Powerline Bushfire Safety Committee

April 2019

Tom Hallam, GM Regulation and Network Strategy

Mike Carter, REFCL Program Executive

Agenda

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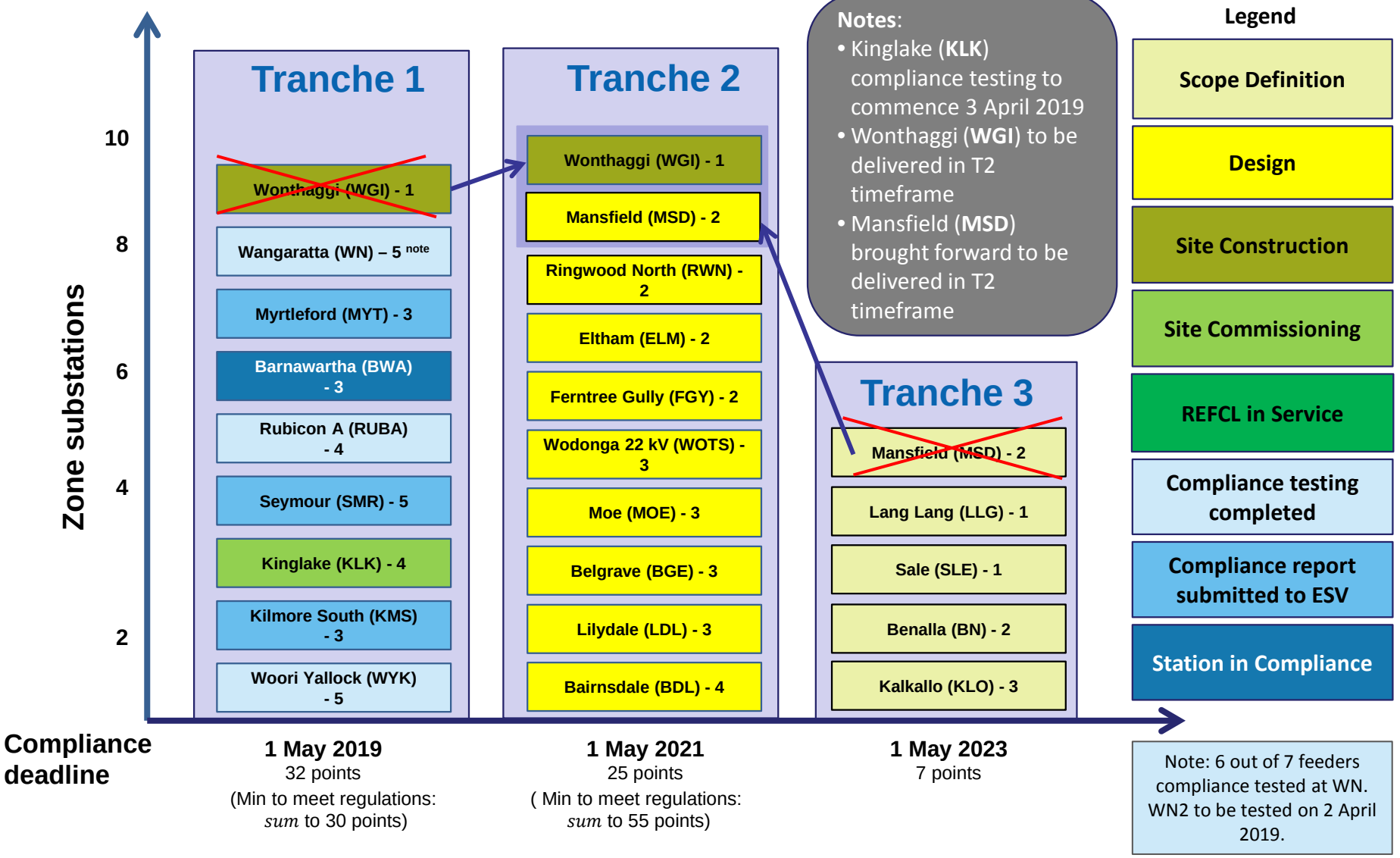
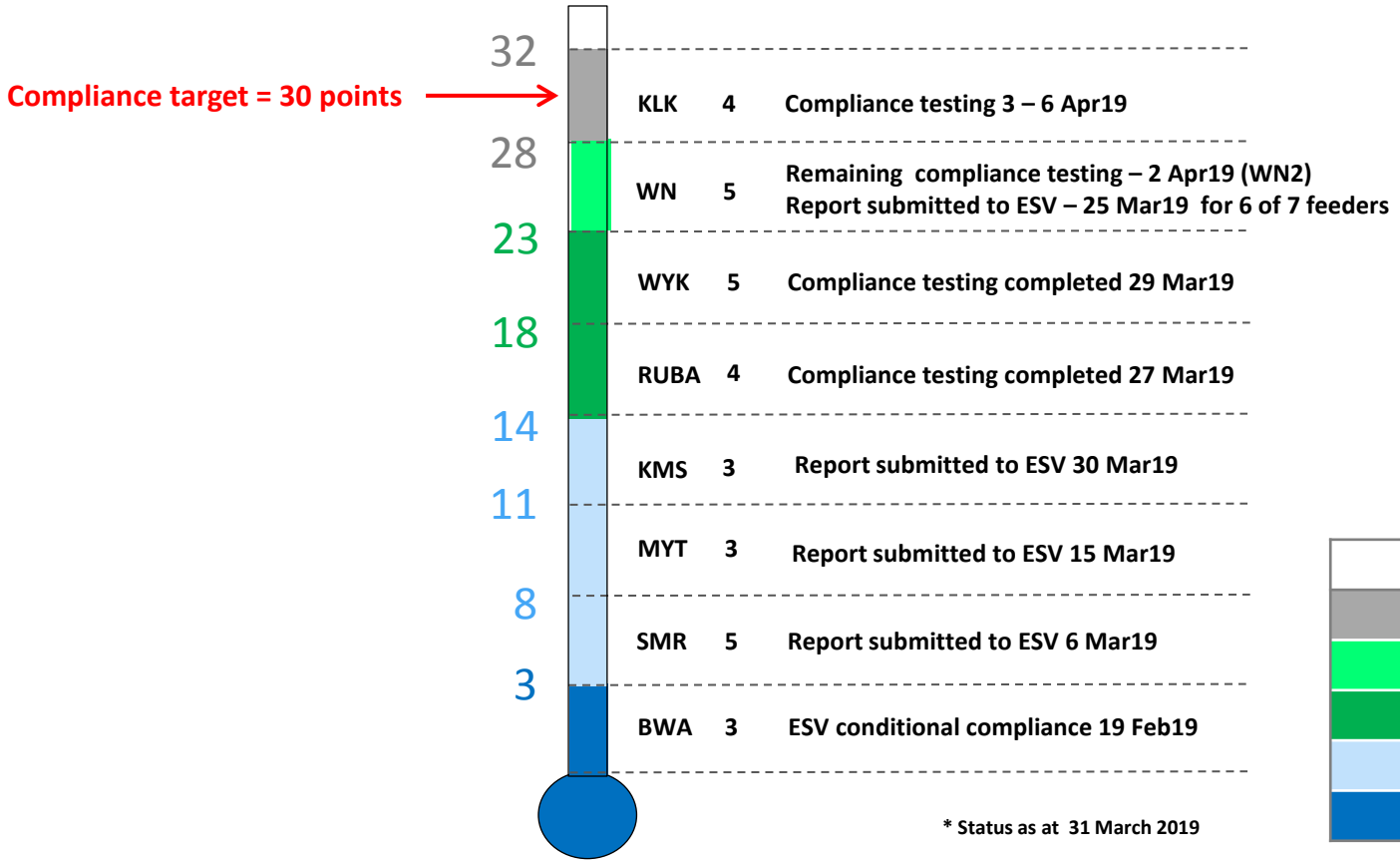
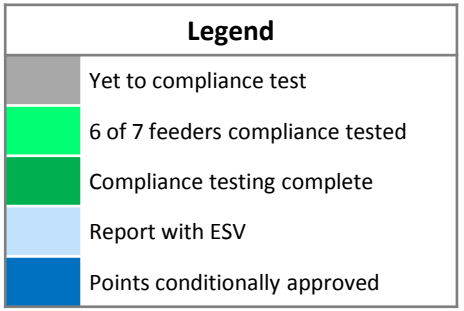
1.0 REFCL Program Overview



2.1 Tranche 1 Compliance testing status





Key messages:

- Compliance testing completed at all zone substations excluding Kinglake (KLK) and Wangaratta (WN)
- 6 out of 7 feeders compliance tested at Wangaratta (WN) in February 2019 with WN2 feeder scheduled to be tested on 2 April 2019
- Conditional compliance expected on all zone substations excluding Woori Yallock (WYK). KLK compliance status is uncertain

2.2 Tranche 1 Compliance testing results

ZSS	Points	# of Feeders	Part A		Part B			Part C	
			Detect	250V 2,000ms	1,900V 85ms	750V 500ms	250V 2,000ms	<0.5A	0.1I²t
WYK	5	4	✓	X	✓	✓	X	✓	X
BWA	3	4	✓	✓	✓	✓	✓	✓	✓
MYT	3	4	✓	✓	✓	✓	✓	✓	✓
KMS	3	2	✓	✓	✓	✓	✓	✓	✓
SMR	5	6	✓	✓	✓	✓	✓	✓	✓
WN	5	7	✓	✓	✓	✓	✓	✓	✓
RUBA	4	5	✓	✓	✓	✓	✓	✓	✓
KLK	4	3			Compliance testing: 3 – 5 Apr19				

Legend: ✓ = passed in ESV observed compliance testing X = failed in ESV observed compliance testing

2.3 Tranche 1 conditional compliance

- **To date, ESV has accepted that one zone substation (ZSS), Barnawartha (BWA) meets the definition of a complying substation**
  - Compliance reports for 4 ZSS's are currently with ESV and the compliance reports for the remaining 3 ZSS's will be provided to ESV by 17 April 2019

- **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

- **We have implemented a solution at all T1 ZSS to address the inverter tripping issue**

- **The following slides provide an update on the remaining technical issues**

2.4.1 Tranche 1 Technical issues update

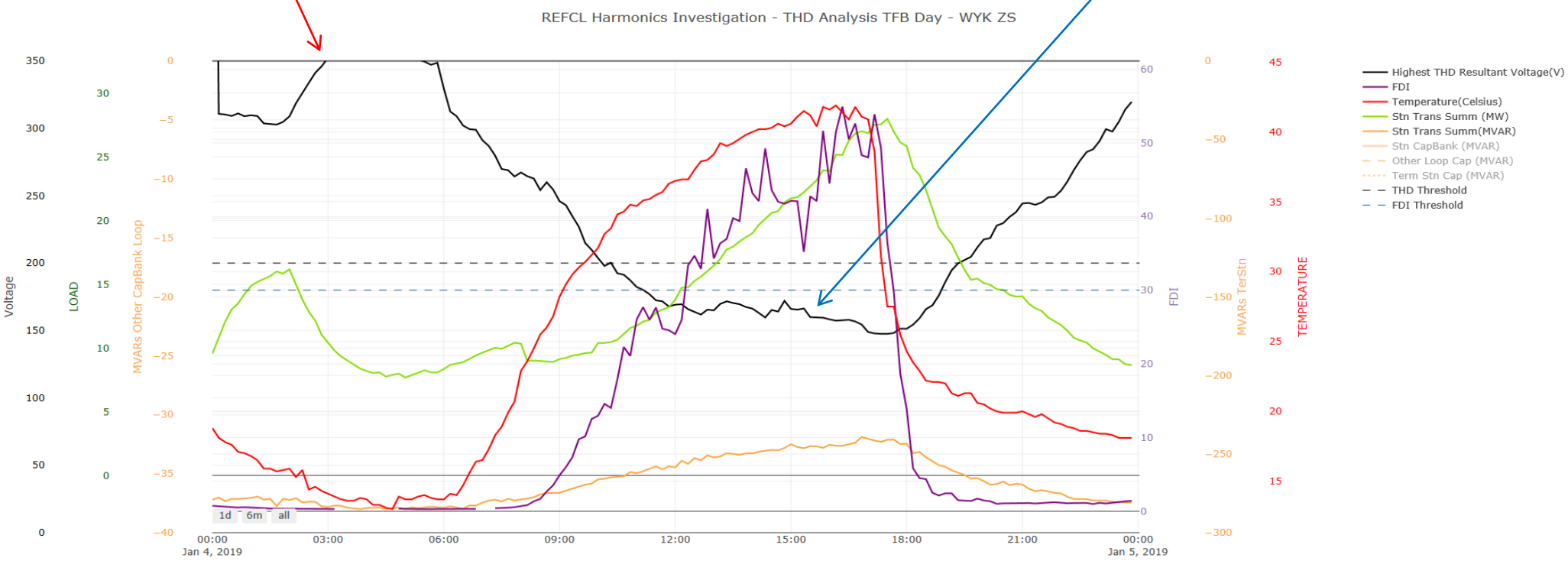
Technical issue	Current status/actions
GFN Performance Issues	
• Delta admittance errors (causing incorrect faulty feeder identification) • Failure of the Arc Suppression Coil (ASC) to always tune accurately • Other minor software defects • Inverter Tripping	• Delta admittance error prevents compliance on feeders larger than ~30 Amps o Swedish Neutral (SN) software solution has been tested by Powercor and AusNet Services, despite some improvement it does not appear to have fixed the issue o SN now saying that they believe the issue to be network related – we disagree • A temporary solution for ASC tuning is in place and we understand that SN are soon to release a permanent fix • SN provided a permanent solution to inverter tripping which has been implemented at all Tranche 1 zone substations
Harmonics	
• On a number of REFCL protected networks, the level of harmonics is close to the voltage collapse target and is resulting in the REFCL performance criteria not being met	• Harmonics are lower when load is high. This has been confirmed by a study of past Total Fire Ban (TFB) days to inform expected performance on these days • Results were presented to ESV on 15 March 2019 • Draft report provided to ESV on 28 March 2019 • The use of existing 22 kV ZSS capacitor banks reduces main harmonic of concern (primarily 5th) • SN have done no work on development of harmonic compensation and, despite requests, have not provided any proposal to do so

Key messages:
- Delta Admittance limits compliance to feeders <= 30A charging current
- Harmonics manageable on TFB days to achieve compliant performance when Fire Danger Index is >30

2.4.2 Tranche 1 Technical issues
Harmonics analysis: WYK – 3 February 2019

Some Zone Substations on TFB days are over the threshold THD value when load is low and in the early morning when FDI is insignificant

But when FDI is over 30 (and hence load is high), THD Voltage is well below the threshold



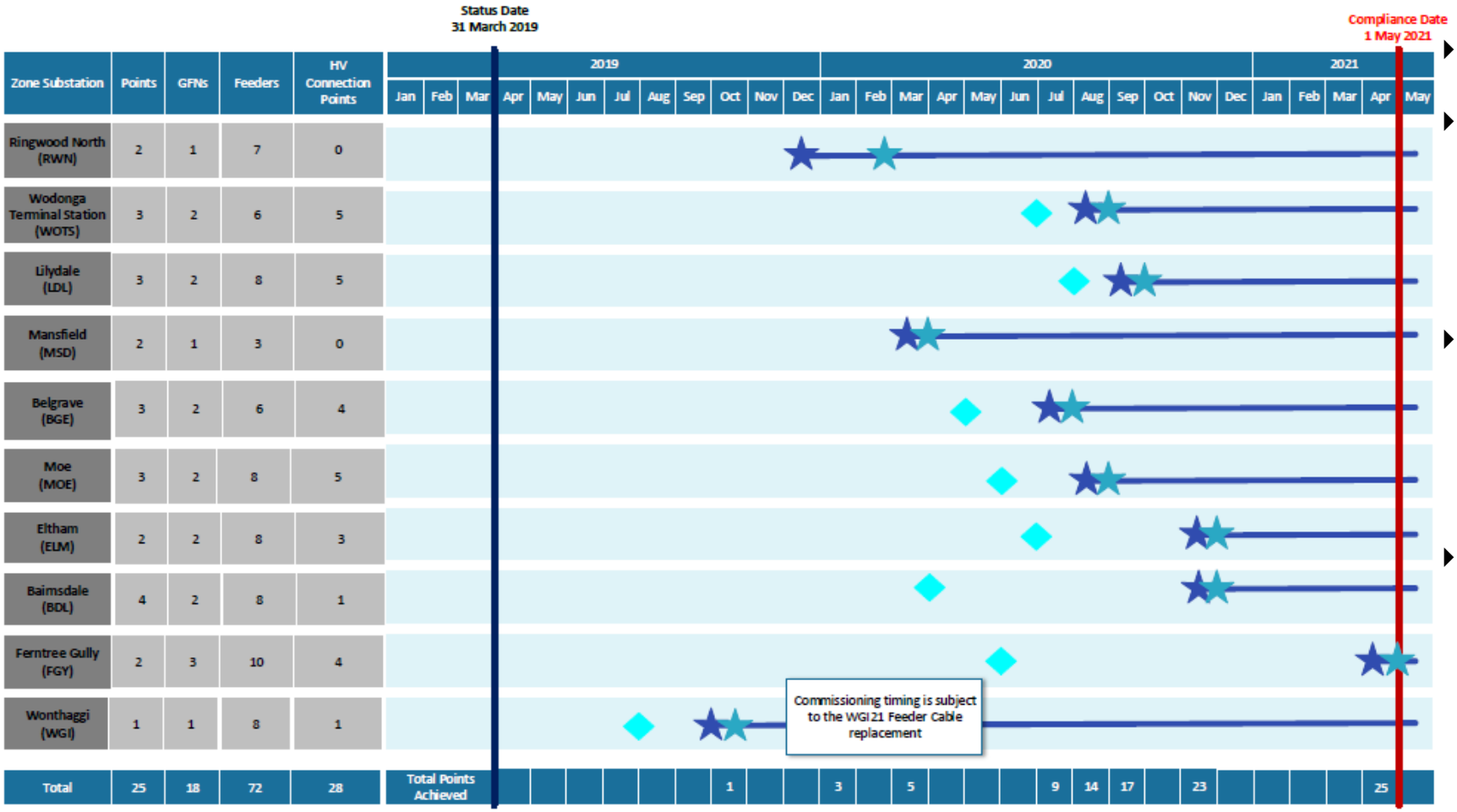
2.5 Tranche 1 Time Extension Request

- **6 of the 8 Tranche 1 zone substations are expected to be achieve 'conditional compliance' in accordance with the criteria**
  - Woori Yallock (WYK), due to the high delta admittance issue, has failed to demonstrate achievement of some aspects of the required performance
  - Kinglake (KLK) is at risk due to unexpectedly high network damping which is limiting fault detection sensitivity

- **A request for an extension of time for WYK will be submitted to ESV in early April 2019 following the completion of compliance testing on 29 March 2019**

- **This extension of time request comprises:**
  - Extension of time request for a 6 month time extension to 1 November 2019
  - Technical reports:
    - REFCL management of Erroneous Delta Admittance
    - REFCL harmonics management strategy

3.1 REFCL Tranche 2 Update



- **Tranche 2 delivery is underway**
- **REFCLs at Wonthaggi (WGI) and Ringwood (RWN) are planned to be in service prior to Christmas 2019**
- **HV Customers have been formally advised of their REFCL readiness dates between March – July 2020**
- **Metro Trains/PTV have advised they cannot meet the T2 compliance deadline**
  - › refer to the following slide

3.2 Tranche 2 HV Customer Issues

- **Of the 27 HV connection points in Tranche 2, two (2) connection points have already been hardened and one (1) connection point has converted to Low Voltage (LV) supply**
- **Of the remaining HV connection points, two (2) are pursuing conversion to LV supply and the remaining HV customers have chosen either hardening or isolating solutions**
- **Whilst REFCL readiness dates were formally communicated to the HV customers in August 2018, there is a significant risk that the HV customers will be unable to meet the requested dates**

<table>
<tr><th>HV Customer</th><th>Connection points overview</th><th>Status</th><th>Description</th><th>Next steps</th></tr>
<tr>
<td>Metro Trains Melbourne (MTM)</td>
<td>
<table>
<tr><th>ZSS</th><th>MTM Connections</th><th>REFCL Readiness Date</th><th>Points</th></tr>
<tr><td>Belgrave (BGE)</td><td>Upwey</td><td>30 April 2020</td><td>3</td></tr>
<tr><td>Ferntree Gully (FGY)</td><td>Ferntree Gully</td><td>31 May 2020</td><td>2</td></tr>
<tr><td>Eltham (ELM)</td><td>Eltham
Montmorency
Wattle Glen</td><td>30 June 2020</td><td>2</td></tr>
<tr><td>Lilydale (LDL)</td><td>Lilydale
Mooroolbark</td><td>31 July 2020</td><td>3</td></tr>
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<td>RED</td>
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• MTM have verbally advised they are unable to meet the T2 compliance deadline of 1 May 2021
• The earliest readiness date is end 2021
• They are currently awaiting the 2019/2020 Victorian Government Budget Outcome in order to proceed with the project
• AusNet Services (AST) informed ESV of this matter in a letter dated 20 March 2019
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<td>
• Preparing a response to the letter from ESV dated 29 March 2019
• Continuing to work with MTM to identify alternate solutions
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<tr>
<td>Melbourne Water (MW)</td>
<td>
<table>
<tr><th>ZSS</th><th>MW Connections</th><th>REFCL Readiness Date</th><th>Points</th></tr>
<tr><td>Belgrave (BGE)</td><td>• Cardinia-Silvian</td><td>30 April 2020</td><td>3</td></tr>
<tr><td>Ferntree Gully (FGY)</td><td>• Thompson Dam
• Thompson Dam, Bells Portal</td><td>31 May 2020</td><td>2</td></tr>
<tr><td>Lilydale (LDL)</td><td>• Silvian
• Olinda</td><td>31 July 2020</td><td>3</td></tr>
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</td>
<td>AMBER</td>
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• MW are currently preparing their REFCL Solution Business Case
• One option under consideration is the provision of an isolated connection service by AST
• Under this option, MW would pay for an isolated connection which is installed and operated by AST
</td>
<td>
• Continuing to work with MW to confirm the preferred solutions and implementation timeframe
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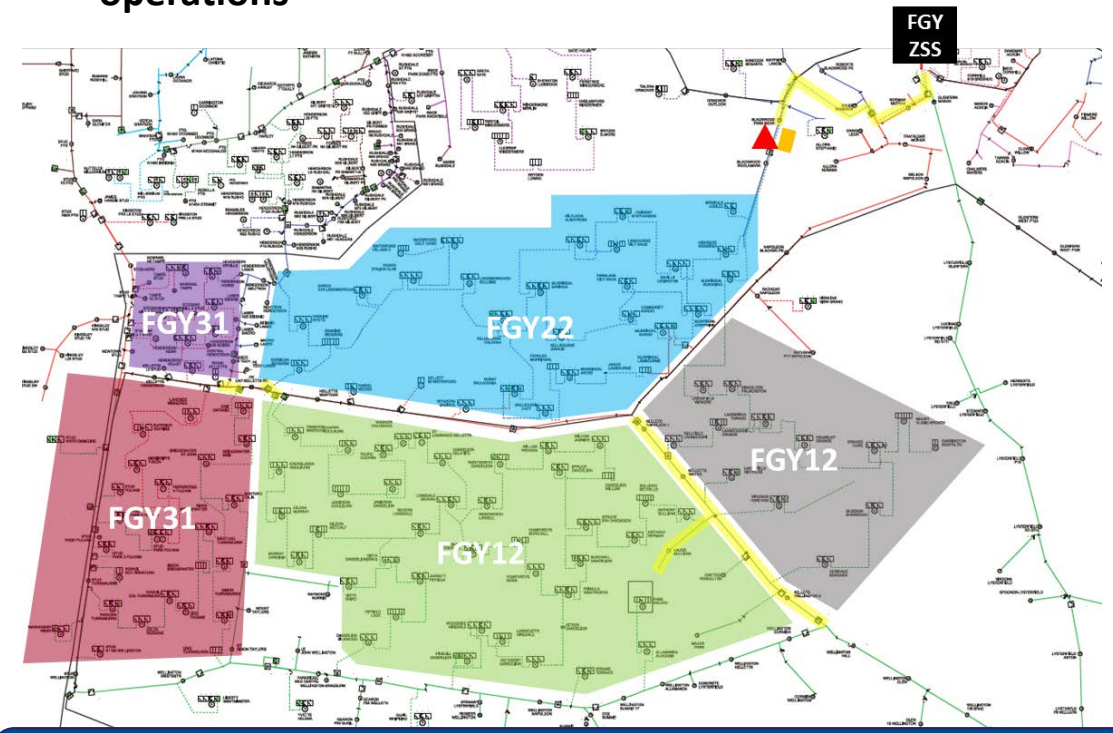
3.3 Tranche 2 Scope exemption applications
Isolation of underground residential estates

- As we continue to review network capacitance forecasts and the condition of existing underground cable, we are identifying opportunities to isolate underground cable from REFCL operations
- At Ferntree Gully (FGY), we've identified 1980's installed steam cured XLPE underground cable on the FGY network which either needs to be replaced to withstand, or isolated from, REFCL operations



UG Cable 1980s vintage - C5 condition	Length (m)	Capacitance (A)
Heyington Park Estate	4580	50.75
The Ridge Estate	2600	9.21
Rowville Lakes Estate	7500	26.57
Listerfield Lakes Estate	1200	30.25
Rowville Heights Estate	850	16.22
		133.00

Benefits of isolation

1. Provides 133A of capacitance relief for FGY, eliminating the need for an additional GFN, to accommodate forecast network capacitance growth for Belgrave (BGE), Lilydale (LDL) and FGY for a 10 year horizon
2. Significant customer impact reduction: Replacement of the existing cable will require ~ 60 outages (impacting 100-200 customers) continually for 9 months compared to a single outage to commission the isolating substation

Recommendation:

- Isolation of the identified underground residential estates is the preferred option as it minimises customer outages and reduces the need for the installation of an additional Ground Fault Neutraliser (GFN) to maintain '*required capacity*'

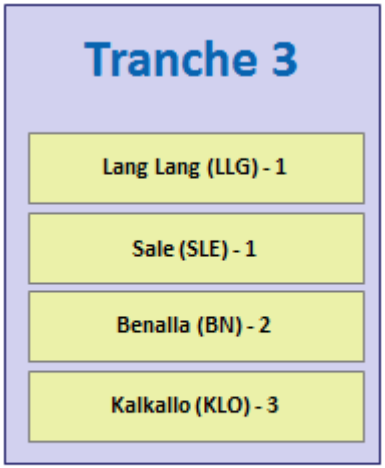
4.0 REFCL Tranche 3 Update

- **Tranche 3 (T3) delivery now comprises four (4) zone substations, with Mansfield (MSD) now included in the Tranche 2 delivery timeframe**

- **The most complex site is Kalkallo (KLO) as this zone substation supplies three (3) Jemena 22 kV feeders in a high growth area**
  - KLO is a 3 GFN ZSS, with current network capacitance forecasts indicating significant ongoing REFCL augmentation to maintain 'required capacity'
  - Options are to be jointly investigated with Jemena on how to best manage the bushfire safety regulatory requirements on an ongoing basis

- **Excluding the 3 Jemena 22 kV feeders, there are four (4) HV customers in T3**
  - These customers have been formally advised of a REFCL readiness date of 30 June 2020
  - We continue to work proactively with these HV customers to achieve the T3 deadline

- **The Tranche 3 contingent project application is currently being prepared for lodgement with the Australian Energy Regulator (AER) in May 2019**



1 May 2023
7 points

Key messages:
- The preferred solution for Kalkallo (KLO) on an ongoing basis is being jointly investigated by AusNet Services and Jemena
- Tranche 3 HV Customer Readiness Date is 30 June 2022 and we continue to work proactively with the HV Customers
- Tranche 3 contingent project application will be lodged with the AER in May 2019

5.0 Network capacitance forecasts

- **Our latest network capacitance forecasts indicate that a large number of GFNs will need to be implemented at Tranche 1 & 2 zone substations (ZSS) in the 2021-2025 regulatory control period to maintain 'required capacity'**
  - The central ZSSs including Woori Yallock (WKY), Kinglake (KLK), Lilydale (LDL), Belgrave (BGE), Ferntree Gully (FGY), Ringwood North (RWN), Eltham (ELM), Kilmore South (KMS) and Kalkallo (KLO) will require additional GFNs
  - In the east region, the Bairnsdale (BDL) network capacitance forecast will increase the number of GFNs from 2 to 3
  - In the north region, the Wodonga Terminal Station (WOTS) network capacitance forecast will increase the number of GFNs from 2 to 3

- **We are currently evaluating options to maintain the REFCL performance which include:**
  - Implementation of further Ground Fault Neutralisers (GFNs)
  - Feeder transfers between REFCL ZSS's
  - Use of remote REFCLs on large feeders
  - Construction of new zone substations
  - Isolation of underground cable

Key messages:
- Significant ongoing expenditure will be required to maintain compliance with the REFCL performance criteria in the Electricity Safety (Bushfire Mitigation) Regulations 2013