Net Benefit Test for a grid reconfiguration and Paraparaumu 220 kV connection

Executive Summary
Transpower owns a 110 kV double circuit line that runs through Transmission Gully. It supplies the Kapiti region via our Paraparaumu substation. Thirteen kilometres of this line would need to be deviated or removed to allow the construction and operation of New Zealand Transport Agency’s (NZTA’s) Transmission Gully road project.

Two options have been considered:
1. deviating the existing 110 kV transmission line through Transmission Gully
2. a new 220 kV connection into Paraparaumu from an alternative line and the complete removal of the existing 110 kV line through Transmission Gully.

We conclude, based on our economic analysis, that option 2 provides the highest net benefit to consumers. It also has the additional non quantified benefit of allowing 22.5kms of the 110 kV lines south of Paraparaumu to be dismantled.

Background
The Kapiti region is presently supplied by two 110 kV circuits from Takapu Road that pass through Transmission Gully. NZTA initially requested an investigation to deviate our existing transmission line through Transmission Gully. However, through the investigation process we identified the alternative 220 kV connection option which is more beneficial to NZ consumers. We therefore intend to reconfigure the grid.

The reconfiguration involves constructing two new 800m 220 kV single circuit lines connecting the Bunnythorpe–Haywards A&B lines to a new substation facility adjoining the existing Paraparaumu substation (on Transpower land). The new substation will transform the voltage down to that needed by Electra Ltd to supply local businesses and consumers. As a result 22.5km of existing 110 kV lines connecting the Pauatahanui substation to the Paraparaumu substation can be decommissioned.

Related upcoming potential projects
Transpower is investigating reconductoring the Bunnythorpe to Haywards transmission line. We are still working on the design of the reconductoring project and will be in a position to update affected landowners later in 2013.

September 2013
Net Benefit Test
The Electricity Industry Participation Code 2010\(^1\) (Code) specifies various reasons Transpower can remove an asset from service and reconfigure the grid, including demonstrating that it results in a net benefit\(^2\).

For the purposes of determining if there is a net benefit the two options were compared, namely:

- **Option 1\(^3\):** No reconfiguration and deviating the existing 110 kV transmission lines supplying Paraparaumu through Transmission Gully
- **Option 2:** Reconfiguration of the grid with a new Paraparaumu 220 kV Connection. This involves building a new connection into Paraparaumu off the nearby Bunnythorpe–Haywards 220 kV transmission lines and dismantling the 110 kV lines south of Paraparaumu to Pauatahanui

The Code specifies that a range of factors must be considered in our assessment. Our assessment of these factors is set out below.

**Direct Labour and Capital Costs**
Our assessment is that the total cost of deviating the existing line (option 1) is $28.7m, and the cost of the new Paraparaumu connection (option 2) is $28.3m.

The Code specifies that only costs incurred by Transpower and designated transmission customers should be shown in the net benefit test\(^4\). The contribution by Transpower and designated transmission customers to each of these options is $0 and $7.6m, respectively. The requirement to only consider designated transmission customers disadvantages the reconfiguration option in the assessment.

**Benefit from reduced unserved energy**
A new Paraparaumu connection at 220 kV (option 2) will provide a reliability benefit of $0.5m over a 35 year period. While this number is modest we consider that the deviation option (option 1) will increase the risk of unserved energy.

**Benefit from avoided maintenance and salvage**
Under the deviation option (option 1) a significant amount of maintenance work will be required on the Paraparaumu 110 kV assets such as transformer repairs and disconnector replacements that have a present value of $5.6m. This can be avoided with a new Paraparaumu connection (option 2).

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\(^1\) Refer Electricity Industry Participation Code Part 12, clause 12.112(1)(b)(ii).
\(^2\) Part 12 clause 12.117(1), Transpower must undertake a net benefit test per clause 12.117(2).
\(^3\) The building of the new Transmission Gully motorway requires the deviation of the existing 110 kV transmission line. This deviation could therefore be considered as the ‘do nothing’ reference case.
\(^4\) Part 12, clause 12.43(1)(ii).
In addition, a new Paraparaumu connection would allow removal of the existing 110 kV lines and salvaging of the metal in the conductors and transmission towers—providing an additional benefit to option 2 of $0.1m.

### Loss and System benefits
Transmitting electricity at higher voltages reduces the amount of electricity lost in transmission. By supplying Paraparaumu via a 220 kV connection rather than a 110 kV connection, losses are reduced. Conversely, supplying Paraparaumu via a 220 kV connection, may, under certain situations (e.g. very high HVDC north transfer and low Wellington load), slightly increase northwards constraints on our Bunnythorpe–Haywards A&B lines.

We have used the simulation software, SDDP, to estimate the amount and value of the reduction in electrical losses and any differences in generation dispatch costs over a 35 year period.

Our assessment is that any difference in constraints is very minor, but supplying Paraparaumu directly off the 220 kV grid reduces losses significantly. We assess that supplying Paraparaumu via a 220 kV line will result in a net loss and system benefit of $5.5 million.

### Table of costs and benefits
Table 1 shows the forecast costs and benefits for the 220 kV Paraparaumu option compared to the option of realigning the existing 110 kV transmission line. The present values use a discount factor of 7%.

<table>
<thead>
<tr>
<th>Option</th>
<th>Costs</th>
<th>Benefits Associated with a new Paraparaumu Connection</th>
<th>Net Benefit (benefits - costs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Transpower and designated transmission customers</td>
<td></td>
<td>Unserved Energy Benefits</td>
<td>Loss Benefits</td>
</tr>
<tr>
<td>Option 1: Deviation of the existing line</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Option 2: Paraparaumu 220 kV Connection</td>
<td>7.6</td>
<td>0.5</td>
<td>5.5</td>
</tr>
</tbody>
</table>

The Paraparaumu 220 kV Connection option has a net benefit over the deviation option of $4.1m. It is associated with significant benefits from reduced electrical losses and avoided future costs. It also has the least overall cost.

### Other benefits and costs
The Code specifies a variety of other costs and benefits. We have assessed these factors and consider that they can either be reasonably estimated to be zero or only add support to the Paraparaumu 220 kV Connection option.

For example, other benefits that have not been quantified include the potential for the Paraparaumu 220 kV Connection option to defer the need to invest in an additional interconnection transformer to supply the Wellington 110 kV network, and the potential to defer the need to upgrade lines from Takapu Road to Pauatahanui. These benefits could be significant, and only add further support to the Paraparaumu 220 kV Connection option.

**Externalities**

It is noted that a new connection to Paraparaumu will allow the dismantling of 22.5 kms of transmission line, and be associated with environmental and social benefits not reflected in the assessment above\(^5\).

**Conclusions**

The net benefit test shows that the Paraparaumu 220 kV Connection option is the best solution compared with a line deviation for enabling works for the Transmission Gully road project. It has a higher net benefit from reduced transmission losses and maintenance costs compared with the option to deviate the existing 110 kV line. As such, the reconfiguration meets the requirements of the Code.

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\(^5\) The environmental and social benefits aren’t admissible net benefit test benefits under the Electricity Participation Code Part 12, clause 12.43(1)(ii)