Meeting Date: 24 October 2019

Update on Waikato and upper North Island Voltage Stability

Security and Reliability Council

Transpower will attend the 24 October 2019 SRC meeting to provide an update on plans for addressing forecast voltage-related grid constraints in the Waikato and Upper North Island (WUNI) region.

Note: This paper has been prepared for the purpose of the Security and Reliability Council (SRC). Content should not be interpreted as representing the views or policy of the Electricity Authority.

Update on Waikato and Upper North Island (WUNI) voltage stability

1. Background

1.1. The SRC action list includes the following item from SRC meeting 17:

> "The secretariat is to keep the SRC updated with the progress of Transpower's major capital project for voltage stability issues in the upper North Island. Updates of milestones should be provided until the investment decision is made."

1.2. Stephen Jay, Transpower's General Manager of Grid Development, will attend the meeting to provide an update.

1.3. The SRC has received a series of papers and presentations since Transpower started analysing the impact of thermal generation retirement on the power system and transmission grid. When the issue was first raised the two remaining Rankine units at Huntly were expected to be retired in 2018, with immediate impacts on grid security.

1.4. Retirement was subsequently deferred and Transpower's current focus is planning measures that will preserve voltage stability in a satisfactory state from 2022. While the planned Rankine unit retirements have a material impact on voltage security, the investment need is also driven by the prospect of demand growth.

1.5. Transpower's current activities include preparing a proposal to the Commerce Commission for approval for the first stage of a sequence of investments. Transpower consulted on a short-list of options in June this year and is concurrently working on procurement of non-transmission solutions (also called transmission alternatives) to complement more traditional investment.

1.6. Major milestones (as per Transpower's project page) are summarised below.

Table 1: Transpower's major milestones for WUNI project

Date	Milestone
June 2019	*Consultation on short-list of investment options*
November 2019	Target for submitting proposal to invest ca. $137m in first stage of investments to address WUNI voltage.
26 November 2019	Deadline for response to request for information (RFI) on non-transmission solutions.
Mid-2020	Target for investment approval and start of procurement
End 2022	Signalled retirement of Huntly Rankine units
Early 2023	Work completed before winter 2023
2024 to 2025	Forecast need date for second stage investment

1.7. The SRC's previous consideration of WUNI voltage issues is summarised below.

Table 2: Previous SRC consideration of North Island voltage issues

Meeting	Summary
21 6 November 2017 Link	*Grid development investigation for Waikato and Upper North Island voltage management* Stephen Jay presented on the drivers for investigating WUNI voltage stability, transmission options, and Transpower's grid support contract framework for procuring transmission alternatives.
19 28 March 2017 Link	*An update on Transpower's major capital proposal in the upper-North Island* Stephen Jay provided an update and took questions.
17 21 June 2016 Link	*Thermal generation decommissioning* Stephen Jay and John Clarke presented Transpower's April 2016 report *Upper North Island Operational Limits: following Huntly Rankine unit retirements*. They discussed how subsequent deferral of unit retirement by four years (to 2022) alleviates immediate concerns but leaves a tight timeframe for delivering voltage support investments needed to address demand growth.
16 15 March 2016 Link	*Thermal generation decommissioning – reports from Transpower assessing the situation and associated transmission investment options* Stephen Jay and John Clarke presented the grid owner's power system planning report *Upper North Island Generation Decommissioning Report: Summary of Investigations Stage 1* and the system operator's report *Security of Supply Analysis Findings and Implications of Thermal Decommissioning*.
14 22 October 2015 Link	*Thermal generation decommissioning – the implications of thermal generation decommissioning on reliability of supply* The Authority provided context on how the market may respond to changes in NZ's generation balance, and Bennett Tucker from the system operator presented a report *Security and Reliability Council discussion paper – Impact of Thermal De-commissioning* which summarised completed and ongoing analytical work.

2. Questions for the SRC to consider

2.1 The SRC may wish to consider the following questions.

Q1. Does the SRC wish to keep action item #1 open?

Q2. What further information, if any, does the SRC wish to have provided to it by the secretariat?

Q3. What advice, if any, does the SRC wish to provide to the Authority?

WAIKATO AND UPPER NORTH ISLAND VOLTAGE MANAGEMENT INVESTIGATION

UPDATE FOR SECURITY AND RELIABILITY COUNCIL

STEPHEN JAY AND NIC DELLER

GM GRID DEVELOPMENT/SENIOR COMMERCIAL ADVISOR

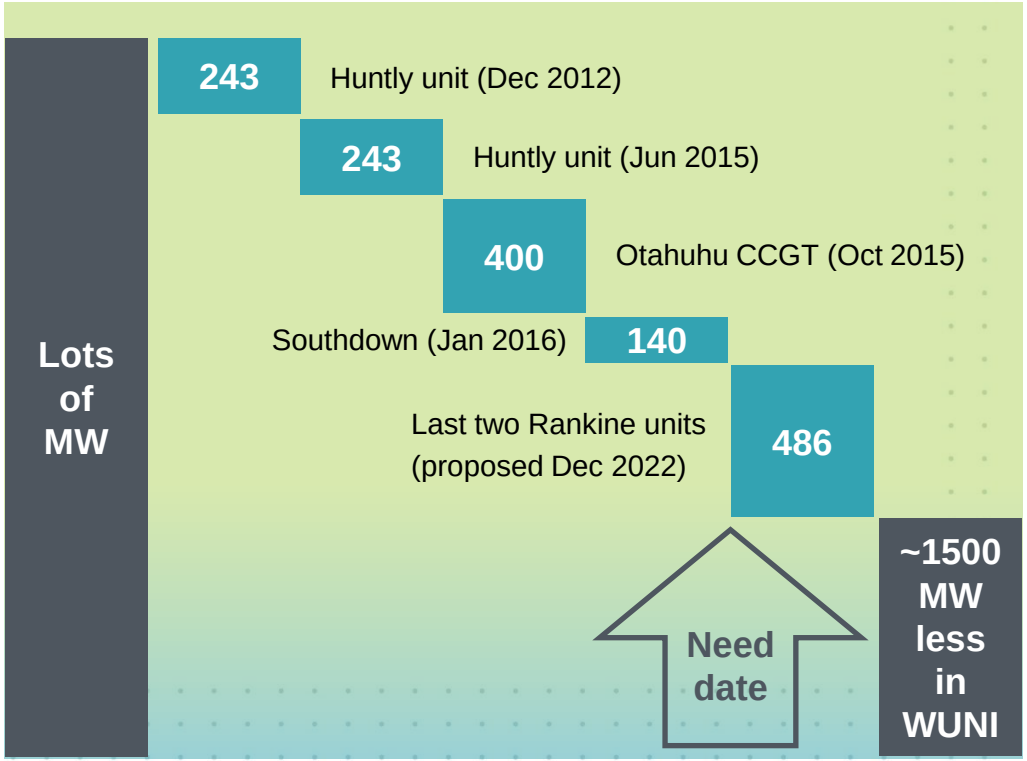
TRANSPOWER

24 OCTOBER 2019

POWERING NEW ZEALAND TODAY + TOMORROW

BACKGROUND TO WAIKATO AND UPPER NORTH ISLAND VOLTAGE MANAGEMENT INVESTIGATION

- The need arises because a significant quantity of thermal generation has been decommissioned in the region
- Genesis has not committed to the operation of the Rankine units beyond 2022
- This is a significant change for the New Zealand power system, especially when coupled with the actual and forecast demand growth in the Upper North Island region



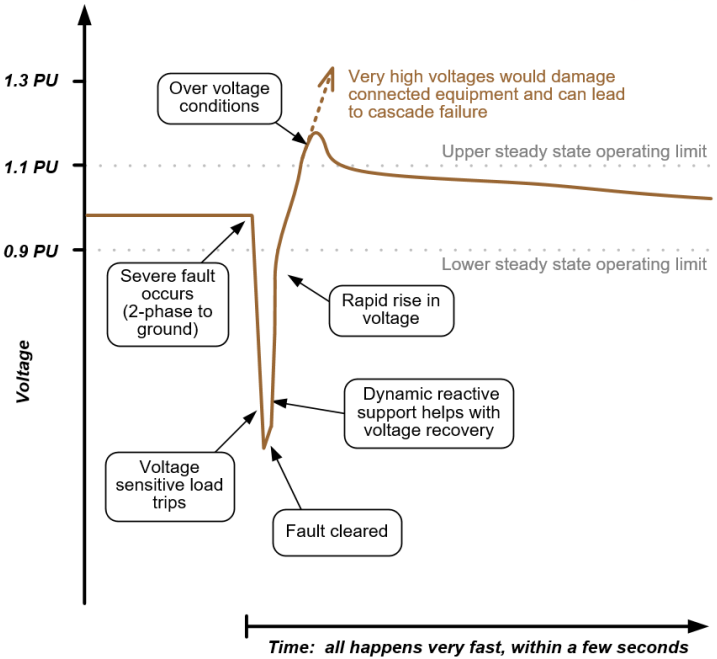
TRANSPOWER HAS CONDUCTED STUDIES TO INVESTIGATE EFFECTS

- Transpower initially began investigating in 2015 to consider the effect that the decommissioning of these generating units may have on the power system.
- Our studies indicated that, based on our prudent (‘P90’) peak demand forecasts, there will be issues with voltage stability in the Waikato and Upper North Island region.
- These issues arise even if the Huntly Rankine units remain due to demand growth; however, the scheduled retirement of these units exacerbate the issues significantly.

Our investigations found voltage stability to be the principal issue

PRINCIPAL ISSUE IS TRANSIENT VOLTAGE STABILITY

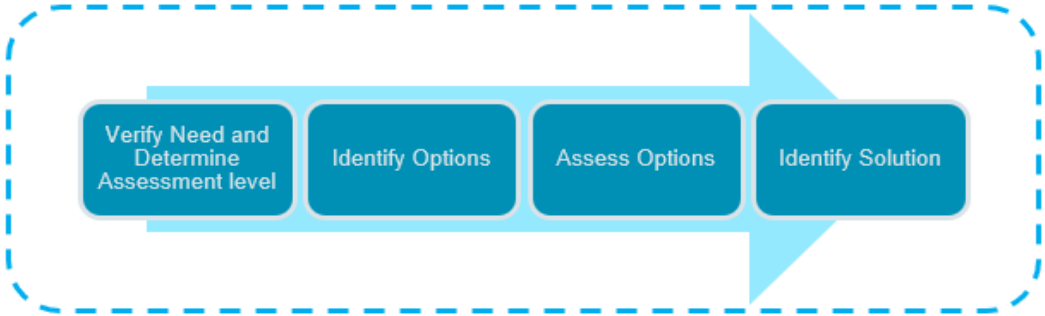
- Voltage stability refers to the ability of the power system to maintain acceptable voltage levels following a disturbance on the system (e.g. circuit outage or loss of generation).
- If the voltage falls below an acceptable level, it is possible that the voltage will collapse and lead to cascade failure over a wide region (under-voltage). It is also possible the voltage could over-correct if a large proportion of voltage sensitive loads trip during a fault (over-voltage), again leading to possible cascade failure.
- We analysed the issue against both the ‘N-1’ and ‘N-G-1’ security standards. The N-G-1 standard requires that the system be robust to a single credible contingency (asset failure) while one generator (or major transmission asset) is out of service.



INVESTIGATION PROCESS

We have considered a variety of options, including non-transmission options, to identify a solution that meets the need and is robust and adaptable to the range of foreseeable outcomes.

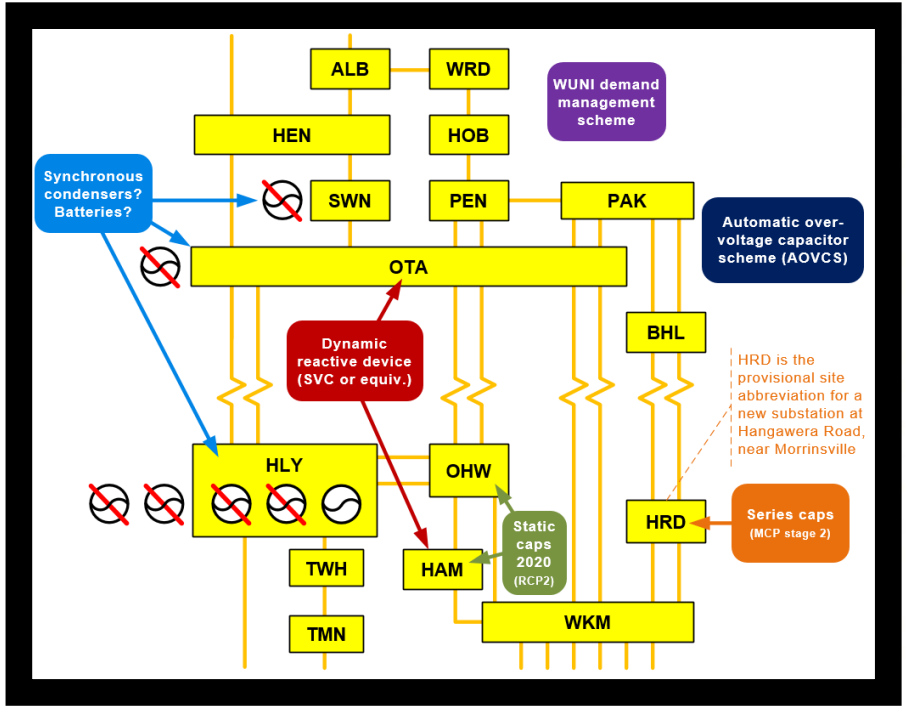
We consulted on the need and options in our 2016 long-list and 2019 short-list consultations. Respondents were supportive of the need to mitigate this risk.



PREFERRED OPTION

The following list and the diagram to the right present the components that make up the preferred option

- 2 × 150 MVAr dynamic reactive devices located at Otahuhu and Hamilton (stage 1)
- Post-contingent demand management scheme, located at several GXPs in the region (stage 1)
- Series capacitors on the BHL-WKM-1 and 2 circuits, connected near Morrinsville (stage 2)
- Possible non-transmission solutions that may defer or supplement our preferred stage 1 or stage 2 components
- Static capacitors at Hamilton and Ohinewai to support pre-event voltage
- Automatic over-voltage capacitor scheme, to switch static capacitors off during an over-voltage event



PROPOSAL TO THE COMMERCE COMMISSION

We are submitting a Major Capex Proposal (MCP) to the Commerce Commission for approval to recover the costs of undertaking investment to address the need.

- It is anticipated this will be the first stage of a Major Capex Project (Staged).
- We are currently requesting information on non-transmission solutions (closing Nov 2019), and our preferred option may be updated if competitive and reliable NTS are identified.
- Series capacitors, although part of our preferred transmission option, are not included in the first stage of this project, given the sensitivity of their need date to the retirement of the Huntly Rankine units.
- If the Rankines do retire by 2022, recent growth in peak demand in the WUNI region identifies the need date of the series capacitors as winter 2024 and a stage 2 investigation and consultation process may need to begin as early as April 2020.
- To facilitate the timely future commissioning of the series capacitors, we intend to seek funding in this first stage to recover the costs of obtaining property rights and environmental approvals for these series capacitors.

Stage 1 Timeline	
Dec 2019	Major Capex Proposal (Stage 1) to Commerce Commission
Q2 2020	Possible update to proposal if competitive non-transmission solutions identified, or significant generation announcements
Jun 2020	Possible Commerce Commission approval
Jul 2020	Transition stage 1 project to delivery
Dec 2022	Commissioning of project components


QUESTIONS?