

**T R A N S P O W E R**

**Bay of Plenty 220/110 kV Interconnection  
Capacity Investigation**

**Assumptions, Approach and Options**

Consultation Document

May 2009

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## 1 Introduction

Transpower owns, operates, maintains and develops the National Grid which underpins New Zealand's electricity industry. Transpower aims to ensure sufficient investment is made in the National Grid to meet the future needs of electricity consumers and participants in the electricity industry.

The 220/110 kV interconnecting transformers at Tarukenga currently supply load in the Western Bay of Plenty region. The Tarukenga 220/110 kV interconnection is defined as part of the core grid and as such should meet the N-1 criterion for security of supply.

Based on recent demand forecasts for the region, the Tarukenga 220/110 kV interconnection will not meet the N-1 security criterion from 2011. From such time, the outage of one of the Tarukenga 220/110 kV interconnecting transformers may potentially result in unserved energy. Transpower is investigating the most appropriate form of investment to ensure the N-1 criterion is met for the Tarukenga 220/110 kV interconnection.

Should the investigation determine that investment in the grid is required, Transpower will look to submit an investment proposal to the Electricity Commission for approval under Part F of the Electricity Governance Rules 2003 (Rules).

Under the Rules, a proposal of this nature would be treated as a reliability investment on the core grid<sup>1</sup> and would need to pass the Grid Investment Test (GIT) to enable Transpower to recover the costs of the investment from its customers.

## 2 Investigation Process

This document describes and seeks feedback on:

- the long list of options to be considered for further analysis; and
- the assumptions and approach to be used in GIT analysis.

This allows Transpower to get stakeholder feedback on important steps in the grid planning process<sup>2</sup> as outlined below.

Having identified a need, a long list of options that address this need is to be found. A draft list is included as part of this document.

With respect to this long list of options, this document also acts as a Request for Information (RFI), in order to enable Transpower to finalise a short list of appropriate options for GIT analysis.

The long list of options will be reduced to a short list and analysed using the GIT, adopting the assumptions and approach that will be refined after considering the feedback received from interested parties.

Following this process, Transpower will determine whether it is appropriate to submit a Grid Upgrade Plan (GUP) to the Electricity Commission for funding approval.

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<sup>1</sup> For definition of core grid, refer <http://www.electricitycommission.govt.nz/pdfs/rulesandregs/rules/rulespdf/PartFSectionIIIScheduleF3A-coregriddetermination-17Jan08.pdf>

<sup>2</sup> A more comprehensive description of the grid planning process can be found in the 2009 Annual Planning Report: [http://www.gridnewzealand.co.nz/f41\\_2202/2202\\_introduction.pdf](http://www.gridnewzealand.co.nz/f41_2202/2202_introduction.pdf)

## 2.1 Assessment of projects under the Rules

The Tarukenga 220/110 kV interconnection will not meet the Grid Reliability Standard criterion for security from 2011 without further investment (transmission or otherwise). As the Tarukenga 220/110 kV interconnection is defined as part of the core grid, any such investment will be treated as a reliability investment under Part F of the EGRs.

For the Electricity Commission to approve cost recovery by Transpower for a reliability investment, the investment proposal must meet the requirements of the Grid Reliability Standards (GRS) and the GIT.

To meet these requirements, any investment must:

- ensure an N-1 security standard can be maintained, to meet the requirements of the GRS; and
- maximise expected net market benefit or minimise expected net market cost, compared to a number of alternatives, to meet the requirements of the GIT.

To determine the expected net market benefit of any option, Transpower must adopt certain input assumptions and parameters, and use these to apply the GIT. Sensitivity analysis is then undertaken to test the robustness of the GIT result.

Transpower sets out in this document, and is seeking feedback on, the assumptions and approach it proposes to use in applying the GIT.

## 2.2 Long list of options

In order to develop a short list of appropriate options for potential investment in interconnection capacity, Transpower intends this document to also act as a Request for Information (RFI). Transpower has begun the process of identifying which options might merit further investigation, and to this end, a draft long list of options is set out in section 0. Transpower seeks feedback on this long list of options and is seeking any further options that parties want Transpower to consider adding to this long-list.

Note that both transmission and non-transmission alternatives can be considered as options, but that (particularly) if non-transmission alternatives are to be considered, sufficient information will need to be provided with any submission to enable their inclusion in the long list of options.

## 2.3 Timetable for consultation

Transpower invites interested persons to provide feedback on the assumptions, approach and long list of options it proposes to adopt in the Bay of Plenty 220/110 kV Interconnection Capacity Investigation. Some questions have been set out in this document, in order to prompt for information which would be relevant to the investigation. However, respondents are not obliged to answer all of the questions and can simply comment on other issues which they believe might be relevant.

We seek responses from interested persons by 8 June 2009. Responses should preferably be in electronic form in either Microsoft Word or PDF format and emailed to:

Manager, Economics and Approvals  
Grid Development  
PO Box 1021  
Wellington  
Email: [gridinvestmentprojects@transpower.co.nz](mailto:gridinvestmentprojects@transpower.co.nz)

Please include "Bay of Plenty 220/110 kV Interconnection Capacity Investigation" in the subject line.

Late submissions may not be considered.

Following the close of submissions, Transpower will publish the full submissions on its project website.<sup>3</sup> Unless otherwise requested by a respondent, Transpower will include the name of the respondent and the entire submission on the website. If there is any aspect of the submission that is confidential, please indicate which sections you require Transpower to omit from publication and why it is regarded as confidential.

Transparency in the transmission planning process is important and whilst Transpower acknowledges that there may be circumstances under which respondents do want to provide feedback confidentially, it is important to recognise that Transpower may not be able to rely on confidential information to justify an investment proposal.

Transpower also asks respondents to provide authorisation for any confidential information to be shared with the Electricity Commission in order to enable the Commission and Transpower to consider this project. If there is information which cannot be shared confidentially with the Electricity Commission, this must be clearly specified.

## 2.4 Process following consultation

Transpower will provide any updates on the project on its project website<sup>4</sup>.

Following this consultation, Transpower will:

- consider feedback received in submissions;
- prepare a short list of options for GIT application;
- apply the GIT; and
- prepare a GUP for submission to the Electricity Commission, if appropriate.

## 2.5 Outline of the document

This remainder of this provides detail as to:

- section 3 – the need for the investment, including demand and generation assumptions;
- section 4 – a proposed long list of options to be considered;
- section 5 – a list of criteria to be used for reducing the long list to a short list;
- section 6 – a proposed commensurate GIT approach;
- section 7 – summary; and
- Appendices A - B.

A glossary of terms and acronyms used in this document is included in Appendix A.

## 3 Need for the investment

Assuming a prudent peak demand forecast in the region shows that the firm capacity of the Tarukenga interconnection may be exceeded:

- by 2011 when the Tarukenga T2 transformer capacity is exceeded; and

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<sup>3</sup> <http://www.gridnewzealand.co.nz/kaitimako-reinforcement-consultation>

<sup>4</sup> <http://www.gridnewzealand.co.nz/kaitimako-reinforcement-consultation>

- by 2012 when the Tarukenga T1 transformer capacity is exceeded.

From this time, the Grid Reliability Standards will not be met and there will be the potential for unserved energy.

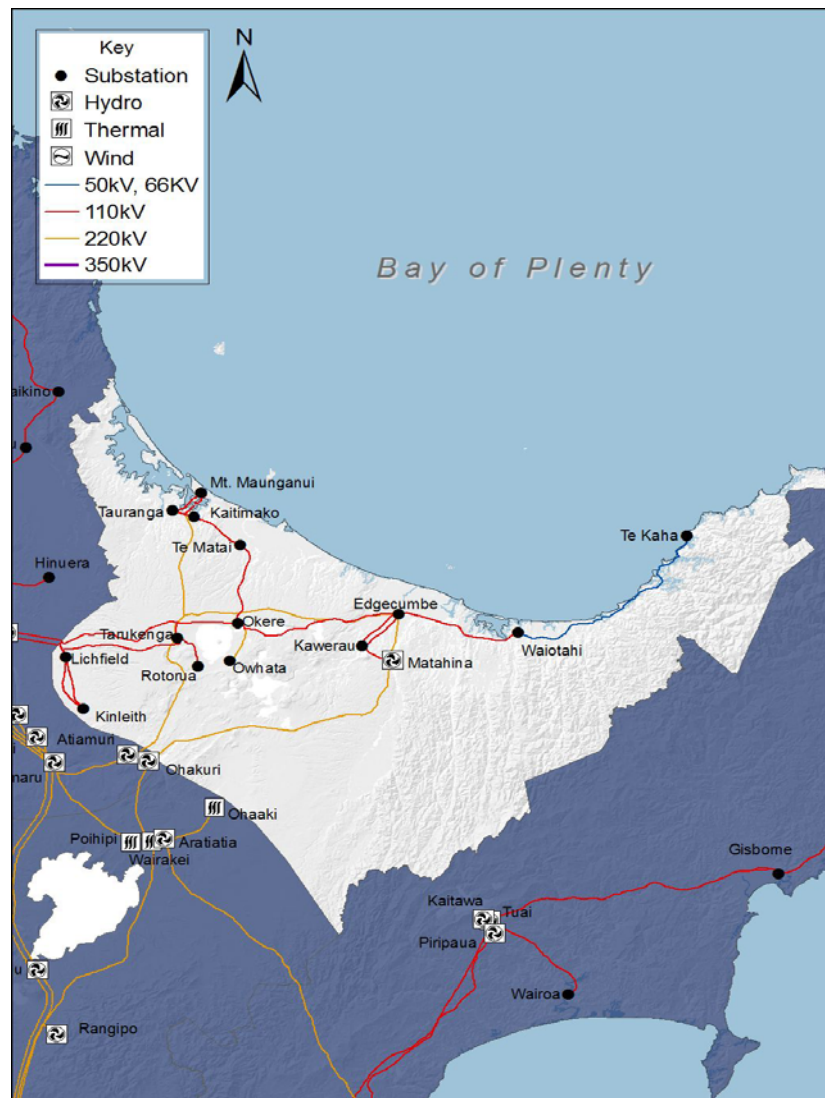
The technical basis is set out below.

### 3.1 Existing network

The Bay of Plenty region is shown geographically in Figure 3-1 with the port of Tauranga, the tourist destination of Mount Maunganui and the vineyards of Te Matai occupying the western area of the region near the east coast of the central North Island.

There are three 110 kV circuits supplying the western region, a 39 km double circuit (shown in yellow) directly between Kaitimako and Tarukenga<sup>5</sup>, and a 65 km single line route which passes via Okere and Te Matai.

Figure 3-1: Map of the Bay of Plenty region



<sup>5</sup> This line was constructed to a 220 kV specification (which is why it is coloured yellow in the map) but is currently operated at 110 kV.

These three circuits are connected to the 220 kV transmission network via the two 200 MVA interconnecting transformers at Tarukenga. Only the double-circuit tower line from Kaitimako to Tarukenga and the two Tarukenga interconnecting transformers are included in the core grid.

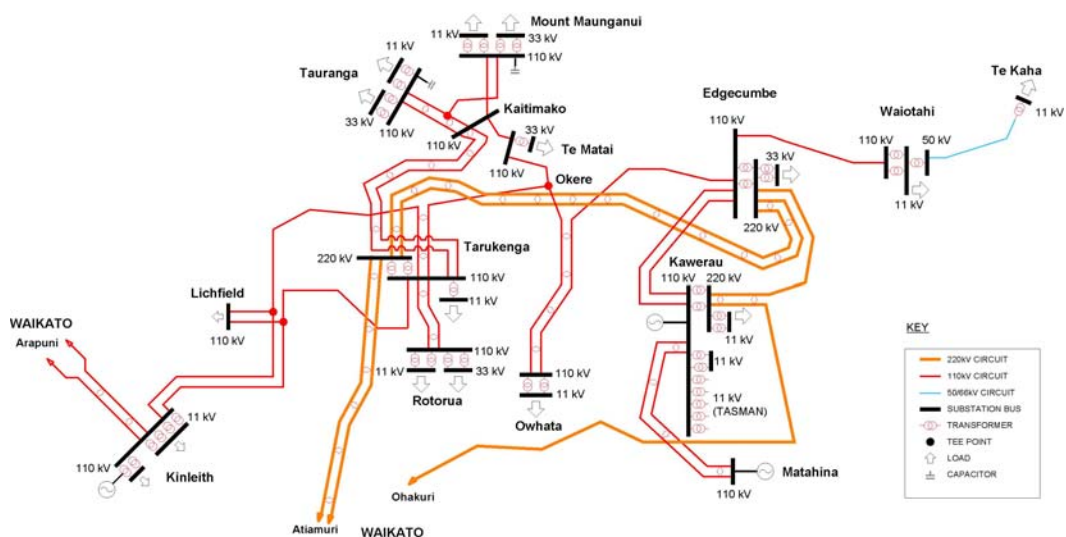
Transformers have three operational ratings: continuous, 24-hour summer rating and a 24-hour winter rating. The seasonal 24 hour ratings are only used when one transformer is out of service, either for planned maintenance or as a result of transformer failure. The rating of the Tarukenga interconnecting transformers are as follows:

- Tarukenga T1 200/248/264 MVA (continuous/24 hour summer/24 hour winter)
- Tarukenga T2 200/246/262 MVA

The network diagram of **Error! Reference source not found.** shows that the Tarukenga 220/110 kV interconnection supplies the western Bay of Plenty loads as well as:

- the Rotorua substation;
- the Lichfield and Kinleith mill substations; and
- an inter-area connection to Arapuni power station.

**Figure 3-2: Existing transmission circuits in the Kaitimako-Tarukenga Region**



There are also future development plans for other parts of the grid in the Bay of Plenty region that could influence this Bay of Plenty 220/110 kV Interconnection Capacity Investigation; these include:

- diverting some load from Mount Maunganui to a new GXP at Papamoa; and
- any new generation that is connected to the Tarukenga 110 kV network before 2011, see section 3.3;

**Q1. Are there any other development plan issues or considerations that should be incorporated into the analysis of the Bay of Plenty 220/110 kV Interconnection Capacity Investigation?**

### 3.2 Demand forecast

In terms of examining the impact of demand growth for this investigation, Transpower proposes to use the after diversity maximum demand prudent peak demand forecast included in its 2009 Annual Planning Report. This peak demand forecast is based on the prudent peak demand forecast published in the Electricity Commission's 2008 Statement of Opportunities<sup>6</sup> (SoO) which has been modified to account for customer information where appropriate.

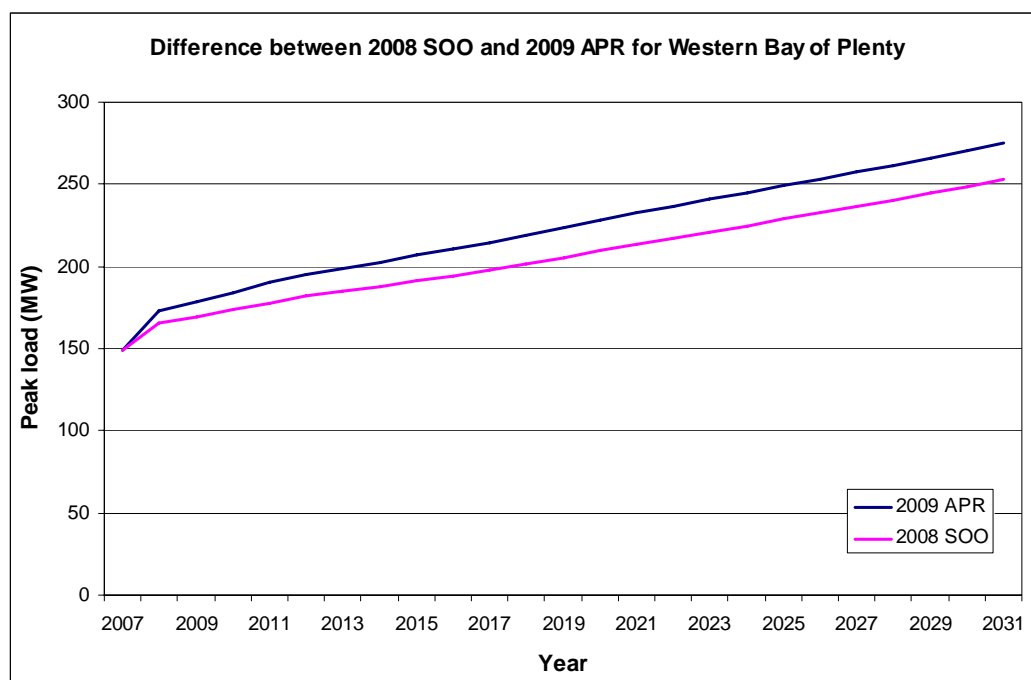
The key changes to the EC's SoO forecasts for the Bay of Plenty region are:

- the industrial load at Kawerau is assumed to remain constant throughout the forecast period – it grows at a rate of 2.6% per annum in the SoO forecast; and
- a re-allocation of this load to the other GXP's within the Bay of Plenty region so that the total regional peak remains similar to that of the 2008 SoO forecast.

The following chart shows the difference between the SoO forecast and APR forecast for the sub-region relevant for the Bay of Plenty 220/110 kV Interconnection Capacity Investigation.

It has been shown for the entire analysis period assuming 20 years from the need date in 2011 (see further Section 6.1).

**Figure 3-3: Differences in the 2008 SoO and 2009 APR prudent peak forecasts**



The following table shows the 2009 APR forecast at the grid exit points corresponding to the Figure 3-3 above.

**Table 3-1: Forecast peak demand (prudent growth rates) at grid exit points relevant to the Bay of Plenty 220/110 kV Interconnection Capacity Investigation**

Year	Peak demand assuming prudent growth rates			
	Tarukenga	Tauranga	Mt Maunganui	Te Matai
2007				
2008				
2009				
2010				
2011				
2012				
2013				
2014				
2015				
2016				
2017				
2018				
2019				
2020				
2021				
2022				
2023				
2024				
2025				
2026				
2027				
2028				
2029				
2030				
2031				

<sup>6</sup> <http://www.electricitycommission.govt.nz/pdfs/opdev/transmis/soo/pdfssoo/2008/Final2008SOO.pdf>.

	MW	%	MW	%	MW	%	MW	%
2008	8.6		78.2		61.1		25.4	
2009	8.9	3.2%	80.7	3.2%	63.1	3.2%	26.2	3.2%
2010	9.2	3.1%	83.2	3.1%	65.0	3.1%	27.0	3.1%
2011	9.4	3.2%	85.9	3.2%	67.1	3.2%	27.9	3.2%
2012	9.7	2.6%	88.1	2.6%	68.8	2.6%	28.6	2.6%
2013	9.9	1.9%	89.7	1.9%	70.2	1.9%	29.2	1.9%
2014	10.1	1.9%	91.4	1.9%	71.5	1.9%	29.7	1.9%
2015	10.3	2.0%	93.2	2.0%	72.9	2.0%	30.3	2.0%
2016	10.4	1.8%	94.9	1.8%	74.2	1.8%	30.9	1.8%
2017	10.6	1.9%	96.8	1.9%	75.6	1.9%	31.5	1.9%
2018	10.9	2.1%	98.8	2.1%	77.2	2.1%	32.1	2.1%
2019	11.1	2.1%	100.9	2.1%	78.8	2.1%	32.8	2.1%
2020	11.3	2.2%	103.1	2.2%	80.6	2.2%	33.5	2.2%
2021	11.5	1.1%	105.3	2.1%	81.8	1.5%	34.0	1.3%
2022	11.6	1.0%	107.5	2.1%	83.1	1.5%	34.4	1.4%
2023	11.7	1.1%	109.7	2.1%	84.4	1.6%	34.9	1.4%
2024	11.8	1.1%	112.0	2.0%	85.7	1.5%	35.4	1.4%
2025	12.0	1.0%	114.3	2.1%	87.0	1.6%	35.9	1.4%
2026	12.1	1.1%	116.5	2.0%	88.3	1.5%	36.4	1.3%
2027	12.2	1.0%	118.8	1.9%	89.6	1.5%	36.9	1.4%
2028	12.4	1.1%	121.0	1.9%	90.9	1.5%	37.4	1.3%
2029	12.5	1.0%	123.3	1.9%	92.3	1.5%	37.9	1.3%
2030	12.6	1.1%	125.7	1.9%	93.6	1.5%	38.4	1.4%
2031	12.7	1.0%	128.1	1.9%	95.0	1.5%	38.9	1.4%

**Q2. Do respondents consider that the demand assumptions are appropriate for this project?**

**Q3. Do respondents know of any step load changes that have not been accounted for in this demand forecast?**

### 3.3 Forecast generation

Relevant existing and potential new generation is as shown in following table. The Grid Injection Point (GIP) for the new generation is indicative only.

**Table 3-2: Generation relevant to the Bay of Plenty 220/110 kV Interconnection Capacity Investigation**

	Generator	Technology	MW max	GIP
Existing	Trustpower	Run-of-river	42	Kaimai
	Trustpower	Co-generation	7	Mt Maunganui
New	Kaituna	Run-of-river	25	Okere/Te Matai
	Tarawera	Run-of-river	9	Tarukenga
	Rotoma	Geothermal	35	Edgecumbe/Okere

For the purposes of this investigation, it is assumed that existing generation will continue to be connected to the grid and generating, for the duration of the analysis period.

The new generation is a combination of information from the Electricity Commission's 2008 Statement of Opportunities and other intelligence of which Transpower is aware.

Note that none of the new generation is committed or is sufficiently advanced to be considered highly likely to emerge before 2011.

To this end, none of the new generation will be taken into account directly in assessing the short list of options. However, the impact of connecting each new generator on the final list of new generation will be acknowledged and the potential lead time required to ensure transmission would be in place to fully dispatch that generation, would be discussed in any investment proposal.

**Q4. Do respondents consider that the generation assumptions are appropriate for this project?**

## 4 Long list of options

The following list of options contains all those Transpower has found relevant with regards to the need set out in Section 3. This list will be made into a short list based on the framework listed in Section 5.

### 4.1 Transmission options

To deal with the need for extra interconnecting capacity at Tarukenga, Transpower considers the following long list of transmission options as appropriate:

- a) Reduce the loading on the Tarukenga 220/110 kV interconnecting transformers by introducing a 110 kV system split at Kinleith on the:
  - i. Tarukenga side of Kinleith; or the
  - ii. Arapuni side of Kinleith.
- b) Increase interconnecting capacity at Tarukenga:
  - i. replace the existing two interconnecting transformers with two new; or
  - ii. install a third interconnecting transformer to supplement the existing two.
- c) Extend the 220 kV transmission system to:
  - i. Kaitimako; or
  - ii. Tauranga and Mt Maunganui.

These options may result in constraints on the Bay of Plenty 110 kV network appearing in 10 to 20 years time. The nature of these constraints will differ depending on which of the three above options is considered.

In assessing the above options, Transpower will therefore also consider what future 110 kV network investments that might be required. Any such investments will be treated as modelled projects in the analysis and will not be part of any proposal.

### Modelled projects

To deal with circuit constraints between Kaitimako and Te Matai that may appear in the 2020s depending on the interconnection options considered above, Transpower will consider increasing the capacity of the Okere loop (Tarukenga, Okere, Te Matai, Kaitimako) by:

- i. thermally upgrading the line;
- ii. using a more refined seasonal line rating method;
- iii. reconductoring the line;
- iv. converting it to a double circuit line;
- v. building a new line; or
- vi. implementing an operational split on the 110 kV network.

To deal with voltage quality of supply in the sub region around Kaitimako that may appear in the 2020s, Transpower will consider installing reactive support at:

- i. Kaitimako; or
- ii. Papamoa (the proposed new GXP between Kaitimako and Te Matai).

To deal with circuit constraints between Tarukenga and Kaitimako that may appear in the 2020s depending on the interconnection options considered above, Transpower will consider increasing the capacity between Tarukenga and Kaitimako through:

- i. thermally upgrading the line;
- ii. using a more refined seasonal line rating method;
- iii. reconductoring the line; or
- iv. building a new line;

## 4.2 Non-transmission options

Non-transmission options to address the problems listed above may include the following:

- a) Local generation, e.g. through installing new local generation, such as diesel peaking plant.
- b) Demand side alternatives, such as:
  - i. direct load control, e.g. ripple control, utilisation of stand-by generation for peak lopping etc.;
  - ii. fuel switching, where demand is reduced by switching to direct use of gas or solar hot water heating;
  - iii. energy efficiency where demand growth is reduced through the promotion and installation of energy efficient heating, motors and appliances; and
  - iv. price signals to consumers, such as critical peak pricing.

Transpower is not aware of any such projects and can thus not include them as options unless a proponent of such project is brought forward. The intention of the RFI below is to bring forward information about such potential projects.

### 4.3 Request for Information (RFI) for alternative projects

Transpower invites respondents to provide any suggestions for other options which they think could be considered as options, bearing in mind the definition of “alternative projects” under the Rules, as described in Appendix B to this document.

In this manner, this document acts as an RFI for possible options for the Bay of Plenty 220/110 kV Interconnection Capacity Investigation. Any submission on this aspect of this consultation should provide as much detail on the alternative as possible. Ideally, this should include:

- full contact details so as to enable Transpower to contact you should it wish to discuss the option in more detail;
- sufficient technical detail to enable an assessment of the option, including information as to intended connection points;
- any relevant cost information to allow a cost/benefit assessment;
- detail of any market benefits; and
- the option’s timing in terms of construction and availability.

As the list of alternative options will be made public, please identify if there is any aspect of the submission that should be treated as confidential and which should not be published.

Transpower may wish to share the confidential information with the Electricity Commission in order for Transpower and the Electricity Commission to discuss any GUP submitted by Transpower. If confidential information is identified, Transpower asks respondents to provide authorisation to allow it to share that information with the Electricity Commission.

Transpower also observes that clause 9 of Schedule F4 (the GIT) allows that where a market benefit or cost cannot be quantified, the direction of the market benefit or cost and likely magnitude of the market benefit or cost must be identified.

If you consider that the option you suggest Transpower should consider has a material benefit or cost that cannot be quantified, please provide an assessment as to the direction of the market benefit or cost and its likely magnitude.

- Q5. Are there any other qualifying options which should be considered as part of Transpower’s long list of options for the Bay of Plenty 220/110 kV Interconnection Capacity Investigation?**
- Q6. Do you consider that any of the identified options in Transpower’s long list do not come within the definition of “alternative projects” as defined under the Rules; or are inconsistent with good electricity practice? Please explain.**

## 5 Reducing the long list to a short list of options

Once the list of options has been finalised, Transpower will assess what options fit within the definition of “alternative projects” using a set of high level screening criteria that reflect the requirements of the definition of “alternative projects” under the Rules, along with the requirements under the Government Policy Statement on Electricity Governance (GPS). These criteria are:

- A. Fit for purpose
- a. Purpose – Will assist enabling renewable energy

- B. Technical feasibility (Rules)
  - a. Complexity of solution
  - b. Reliability, availability and maintainability of the solution
  - c. Future flexibility - Grid Development Strategy
- C. Practicality of implementation
  - a. Solution implementable by required date (probability of proceeding) (Rules and GPS)
  - b. Property and environmental risks
  - c. Implementation risks
- D. Good electricity industry practice (GEIP)
  - a. Consistent with good international practice
  - b. Ensure safety and environmental protection
  - c. Accounts for relative size, duty, age and technological status
  - d. Low technology risks
- E. System security (additional benefit resulting from an economic investment)
  - a. Improved system security
  - b. Operability – System Operator must be able to observe and control the power system
  - c. Dynamic benefits (modulation features and improved system stability)

The short list of options will then be assessed in accordance with the GIT.

## 6 Commensurate GIT approach

Under the Rules, the rigour and comprehensiveness of the GIT analysis should be commensurate with the estimated capital expenditure of a proposed investment.

In order to ensure commensurate analysis for this investigation project, Transpower has assessed the requirements for application of the GIT and believes that only the following need to be considered:

- project costs;
- loss differences; and
- reliability differences (under limited circumstances)

**Q7. Do respondents consider this commensurate GIT approach to be reasonable for Transpower to apply when considering the Bay of Plenty 220/110 kV Interconnection Capacity Investigation?**

**Q8. Are there other market costs or benefits which should be reflected in the analysis?**

### 6.1 Analysis period

Clause 27 of Schedule F4 of the Rules requires that in applying the GIT, the market benefit of a proposed investment or alternative project be assessed:

*“...over a period of 20 years from the commissioning date (unless significant market benefits or costs are expected to arise from the proposed investment or alternative project after that time, in which case the then present-value of any future benefits may also be included...)”*

The generally accepted approach in cost benefit analysis is to assess the cash flows arising from costs and benefits over the full economic/useful life of a proposed investment.

The analysis will thus cover 20 years from the need date in 2011. Nonetheless, transmission assets in general have an expected life considerably longer than 20 years and it is expected that there will be significant benefits arising from a voltage upgrade from 110 kV to 220 kV.

Transpower therefore proposes to use a 40-year analysis period in its application of the GIT. However, the results of the analysis will be reported using a terminal value approach, with the GIT results being reported for a period of 20 years after commissioning and future benefits after 20 years being reported as a terminal value.

**Q9. Do respondents consider the proposed 40 year analysis period to be appropriate for the evaluation of options?**

## 6.2 Value of Lost Load (VoLL)

If reliability differences are relevant to the consideration of the short list options, Transpower will need to use a Value of Lost Load figure in the reliability analysis.

The Rules require that unserved energy differences are valued at \$20,000 per MWh.<sup>7</sup> The \$20,000 per MWh was determined in December 2004 and Transpower proposes to inflate it accordingly to a December 2008 value of \$22,600 per MWh.

Some industrial or other loads may have a cost of unserved energy that exceeds \$22,600 per MWh. For example, a short power interruption to a milk product drier may result in a requirement to clean and sterilise the plant. If Transpower can substantiate a different value of lost load, the cost benefit analysis can use this revised number.

**Q10. Do respondents consider this Value of Lost load is appropriate for valuing lost load in the Bay of Plenty region?**

## 7 Summary

The purpose of this document is to seek feedback, on the approach and inputs Transpower will use in applying the GIT to the Bay of Plenty 220/110 kV Interconnection Capacity Investigation.

Transpower is not committed (except where the Rules prescribe certain factors) to any input variable or approach set out in this document.

Transpower's intention in releasing this document is also to solicit additional options (alternative projects) to those identified above. To this end, Transpower will assess any further options proposed, using the criteria outlined in Appendix B, to determine whether they could be alternative projects under the Rules and can therefore be added to the long list of options.

<sup>7</sup> Clause 8.3.4, Schedule F4 of the Rules.

The long list of options will then be reduced to a short list of options using the criteria outlined in section 5.

A commensurate GIT will then be applied to the short list of options to determine whether any meet the requirements of the GIT and a GUP will be prepared for the Electricity Commission if appropriate.

## Appendix A Glossary

Term	Description
<b>Alternative Project</b>	Options which are reasonable alternatives to any investment proposal as defined in clause 19, Schedule F4 of the Rules.
<b>Economic Investment</b>	Investments in the grid that can be justified on the basis of the Grid Investment Test set out at Schedule F4 of the Rules and are not reliability investments.
<b>Electricity Commission</b>	A Crown entity established under the Electricity Act 1992 to oversee New Zealand's electricity industry and markets.
<b>Expected unserved energy</b>	A forecast of the aggregate amount by which the demand for electricity exceeds the supply of electricity at each grid exit point as a result of likely planned or unplanned outages of primary transmission equipment.
<b>GIT</b>	Grid Investment Test. A test for reliability investments and economic investments in the grid developed in accordance with Rule 6. The specific rules defining the Grid Investment Test, are set out in Schedule F4 of Part F of the Rules.
<b>GPS</b>	Government Policy Statement on Electricity Governance.
<b>Grid</b>	Is the system of transmission lines, substations and other works used to connect grid injection points and grid exit points to convey electricity throughout the North and South Islands of New Zealand.
<b>GRS</b>	Grid Reliability Standards are standards for reliability of the grid developed in accordance with Rule 4. The standards themselves as currently developed are detailed in Schedule F3 of Part F.
<b>GUP</b>	Grid Upgrade Plan. A plan for grid expansions, replacements and upgrades.
<b>GXP</b>	Grid Exit Point
<b>Modelled project</b>	A modelled project is a project which is not part of the proposal, but is likely to occur in one or more scenarios within the time horizon of the analysis. Details can be found in Part F, Schedule F4 of the Rules.
<b>MWh</b>	Megawatt hour of electrical energy
<b>Primary Transmission Equipment</b>	Any plant or equipment forming part of the grid which enables the bulk transfer of electricity, including without limitation transmission circuits, busbars and switchgear.
<b>Prudent Demand Forecast</b>	The prudent peak forecast represents a 10% POE (probability of exceedance) forecast. In other words, one would expect actual demand to exceed the forecast one year out of ten
<b>Reliability investment</b>	Investments by Transpower in the grid, or alternative arrangements by Transpower, the primary effect of which is, or would be, to reduce expected unserved energy.
<b>RFI</b>	Request for Information
<b>RMA</b>	Resource Management Act 1991
<b>Rules</b>	The Electricity Governance Rules 2003. Unless otherwise specified, the reference to the Rules in this document is to the rules in Part F, Section III of the Electricity Governance Rules 2003.
<b>SDDP</b>	A model developed by Power Systems Research in Brazil.
<b>SoO</b>	Statement of Opportunities developed by the Electricity Commission in accordance with Rule 9.
<b>Transpower</b>	Transpower New Zealand Limited, owner and operator of New Zealand's high-voltage electricity network (the national grid).
<b>USE</b>	Unserviced Energy
<b>VoLL</b>	Value of Lost Load

## Appendix B Requirements for alternatives

As discussed above, the GIT involves determining a number of "alternative projects," to evaluate against the Base Case so as to determine a proposed investment.

Alternative projects are defined in the Rules as meaning<sup>8</sup>:

*"...any alternative transmission augmentation projects and **transmission alternatives** to the **proposed investment**, including any variant of the **proposed investment** that involves a non-negligible change in the timing of that **proposed investment** that are:*

*19.1 technically feasible;*

*19.2 reasonably practicable having regard to the matters set out in clauses 8.1 to 8.4 [of Schedule F4];*

*19.3 reasonably likely to proceed if neither the **proposed investment** nor any other **alternative project** proceeds and unlikely to proceed if the **proposed investment** does proceed;*

*19.4 reasonably expected to provide similar benefits in type but not necessarily in magnitude, or relevant nodes, as the **proposed investment**; and*

*19.5 reasonably expected to enable the deferment of investment of the type contemplated by the **proposed investment** for a period of 12 months or more"*

The definition requires an alternative project to be a technically feasible option which could be expected to act as an alternative to an option ultimately identified as Transpower's investment proposal given:

- the grid reliability standards;
- demand growth;
- associated costs; and
- the time period in which the option could be operational.

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<sup>8</sup> Clause 19 of Schedule F4, Part F of the Rules.