

SUMMARY OF OPTIONS FOR THE LOWER SOUTH ISLAND RELIABILITY GRID UPGRADE PROJECT

You have recently been invited to a Forum in Invercargill on the proposed upgrade to the Lower South Island Transmission Networks. This document is a high level summary provided for your information on the short-listed options. Further detail on how these options were arrived at and how the technical and economic considerations have been addressed will be discussed at the Forum.

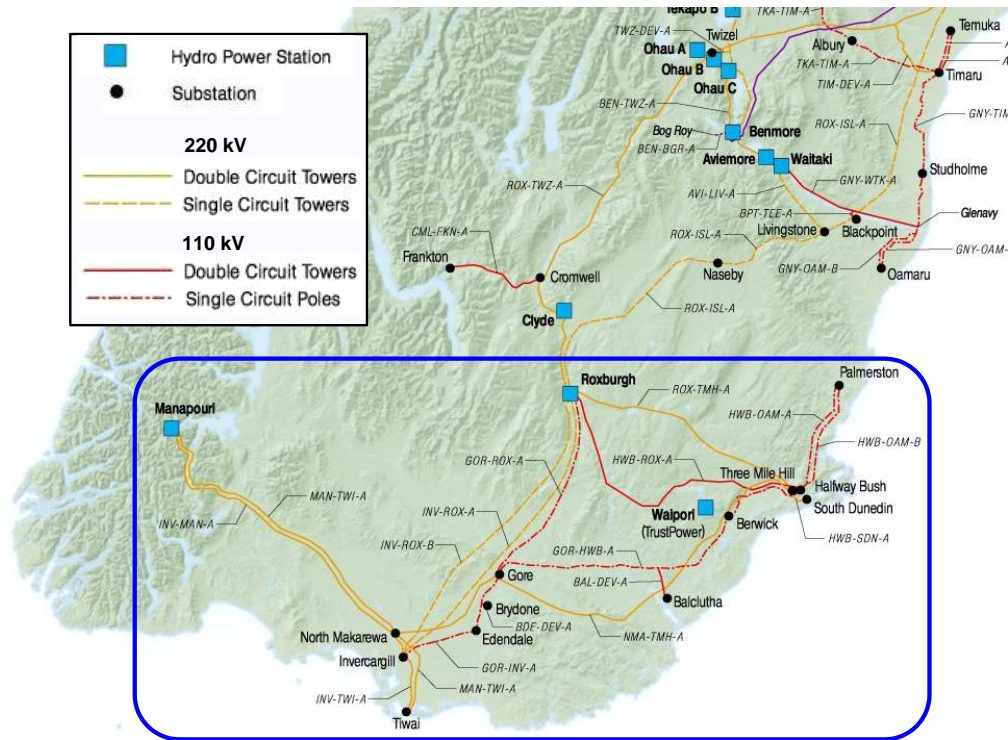


Figure 1.1 Lower South Island Transmission Network

This project was initiated to meet security of supply into Southland region during “dry” periods (ie low or no Manapouri generation), as well as reinforce the 110 kV network due to increasing demand.

There are three short listed options (including the base case) reflecting combinations and staging of new interconnection transformers at or near Gore, series capacitors, and a possible 2 km feeder line into Gore. They reflect two different levels of security – n, and n-1.

What is meant by ‘n’ versus ‘n-1’ security in the Lower South Island region?

These terms have specific technical definitions, but in general

- ‘n’ security means that the system is in a satisfactory state with all components of the power system operating. However, loss of one component will cause loss of supply.
- ‘n-1’ security means that the system can continue providing satisfactory supply following loss of one component.

The distinction is important, as under the Rules, Transpower must provide ‘n-1’ security to the ‘core grid’, and ‘n’ security for the non-core grid. The Lower South Island 220 kV network is part of the core grid, but the 110 kV network is part of the non-core grid, and therefore Transpower must provide a minimum of ‘n’ security.

Option 7

This is the final stage of all development plans. The timing for building each stage depends on the security standard required. The greatest level of security and flexibility for generation occurs if all stages are built initially (except for some shunt capacitors).

The components of Option 7 are:

- a 70% series capacitor on one North Makarewa–Three Mile Hill circuit (installed at Three Mile Hill)
- a new 220 kV switching station near Gore
- two 220/110 kV transformers supplying Gore (either at the switching station or at Gore)
- a 220 kV or 110 kV double circuit line from the switchyard to Gore (220 kV or 110 kV depending on 220/110 kV transformer location).
- two 110/33 kV replacement supply transformers at Gore.
- single 110 kV bus at Gore.
- various shunt capacitors on the 110 kV network (at Balclutha and perhaps Edendale).
- replacement 220/110 kV transformers at Invercargill and Roxburgh.

The features of this option are:

- The effect of tapping into the North Makarewa–Three Mile Hill circuit is to provide n-1 security for Gore.
- By increasing the load on the 220 kV network, series capacitors are needed.
- This allows for the Edendale load to increase by two additional driers at the Fonterra factory, a doubling of the non-Fonterra load, and about another 1.5 MW at Brydone.

Option 8

This option provides n-1 security, but reduces the cost of Option 7 by using Special Protection Schemes (SPSs) on the 110 kV network to defer the need for:

- the series capacitor (until 2018)
- the 220 kV switchyard
- one of the 220/110 kV transformers (although the second may be justified for maintenance outages).

Option 8 could ultimately be developed into Option 7.

The features of this option are:

- The use of an SPS to split load on the Gore bus post-contingency
- The use of an SPS to ramp up Manapouri generation/decrease Tiwai load post-contingency
- Deferring capital expenditure

Option 0 (Base Case)

Option 0 provides n security only. Compared with option 8, it defers the need for the Gore 220/110 kV transformer.

Parts of Option 0 could be developed into Option 8 or Option 7. However, option 0 has more extensive Gore 110 kV bus modifications and more shunt capacitors.

The features of this option are similar to Option 8, except Option 0 (compared with Option 8) requires:

- Gore 110 kV bus and load to be split pre-contingency at high loads.
- “Lights out” following a 110 kV contingency.
- Potentially very restrictive outage windows and/or a partial loss of supply for maintenance.

The Context of an Investment

Transpower's investments like that for the Lower South Island Reliability upgrade must have funding approved by the Electricity Commission for Transpower to proceed. They require the investment to pass a cost/benefit assessment known as the Grid Investment Test. Basically, the Test is driven by the future demand for electricity and the cost of interruptions given a standard 'unserved energy' value of about \$24,000 per MWh.

Appendix A

Glossary

Bussing – the connecting of two or more circuits onto a common 'bus'. This breaks a long line into two shorter sections and typically involves a new switching station. If there is a fault, a shorter section of line is taken out of service resulting in a less detrimental effect on the voltage for the end user.

Grid Exit Point (GXP) - is a substation where electricity exits the Transpower network usually on to the local lines company network.

Interconnecting Transformer (ICT) – Devices used for connecting 220 kV and 110 kV systems

Re-conductoring – changing the conductor configuration on the existing line by replacing with a fatter conductor or more conductors per phase, thus allowing a greater current. The new fatter conductor or conductor configuration is likely to be heavier and require some tower strengthening and upgrading of existing tower foundations.

Series capacitors (also known as Series compensation) – Equipment connected along a transmission line, which makes the line "electrically shorter". This forces more power to flow along the line.

Shunt capacitors – Equipment installed within the substation that helps support voltage on a transmission network.

Special Protection Scheme (SPS) – An SPS allows fast, automatic action to be taken in a controlled manner when there is an unplanned circuit outage (for example a fault during a snow storm). This ensures that any remaining circuits are not overloaded. The automatic action could include sectionalising the power system to control where power follows, cut off some of the load at specific locations, or increasing generation.

Supply Transformer – Devices used for connecting 220 kV and 110 kV systems to 33 kV and 11 kV systems, thus the point where power enters local supply networks

Switching station – different from a substation. It is an area used for connecting circuits, it does not change voltage and therefore does not contain transformers.