Powerco CPP – Portfolio Overview Document

Portfolio Name	Kerepehi-Paeroa Upgrade Project
Expenditure Class	Capex
Expenditure Category	Growth & Security
As at Date	12 June 2017

Expenditure Forecast[1,2]	Pre CPP	FY19	FY20	FY21	FY22	FY23	Post CPP	CPP Period Total	Project Total
Pre-Internal Cost Capitalisation and Efficiency Adjustments[3] *(2016 Constant NZ$(M))*	$0.3	$0.0	$0.0	$1.5	$4.1	$0.0	$0.0	$5.6	$5.9
Post-Internal Cost Capitalisation and Efficiency Adjustments *(2016 Constant NZ$(M))*	$0.3	$0.0	$0.0	$1.6	$4.3	$0.0	$0.0	$5.9	$6.2

Description

Project need Overview	Powerco's Kerepehi substation does not meet the desired security of supply standards due to the growing demand in the area. There is limited backup to the substation via the 11kV distribution network.

Proposed solution

Project solution Overview	As part of Powerco's overall network development strategy for the Kerepehi areas, Powerco is proposing to reinstate the old and decommissioned 50kV line from Paeroa to Kerepehi substation as a 33kV line, and install a backup 33/11kV transformer at the Kerepehi substation.

[1] Forecast expenditure is based on Powerco's financial year (i.e. FY18 is for the period April 2017 through March 2018). Expenditures do not consider general price level changes over time (i.e. are in real or constant terms).
[2] Only includes Growth & Security Expenditure. Some projects discuss and rely on the replacement of assets that are at "end of life". However, the replacement cost for these assets is accounted for in the Replacement Expenditure category.
[3] All other forecast expenditure / cost estimates in this POD are pre-internal cost capitalisation and efficiency adjustments, consistent with this forecast.

	Once this is built, the line can provide a potential alternative supply source to Kerepehi substation and achieve the required A1 security level.

Need Identification

Background	Kerepehi is situated in the Hauraki Plains and is part of Powerco's Coromandel Area. The nearest towns are Ngatea, Thames and Paeroa. The area surrounding Kerepehi is largely rural, and is mainly flat swamp land which has been drained for agricultural use. The terrain presents challenges for building electricity infrastructure. Kerepehi substation is supplied by a single 66kV supply from Transpower's Kopu GXP. The substation contains two 66/11kV transformers, rated at 7.5MVA each and is supplied by a single 66kV overhead line of approximately 14km (highlight in red in Figure 1) from the Kopu GXP.
Underlying Drivers and Investment Triggers	The 2015 peak load (maximum demand) was 10.1MVA. This is forecased to increase to 10.3MVA in 2026. A new dairy factory development at Kerepehi township is expected to further increase the peak load by up to 1.2MVA. The present load level exceeds the existing security criteria at the substation, which is N-1 with unlimited switching time. (This is classed as 'A1' according to Powerco's Security Criteria[4]). There is limited backup to the substation via the 11kV distribution network of approximately 5MVA. Because of this limitation, the existing security class of Kerepehi is A2. Outages that affect customers supplied from this substation include: (i) planned maintenance outages; (ii) unplanned outages including transformer trips/failures; and (iii) the loss of the single 66kV line from Kopu, which is the most critical outage at the substation .
Timing of the need	The proposed Kerepehi-Paeroa 33kV link is required now (as of 2016) as the present load level already exceeds the required security criteria. Kerepehi is classed as A1[5]. This is N-1 with unlimited switching time.

[4] Powerco Security of Supply Standard 310S001
[5] Powerco AMP 2016, pp83

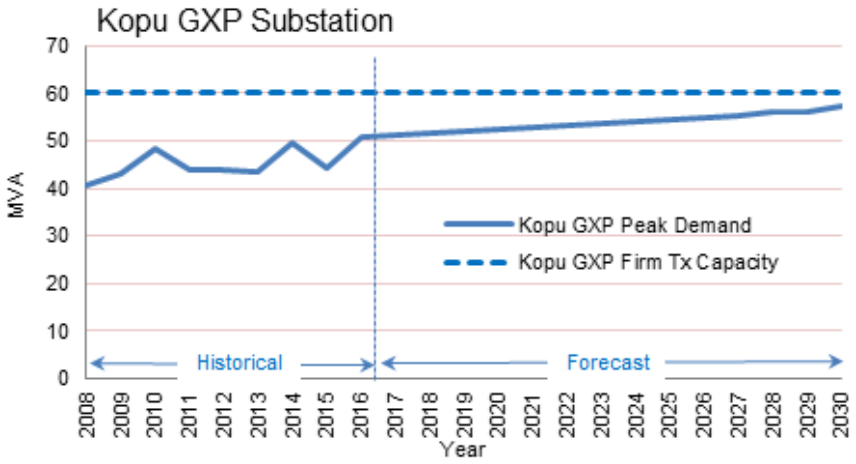
Demand Forecast | Coromandel Area[6]

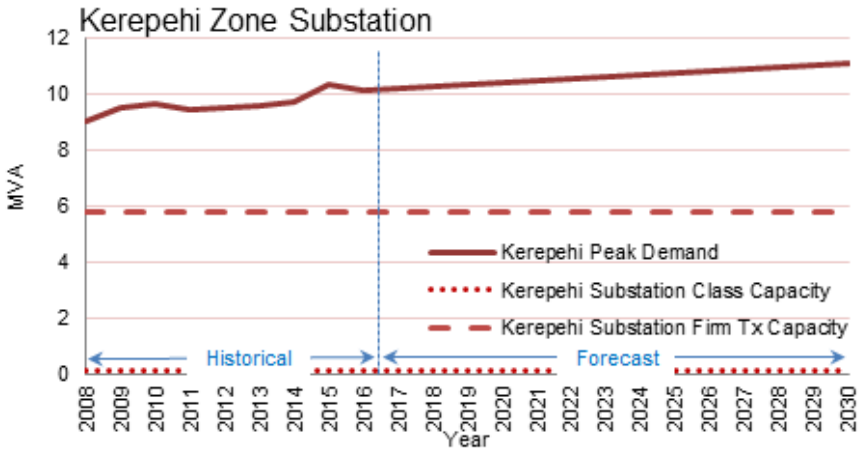
COROMANDEL AREA SUBSTATIONS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	CLASS CAPACITY[7]	GROWTH	2016	2017	2018	2019	2020	2025	2030
Coromandel	0.0	0.9%	4.7	4.8	4.8	4.8	4.9	5.1	5.3
Kerepehi	0.0	0.7%	10.1	10.2	10.3	10.3	10.4	10.8	11.1
Matatoki	0.0	0.9%	5.6	5.7	5.7	5.8	5.8	6.1	6.3
Tairua	7.5	0.7%	8.6	8.7	8.7	8.8	8.8	9.1	9.4
Thames T1 & T2	0.0	0.3%	13.4	13.5	13.5	13.5	13.6	13.8	13.9
Thames T3	6.9	0.0%	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Whitianga	0.0	1.6%	17.2	17.4	17.7	18.0	18.3	19.6	21.0

COROMANDEL AREA SUBSTATIONS			FORECAST MAXIMUM DEMAND [MVA]						
SUBSTATION	TX CAPACITY	GROWTH	2016	2017	2018	2019	2020	2025	2030
Kopu GXP	60.0	0.9%	50.6	51.1	51.5	52.0	52.4	54.6	56.8

Notes:

1. Class capacity is similar to Firm Capacity and represents the capacity that can be delivered following the first outage of any major equipment. Unlike Firm Capacity it considers the long term deliverable capacity in the context of switching and network reconfiguration (11kV & 33kV) post-fault conditions.
2. All maximum demand values are in MVA.
3. Purple shaded cells indicate that the substation's Class Capacity has been exceeded and network enhancements should be considered.





[6] Powerco AMP 2016 (pp331)

[7] Class Capacity is similar in concept to Firm Capacity and represents the capacity that can be delivered following the first outage of any major equipment or circuit. Unlike Firm Capacity it considers the deliverable capacity in the context of the allowable time frame for switching and network reconfiguration post-fault. It is strongly a function of substation inter-tie or transfer capacity, especially at the 11kV level

Options Analysis | Long List of Project Options | High Level Assessment	
Assessment Process	A wide range of potential options are available for the resolution of electrical network constraints. However, depending on local conditions many of the options can have fatal flaws. On this basis a two tier Options Analysis is followed. In the first instance all potential options are considered against a set of high level criteria. Those options that are identified as having significant challenges and not favourable are not considered further. A significant issue that Powerco often faces is the reality of trying to secure landowner easements and or public support for projects that the local community or landowners are opposed to. For this reason the costs associated with easements/consents are often difficult to estimate and the consenting/land-acquisition stage of a project can take a significant period. Given this fact, Powerco assesses the risk / likelihood of securing development rights for individual projects (within a realistic timeframe) during the high level assessment stage.
Long List of Options	The following table contains a list of the high level project options that are potentially available to resolve the specific network constraints that have been identified. Option 1 involves maintaining the status quo. Whilst doing nothing is possible, as a prudent network operator, Powerco is of the view that following this path would not be appropriate, given that Kerepehi substation is already operating below its required A1 security level and demand in the area continues to grow. The four non-network options (Nos. 2, 3, 4 & 5) are not shortlisted on the following basis: 1. **Fossil fuelled generation (i.e. diesel generation)** – this is technically viable but not preferred due to the cost and environmental/consenting challenges. This form of generation has limited potential due to the reliability of a single generator in comparison to the reliability of a network. 2. **Renewable generation** – no viable option has been identified that would provide a secure backup supply during peak network loading periods[8]. 3. **Fuel switching** – these are considered to be deferment strategies and are not preferred due to the relatively large load involved. 4. **Demand side response** – Powerco currently uses a ripple control system to manage the hot water load in the Kerepehi area. During peak loading periods most hot water cylinders are turned off. 5. **Energy storage** – this is potentially viable but the high costs associated with energy storage mean that this is not presently the preferred option. For example, an emerging technology that could potentially be employed is storage batteries installed in domestic premises. However, the capital costs associated with 11MW of domestic backup batteries with two hours capacity are estimated to be greater than $18.9 million[9]. Alternatively, a grid-scale battery solution providing 11MW for two hours would, at current rates, cost >$31M. Furthermore the current application of battery storage technology to power networks is very limited and it would be wise to

[8] Typical plant might involve wind turbines or photovoltaic arrays. Both of these generators have an intermittent output which cannot be relied upon unless there was significant penetration and diversity.
[9] The installed costs of domestic battery storage systems are currently around $10k - $12k for a 7kWh unit.

	undertake a trial before committing to a significant installation. Many outages could be addressed within two hours and peak demand periods are also usually less than two hours duration. Storage solutions at this size however, would not provide sufficient back-up for extended outages lasting for several hours. Three network reinforcement options were identified (Nos. 6, 7, and 8) as potential solutions to the network constraints and issues. Option 6 involves reinstating the existing old decommissioned 50kV line from Paeroa to Kerepehi substation to 33kV, and installing a 33/11kV transformer at the Kerepehi substation. Option 7 involves the construction of a new 66kV line from Kopu GXP to Kerepehi substation. This new overhead line will be constructed on a new route with an estimated distance of 15km. Option 8 looks to upgrade the existing 11kV lines and network to provide additional 11kV backfeed capacity to the Kerepehi substation.

Long List of Options | High Level Assessment

Paeroa - Kerepehi Upgrade Project		*Long list of projects and high level assessment*	*Assessment Criteria*						
PROJECT FOCUS	**No.**	**PROJECT**	Safety	Fit	Feasible	Practical	GEIP	Security	Cost	**Short-list**
Do Nothing	1	Allow the electrical demand & risk of consumer non-supply to increase	✓	✗	✗	✗	✗	✗	✓	✗
Non-network	2	Distributed Generation (DG) including peak lopping generation	✓	✗	✓	✗	✓	✓	✗	✗
	3	Fuel switching to reduce electrical demand	✓	✓	✗	✗	✓	✓	✗	✗
	4	Demand Side Response (DSR)	✓	✓	✗	✗	✓	✓	✗	✗
	5	Energy storage	✓	✓	✓	✓	✗	✓	✗	✗
Network Reinforcement	6	Reinstate 50kV line to 33kV from Paeroa to Kerepehi Substation	✓	✓	✓	✓	✓	✓	✓	✓
	7	Construct new 66kV line from Kopu GXP	✓	✓	✓	✓	✓	✓	✓	✓
	8	Upgrade existing 11kV lines and network to provide additional backfeed capacity	✓	✓	✓	✓	✓	✓	✓	✓

Key:

Safety	Health and Safety: Any significant implications in terms of Safety or Health - new products or compounds or practices, or requires difficult live line access etc.
Fit	Fit for Purpose: Does the option address the need appropriately and does it fit with other developments in the vicinity.
Feasible	Technically Feasible: Consider the complexity, future adaptability, and whether it aligns with company standards, strategies and policies.
Practicality	Practical to Implement: Are there potential environmental or property issues which may be insurmountable. Can it be achieved in the required time frame.
GEIP	Good Electricity Industry Practice (GEIP): Good practice (technically and environmentally) and in terms of AM practice (capacity, age, technological, safety)
Security	Security and Reliability: Does the option provide adequate levels of security and appropriate reliability considering the demand, load type and future growth.
Cost	Some options will intuitively be known to be far more expensive than other options, and this may preclude them.

Options Analysis | Short List of Options		
Option	**Capital Cost**[10]	**Description**
Option 6 *(Reinstate 50kV line to 33kV from Paeroa to Kerepehi substation)*	**$5.9M**	This option involves the following network enhancements: • Reinstate the old decommissioned 50kV line to 33kV from Paeroa to Kerepehi substation. • Obtain approval for easements and consenting • Install a new 33/11kV transformer at Kerepehi (on hot-stand by) • Install new 11kV and 33kV feeder circuit breakers and buswork • Install 33kV protection at Paeroa and Kerepehi
Option 7 *(Construct new 66kV line from Kopu GXP)*	**$7.9M**	This option involves the following network enhancements: • Constructing a new 66kV line from Kopu GXP to Kerepehi substation • Obtain approval for easements and consenting • Install 66kV outdoor switchgear and bay • Install 66kVbuswork and protection at Kerepehi
Option 8 *(Reinforce Kerepehi 11kV network*	**$7.7M**	This option involves the following network enhancements: • Two 11kV feeders to be built out of Matatoki and Paeroa substations respectively. • Transformer upgrades at both Matatoki and Paeroa substations

[10] The total capital cost of each project. The costs do not consider the time value of money and do not include the economic value of other factors (i.e. network losses and consumer outage costs).

Option Analysis | Advantages vs Disadvantages and Cost Breakdown

The following sections summarise the advantages/disadvantages associated with the short listed options. The intention being to also capture project risks and inter-dependencies.

Option	Advantages	Disadvantages
Option 6 *(Reinstate 50kV line to 33kV from Paeroa to Kerepehi substation)*	• Utilises the decommissioned 50kV line which Powerco has existing rights to, thereby considerably reducing consenting and easement costs • Improves security class at Kerepehi	• Introduce a new voltage level at Kerepehi substation
Option 7 *(Construct new 66kV line from Kopu GXP)*	• Improves security of supply to Kerepehi	• High consenting and easement costs and challenges • A crossing of the Waihou River will be required
Option 8 *(Reinforce Kerepehi 11kV network)*	• Improves security of supply to Kerepehi	• High consenting and easement costs and challenges • A crossing of the Waihou River will be required • Not an effective long term option

Preferred Option(s)	
Preferred Option	**Option 6 - Reinstate 50kV line to 33kV from Paeroa to Kerepehi substation**
Reasons for choosing Option	The preferred option is to utilise the old 50kV line route, construct a new 33kV line from Paeroa to Kerepehi and install a back-up 33/11kV transformer at Kerepehi substation. Option 6 is preferred for the following reasons: • Improves Kerepehi substation's security class to the required A1 security level[11]. • Is the lowest cost option • Has the lowest consenting and easement risks and costs

[11] The capacity at Waikino GXP will need to be increased to cater for the increase demand for the Kerepehi backup, but this will be addressed in consultation with Transpower".

Option 6| Detailed Costs[12]

Item	Description	Actual Cost	Projected Cost
A	Property & Consent Costs		
A.1	Consenting/Easements	-	$295,000
B	Overhead line costs		
B.1	Subtransmission Line		$1,705,000
C	Substation Costs		
C.1	Indoor switchgear		$60,000
C.2	SCADA and comms		$95,000
C.3	Outdoor switchgear		$380,000
C.4	Building and site development		$210,000
C.5	Zone substation - other		$75,000
C.6	Power Transformers		$800,000
D	Cable Costs		
D.1	Subtransmission cables	-	$1,230,000
D.2	Trenching		$1,050,000

E	Committed/Historical Costs (A+B+C+D)	$0	
F	Future Projected Costs (A+B+C+D)		$5,900,000
G	Anticipated Final Cost (E+F)		**$5,900,000**

[12] Excludes Powerco's internal/overhead costs.

Option 6 | Implementation Plan				
Project or Action	**Start Year**	**End Year**	**NZ $'000**	**Details / Comments**
Consenting/Design Modifications	FY17	FY18	$295	Costs associated with easements, compensation, designations and designs to modify existing lines & erect new poles
Subtransmission line	FY20	FY21	$1,705	Construction of 10kms of overhead subtransmission line
Substation modifications	FY20	FY21	$1,620	33/11kV transformer installation, bus modifications, bunding, earthing, SCADA & Comms, indoor switchgear, commissioning
Subtransmission cables	FY20	FY21	$2,280	6.0 kms of subtransmission cable and trenching
Total Project Costs	FY16	FY21	$5,900	Includes Only Growth & Security Expenditure.

Supporting Documents and Models	
Planning documents ***Standards | Policies*** ***Reviews and Consultant reports*** ***Concept Designs | Estimates***	1. Kerepehi-Paeroa Upgrade Project Options Analysis. 2. Kerepehi-Paeroa Upgrade Project Economic Analysis Spreadsheet. 3. Cost Estimates- 33kV Paeroa-Kerepehi. 4. Powerco's 2016 Asset Management Plan (AMP). 5. Transpower's 2015 Transmission Planning Report (TPR 2015). 6. "*310S001 Security-of-Supply Classifications – Zone Substations*", Powerco Standard. 7. "*393S041 Zone Substation Transformer Ratings*", Powerco Standard. 8. "*393S035 Electrical network Conductor Rating Standard*", Powerco Standard.

Notes/Assumptions	
Generic Assumptions in relation to Options Costs	• Costs are expressed in 2016 (real) dollars. • The capital costs fall within the Growth and Security expenditure categories only. • The capital costs only include Powerco's capital expenditure (not Transpower or other parties). • The costs include all costs associated with the proposed projects (or alternate options) regardless of whether those costs fall within the CPP period or not, although they do not include any sunk costs (committed already). • Reliability costs are the NPV of the Value of Loss Load calculation for each option.
Specific Assumptions in Relation to Options Costs	• Cost estimation for the options has initially been achieved via a desktop study using Powerco's standard building block unit costs. The costs have then been refined by further investigations. • Property and consenting costs are usually a high risk area involving considerable uncertainty. The proposed underground cables are installed, where possible, in road reserve.

Figure 1: Existing Kopu GXP Sub-transmission Network: Geographic Diagram

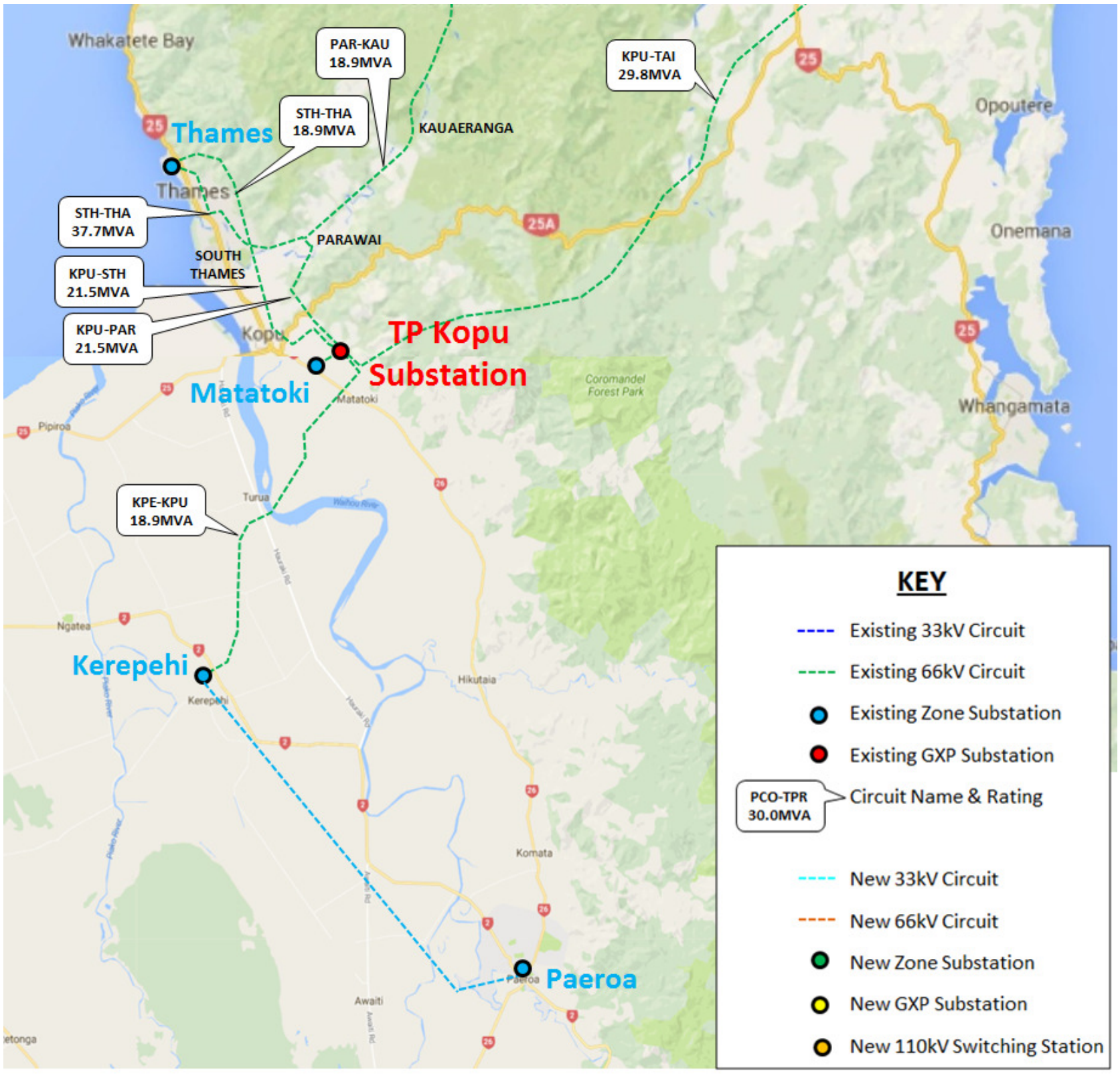


Figure 2: Option 6: Reinstate 50kV line to 33kV from Paeroa to Kerepehi substation Geographic Diagram

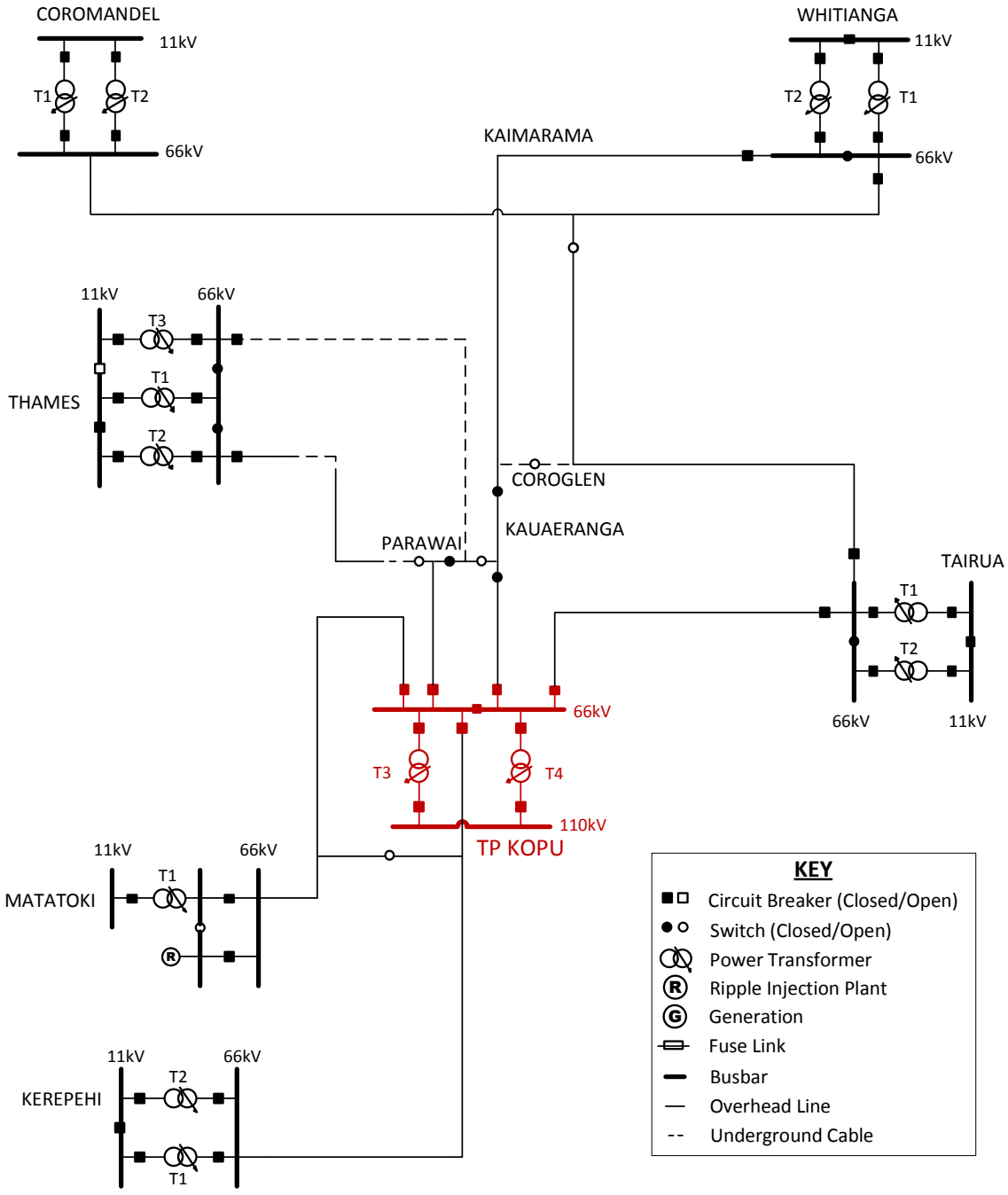


Figure 3: Existing Kopu GXP Sub-transmission Network: Single Line Diagram

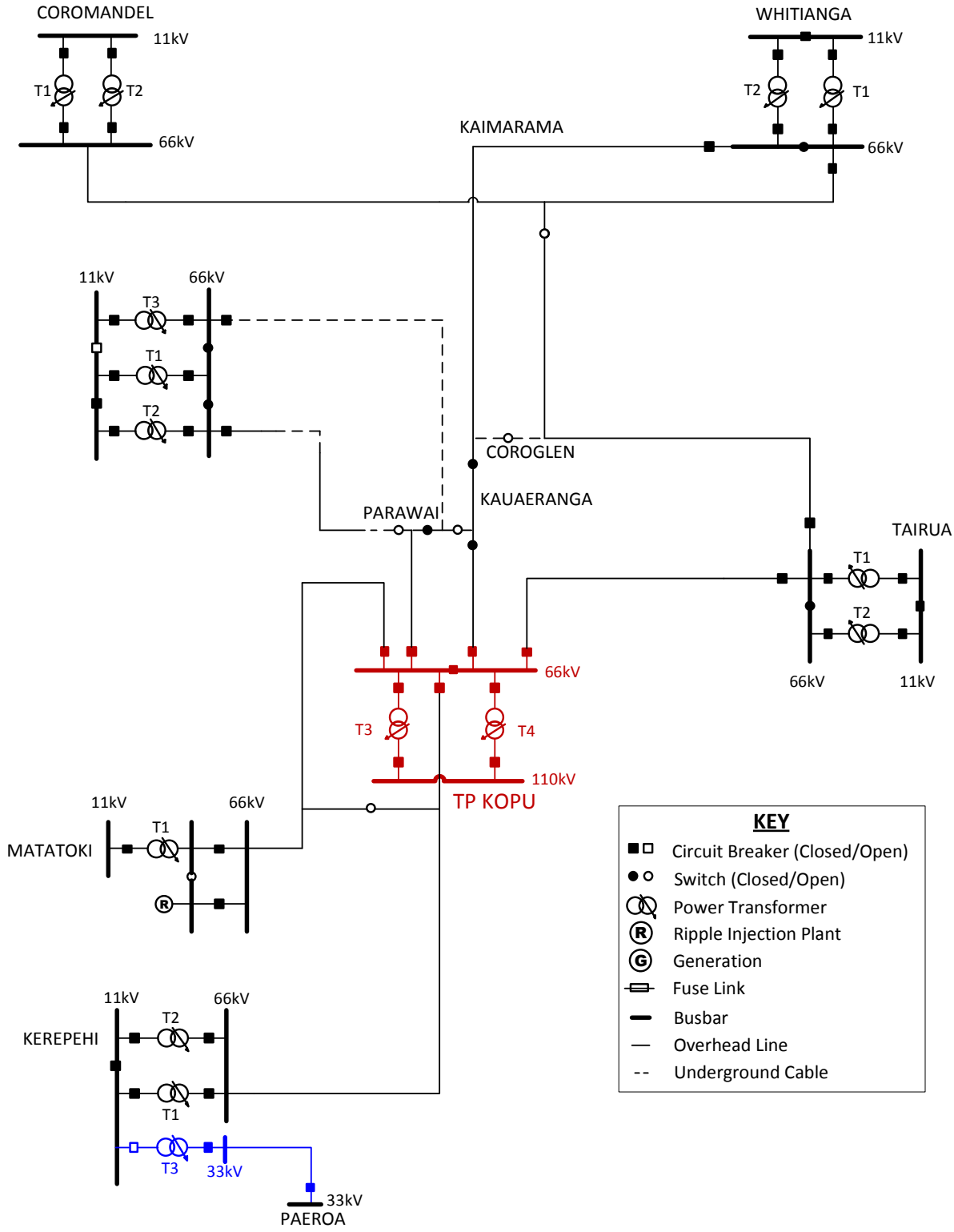


Figure 4: Option 6: Reinstate 50kV line to 33kV from Paeroa to Kerepehi substation: Single Line Diagram