REFCL

Overview of KLO Zone Substation (ZSS)

Contingent Project Application – Tranche 3

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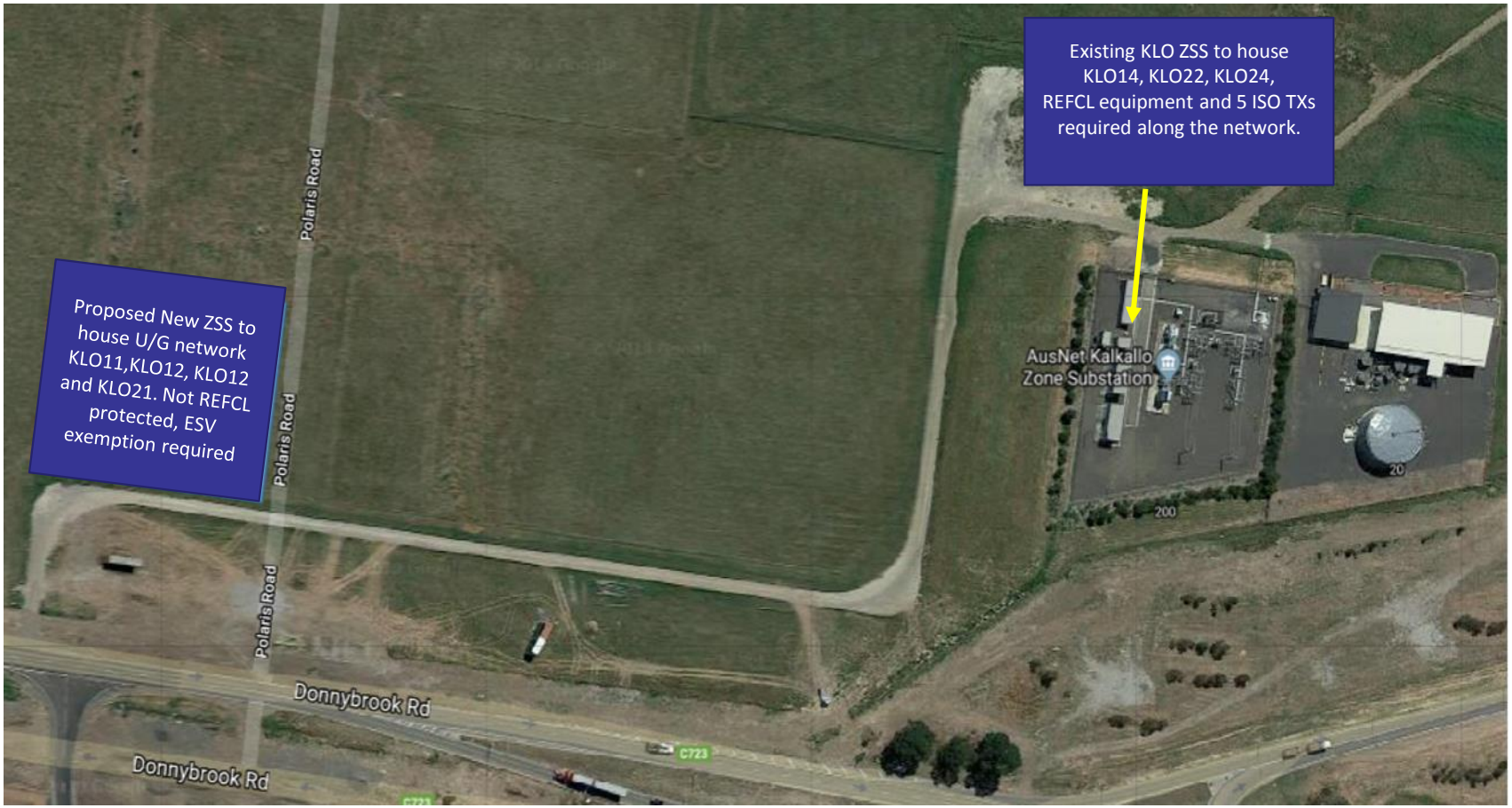
Kalkallo (KLO) Zone Substation
Overview and challenges

- **The Kalkallo (KLO) zone substation is included in Tranche 3 of the AusNet Services REFCL Program**
- **KLO was established in 2010 and supplies approximately 9,400 customers by means of two (2) 20/33/49.5 MVA transformers and seven (7) 22kV distribution feeders, four (4) underground and three (3) overhead**
  - Three (3) of the feeders (2 underground and 1 overhead) originating from KLO are owned by Jemena Electricity Network (Jemena)
- **Feeders emanating from KLO have long lengths of underground cables to supply Melbourne's northern growth corridor and these underground cables produce a high level of capacitive current**
- **A large number of residential and industrial/commercial estates are proposed in and around KLO including the Merrifield Estate which is expected to add a load of approximately 30MVA within the next four years. This load will serve residential, commercial and industrial customers**
- **It is expected that future extensions to the KLO network will be predominantly underground cable further exacerbating capacitive current growth**
- **The existing total capacitive current of the KLO ZSS 22kV network is 315.8Amperes (A). As the capacitive current able to be accommodated by a single GFN is 101A, there will be four (4) REFCLs required to cater for the existing capacitive current**
  - AusNet Services and the supplier of the GFNs do not have a technical solution in place that can enable the synchronisation of three (3) GFNs within a ZSS, therefore the requirement of four (4) GFNs in a zone substation appears to be unachievable
- **Network capacitance forecasts are indicating that the KLO network capacitive current by 2025 will be in the vicinity of 466A which will require 5 GFNs and, by 2030, the forecast network capacitive current will increase to 1,644A which will require 17 GFNs**

Kalkallo (KLO) Zone Substation
Options analysis

Options	Scope	Outcome
• **Install 2 GFNs at KLO** • **Build a new ZSS (single transformer and associated equipment)** • **Relocate 4 underground feeders from KLO to the new ZSS** • **Install 5 isolation transformers on the KLO 22kV network** • **Seek scope exemption to not install REFCL technology at the new ZSS**	• Build a new ZSS (single transformer with land provision for additional transformers and associated equipment as load is expected to increase significantly). • Relocate four (4) underground 22kV feeders (KLO11, KLO12, KLO13, KLO21) from KLO ZSS to the new ZSS at least 120m away from the existing ZSS for earthing reasons • Seek scope exemption to not install REFCL technology at the new ZSS as all feeders will be underground • The remaining three (3) 22kV feeders supplied by the KLO ZSS are comprised of overhead and underground cables, with approximately 231A of network capacitive current which requires three (3) GFNs to meet the REFCL performance criteria • Install five (5) isolation transformers to isolate large underground residential developments supplied on KLO14, KLO22 and KLO24, resulting in a reduced station capacitive current of 130Amps. This reduces the number of GFNs from three (3) to two (2)	**Preferred option** • Limits the installation of a 3rd GFN for now and the near future • KLO meets the forecast capacitance • The new ZSS Meets the future load growth predicted in Melbourne's northern growth corridor
• **Install 4 GFNs** • **Install 1 new ZSS**	• This is an unviable option as AusNet Services and the GFN supplier do not have a solution currently on how to synchronise 4 GFNs within a ZSS	**Not achievable**
• **Install 2 GFNs.** • **Install 8-9 isolation transformers**	• This is an unviable option as finding land for 8-9 isolating transformers to reduce capacitive current largely driven by fully underground feeders is considered impractical	**Not achievable**
• **Build a new ZSS (single transformer and associated equipment)** • **Install 2 GFNs at the new ZSS** • **Relocate 3 O/H feeders from KLO to the new ZSS and install 5 isolation transformers on the 22kv network for the new ZSS** • **Seek scope exemption to not install REFCL technology at existing KLO ZSS**	• Build a new ZSS • Relocate 3 overhead 22kV feeders from KLO to the new ZSS. These 22kV feeders are comprised of overhead and underground cables, with approximately 231A of network capacitive current which requires three (3) GFNs to meet REFCL performance criteria • Install five (5) isolation transformers on the new ZSS to isolate large underground residential developments supplied on KLO14, KLO22 and KLO24, resulting in a reduced station capacitive current of 130Amps • Seek scope exemption to not install REFCL technology at the new ZSS as all feeders will be underground	**Not preferred** • Given the predicted future load growth in and around KLO, additional supply transformers will be required in the future. • The current KLO site can not cater for this additional equipment due to site size restriction

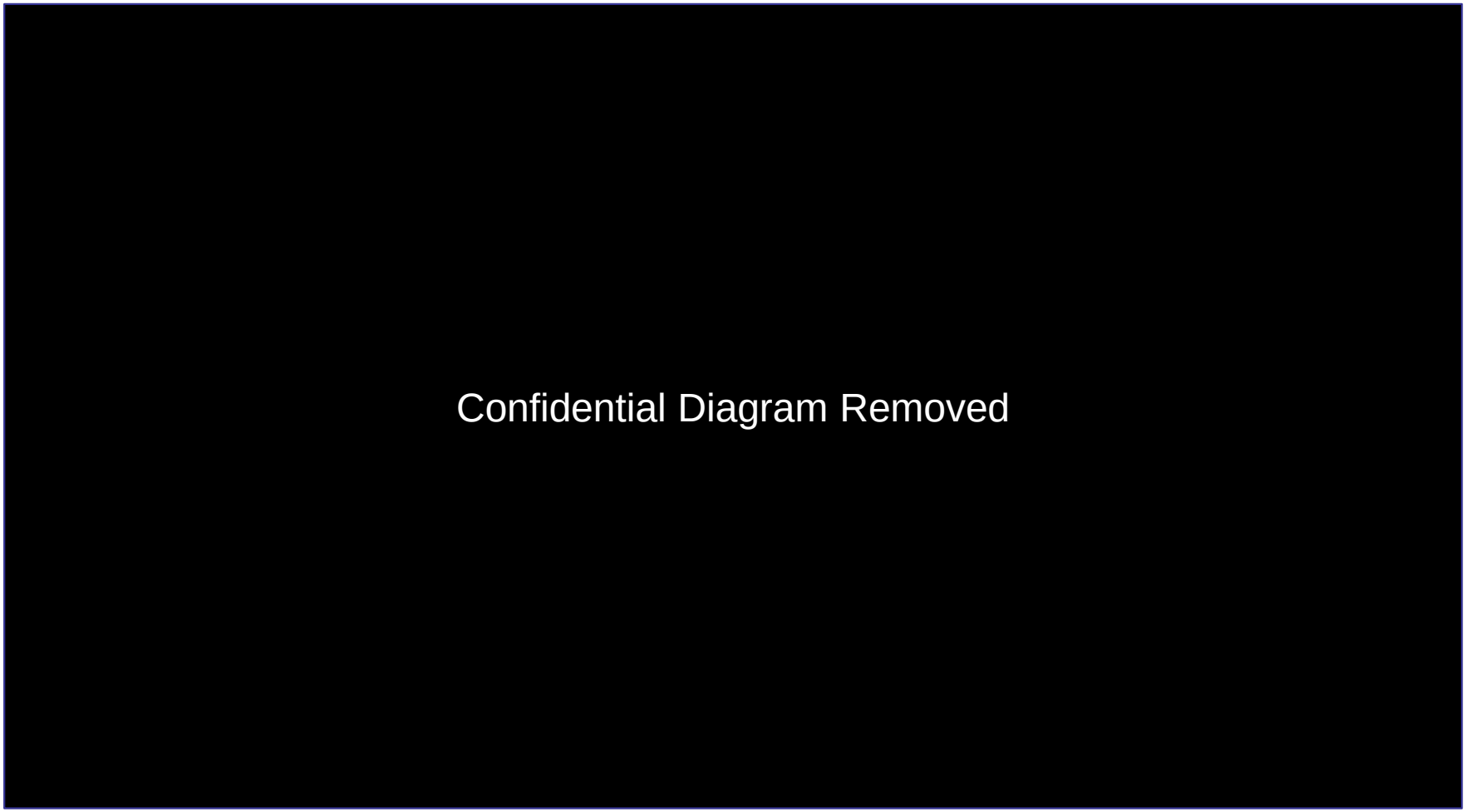
Kalkallo (KLO) Zone Substation
Preferred option



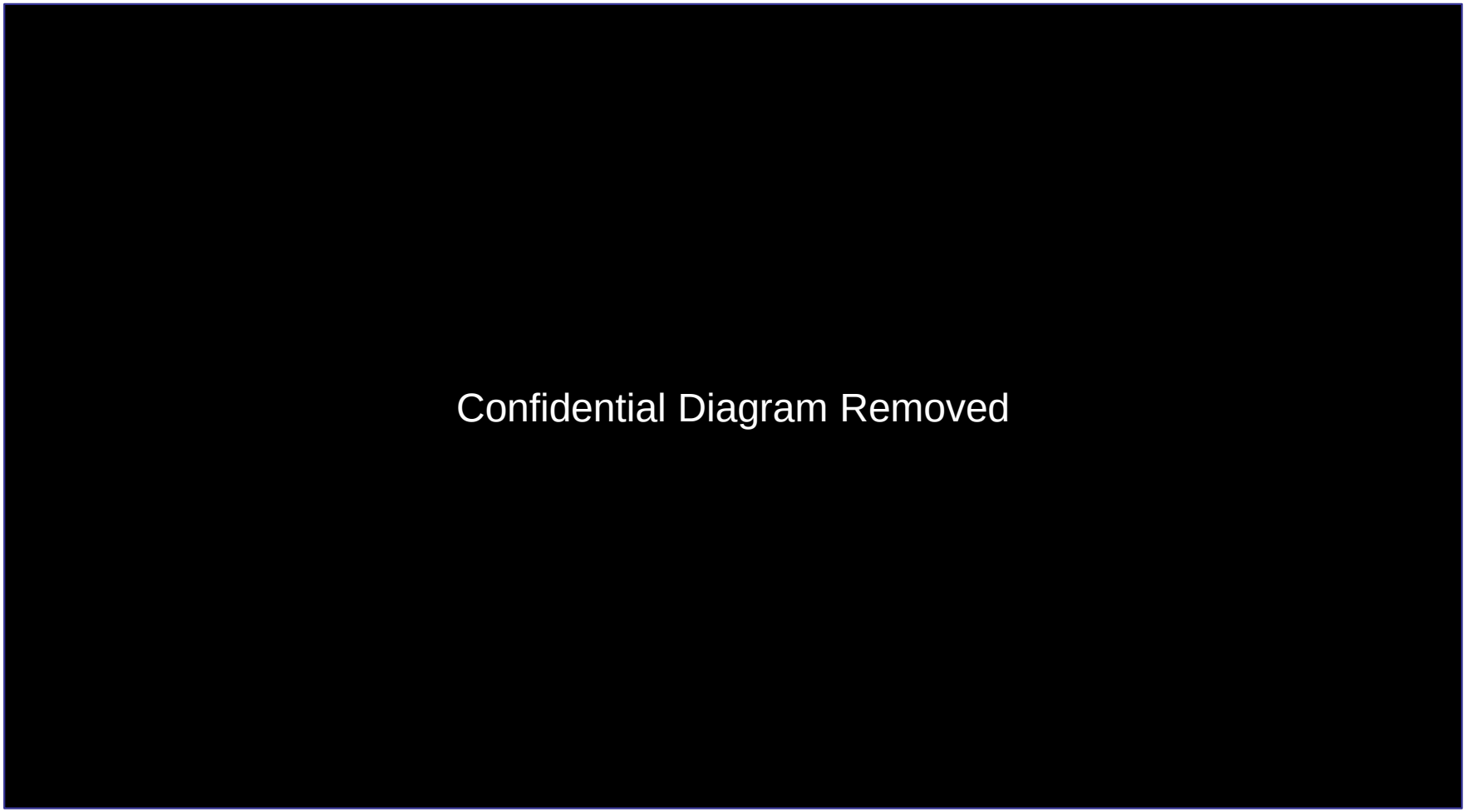
Kalkallo (KLO) Zone Substation
Feeder overview

Bus	Feeder	Approx. Existing KLO Current Capacitance (A)	Existing Summary	Proposal	Proposed KLO Current Capacitance (A)
1	KLO11	0.52	All cables are underground, supplies Stormwater Treatment Plant as part of a new industrial estate. Potential for extensive future underground growth	Relocate to new ZSS	0
1	KLO12	5.38	All cables are underground, supplies new Industrial estate and potential for extensive future underground growth	Relocate to new ZSS	0
1	KLO13[Jemena]	72.93	All cables are underground and 170m OH 3/2.75 steel. Large underground estates with potential for extensive future underground growth	Relocate to new ZSS Underground 170m of overhead cable	0
2	KLO21[Jemena]	11.25	All cables are underground with large estates. Potential for extensive future underground growth	Relocate to new ZSS	0
1	KLO14	75.36	Large housing estate at the end of the feeder. Feeder comprises overhead and underground assets	Install isolating transformer near SWGB094 (removing ~20 Amps)	55.36
2	KLO22[Jemena]	66.22	Multiple large housing estates. Feeder comprises overhead and underground assets Jemena have a large transfer feeder(ST22) to KLO22, exiting Somerton ZSS. Jemena are expecting large industrial growth and may utilise KLO22 transfer tie to transfer load to KLO22	Install 3 isolating transformers near SW12610, SW17619 and SW14102 (removing ~40 Amps) The ISO near SW17619 will reduce the capacitance on KLO22. The ISO will remove the potential increase in capacitance through the possible transfer of future load from ST22 to KLO22	26.22
2	KLO23	Spare	Jemena have requested a 15MVA supply for a new HV customer to be supplied by the end of 2019	Scope is still in development	Spare
2	KLO24	89.51	Large housing estate at the end of the feeder. Feeder comprises overhead and underground assets	Install a single isolating transformer near SWGB693 to remove 20A Reconfigure the network using existing tie between KLO24 and KLO14 to transfer an additional 20A from KLO24 to KLO14 behind the isolation point (removing ~40 Amps)	49.51
Total Current Capacitance		**321**			**131**

Kalkallo (KLO) Zone Substation
Proposal KLO14 and KLO24



Kalkallo (KLO) Zone Substation
Proposal KLO22



Kalkallo (KLO) Zone Substation
Conclusion

- Considering the existing high capacitance at KLO, option 1 is the preferred option

- This option is to:
  - install two (2) GFNs at KLO
  - install five (5) isolation transformers on the three mixed underground/overhead feeders KLO14, KLO22 and KLO24 to reduce the total station capacitive current to ~130A
  - relocate the four (4) fully underground feeders KLO11, KLO12, KLO13 and KLO21 to a new non-REFCL ZSS

- In addition to ensuring the required performance criteria can be met by the 1 May 2023 Tranche 3 compliance deadline, this option also considers future load growth with the new ZSS footprint accommodating the ability to install additional transformers as required to meet future demand

- Whilst the proposed solution is currently considered to be the only viable option, a joint AusNet Services/Jemena network planning engagement has commenced, conducted by a third party, to confirm the least cost, technically acceptable solution for both Jemena and AusNet Services