

REFCL Timetable

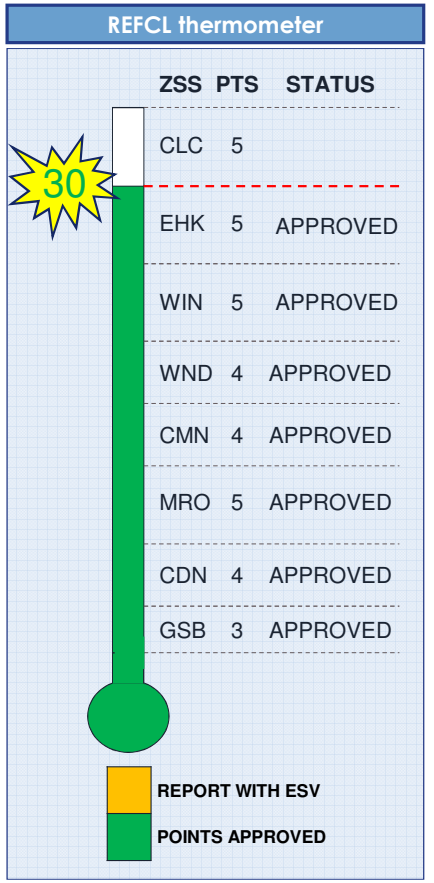


REFCL Deployment timetable – Tranche 1



Powercor has REFCLs at *required* capacity at seven zone substations operating over the 2018/19 summer.

We have deferred compliance testing at Colac to focus on REFCL performance.



REFCL Implementation Update

Tranche One

ESV has accepted that seven zone substations meet the definition of a *complying substation*

Acceptance is conditional upon four unresolved anomalous results. These are:

1. Calibration
2. Harmonics and voltage collapse
3. Sampling of admittance values
4. Inverter tripping

By June 30 2019 we hope to have resolved (1) & (4), developed mitigation options for (2) and diagnosed the root cause and developed a resolution plan for (3).

Testing on WIN011 27th November

REFCL Performance update (1)

Calibration

To provide assurance that the voltage collapse target will be met given a variance in network conditions from the original calibration point.

Powercor has received a beta version of the REFCL software which goal seeks the faulted phase voltage. This has been trialled at Winchelsea and Colac with promising results.

With improvements to the speed of operation, this could alleviate any concerns around calibration.

Harmonics and voltage collapse

Powercor had minimal harmonic impact on compliance.

To understand harmonic reduction options, Powercor is:

- Working with a consultant to analyse the MRO network and identify mitigating options
- Explore the GFN's ability to compensate for harmonic voltages

The improvement to the voltage collapse functionality will help mitigate the impact of harmonics.

Admittance measurement

The level of admittance to measure is an extraordinarily small quantity, even with laboratory-grade current transformers (CTs). Measurement error and imbalance can appear as faults.

We have analysed eleven months of real REFCL data across Gisborne and Maryborough, and we have had only one instance of a permanent high impedance fault.

Swedish Neutral have improved their sampling technique which tested very well in Sweden (refer following slide).

The next steps are:

1. Validate that the network is not contributing to this problem.
2. Review the accuracy of our equipment and confirm correct measurements are taken in a fault-free state.
3. Evaluate the data and formulate the next steps.

Inverter tripping

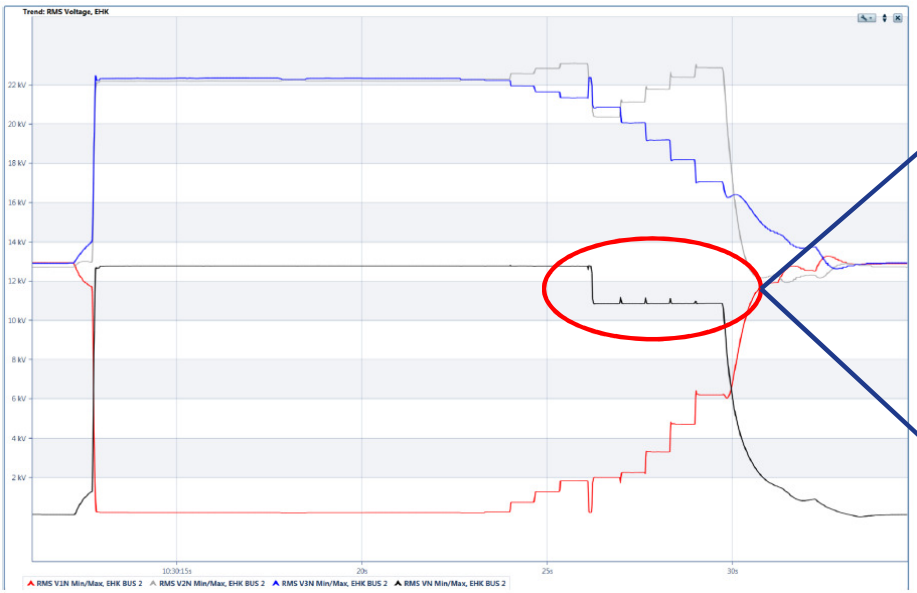
Swedish Neutral have undertaken significant work with REFU (the inverter supplier). Their testing identified a potential millisecond delay between the two halves of the inverter would result in a trip. They have proposed a modification to the installation of the RCC, which is essentially a wiring change.

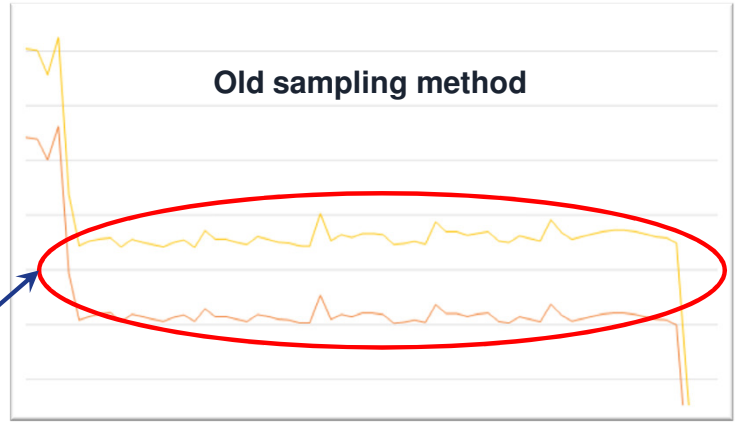
The change tested well during commissioning at Colac, has been trialled at Woodend and has been implemented at Eaglehawk.

We intend to roll this out at the rest of our sites in the next few weeks, test and monitor performance.

REFCL Performance update (2)

- Test 156 during Eaglehawk compliance testing
- High impedance (25.4kΩ) fault, red phase
- The REFCL failed to confirm the fault





REFCL TFB Performance – Summer 2018/19

- Powercor had 10 REFCLs in service across 7 zone substations this summer.
- There were 17 TFB days declared across the Powercor network, with the Maryborough REFCL put into fire mode 14 times as Maryborough serves three fire districts.

On TFB days the REFCLs detected:

- 9 transient faults (4 at Maryborough and recordings show that the voltage collapse was always below 250V indicating low harmonic content); and
- 3 permanent faults

The three permanent faults occurred on:

1. EHK031 (25th January) – no cause was found
2. EHK024 (3rd February) – this fault is discussed in more detail on the next slide
3. CDN004 (1st March) – the cause was a failed SWER ISO transformer. Due to the admittance issue, the REFCL falsely identified the fault on CDN001.

Further information on the permanent faults is to be shared at the next REFCL Technical Working Group (TWG) meeting.

EHK024 fault 3rd February

EHK024 fault – 3/2/19

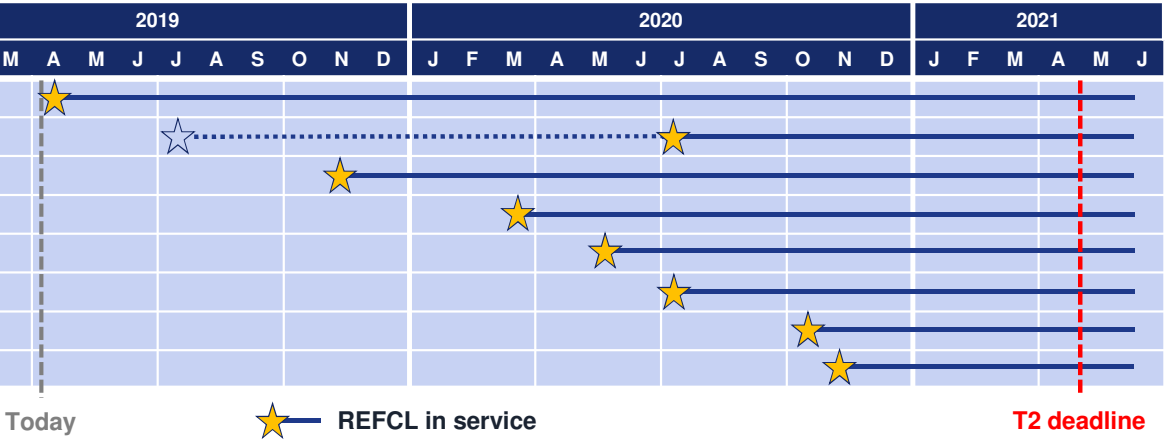
Summary of the day

- 08:09am - EHK024 feeder CB tripped (opened)
- The trip was initiated by the GFN
- The feeder was sectionalised and patrolled as part of normal fault response
- The location was narrowed down but the fault itself could not be found
- Approval was granted to bypass the REFCL
- At 16:46 the Prairie P3 ACR tripped and the fault was located

Powercor is still refining our TFB day processes to determine the criteria, if any, when we may bypass the REFCL to find a fault.

REFCL Tranche 2 Update

Zone Substation	HVC
Colac (T1)	6
Charlton	5
Ararat	1
Bendigo	3
Terang	4
Ballarat North	9
Ballarat South	5
Bendigo Terminal	4



This year, Powercor plans to commission REFCLs at Colac (T1) and Ararat, have Charlton available for the 2019/20 summer and have completed construction and stress testing at Ballarat North.

Powercor is concerned that high voltage customers (HVCs) are unlikely to be REFCL-ready to meet our schedule. Some HVCs are not progressing with their REFCL works while they appeal for additional funding and time.

Powercor has changed our tranche 2 delivery schedule, moving Ballarat North commissioning from late 2019 to July 2020, mindful of the large number of HVCs, and have brought forward Terang to May 2020. We still plan to stress test Ballarat North in 2019 and isolate HVCs as required.

We have proposed to ESV that we will have Charlton available for service this summer (2019/20), operating the REFCL and isolating non-REFCL-ready HVCs on TFB days.

At this stage we don't expect delays to our schedule at Ararat and Bendigo as HVCs are working to our timelines.

SWER ACR status

A total of 1,045 SWER systems are to be protected with new functionality ACRs

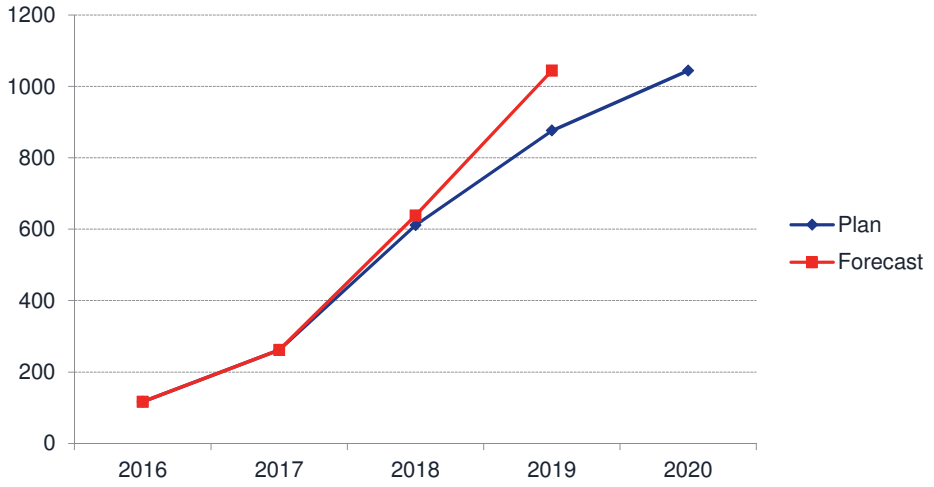
2016
117 ACRs installed; 50 in the high risk Electric Line Construction Areas

2017
145 ACRs installed

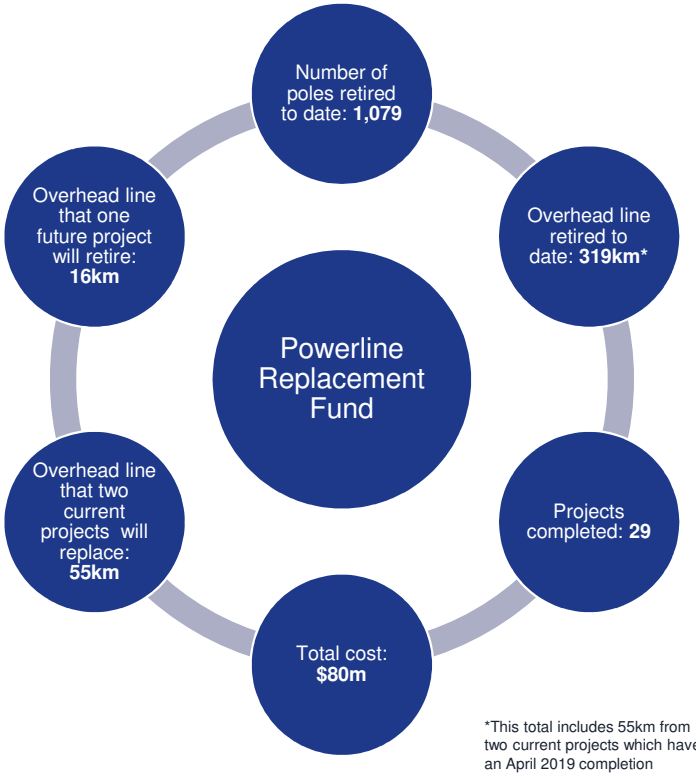
2018
377 ACRs installed

2019
78 ACRs installed, 328 remain. Targeting 2019 completion for all ACRs which is one year ahead of the ESV required completion date of November 2020

377 ACRs were installed in 2018 which exceeded our plan of 350 ACRs.



Powerline Replacement



*This total includes 55km from two current projects which have an April 2019 completion

Commentary

- Ashbourne was approved by DELWP in Feb 2019 and will now proceed to construction. Completion is anticipated in October 2019.
- Fogarty and Coliban 1 are due for completion at the end of April 2019. These 2 projects installed 70km of new cable and retired 55km of overhead line.
- Powercor plans to complete further powerline replacement works where a total of 100km of overhead line will be retired by the end of 2020.